ACCELERATING ACTION WITH KNOWLEDGE



Transport, Climate and Sustainability Global Status Report

SLOCAT Partnership on Sustainable, Low Carbon Transport

4TH EDITION

ABOUT

ABOUT SLOCAT

SLOCAT accelerates the transformation of transport systems and services towards inclusive, healthy, green and resilient solutions for people and the planet. SLOCAT provides collaborative data and evidence-based knowledge, action initiatives, political strategies, dialogue, and strategic communications. This helps build collective thought leadership and advocacy at the crossroads of transport, sustainability, climate and social justice issues.

SLOCAT emphasises all land transport modes with universal analyses and actions, especially for low- and middle-income countries. As a multi-sectoral partnership, SLOCAT leverages the expertise and action of an ecosystem of over 100 entities, including transport professional associations, NGOs, academia, governments, multilateral organisations, philanthropy, and business. Created in 2009 as a "coalition of the willing" committed to accelerating the development of sustainable, low-carbon transport, since then the SLOCAT Partnership's mandate has been to go where others do not or cannot go individually in order to set bold global agendas, amplify the voices of the movement at international climate and sustainability discussions, and foster collaboration for policy and societal change.

ABOUT THE REPORT

The GSR is your one stop-hub for the latest data, trends, and policies shaping sustainable transport worldwide, covering demand, use and access to transport; climate and sustainability trends; and policy and investment developments. The goal? Equip decision-makers and actors within and beyond transport with an assessment of where we stand, and knowledge for faster, bolder action.

Since 2018 and over four editions, the GSR has grown into a powerful collective effort, with 300+ experts from 200+ organisations worldwide as advisors, authors, data contributors and peer reviewers. This diverse community is what makes the GSR rich and relevant.

HOW TO NAVIGATE THE MODULAR APPROACH OF GSR4

GSR4 consists of six modules, and a set of country factsheets. While the full report, modules and factsheets can be downloaded as a single file and read from start to finish, it is also possible to download each of them individually from the website.

Information sources and references are listed at the end of each chapter or spotlight, and cross references among chapters are included where relevant.

The six modules are as follows:

Module 1. Shaping the Just Transition: Challenges and Opportunities towards Sustainable Transport

Module 2. Transport Pathways to Reach Climate and Sustainability Goals

Module 3. Regional Overviews: Trends and Policy Development

Module 4. Climate and Sustainability Responses in Transport Sub-Sectors and Modes

Module 5. Transport and Energy

Module 6. Economics, Finance and Capacity Building for Transformative Change in Transport

Country Factsheets

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FOREWORD



Maruxa Cardama
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Transport is the lifeline of our societies and economies, connecting people, communities, and goods. It shapes opportunities to access education, employment, healthcare, social services, and cultural life, while also underpinning economic activity at every scale. Yet, today's transport systems still leave billions behind, perpetuate inequalities between countries, restrict opportunities for marginalised communities, and drive emissions, air pollution, and fossil fuel dependency. A just transformation of how people and goods move, and how transport is powered, towards systems and services that are socially inclusive, economically viable, environmentally responsible, and resilient remains as urgent as ever.

The impacts of climate change are no longer projections; they are a lived reality. Most transport systems worldwide have become more vulnerable to systemic shocks, disproportionately affecting people living in vulnerable situations and undermining economic development and connectivity. Wide-ranging challenges are putting already-elusive progress towards global climate and sustainability goals at greater risk, while recent years are shaking the foundations of international cooperation and multilateralism.

The year 2025 is pivotal. It marks ten years since the adoption of the Paris Agreement and the 2030 Agenda for Sustainable Development, and just five years remain until their implementation deadlines. It is also the year in which countries are expected to strengthen their Nationally Determined Contributions for decarbonisation, and the lead up of the first-ever United Nations Decade of Sustainable Transport (2026-2035). These milestones bring into sharp focus both the risks of inaction and the opportunities for bold, coordinated transport transformations.

The evidence is clear: current transport policies and investments are not yet aligned with the systemic shifts required to deliver on our shared inclusion, climate, and sustainability goals. Transport demand will continue to grow sharply, and without robust action, so too will its negative impacts. Yet the decade ahead is also a decisive window of opportunity. Many transport systems, particularly in low- and middle-income countries, are still being shaped. Choices made today will determine whether investments entrench costly, inefficient, polluting, and inequitable transport patterns—or unlock cleaner, more inclusive and resilient futures.

This fourth edition of the SLOCAT Transport, Climate and Sustainability Global Status Report (GSR4) builds on the legacy of this flagship knowledge series while looking resolutely ahead. GSR4 brings together the latest data, trends, and policies shaping sustainable transport worldwide, highlighting both challenges and opportunities for accelerating the transition — across demand, use, and access to transport, as well as climate and sustainability trends, and policy and investment developments. The goal? Equip decision-makers and actors within and beyond the transport sector with an assessment of the current situation, and with knowledge for faster, bolder climate and sustainability action in transport.

Since 2018, the GSR has grown into a powerful collective effort, with over 300 experts from more than 200 organisations from across the globe working together across editions. Whether as advisors, authors, contributors or peer reviewers, the diverse and multi-disciplinary community behind the GSR is what makes it so rich and relevant. This collaborative, open knowledge effort is not only a repository of evidence but also a platform for dialogue, co-creation, and collective visioning. It testifies to the strength of our transport community, which continues to mobilise and shape sustainable transport despite constrained resources and rising systemic shocks and challenges.

On behalf of SLOCAT, I would like to extend our deepest gratitude to all who have contributed to the co-creation of GSR4. A significant share of the research and drafting was conducted on a voluntary basis and it has been a great privilege to work with the diversity of voices and learn from the expertise across our SLOCAT Partnership and beyond. Your commitment reflects the spirit of collaboration and shared responsibility that is essential for the decade of transport transformations ahead - and that lies at the heart of SLOCAT's identity.

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As we approach COP 30 in Belém, Brazil in November 2025 and the start of the UN Decade of Sustainable Transport in January 2026, this report stands as both a record of progress and a call to action: to accelerate transformation, to ensure transport systems serve both people and planet, and to seize the unprecedented opportunities of this decisive moment. I hope you will find this report a valuable tool.

CONTENTS



SHAPING THE JUST TRANSITION: CHALLENGES AND OPPORTUNITIES TOWARDS SUSTAINABLE TRANSPORT

MODULE 1

10 Years After the Paris Agreement and the 2030 Agenda, on the Path to the UN Decade of Sustainable Transport 5

The Right to Mobility in a Sustainable and Inclusive Society 34

Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet 52

Logistics for Climate Action 76

Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies 85

Driving Gender Equality: Empowering Women and Transforming Transport 105

Gender-Responsive Approaches in Freight Transport in Asia 117

A Just Transition in Transport: A Double Challenge 123

Driving Health Forward: The Critical Link Between Transport and Wellbeing 138



TRANSPORT PATHWAYS TO REACH CLIMATE AND SUSTAINABILITY GOALS

MODULE 2

National Transport Pathways to Reach Climate and Sustainability Goals 161

Transport Ambition in NDCs 3.0 181

Transport in National Adaptation Plans 195

Assessing Progress: The Transport Decarbonisation Index 204

Sub-National Transport Pathways to Reach Climate and Sustainability Goals 211

The Role of Business in Delivering Climate and Sustainability Goals in Transport 228



REGIONAL OVERVIEWS: TRENDS AND POLICY DEVELOPMENT

MODULE 3

Africa Regional Overview 256

Asia Regional Overview 276

Europe Regional Overview 298

Latin America and the Caribbean Regional Overview 319

North America Regional Overview 340

Oceania Regional Overview 361

Small Island Developing States Overview 380



CLIMATE AND SUSTAINABILITY RESPONSES IN TRANSPORT SUB-SECTORS AND MODES

MODULE 4

Freight Transport and Logistics	399
Integrated Transport Planning	417
Walking	439
Cycling	455
Public Transport	470
Informal Transport	491
Rail	512
Road Transport	528
Second-hand Vehicles	549
Aviation	563
Shipping	584



TRANSPORT AND ENERGY

MODULE 5

Transport Energy Sources	602
Road Vehicle Electrification	622

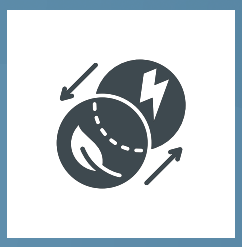


ECONOMICS, FINANCE AND CAPACITY BUILDING FOR TRANSFORMATIVE CHANGE IN TRANSPORT

MODULE 6

Financing Sustainable Transport in Times of Constrained Public Budgets	653
Evolving the Economic Appraisals for Land Transport Investments	670
Improving Access to Climate Finance for Transport in Low- and Middle-Income Countries	677
Capacity Building for Transport Transformation	686

About	ii
Acknowledgements	iii
Foreword	vi
List of abbreviations	707
Endnotes	710



Shaping the Just Transition: Challenges and Opportunities towards Sustainable Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION



MODULE 1

1.1  10 Years After the Paris Agreement and the 2030 Agenda, on the Path to the UN Decade of Sustainable Transport 5

1.2  The Right to Mobility in a Sustainable and Inclusive Society 34

1.3  Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet 52

  Logistics for Climate Action 76

1.4  Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies 85

1.5  Driving Gender Equality: Empowering Women and Transforming Transport 105

  Gender-Responsive Approaches in Freight Transport in Asia 117

1.6  A Just Transition in Transport: A Double Challenge 123

1.7  Driving Health Forward: The Critical Link Between Transport and Wellbeing 138

LIST OF FIGURES

10 Years After the Paris Agreement and the 2030 Agenda, on the Path to the UN Decade of Sustainable Transport

Figure 1. Transport CO_2 emissions by transport activity and mode, 2023. . . . 18
Figure 2. Average impact of physical risk on net asset value within the "current policies" scenario for 2050 for different infrastructure segments . . . 19
Figure 3. Relevant SDG targets for transport . . . 21
Figure 4. Pathways for current policies versus low-carbon pathway for transport CO_2 emissions . . . 28
Figure 5. Benefits of robust transport actions in new NDCs . . . 28
Figure 6. Five-Point Plan for Transport in New NDCs . . . 29
Figure 7. Five transport priorities for climate and sustainability action at COP 30 . . . 31
Figure 8. What can the UN Decade of Sustainable Transport achieve by 2035? . . . 32

The Right to Mobility in a Sustainable and Inclusive Society

Figure 1. Access to convenient public transport, 2023. . . . 41
Figure 2. Access to all-weather primary and secondary roads, 2019 . . . 42
Figure 3. Prices of public transport tickets, 2023 . . . 44

Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet

Figure 1. The concept of contemporary supply chains. . . . 58
Figure 2. Global volumes of three types of freight carried by maritime transport, 2000-2023 . . . 61
Figure 3. Global freight transport by modal share, based on transport performance, 2025 estimates . . . 62
Figure 4. Average distance for wheat flows across the African continent, 2022 . . . 63
Figure 5. Global Supply Chain Stress Index, January 2019 to May 2025. . . . 64
Figure 6. Freight transport CO_2 by transport mode, 1990-2023 . . . 65
Figure 7. Global freight transport CO_2 emissions in two policy scenarios, 2019-2050 . . . 66
Figure 8. Urban freight transport CO_2 emissions in the Netherlands, by logistic activities, 2015 . . . 68
Figure 9. Five clusters of interventions to deliver quick wins and initiate long-term transformations in freight transport and logistics . . . 73

Logistics for Climate Action

Figure 1. The 9 contributions of logistics to a low-carbon society. . . . 79
Figure 2. The "5R's" of reverse logistics . . . 81

Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies

Figure 1. Average impact of physical risk on net asset value within the "current policies" scenario for 2050 for different infrastructure segments . . . 93
Figure 2. Physical infrastructure risk (2025) compared to per capita GDP (2023) . . . 96
Figure 3. Physical infrastructure risk (2025) compared to transport greenhouse gas emissions (2023). . . . 98

Driving Gender Equality: Empowering Women and Transforming Transport

Figure 1. Share of women and men walking and using public transport in selected cities, 2022 study results 111
Figure 2. Share of women employed in transport and storage, 2023 112

A Just Transition in Transport: A Double Challenge

Figure 1. Just transition for urban transport 128

Driving Health Forward: The Critical Link Between Transport and Wellbeing

Figure 1. The links between the benefits (3 A's) and harms (9 C's) of road transport by travel mode: car use, cycling and walking 144
Figure 2. Health benefits of walking and cycling 146
Figure 3. Contribution of transport to air pollution in 2019. 150
Figure 4. Road traffic casualties per 100,000 people, by region, 2021 152
Figure 5. The human impact of road traffic injuries 153

LIST OF TABLES

Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet

Table 1. Key indicators of goods movement 60
Table 2. Top six e-commerce commodities in the European Union and the United States in 2024, based on purchasing frequency and trade value, respectively 69
Table 3. Examples of city logistics measures deployed or explored by private businesses and local authorities. 71

Logistics for Climate Action

Table 1. The dual role of logistics in adapting to a changing climate 84

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10 Years After the Paris Agreement and the 2030 Agenda, on the Path to the UN Decade of Sustainable Transport



KEY FINDINGS



Context, challenges and opportunities

- Transport is the lifeline of our societies and economies, connecting people, communities and goods.
- However, persistent gaps remain in inclusive access to reliable, efficient, and affordable transport, leaving billions of people worldwide in situations of transport poverty while limiting the economic development of countries.
- Transport is a leading contributor to greenhouse gas and carbon dioxide (CO_2) emissions: in 2023, it remained the second largest and fastest growing emission sector, responsible for 15.9% of global greenhouse gas emissions and for 21.9% of global CO_2 emissions.
- Meanwhile, the impacts of climate change are no longer simply projections, but a lived reality. The year 2024 was the hottest on record, with the global mean near-surface temperature reaching 1.55 degrees Celsius (°C) (± 0.13°C) above the pre-industrial average of 1850-1900.
- Transport systems, roads, rails, ports, and runways were severely damaged, exposing the fragility and high replacement costs of transport assets and infrastructure.
- The year 2025 is a critical moment to course-correct. Ten years after the 2015 Paris Agreement, and just five years from the 2030 implementation deadline for the United Nations (UN) Sustainable Development Goals (SDGs), these milestones bring into sharp focus both the risks of inaction and the opportunities for bold, co-ordinated transport transformations.
- However, current transport policies and investments for climate and sustainability action are not yet aligned with the systemic shifts required, and they fall short in enabling a shift towards greener, more efficient solutions across land, maritime and air transport.
- Meeting climate targets in transport will cost an estimated USD 2.7 trillion annually until 2050 – seven times the investment levels in transport in 2023
- The investment gaps are highest in low- and middle-income countries (LMICs) in Africa and Asia, and with many transport systems in LMICs still developing, the next decade is a decisive window to avoid inefficient investments and costly retrofits.
- Against this backdrop, the new Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, and the UN Climate Change Conference (COP 30) in Belém, Brazil in November 2025, are pivotal opportunities to accelerate the transport sector's contribution to climate and sustainability goals, and to drive co-ordinated action for lasting impact.
- Similarly, the launch of the first-ever UN Decade of Sustainable Transport (2026-2035) is an unprecedented opportunity to catalyse inclusive, co-ordinated and transformative change – strengthening transport systems and services that are socially inclusive, economically viable, environmentally responsible, and resilient and future-ready.

KEY FINDINGS



Transport demand, use and access, and sustainability and climate trends in transport

- The transport sector contributed 7% of the global gross domestic product (GDP) in 2021, while the logistics sector contributed between 5% and 10% of the global GDP in 2024.
- Globally, the transport sector employed 193 million people in 2021, but only 15.6% of transport jobs were held by women in 2023.
- The availability of an appropriately skilled workforce – including through workforce development and reskilling – is a critical issue in the transport sector, particularly given the high numbers of workers that have left the industry since the COVID-19 pandemic. Across the transport sector, there are positive examples of how a just transition can be implemented based on the principles of decent work and labour rights; equity for women and young workers; and social dialogue across workers' organisations, employers and governments.
- By 2023, transport activity levels had mostly recovered from the impacts of the COVID-19 pandemic in 2020 and 2021. Passenger and freight activity have likely hit record levels since 2023, although international air passenger travel and rail freight transport activity have remained lower.
- Access to efficient, safe, affordable and resilient transport remains profoundly unequal across the world, with stark consequences for economic development, social inclusion and environmental impacts.
- This lack of access further deepens social inequities and marginalisation of certain communities. In many places, the limited public transport that exists is not always equally available or accessible, as it may be too expensive, unsafe or inaccessible (to people with disabilities).
- On average, households spend 10-15% of their income on transport, with higher costs experienced by people who live and move in car-centred transport systems.
- As income increases, so does individual vehicle ownership and use. Since 2015, the sustained rise in private vehicle use has been linked to the growth in transport-related emissions and energy demand, as well as increased congestion, air pollution, and fatalities and injuries from road crashes. By 2022, at least 1.1 billion four-wheeled vehicles were on the world's roads.Motorisation levels ranged from 51 vehicles per 1,000 people in Africa to 805 vehicles per 1,000 people in North America in 2022.
- New vehicle sales rose more than 10% in 2023, with fossil fuel-powered vehicles still dominating the market. However, the primary method of acquiring an internal combustion engine vehicle in 2023 was the second-hand market, which outsized the new car market in some countries, primarily LMICs.
- The combination of poorly planned urban sprawl and rising private vehicle use, particularly in LMICs, is putting pressure on infrastructure and transport systems, leading to greater traffic congestion and average travel times.
- Average travel times in wealthier countries are 50% shorter than in poorer ones, yet congestion alone drains 1-2% of the GDP in high-income countries.The situation is starker in LMICs. For example, congestion in Kampala (Uganda) cost the city USD 1.5 million per day or 4.2% of its GDP in 2020.
- Transport accounted for an estimated 6% of global air pollution in 2019, although this share varies widely by region.

KEY FINDINGS

- Road safety continues to be a major global issue. Globally, road traffic injuries were the leading cause of death for children and young adults aged 5-29 years in 2021.
- Transport is a significant contributor to greenhouse gas and CO_2 emissions. In 2023, it remained the fastest growing and second largest emission sector (after the power industry), responsible for 15.9% of global greenhouse gas emissions and for 21.9% of global CO_2 emissions.
- In terms of energy consumption, transport remained the fastest growing sector in 2023, consuming 27% of the global energy for end-uses.
- Despite diversification efforts and recent rapid increases in electric vehicles, fossil fuels still accounted for 95.4% of the transport sector's energy consumption in 2023; a share that has remained virtually unchanged for five decades and is directly linked to the high emissions and air pollution caused by transport activity.
- Because transport activity is closely intertwined with economic activity, the relationship between GDP and transport emissions requires close attention.
- Since the COVID-19 pandemic, annual transport emissions have grown much faster than economic output, averaging 5.2% compared with 3.9% for GDP between 2021 and 2023 suggesting that decoupling cannot yet be identified at either the regional or global level.
- Freight transport contributed an estimated 43% of global transport CO_2 emissions in 2023, whereas passenger transport contributed 57%.
- Greenhouse gas emissions from international aviation and shipping grew continuously between 2015 and 2019 then fell rapidly by 9% (shipping) and 52% (aviation) in 2020 during the COVID-19 pandemic.
- According to the Intergovernmental Panel on Climate Change (IPCC) (2022), transport emissions need to fall 59% by 2050 (from modelled 2020 levels) to keep global warming to within 1.5°C. However, demand for moving people and goods is set to grow sharply, and access to sustainable transport remains unequal. Without a paradigm shift, rising transport demand will worsen transport's impacts on emissions, air quality and energy use.
- In terms of climate change adaptation and resilience, transport systems, roads, rails, ports and runways have been severely damaged by severe weather events exacerbated by climate change in recent years; the resulting impacts on communities and economies have exposed the fragility and high replacement costs of transport assets and infrastructure.

10 Years After the Paris Agreement and the 2030 Agenda for Sustainable Development



KEY FINDINGS

- Many criticisms have been raised about the inter-governmental processes on climate change and sustainability.
- Despite such (often legitimate) concerns, these inter-governmental processes have also helped catalyse new ways of thinking over the years that have resulted in positive impacts for people and the planet.
- Ten years after the adoption of the 2030 Agenda for Sustainable Development, the Paris Agreement on climate change, and the Sendai Framework for Disaster Risk Reduction – and in the midst of the Second UN Decade of Action for Road Safety – these global agendas have collectively driven national and sub-national sustainable transport policies. Similarly, they have informed the action and funding priorities of multilateral development banks, donor agencies, philanthropies and other financiers, and strengthened international multi-stakeholder co-operation on sustainable transport. They have also contributed to increasing both the political appreciation of sustainable transport and the scientific understanding of transport's linkages, synergies and trade-offs.
- Over the years, the transport dimension of multilateral climate and sustainability processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes. However, current transport policies and investments for climate and sustainability action remain off-track to deliver on the ambitious goals set out in these agendas and the transformations of transport systems and services that are required worldwide.
- In 2023, more than USD 7 trillion was spent on fossil fuel subsidies, which directly support conventional (car-centred) transport paradigms; meanwhile, the transition to clean transport solutions is estimated to cost roughly USD 2.7 trillion annually until 2050 – more than seven times the current (2023) investment levels in transport.

The 2030 Agenda for Sustainable Development

- Although no stand-alone SDG is focused on transport, the successful implementation of efficient, accessible, affordable, safe, sustainable, and resilient passenger and freight transport supports the achievement of almost every SDG. Out of the 169 SDG targets, only 3 relate directly to transport: target 3.6 on road safety, target 9.1 on access to all-weather roads and target 11.2 on public transport access.
- Additionally, several transport aspects are captured at the level of the indicators used to measure progress towards SDG targets.
- Assessments of Voluntary National Reviews (VNRs) during the period 2016-2022 (when SLOCAT conducted annual assessments) revealed consensus on transport's role as a key contributor to SDG implementation. More than 90% of the VNR submissions highlighted progress in the transport sector.

The two UN Decades for Road Safety

- Two consecutive United Nations Decades for Road Safety have increased awareness and political commitment around road safety as a crucial element of the global health and development agendas, fostering partnerships and mobilising resources for targeted actions. The second UN Decade (2021-2030) is seeking to improve on the lukewarm progress made during the first UN Decade (2011-2020) by setting an ambitious target to halve road deaths worldwide by 2030.
- The Global Ministerial Conference of Road Safety held in Morocco in February 2025, and the associated Marrakech Declaration, urged UN Member States and related actors to accelerate and scale up efforts on road safety, and to ensure its integration into the sustainable transport agenda.

KEY FINDINGS

The Paris Agreement on climate change and the first Global Stocktake

- Current decarbonisation ambitions remain insufficient to achieve the goals of the Paris Agreement; however, inter-governmental climate processes have moved the needle in numerous ways over the past 30 years, including helping to lower long-term projections for global warming.
- The Paris Agreement has also had a tangible impact on national climate policy making and governance and on concrete climate policies and long-term climate action.
- Under the Paris Agreement, each country sets its own climate goals through NDCs and Long-Term Low Emission Development Strategies (LT-LEDS) – the two most important instruments to limit global warming to well below 2°C – as well as National Adaptations Plans (NAPs).
- The Paris Agreement also introduced the Enhanced Transparency Framework for action and support (ETF) as a central component that specifies how countries should report their progress in mitigating and adapting to climate change.
- The inclusion of just transition in the preamble to the Paris Agreement elevated the recognition of this concept in the climate policy arena.
- Applied to the transport sector, the concept of just transition has helped increase political awareness of the need to integrate critical social dimensions in climate action in transport.
- In their NDCs, LT-LEDS, and NAPs, countries have increasingly focused on transport action. In the second-generation NDCs (submitted during 2019-2024), the number of transport-related actions and transport greenhouse gas mitigation targets doubled compared to first-generation NDCs.
- Among the 78 LT-LEDS submitted between 2016 and August 2025, 23 (30%) outlined transport greenhouse gas mitigation targets.
- The ambition levels shown by countries in their LT-LEDS are not sufficient to meet global warming goals under the Paris Agreement.
- The combined ambition from LT-LEDS and long-term targets in NDCs would result in estimated economy-wide per capita greenhouse gas emissions of 2.3 tonnes of CO_2 equivalent by 2050. While this is consistent with scenarios limiting warming to below 2°C (with 67% probability), it exceeds the level compatible with the 1.5°C limit (1.3 tonnes per person by 2050).
- A key shortcoming of NDCs and LT-LEDS is the delayed timing of emission reductions: as of 2023, two-thirds of the planned reductions were for the period 2030-2050, making it impossible to remain within the 1.5°C global warming limit as the carbon budget to stay within 1.5°C would be used up by 2032.
- The number of NAPs increased sharply between 2023 and August 2025, with nearly half (48%) of all submissions occurring during this period (35 new submissions, out of 74 in total). Among these latest submissions, all contain actions to enhance transport adaptation and resilience efforts.
- In 2021, Parties established the Mitigation Work Programme (MWP) at the UN Climate Change Conference in Glasgow, United Kingdom (COP 26) to "urgently scale up mitigation ambition and implementation" to help reach the Paris Agreement's 1.5°C goal.
- Also in 2021, for the first time in the history of UN climate talks, the Glasgow Pact – the outcome agreement of COP 26 – called on nations to phase down unabated coal power and inefficient subsidies for fossil fuels.
- The UAE Consensus – the outcome document of COP 28 in 2023 – called for countries to transition away from fossil fuels in energy systems, and for world leaders to deploy strong political support by COP 30 (in 2025) through NDCs and NAPs.
- In 2024, building on previous multi-stakeholder efforts, the Climate Champions Team launched the Avoid and Shift Breakthrough at the UN Climate Change Conference in Baku, Azerbaijan (COP 29). The Breakthrough features the same doubling goal for land transport that was championed in the 2023 multi-stakeholder call to action. It also seeks to strengthen transport targets that focus on "Avoid" and "Shift" measures, in complementarity with initiatives that favour "Improve" measures.
- The first Global Stocktake, finalised in December 2023 at COP 28, showed that the world is not on track to meet the goals of the Paris Agreement.Through the Stocktake, nearly all the world's countries agreed (for the first time) to "transition away" from all fossil fuels to achieve net zero greenhouse gas emissions. Countries also agreed to triple renewable energy capacity and double the rate of energy efficiency improvements. Furthermore, the first Global Stocktake made the most significant commitment on transport ever made under the UNFCCC process, by agreeing to "significantly reduce road transport emissions on a range of pathways, including through development of infrastructure and rapid deployment of zero- and low-emission vehicles".
- Against the backdrop of current climate finance flows to transport and the acute need to increase them to deliver on the required transformations in the transport sector, COP 29 was considered by many as a missed opportunity to set a new ambitious climate finance goal and align it with sectoral needs, including for transport.

KEY FINDINGS

The global transport community's engagement in multilateral climate and sustainability processes

- Over the years, the transport dimension of multilateral climate and sustainability processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes.
- The 2016 UN Climate Change Conference in Marrakesh, Morocco (COP 22) gave birth to the Marrakech Partnership for Global Climate Action, which brings together stakeholders working in key sectors and themes. Transport was recognised among the key sectors to spur enhanced climate ambition and action.
- Inspired by the call to action by UN Secretary-General Ban Ki-moon at the 2014 Climate Summit, and followed up by the Lima-Paris Action Agenda, 15 voluntary sustainable, low-carbon transport commitments and initiatives established by non-state actors in the transport sector were showcased at COP 21 in 2015.
- Six years later, in 2021, COP 26 kicked off an unprecedented number of voluntary commitments and initiatives on sustainable, low-carbon transport.
- While plans for a transport ministerial meeting at COP25 in Madrid did not materialise (due to the movement of the COP from Chile to Madrid), COP 26, COP 28 and COP 29 featured transport ministerial meetings, in collaboration with the International Transport Forum.
- Beyond the UNFCCC, the intensity and impact of global transport community engagement has extended across other multilateral processes that both directly and indirectly relate to the implementation of the global climate and sustainability agendas.

On the road to the first-ever UN Decade of Sustainable Transport

- Expanding passenger and freight transport services that are efficient, accessible, affordable, safe, clean, sustainable and resilient is among the most impactful steps to enable inclusive communities and shared prosperity for a liveable planet.
- There are ample opportunities to accelerate transport decarbonisation, sustainability, and adaptation and resilience solutions across all transport modes. However, advancing will require a multi-faceted approach involving changes in policy, finance, workforce, data, business models, technology, services, behaviours and perceptions, power dynamics and partnerships.
- With many transport systems still developing in LMICs, effective and context-adapted support over the next decade is decisive to avoid inefficient investments and costly retrofits.



KEY FINDINGS

The new NDCs and the implementation of the first Global Stocktake

- The implementation of countries' commitments made in 2023 under the first Global Stocktake of the Paris Agreement remains highly contested and politically sensitive. This tension is likely to dominate the agendas of the next several UN climate conferences, as implementation – or lack thereof – will determine whether the world can stay on track to meet the Paris goals.
- The IPCC has highlighted that total economy-wide greenhouse gas emissions need to peak before 2025 at the latest and to decline 43% by 2030 to limit global warming to 1.5°C (with no or limited overshoot).
- According to the IPCC, achieving low-carbon transport pathways that limit global warming to 1.5 °C (with no or limited overshoot) will require at least a 59% reduction in transport-related CO_2 emissions by 2050, compared to 2020 levels.
- The 2025 NDCs are a major opportunity for countries to implement – through robust transport targets – their agreements under the first Global Stocktake. These include efforts to reduce road transport emissions through a range of pathways, transition away from fossil fuels, triple renewable energy capacity and double the rate of energy efficiency.
- Integrating robust transport actions in NDCs offers multi-faceted benefits that extend beyond emission reductions.
- As outlined in SLOCAT's Five-Point Plan for Transport in New NDCs, the third-generation NDCs can deliver strong transport emission reductions targets aligned with net zero pathways by 2050, scale up action to accelerate the transformations towards energy-efficient and fossil-free transport, and secure assets by building resilience and adaptation in transport.
- The share of third-generation NDCs that included mitigation targets for reducing transport greenhouse gas emissions was the highest among all three NDC generations (34.5%, or 10 out of 29 NDCs, as of August 2025); however, the ambition in these NDCs was still not sufficient to align transport emissions to the required low-carbon pathways.
- Overall, the actions to reduce transport emissions included in the third-generation NDCs as of August 2025 rarely aim to achieve a holistic, systemic transformation of transport systems (which could be enabled through the Avoid-Shift-Improve framework).
- Nevertheless, as of August 2025, some of the third-generation NDCs featured inspiring efforts towards systematic approaches.
- Few countries triangulate their NDCs and climate change policies with equity, and most references to a just transition are vague. The concepts of transport poverty and of sustainable transport that is "accessible and affordable for all, ensuring that disadvantaged communities are not left behind", is not yet at the heart of climate actions.
- Integrating the "Shift" part of the Avoid-Shift-Improve framework into climate and sustainability policies for transport offers good opportunities for improving accessibility and connectivity for women, person with disabilities, elderly and youth.
- The aviation and maritime transport sectors have traditionally received less attention in NDCs, although there is a growing recognition of the need to include them in decarbonisation strategies.
- The 2025 UN Climate Change Conference in Belém, Brazil (COP 30) is a pivotal opportunity to accelerate the transport sector's role in advancing climate and sustainability goals, and to drive co-ordinated action for lasting impact that meets the scale of the challenges. To strengthen transport systems and services that are climate compatible and environmentally responsible, socially inclusive, economically viable, and resilient, SLOCAT has called on participants in COP 30 to prioritise progress in five key areas.
- At COP 30, leaders can kick-off a structured process for setting a quantified global goal for the decarbonisation of transport.
- While countries may start from different contexts, a global transport goal would bring clarity and shared direction for expanding inclusive, climate-compatible, and resilient transport systems and services worldwide.
- COP 30 marks the first opportunity to assess the collective ambition of new and revised NDCs.
- Going forward, a stocktake of transport in new NDCs will be essential to inform preparations for the second Global Stocktake due for finalisation in 2028, and the first-ever UN Decade of Sustainable Transport (2026-2035).
- As the global community continues to work at COP 30 towards mobilising USD 1.3 trillion annually by 2035 to address multiple priorities in climate action for LMICs, investing in sustainable transport must be part of the solution.
- To protect communities and economies, it is essential to prioritise transport adaptation and resilience both in the monitoring efforts.

KEY FINDINGS

The UN Decade of Sustainable Transport

- The UN Decade of Sustainable Transport represents a significant global commitment to advancing sustainable, inclusive, and resilient transport systems and underscores the critical role of transport in achieving both the SDGs and climate ambitions.
- SLOCAT underscores that this UN Decade should serve as a global call to action, encouraging and supporting governments, businesses, users, financiers, civil society and academia to accelerate both individual and collaborative efforts in advancing sustainable transport.
- Monitoring progress will be essential to ensure that the UN Decade becomes a compass for the positive transformation of transport systems and remains focused, responsive and accountable.
- While existing transport-related SDG indicators offer a foundation to reflect the progress and actions carried out by UN Member States, the UN Decade of Sustainable Transport provides an opportunity to explore a more tailored set of indicators to better address specific challenges and opportunities of sustainable transport.
- Strengthening reliable and open-access data systems and institutional capacities, particularly in countries with limited resources, will be critical. Existing initiatives, such as the Transport Data Commons, offer a basis for further multistakeholder collaboration.
- Through adequate and co-ordinated policy and investment efforts, robust monitoring, open-access data platforms, multi-stakeholder collaboration, and peer-to-peer learning, the next 10 years can bring tangible, transformative change across all modes of transport and reduce regional disparities. If harnessed effectively, these 10 years can leave a lasting legacy of socially inclusive, economically viable, environmentally responsible and resilient transport systems for shared prosperity well beyond 2035.





Context, challenges and opportunities

Transport is the lifeline of our societies and economies, connecting people, communities and goods. A critical function of passenger transport (movement of people) is to enable access to socio-economic opportunities and services such as education, employment, health care, social services, community activities and cultural activities.[1] The movement of goods (freight transport and logistics) is an essential pre-condition for almost any contemporary economic activity, whether on a local, national or global scale.

However, persistent gaps remain in inclusive access to reliable, efficient, and affordable transport, leaving billions of people worldwide in situations of transport poverty while limiting the economic development of countries.[2] Transport poverty bars people from fully participating in society, perpetuating cycles of poverty and exclusion. The inefficient infrastructures and high costs of moving goods in many low- and middle-income countries (LMICs) hinder economic growth, while limiting the availability of goods and increasing their final price. (See 1.2 Advancing the Right to Mobility for Sustainable and Inclusive Societies, and 1.3 Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet.)

Transport is a leading contributor to greenhouse gas and carbon dioxide (CO_2) emissions: in 2023, it remained the second largest and fastest growing emission sector, responsible for 15.9% of global greenhouse gas emissions and for 21.9% of global CO_2 emissions.[3] Transport was also the fastest growing energy-use sector in 2023, consuming 27% of the global energy for end-uses.[4] Despite advances in renewable energy and clean vehicle regulations, and recent rapid increases in electric vehicle adoption, fossil fuels still accounted for 95.4% of the total energy consumption in the transport sector in 2023.[5] This share has remained virtually unchanged for five decades and is directly linked to the high emissions and air pollution caused by transport activity. (See 4.8 Road Transport and 5.1 Transport Energy Sources.)

Meanwhile, the impacts of climate change are no longer simply projections, but a lived reality. The year 2024 was the hottest on record, with the global mean near-surface temperature reaching 1.55 degrees Celsius (°C) (± 0.13°C) above the pre-industrial average of 1850-1900. [6] The ten years from 2015 to 2024 were the warmest in recorded history.[7] New national temperature records were broken in dozens of countries in 2024, and 44% of global land experienced strong to extreme heat stress by mid-year.[8]

Intensified water cycles have brought more frequent extreme rainfall, devastating floods and landslides. Water-related disasters in 2024 displaced around 40 million people, led to thousands of deaths and caused hundreds of billions of dollars in damages.[9] In 2023, natural disasters (including climate-induced events) resulted in overall losses totalling USD 250 billion, more than twice the five-year average of USD 105 billion.[10] **Transport systems, roads, rails, ports, and runways were severely damaged, exposing the fragility and high replacement costs of transport assets and infrastructure.** (See 1.4 Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies.)

The year 2025 is a critical moment to course-correct. Ten years after the 2015 Paris Agreement, and just five years from the 2030 implementation deadline for the United Nations (UN) Sustainable Development Goals (SDGs), these milestones bring into sharp focus both the risks of inaction and the opportunities for bold, co-ordinated transport transformations. These global agendas have stimulated national and sub-national transport policies and actions, informed the action and funding priorities of financiers, and strengthened international multi-stakeholder co-operation on sustainable transport. They have also contributed to increasing both the political appreciation of sustainable transport and global scientific understanding of transport's linkages, synergies and trade-offs. Over the years, the transport dimension of multilateral climate and sustainability processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes.

However, current transport policies and investments for climate and sustainability action are not yet aligned with the systemic shifts required, and they fall short in enabling a shift towards greener, more efficient solutions across land, maritime and air transport. Efforts remain insufficient to move us away from inequitable transport patterns, support transport demand management, and reduce emissions, air and noise pollution, and fossil fuel dependency at the required speed and scale. With transport demand projected to grow sharply over the coming decades, so too will the negative impacts of transport, in the absence of urgent and decisive action.

Meeting climate targets in transport will cost an estimated USD 2.7 trillion annually until 2050 – seven times the investment levels in transport in 2023.[11] The investment gaps are highest in low- and middle-income countries (LMICs) in Africa and Asia, and with many transport systems in LMICs still developing, the next decade is a decisive window to avoid inefficient investments and costly retrofits. (See 6.1 Financing Sustainable Transport in Times of Constrained Public Budgets.)

Against this backdrop, the new Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, and the UN Climate Change Conference (COP 30) in Belém, Brazil in November 2025, are pivotal opportunities to accelerate the transport sector's contribution to climate and sustainability goals, and to drive co-ordinated action for lasting impact.

Similarly, the launch of the first-ever UN Decade of Sustainable Transport (2026-2035) is a call to action for the transformation of transport systems, encouraging and supporting governments, businesses, users, financiers, civil society and academia worldwide to accelerate both individual and collaborative efforts in advancing sustainable transport. This UN Decade **is an unprecedented opportunity to catalyse inclusive, co-ordinated and transformative change – strengthening transport systems and services that are socially inclusive, economically viable, environmentally responsible, and resilient and future-ready**

Transport demand, use and access, and sustainability and climate trends in transport

The transport sector contributed 7% of the global gross domestic product (GDP) in 2021, while the logistics sector contributed between 5% and 10% of the global GDP in 2023.[12] However, freight costs and therefore trade costs vary greatly across regions, with gaps in infrastructure for transport, energy, and information and communications technology reducing competitiveness. **Studies have shown that trade costs in Africa are five times the global average, and that a 10% drop in the region's transport costs could increase African trade volumes by 20%.**[13]

Globally, the transport sector employed 193 million people in 2021, but only 15.6% of transport jobs were held by women in 2023.[14] By sub-sector, this included 9 million public transport workers (2023), 43 million truck drivers (2024), 11 million aviation workers (2018), 7 million rail workers (2023) and 1.9 million seafarers (2021).[15] However, these figures vastly undercount the actual size of the transport workforce, as they do not account for the millions of workers employed in informal transport and platform-based transport services, nor the millions who are indirectly employed by the transport sector. This includes workers in train station and airport businesses (both formal and informal) as well as those servicing the sector or who are part of wider supply chains.

The availability of an appropriately skilled workforce – including through workforce development and reskilling – is a critical issue in the transport sector, particularly given

the high numbers of workers that have left the industry since the COVID-19 pandemic. Across the transport sector, there are positive examples of how a just transition can be implemented based on the principles of decent work and labour rights; equity for women and young workers; and social dialogue across workers' organisations, employers and governments. A 2020 study found that greening the transport sector could create an estimated 15 million new jobs worldwide by 2030.[16] The transition to clean transport offers crucial opportunities for youth employment in LMICs, a key issue. (See 1.5 Driving Gender Equality: Empowering Women and Transforming Transport, 1.6 A Just Transition for Workers in the Transport Sector, 4.1 Freight Transport and Logistics and 4.6 Informal Transport.)

By 2023, transport activity levels had mostly recovered from the impacts of the COVID-19 pandemic in 2020 and 2021.[17] Passenger and freight activity have likely hit record levels since 2023, although international air passenger travel and rail freight transport activity have remained lower.

- Global demand for passenger transport grew 10% between 2019 and 2025 (modelled values), reaching 68.3 trillion passenger-kilometres in 2025.[18]
- Road vehicles accounted for an estimated two-thirds (67%) of passenger transport globally in 2025.[19]
- Global freight activity grew an estimated 8% between 2020 and 2025 (modelled values) to surpass 171 trillion tonne-kilometres.[20] Most of this is carried by water (74% by international shipping and 5% by domestic shipping) followed by rail (11%), road transport (10%) and aviation (0.1%).[21]

Access to efficient, safe, affordable and resilient transport remains profoundly unequal across the world, with stark consequences for economic development, social inclusion and environmental impacts.

- Only 38% of the global population had access to all-weather roads in 2019, with 1 billion people still living more than two kilometres from such roads.[22]
- Although 58% of the world's population lived in urban environments in 2024, only 52% of the world's urban population had convenient access to public transport in 2022, a trend that has barely improved since 2018; meanwhile, only 5% of urban dwellers had access to a protected bike lane within 300 metres in 2023.[23] Differences across regions are notable.
- Globally, only 33% of people in urban areas lived within a one-kilometre walking distance of both health and educational facilities in 2023.[24]
- In Africa, on average only 32% of the urban population had convenient access to public transport in 2022, while 41% in Oceania, 42% in Latin America and the Caribbean and 49% in Asia had it.[25] The highest shares were in North America (67%) and Europe (88%).[26]
- Whereas 27.6% of urban citizens in Europe had access to protected bike lanes in 2023, just 0.7% in Africa did. [27] (See 4.3 Walking, 4.4 Cycling and 4.5 Public Transport.)

This lack of access further deepens social inequities and marginalisation of certain communities. In many places, the limited public transport that exists is not always equally available or accessible, as it may be too expensive, unsafe or inaccessible (to people with disabilities). Evidence indicates that most persons with disabilities already suffer from a widespread lack of accessibility, especially in built environments, and are poorly served by public transport. Similarly, the elderly face increased social isolation and reduced participation in community life due to barriers in transport access. Of the 6.25 billion people who are predicted to be living in urban centres by 2050, an estimated 15% will be persons with disabilities.[28] Transport barriers for women and girls limit their access to education and jobs and thus have a significant toll on countries' economic growth.[29] (See 1.2 Right to Mobility, 1.5 Driving Gender Equality: Empowering Women and Transforming Transport, and 1.7 Driving Health and Wellbeing Forward: The Critical Link with Transport.)

On average, households spend 10-15% of their income on transport, with higher costs experienced by people who live and move in car-centred transport systems.[30] Transport costs relative to household income are higher in lower- to upper-middle income countries than in high-income countries, with many cities across Africa and Latin America and the Caribbean having lower affordability of public transport.[31] (See 4.2. Integrated Transport Planning.)

As income increases, so does individual vehicle ownership and use. Since 2015, the sustained rise in private vehicle use has been linked to the growth in transport-related emissions and energy demand, as well as increased congestion, air pollution, and fatalities and injuries from road crashes.[32] By 2022, at least 1.1 billion four-wheeled vehicles were on the world's roads.[33] Motorisation levels ranged from 51 vehicles per 1,000 people in Africa to 805 vehicles per 1,000 people in North America in 2022.[34] In many LMICs, most of the vehicle growth has been in two- and three-wheelers, which have outnumbered cars in many places.[35] (See 3.9 Road Transport.)

New vehicle sales rose more than 10% in 2023, with fossil fuel-powered vehicles still dominating the market.[36] However, the primary method of acquiring an internal combustion engine vehicle in 2023 was the second-hand market, which outsized the new car market in some countries, primarily LMICs.[37] Second-hand vehicles play a dual, contradictory role in transport sustainability. On one hand, they allow improved access to mobility by providing lower-cost

vehicle options and enable the extension of vehicle lifespans. On the other hand, the poor quality of the used vehicles (many not roadworthy) exported to emerging markets raises safety, public health and environmental concerns and contributes to overall emissions from road transport. (See Spotlight on Second-hand Vehicles.)

The combination of poorly planned urban sprawl and rising private vehicle use, particularly in LMICs, is putting pressure on infrastructure and transport systems, leading to greater traffic congestion and average travel times. Traffic congestion wastes time and fuel; increases emissions, air pollution and road crashes; and causes substantial economic losses related to productivity and the cost of transporting goods.[38]

Average travel times in wealthier countries are 50% shorter than in poorer ones, yet congestion alone drains 1-2% of the GDP in high-income countries.[39] The situation is starker in LMICs. For example, congestion in Kampala (Uganda) cost the city USD 1.5 million per day or 4.2% of its GDP in 2020.[40]

- In 2024, Istanbul (Türkiye) topped the list of surveyed cities worldwide with the most hours lost due to congestion (105 hours per driver per year), followed by New York City and Chicago (102 hours each) and London (101 hours).[41]
- Congestion in the European Union (EU) cost nearly an estimated 110 billion EUR annually, or 1% of the region's GDP, in 2019.[42] (See 4.2 Integrated Transport Planning.)

Transport accounted for an estimated 6% of global air pollution in 2019, although this share varies widely by region.[43] Transport plays a major role in health impacts, with 61% of air pollution deaths worldwide in 2019 linked to fossil fuel combustion.[44] Air pollution caused 8.1 million premature deaths in 2021, including 700,000 children under five – for whom air pollution was the second-leading cause of death as of 2021.[45] Exposure to transport-related pollution is inequitable and disproportionately affects lower-income households, who tend to live near high-traffic roads where air pollution is worst.[46]

- In 2019, transport accounted for 12.6% of air pollution in North America, compared to 9% in Europe, 8% in Asia, 6.1% in Latin America and the Caribbean, 3.2% in Africa and 2% in Oceania.[47]
- In Africa, air pollution became the second-largest cause of death in 2022.[48]

Road safety continues to be a major global issue. Globally, road traffic injuries were the leading cause of death for children and young adults aged 5-29 years in 2021.[49] Road crashes killed 1.19 million people and left 50 million with severe or life-changing injuries in 2021.[50] Among road fatalities, 90% occurred in LMICs despite having only 60% of the world's vehicle fleets.[51] (See 1.7 Driving Health Forward: The Critical Link Between Transport and Wellbeing.)

- Asia-Pacific led in global traffic fatalities in 2021, with more than 0.7 million lives lost.[52]
- On a per capita basis, Africa had the highest road fatality levels in 2021 with 18.8 deaths per 100,000 people, above the global average of 15 deaths per 100,000 people.[53]

Global greenhouse gas emissions (from all sources) grew 1.9% in 2023 to surpass 52 gigatonnes CO_2equivalent.[54] In 2023, atmospheric CO_2 levels concentration reached a record high of 420 parts per million (ppm), which was 2.3 ppm higher than in 2022.[55] 2023 also saw the fourth-largest annual increase ever recorded, with CO_2 concentrations rising by 2.8 ppm.[56]

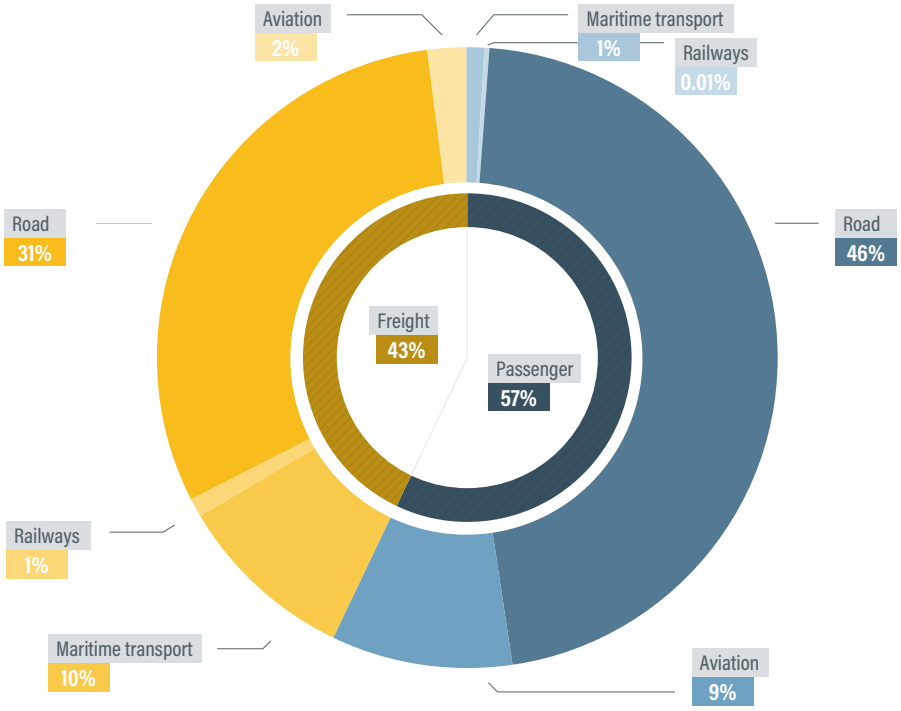
Transport is a significant contributor to greenhouse gas and CO_2 emissions. In 2023, it remained the fastest growing and second largest emission sector (after the power industry sector), responsible for 15.9% of global greenhouse gas emissions and for 21.9% of global CO_2 emissions.[57] Road vehicles alone contributed nearly three-quarters of transport emissions.[58] Transport emissions (including international aviation and shipping) grew 6.6% between 2015 and 2023 to reach 8.37 gigatonnes of CO_2 equivalent.[59]

In terms of energy consumption, transport remained the fastest growing sector in 2023, consuming 27% of the global energy for end-uses.[60] The sector's energy consumption increased 2% annually on average between 2010 and 2023 but rose 4% in 2023, doubling the average annual growth of the past decade.[61] Road transport continued to dominate energy consumption, accounting for 75% of transport energy use in 2023.[62] As the automotive industry pushes the trend towards larger, energy-intensive sport-utility vehicles (SUVs), this contributes greatly to increasing energy demand from transport.[63]

Despite diversification efforts and recent rapid increases in electric vehicles, fossil fuels still accounted for 95.4% of the transport sector's energy consumption in 2023; a share has remained virtually unchanged for five decades and is directly linked to the high emissions and air pollution caused by transport activity.[64] Renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport in 2023, underscoring the significant challenge of decarbonising the sector.[65] (See 4.8 Road Transport, 5.1 Transport and Energy Sources and 5.2 Road Vehicle Electrification.)

Greenhouse gas emissions in transport experienced the strongest hit from the COVID-19 pandemic in 2020 and 2021, falling 14% to revert to the annual levels of 2010/11.[66] However, by 2023 transport emissions were only 0.4% below

FIGURE 1. Transport CO_2 emissions by transport activity and mode, 2023



By transport activity, freight transport was estimated to contribute 43% of CO_2 emissions in 2023, while passenger transport contributed 57%. Since 2015, estimates point to an increasing role of freight transport in greenhouse gas emissions.

Source: See endnote 74 for this section.

their historic high of 8.4 gigatonnes in 2019.[67] Transport was the largest greenhouse gas-emitting sector in 41 countries in 2023, up from just 10 countries in 1990 and 29 countries in 2015.[68] Transport emissions were expected to hit new record levels in 2024, with CO_2 emissions in three sectors – surface transport and domestic and international aviation – growing to surpass 2023 levels.[69]

Because transport activity is closely intertwined with economic activity, the relationship between GDP and transport emissions requires close attention. Globally, between 2010 and 2019, the annual economic growth of 3% on average outpaced the annual growth in transport greenhouse gas emissions (1.8% on average).[70] This trend was often interpreted as an early sign of decoupling between economic growth and transport emissions. The COVID-19 pandemic, however, disrupted this pattern, with transport emissions falling 14% in 2020 while GDP declined 3%.[71] **Since the COVID-19 pandemic, annual transport emissions have grown much faster than economic output, averaging 5.2% compared with 3.9% for GDP between 2021 and 2023.**[72] Transport emissions rose faster than GDP in Africa and Europe in 2022 and 2023, in Asia and Oceania in 2022, and in North America in 2023**, suggesting that decoupling cannot yet be identified at either the regional or global level.**[73]

Freight transport contributed an estimated 43% of global transport CO_2 emissions in 2023, whereas passenger transport contributed 57% (Figure 1).[74] Since 2015, estimates point to an increased contribution of freight transport to greenhouse gas emissions.[75] Within freight transport, road transport contributed the largest share of emissions, even though maritime transport was responsible for two-thirds of freight activity.[76] On the contrary, aviation contributed 6% of freight transport emissions in 2023 despite transporting a tiny fraction of goods (0.1% in 2025).[77]

Greenhouse gas emissions from international aviation and shipping grew continuously between 2015 and 2019 then fell rapidly by 9% (shipping) and 52% (aviation) in 2020 during the COVID-19 pandemic.[78] Because freight and logistics were less affected than passenger transport, emissions from international shipping returned quickly to pre-pandemic levels by 2022.[79] By 2023, international shipping emissions were 6.4% above 2015 levels, while international aviation emissions were still 8.3% below.[80]

- Aviation (domestic and international) contributed only around 2.2% of the global CO_2 emissions from human activities in 2023; however, the absolute volume of aviation emissions was still substantial.[81] Between 1990 and 2023, air traffic grew 5% annually on average, while

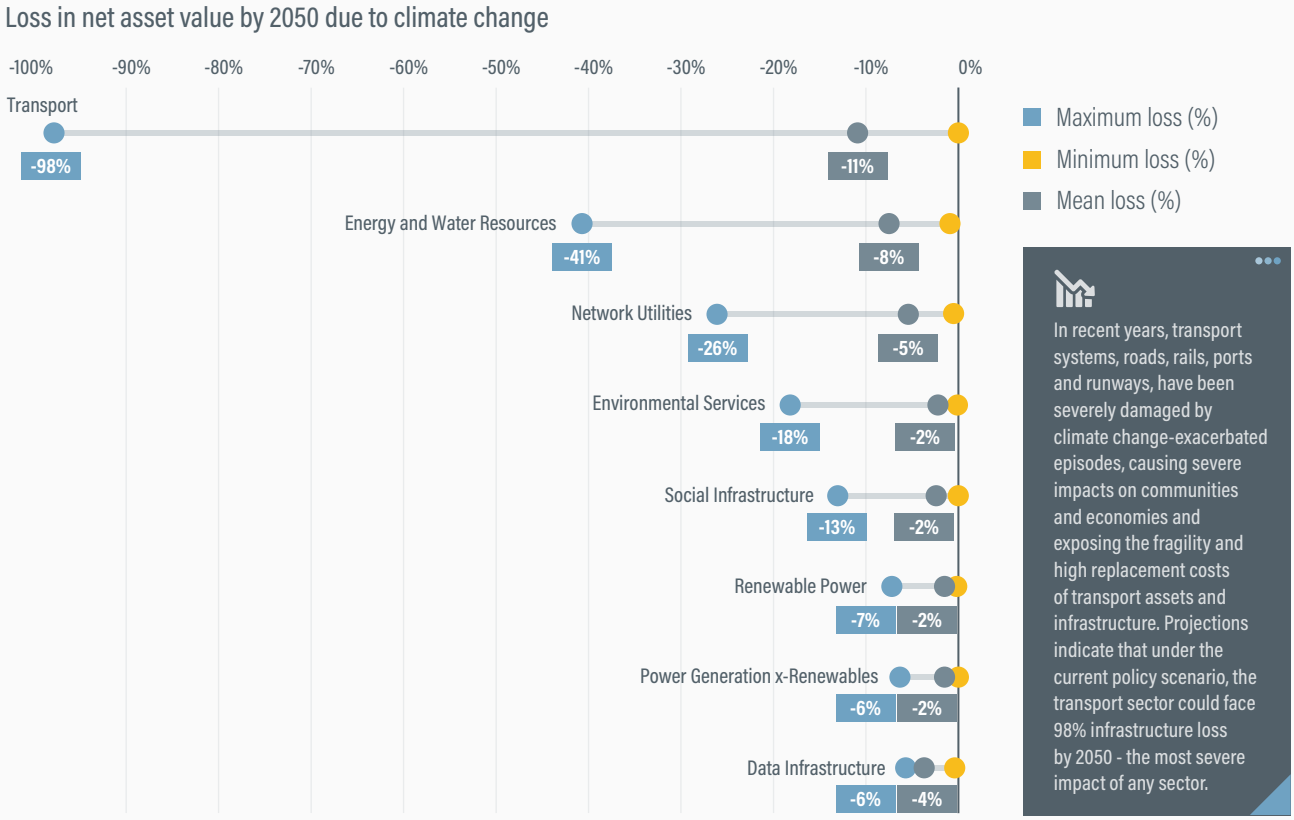
CO_2 emissions from aviation grew 2%, indicating some efficiency gains but still resulting in a net increase in emissions over the period.[82] In 2023, international aviation emitted 498 million tonnes of CO_2 equivalent.[83] Aviation's CO_2 equivalent emissions were expected to surpass their 2019 level in 2025.[84] (See 4.9 Aviation.)

- In 2023, the global shipping sector (domestic and international) was the ninth largest emitter of greenhouse gases worldwide, when ranked alongside the economy-wide emissions of countries.[85] International shipping emitted 746 million tonnes of CO_2 equivalent in 2023 (up 1.1% from 2022 and 11.2% from 2020), surpassing 2019 levels and nearing the sector's all-time high of 752 million tonnes of CO_2 equivalent emissions in 2018.[86] (See 4.10 Shipping.)

According to the Intergovernmental Panel on Climate Change (IPCC) (2022), transport emissions need to fall 59% by 2050 (from modelled 2020 levels) to keep global warming to within 1.5°C.[87] However, demand for moving people and goods is set to grow sharply, and access to sustainable transport remains unequal. Without a paradigm shift, rising transport demand will worsen transport's impacts on emissions, air quality and energy use.

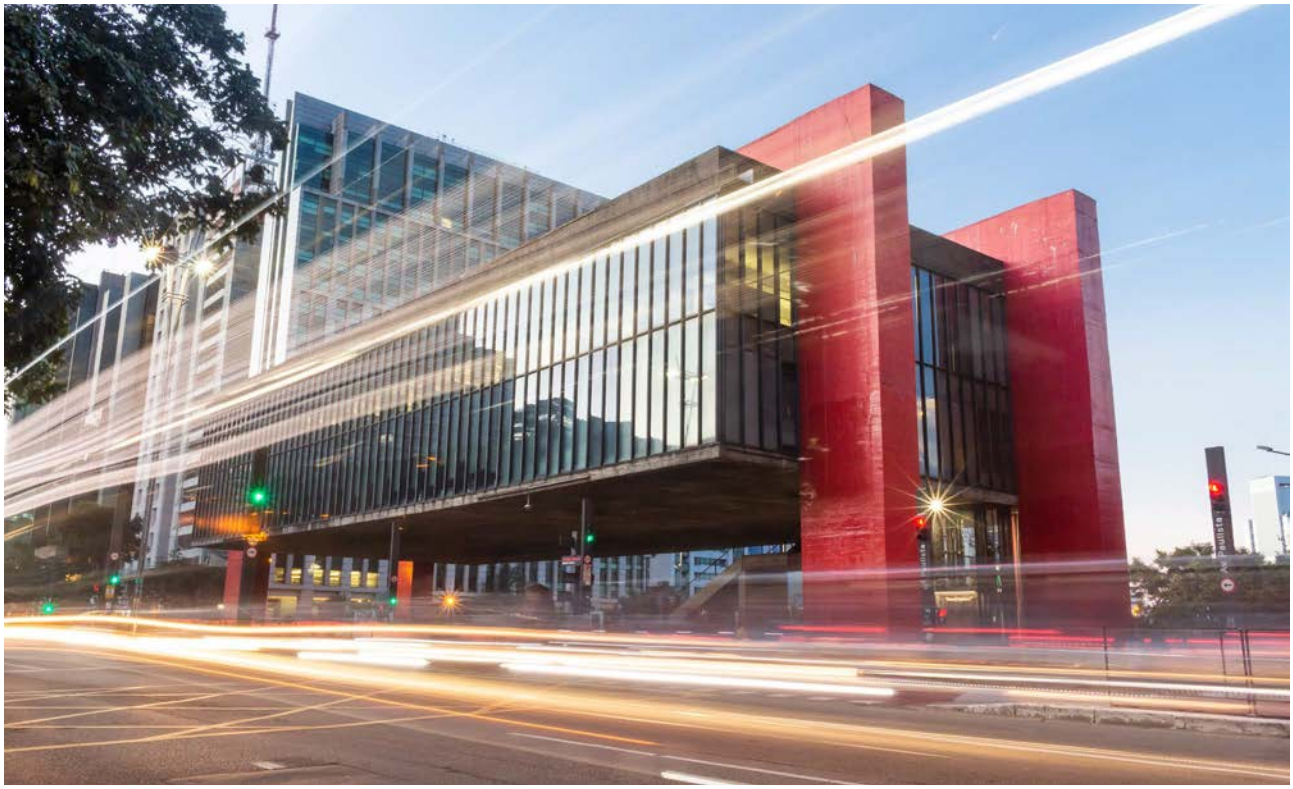
In terms of climate change adaptation and resilience, transport systems, roads, rails, ports and runways have been severely damaged by severe weather events exacerbated by climate change in recent years; the resulting impacts on communities and economies have exposed the fragility and high replacement costs of transport assets and infrastructure. As of 2022, climate-induced natural hazards were causing an estimated USD 15 billion in direct damage to transport systems annually, of which an estimated USD 8 billion was in LMICs.[88] LMICs experience the highest costs relative to their GDP.[89] Projections indicate that under the current policy scenario, the transport sector could face 98% infrastructure loss by 2050 – the most severe impact of any sector (Figure 2).[90] Against this backdrop, the long-term reliability and functioning of transport systems calls for enhanced adaptation and resilience plans. (See 1.4 Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies.)

FIGURE 2. Average impact of physical risk on net asset value within the "current policies" scenario for 2050 for different infrastructure segments



Note: Infrastructure segments are from the Infrastructure Company Classification Standard (TICCS)

Source: See endnote 90 for this section.



10 Years After the Paris Agreement and the 2030 Agenda for Sustainable Development

Many criticisms have been raised about the inter-governmental processes on climate change and sustainability. Challenges cited include their painstakingly slow pace, insufficient political ambition, and lack of legally binding accountability, with many critics suggesting that climate negotiations are simply "greenwashing talk shows" or a "polluting world tour of climate and sustainability diplomats".[91]

Despite such (often legitimate) concerns, these inter-governmental processes have also helped catalyse new ways of thinking over the years that have resulted in positive impacts for people and the planet. Over the past 30 years, these processes have shined a spotlight on the need to shift economic systems away from 200 years of dependence on fossil fuels. The transport sector is central to this paradigm shift.

When the UN Framework Convention on Climate Change (UNFCCC) was signed in 1992, it triggered a wave of national legislation and policies across nearly all countries. In 1997, the Kyoto Protocol brought into the equation carbon markets and the crucial role of private sector investment. In 2015, the Paris Agreement drew attention to the social interventions needed to secure workers' rights and livelihoods, and the well-being of communities and vulnerable populations as economies shift to paradigms of sustainability and climate action. This so-called just transition is central to the transformation of the transport sector.

Ten years after the adoption of the 2030 Agenda for Sustainable Development, the Paris Agreement on climate change, and the Sendai Framework for Disaster Risk Reduction – and in the midst of the Second UN Decade of Action for Road Safety – these global agendas have collectively driven national and sub-national sustainable transport policies. Similarly, they have informed the action and funding priorities of multilateral development banks, donor agencies, philanthropies and other financiers, and strengthened international multi-stakeholder co-operation on sustainable transport. They have also contributed to increasing both the political appreciation of sustainable transport and the scientific understanding of transport's linkages, synergies and trade-offs.

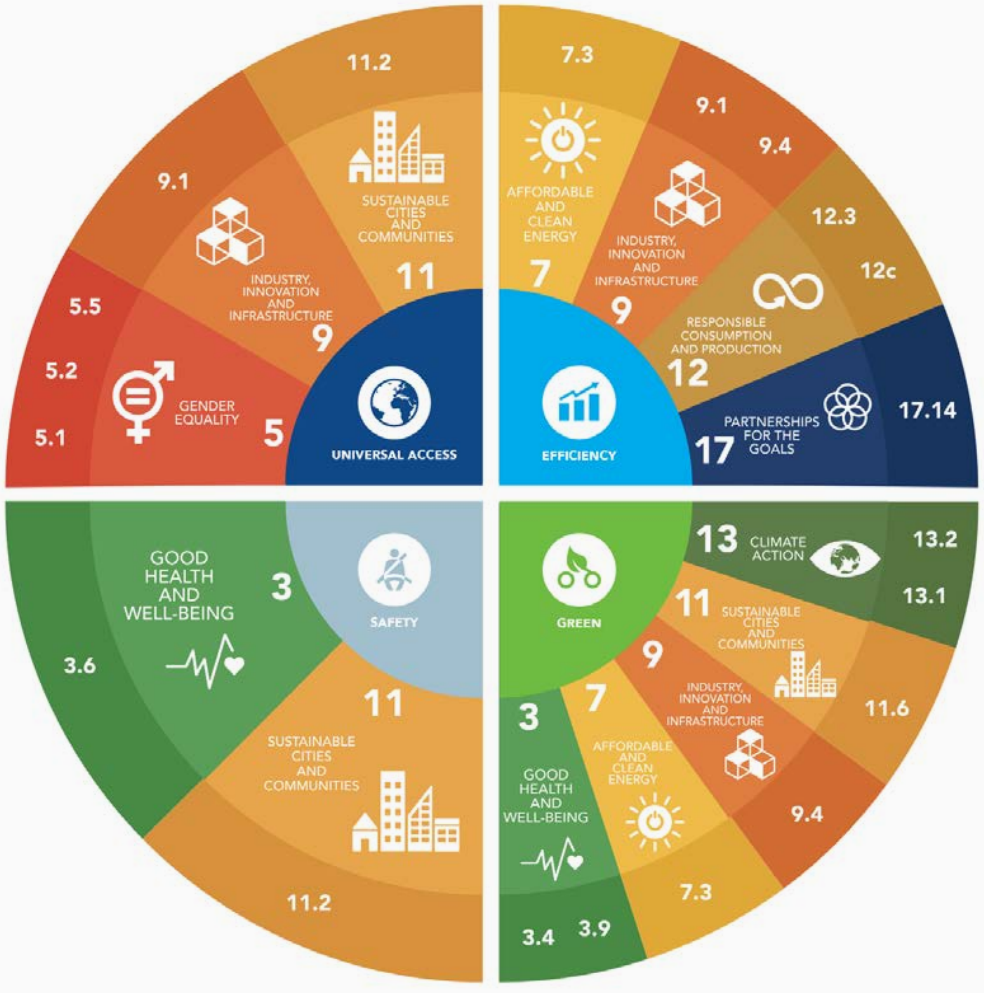
Over the years, the transport dimension of multilateral climate and sustainability processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes. However, current transport policies and investments for climate and sustainability action remain off-track to deliver on the ambitious goals set out in these agendas and the transformations of transport systems and services that are required worldwide.

In 2023, more than USD 7 trillion was spent on fossil fuel subsidies, which directly support conventional (car-centred) transport paradigms; meanwhile, the transition to clean transport solutions is estimated to cost roughly USD 2.7 trillion annually until 2050 – more than seven times the current (2023) investment levels in transport.[92] Climate finance for transport remains inadequate and inequitable, with the highest investment gaps in LMICs in Africa and Asia. In 2023, the sector received USD 545 billion per year in climate finance, mostly directed to high-income countries and road transport.[93] LMICs, particularly the most climate vulnerable, received only a fraction: 3% went to least developed countries.[94] Adaptation finance for transport averaged just USD 1.5 billion annually in 2023, barely 2% of global adaptation funding.[95] (See 6.1. Financing Sustainable Transport in Times of Constrained Public Budgets.)

The 2030 Agenda for Sustainable Development

The 2030 Agenda for Sustainable Development is a cross-cutting, inter-connected agenda, wherein the achievement of one of its 17 Sustainable Development Goals (SDGs) is often dependent on the achievement of others. **Although no stand-alone SDG is focused on transport, the successful implementation of efficient, accessible, affordable, safe, sustainable, and resilient passenger and freight transport supports the achievement of almost every SDG.**[96] **Out of the 169 SDG targets, only 3 relate directly to transport: target 3.6 on road safety, target 9.1 on access to all-weather roads and target 11.2 on public transport access.**[97] However, another 15 targets relate indirectly to transport, and adequate transport action can contribute to their achievement (Figure 3).[98] **Additionally, several transport aspects are captured at the level of the indicators used to measure progress towards SDG targets.**

FIGURE 3. Relevant SDG targets for transport



Out of the 169 SDG targets, only three relate directly to transport, namely target 3.6 on road safety, target 9.1 on access to all-weather roads and target 11.2 on public transport access. However, another 15 targets relate indirectly to transport, and adequate transport action can contribute to their achievement.

Additionally, several transport aspects are also captured at the level of the indicators used to measure progress towards SDG targets. (NB: indicators are not represented in this figure).

Source: See endnote 98 for this section.



As of mid-2025, with just five years until the implementation deadline, countries were not on track to achieve the SDGs by 2030. Only 18% of the SDG targets that had sufficient data coverage (139 out of 169 total targets) were on track to meet the 2030 deadline; a further 17% showed moderate progress, 31% showed marginal progress, 17% had stagnated, and 18% had regressed below the 2015 baseline.[99] **Of the SDG targets with sufficient data coverage and most relevant to transport, moderate progress has been made on target 3.6 (road safety) and marginal progress on target 9.1 (all-weather roads), indicating that significant acceleration is needed.**[100]

- Analysis from 2023 found that both target 3.6 and target 9.1 had regressed in Africa.[101]
- At the current (2024) pace, the Asia-Pacific region would not be able to achieve all SDGs before 2062.[102] Benchmarking of the transport sector in Asia-Pacific found that it performed better than other regions in areas linked to road safety, infrastructure (roads and railways), transport energy intensity, renewable energy in transport, and rural access, but that it was outperformed in areas such as clean power, air pollution, public transport access and removal of fossil fuel subsidies.[103]
- For Latin America and the Caribbean, a 2024 study found that target 9.1 (the only transport-relevant target with sufficient data for assessment) showed a positive trend but was unlikely to be achieved by 2030.[104]

Since the first High-Level Political Forum in 2016, countries have reported on transport as a vital sector to implement the SDGs, showcasing on-the-ground actions and best practices. **Assessments of Voluntary National Reviews (VNRs) during the period 2016-2022 (when SLOCAT conducted annual assessments) revealed consensus on transport's role as a key contributor to SDG implementation. More than 90% of the VNR submissions highlighted progress in the transport sector.**[105] (See 2.1. National Transport Pathways to Reach Climate and Sustainability Goals.)

The two UN Decades for Road Safety

Two consecutive United Nations Decades for Road Safety have increased awareness and political commitment around road safety as a crucial element of the global health and development agendas, fostering partnerships and mobilising resources for targeted actions. The second UN Decade (2021-2030) is seeking to improve on the lukewarm progress made during the first UN Decade (2011-2020) by setting an ambitious target to halve road deaths and injuries worldwide by 2030.[106] Just 10 countries – including some hard-hit LMICs – managed to reduce road deaths by more than 50% in the first decade, and a further 30 countries are close behind. This shows that the target can be met, but it is nowhere near enough.[107]

- Fatalities and lost days due to road crashes impact LMICs in particular, with Africa and the Asia-Pacific region having the highest road traffic fatality rates.[108]
- Africa recorded a 17% increase in road-related fatalities between 2010 and 2021, with road-related deaths of motorcyclists doubling during the decade[109]
- In 2019, 700,000 lives were lost to road crashes in the Asia-Pacific region alone.[110]

The Global Ministerial Conference of Road Safety held in Morocco in February 2025, and the associated Marrakech Declaration, urged UN Member States and related actors to accelerate and scale up efforts on road safety, and to ensure its integration into the sustainable transport agenda.[111] Member States are encouraged to make tangible national commitments addressing financing, implementation and reporting strategies, inter-ministerial co-ordination, and the adoption of comprehensive legislation on key risk factors. The Marrakech Declaration also encourages the incorporation of minimum safety standards in vehicle design and infrastructure, the promotion of multi-modal mobility and road safety education, and the prioritisation of evidence-based interventions, especially in LMICs. (See 1.7 Driving Health Forward: The Critical Link Between Transport and Well-being.)



The Paris Agreement on climate change and the first Global Stocktake

Current decarbonisation ambitions remain insufficient to achieve the goals of the Paris Agreement; however, inter-governmental climate processes have moved the needle in numerous ways over the past 30 years, including helping to lower long-term projections for global warming. Before the Paris Agreement, the world was heading towards 4-5°C of warming by the end of this century. The commitments to emission reduction expressed in the first generation of Nationally Determined Contributions (NDCs), submitted by countries under the Paris Agreement in 2015/2016, would have resulted in an estimated 3.7°C of warming by century's end (assuming they were delivered).[112] Ambitions in the second-generation NDCs of 2020 lowered these projections to 2.1-2.8°C of warming by century's end – although the carbon budget to keep average global temperature rise within 1.5°C by 2050 would still be used up by 2032.[113]

The Paris Agreement has also had a tangible impact on national climate policy making and governance and on concrete climate policies and long-term climate action. Planning based on the Paris goals has become a mainstream characteristic of national climate policy and of governance and policy approaches.[114]

Under the Paris Agreement, each country sets its own climate goals through NDCs and Long-Term Low Emission Development Strategies (LT-LEDS) – the two most important instruments to limit global warming to well below 2°C – as well as National Adaptations Plans (NAPs). While there are no enforcement mechanism(s) or penalties for unmet targets, countries are expected to regularly update these instruments – every five years for the NDCs, while the NAPs and LT-LEDS do not follow fixed cycles. An essential provision of the Paris Agreement is that Parties (countries) will gradually increase their climate ambition from one round of NDCs, LT-LEDS and NAPs to the next. Discussions are ongoing around unequal burden sharing and the responsibility of wealthier countries, who have been bigger emitters for longer.

The Paris Agreement also introduced the Enhanced Transparency Framework for action and support (ETF) as a central component that specifies how countries should report their progress in mitigating and adapting to climate change. The ETF is now fully operational, including with the submissions of the first biennial transparency reports (BTRs).[115]

The inclusion of just transition in the preamble to the Paris Agreement elevated the recognition of this concept in the climate policy arena. Prior to this, the international climate change regime had used the principle of common but differentiated responsibilities (CBDR) to address macro-level injustices between countries through the provision of climate finance, technology and capacity-building support from developed countries to developing countries.[116] **Applied to the transport sector, the concept of just transition has helped increase political awareness of the need to integrate critical social dimensions in climate action in transport.**

Following the declaration on the just transition at the 2018 UN Climate Change Conference in Katowice, Poland (COP 24), countries signed up to a set of just transition principles at COP 26 in 2021, then established a work programme on implementing just transition pathways through international co-operation at COP 28 in 2023. The outcomes regarding a climate finance goal at COP 29 in 2024 highlight the importance of supporting "just transitions in all sectors and thematic areas".[117] (See 1.6 A Just Transition in Transport: A Double Challenge.)

According to the Paris Agreement, countries must undertake periodic stocktakes of the agreement's implementation to assess collective progress towards achieving its purpose and long-term goals. Countries concluded the first Global Stocktake at COP 28 in 2023, and agreed to subsequent ones every five years.

In their NDCs, LT-LEDS, and NAPs, countries have increasingly focused on transport action. In the second-generation NDCs (submitted during 2019-2024), the number of transport-related actions and transport greenhouse gas mitigation targets doubled compared to first-generation NDCs.[118] Transport greenhouse gas mitigation targets appeared in only 11% of first-generation NDCs (2015-2018 submissions; 18 out of 169) but rose to 19% of second-generation NDCs (28 out of 154) (see below for data on the 2025 NDCs).[119]

Among the 78 LT-LEDS submitted between 2016 and August 2025, 23 (30%) outlined transport greenhouse gas mitigation targets.[120] Between 2023 and August 2025, 11 countries (Armenia, Belize, Burkina Faso, Ireland, Nigeria, Oman, Peru, Serbia, Solomon Islands, the United Arab Emirates and Vanuatu) submitted LT-LEDS with transport greenhouse gas mitigation targets.[121]

The ambition levels shown by countries in their LT-LEDS are not sufficient to meet global warming goals under the Paris Agreement. An assessment of the 68 LT-LEDS submissions as of 25 September 2023 found that even if all the actions were fully implemented and delivered on time, the greenhouse gas emissions from submitting countries would fall only 63% below 2019 levels by 2050.[122] Overall, a lack of clarity remains regarding the scope and coverage of long-term goals outlined in LT-LEDS.

The combined ambition from LT-LEDS and long-term targets in NDCs would result in estimated economy-wide per capita greenhouse gas emissions of 2.3 tonnes of CO_2 equivalent by 2050.[123] **While this is consistent with scenarios limiting warming to below 2°C (with 67% probability), it exceeds the level compatible with the 1.5°C limit (1.3 tonnes per person by 2050).**[124]

A key shortcoming of NDCs and LT-LEDS is the delayed timing of emission reductions: as of 2023, two-thirds of the planned reductions were for the period 2030-2050, making it impossible to remain within the 1.5°C global warming limit as the carbon budget to stay within 1.5°C would be used up by 2032.[125] (See 2.1. National Transport Pathways to Reach Climate and Sustainability Goals.)

The number of NAPs increased sharply between 2023 and August 2025, with nearly half (48%) of all submissions occurring during this period (35 new submissions, out of 74 in total).[126] **Among these latest submissions, all contain actions to enhance transport adaptation and resilience efforts.** A common action area is a focus on climate-resilient standards and codes for the construction of transport infrastructure.[127] (See 2.1. National Transport Pathways to Reach Climate and Sustainability Goals; Spotlight on Transport in National Adaptation Plans.)

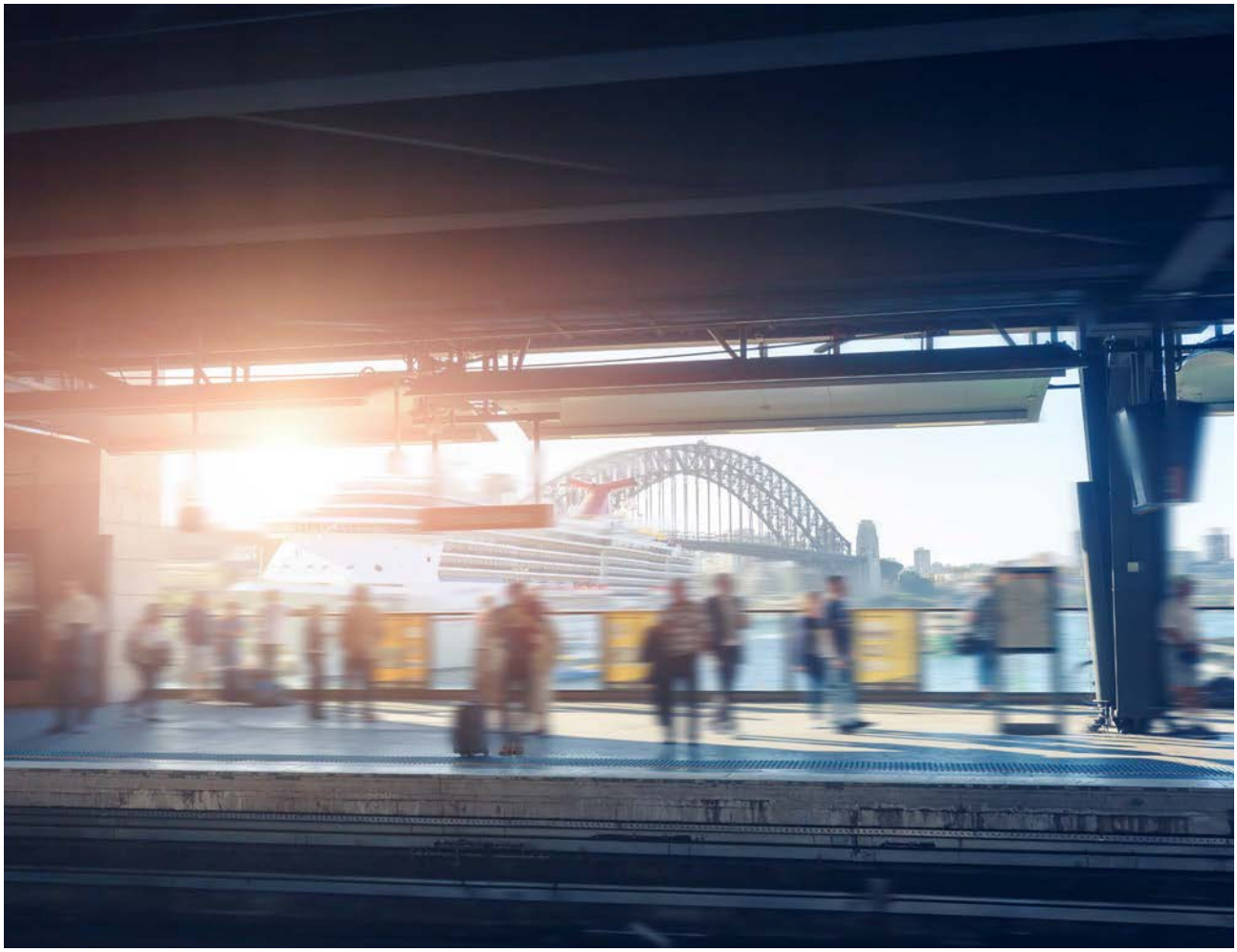
In 2021, Parties established the Mitigation Work Programme (MWP) at the UN Climate Change Conference in Glasgow, United Kingdom (COP 26) to "urgently scale up mitigation ambition and implementation" to help reach the Paris Agreement's 1.5°C goal.[128] At COP 27 in Sharm El-Sheikh (Egypt), Parties further fleshed out the MWP, to be operationalised between 2023-2026 through at least two annual global dialogues and investment-focused events.[129] SLOCAT participated in the MWP Global Dialogues in 2023 and submitted input on the critical challenges and opportunities in the transport sector.

Also in 2021, for the first time in the history of UN climate talks, the Glasgow Pact – the outcome agreement of COP 26 – called on nations to phase down unabated coal power and inefficient subsidies for fossil fuels.[130] Two years later, in the lead-up to the 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28), a group of organisations launched a call to double the share of energy-efficient and fossil-free forms of land transport by 2030, with the goal of fossil-free land transport by 2050.[131] The call to action attracted more than 60 multi-stakeholder signatories (including Chile and Colombia) and emphasised shifts towards public transport, walking, cycling, and rail freight, as well as electric vehicles and railways, while drastically scaling up the use of renewable and zero-emission energy sources.[132]

The UAE Consensus – the outcome document of COP 28 in 2023 – called for countries to transition away from fossil fuels in energy systems, and for world leaders to deploy strong political support by COP 30 (in 2025) through NDCs and NAPs.[133] The public and private sectors were asked to work together to invest in clean technologies and to commit to ultimately eliminating the prevailing reliance on fossil fuels by accelerating actions to reduce greenhouse gas emissions and improve resilience and adaptive capacities.

In 2024, building on previous multi-stakeholder efforts, the Climate Champions Team launched the Avoid and Shift Breakthrough at the UN Climate Change Conference in Baku, Azerbaijan (COP 29).[134] **The Breakthrough features the same doubling goal for land transport that was championed in the 2023 multi-stakeholder call to action. It also seeks to strengthen transport targets that focus on "Avoid" and "Shift" measures, in complementarity with initiatives that favour "Improve" measures.**[135]

The first Global Stocktake, finalised in December 2023 at COP 28, showed that the world is not on track to meet the goals of the Paris Agreement.[136] **Through the Stocktake, nearly all the world's countries agreed (for the first time) to "transition away" from all fossil fuels to achieve net zero greenhouse gas emissions.**[137] **Countries also agreed to triple renewable energy capacity and double the rate of**



energy efficiency improvements.[138] **Furthermore, the first Global Stocktake made the most significant commitment on transport ever made under the UNFCCC process, by agreeing to "significantly reduce road transport emissions on a range of pathways, including through development of infrastructure and rapid deployment of zero- and low-emission vehicles".**[139] (See 2.1 National Transport Pathways to Reach Climate and Sustainability Goals.)

Against the backdrop of current climate finance flows to transport and the acute need to increase them to deliver on the required transformations in the transport sector, COP 29 was considered by many as a missed opportunity to set a new ambitious climate finance goal and align it with sectoral needs, including for transport. High-income countries pledged to contribute USD 300 billion to LMICs by 2035, starting in 2026.[140] In addition, all actors are supposed to scale up financing from public and private sources, amounting to at least USD 1.3 trillion per year by 2035.[141]

Despite high-income countries tripling their climate finance commitments to LMICs (from the previous goal of USD 100 billion annually), the new goal, known formally as the New Collective Quantified Goal on Climate Finance, falls well short of meeting LMICs' calls for the trillions required.[142] As a result, most of the financing agreed at COP 29 will rely on private investment and alternative sources, both of which carry uncertainties in realisation.[143]

The new climate finance goal has attracted criticism regarding its qualitative criteria. The goal is not accompanied by minimum allocation floors for sub-groups of LMICs (such as small island developing states), nor does it set sub-targets for mitigation, adaptation, and loss and damage. It provides no obligations to prioritise grants over loans, and no safeguards to preclude investments in fossil fuel infrastructure from being classified as "climate finance". This combination of factors brings little guarantee that the finance needed to transition to sustainable and low-carbon transport will be delivered at the speed required to meet the Paris Agreement targets and the SDGs.[144] (See 6.1. Financing Sustainable Transport in Times of Constrained Public Budgets.)

The global transport community's engagement in multilateral climate and sustainability processes

Over the years, the transport dimension of multilateral climate and sustainability processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes. The third edition of the SLOCAT *Transport and Climate Change Global Status Report* compiled key milestones of transport stakeholders' engagement in UNFCCC processes.[145]

At the 2015 UN Climate Change Conference in Paris, France (COP 21), negotiators agreed that mobilising stronger and more ambitious climate action by all Parties, as well as by all other public and private actors, is urgently required to achieve the goals of the Paris Agreement. To that end, **the 2016 UN Climate Change Conference in Marrakesh, Morocco (COP 22) gave birth to the Marrakech Partnership for Global Climate Action, which brings together stakeholders working in key sectors and themes.**[146] **Transport was recognised among the key sectors to spur enhanced climate ambition and action.** SLOCAT was officially appointed as the focal point for the engagement of the transport sector and has been reappointed since.

Inspired by the call to action by UN Secretary-General Ban Ki-moon at the 2014 Climate Summit, and followed up by the Lima-Paris Action Agenda, 15 voluntary sustainable, low-carbon transport commitments and initiatives established by non-state actors in the transport sector were showcased at COP 21 in 2015.[147] These efforts support countries' climate ambitions through non-binding actions and agreements.

Six years later, in 2021, COP 26 kicked off an unprecedented number of voluntary commitments and initiatives on sustainable, low-carbon transport. These include but are not limited to: the Breakthrough Agenda on Road Transport, the Clydebank Declaration for Green Shipping Corridors, the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU), the International Aviation Climate Ambition Coalition and the Zero Emission Vehicles Declaration (which later became the Accelerating to Zero Coalition at COP 27).[148] These efforts have continued to develop and grow, with every subsequent UN Climate Conference adding new initiatives or multilateral agreements. A comprehensive review of such transport initiatives identified 19 total as of December 2024.[149]

The approach of thematic ministerial meetings at COPs was a legacy of the Chilean Presidency of the 2019 UN Climate Change Conference (COP25), as part of its vision to direct climate change conversations to specific economic sectors. **While plans for a transport ministerial meeting at COP25 in Madrid did not materialise (due to the movement of the COP from Chile to Madrid), COP 26, COP 28 and COP 29 featured transport ministerial meetings, in collaboration with the International Transport Forum.**

Beyond the UNFCCC, the intensity and impact of global transport community engagement has extended across other multilateral processes that both directly and indirectly relate to the implementation of the global climate and sustainability agendas. Two prominent examples (among many) are the High-level Meeting on Transport, Health and Environment (THE PEP) and the Clean Energy Ministerial.[150]



On the road to the first-ever UN Decade of Sustainable Transport

Expanding passenger and freight transport services that are efficient, accessible, affordable, safe, clean, sustainable and resilient is among the most impactful steps to enable inclusive communities and shared prosperity for a liveable planet. Even as billions of people still lack convenient access to transport today, by 2050, under current policies, privately owned vehicles are projected to continue to dominate urban passenger transport, passenger demand will increase 79%, and freight demand will roughly double.[151] Without a paradigm shift, the negative impacts from transport will continue to rise.

There are ample opportunities to accelerate transport decarbonisation, sustainability, and adaptation and resilience solutions across all transport modes. However, advancing will require a multi-faceted approach involving changes in policy, finance, workforce, data, business models, technology, services, behaviours and perceptions, power dynamics and partnerships. The pursuit of climate and sustainability agendas for transport systems and services in LMICs is compounded by limited capacity and data, as well as inadequate policy frameworks and access to (climate) finance. **With many transport systems still developing in LMICs, effective and context-adapted support over the next decade is decisive to avoid inefficient investments and costly retrofits.**

The new NDCs and the implementation of the first Global Stocktake

The implementation of countries' commitments made in 2023 under the first Global Stocktake of the Paris Agreement remains highly contested and politically sensitive. This tension is likely to dominate the agendas of the next several UN climate conferences, as implementation – or lack thereof – will determine whether the world can stay on track to meet the Paris goals.

The Global Stocktake was designed to assess collective progress and to guide countries towards stronger climate action; however, translating its outcomes into concrete national policies and enhanced new NDCs has proven challenging. Against a challenging geopolitical environment for multilateralism, the wide range of national circumstances, economic interests, and interpretations of equity and responsibility has fuelled debates over who should bear the greatest burden of action and finance.

The 2025 round of NDCs (so-called NDCs 3.0 or third-generation NDCs) is expected to reflect the lessons of the Global Stocktake and to embody higher ambition. The credibility of countries' climate action hinges on whether they will follow through what they agreed in 2023.

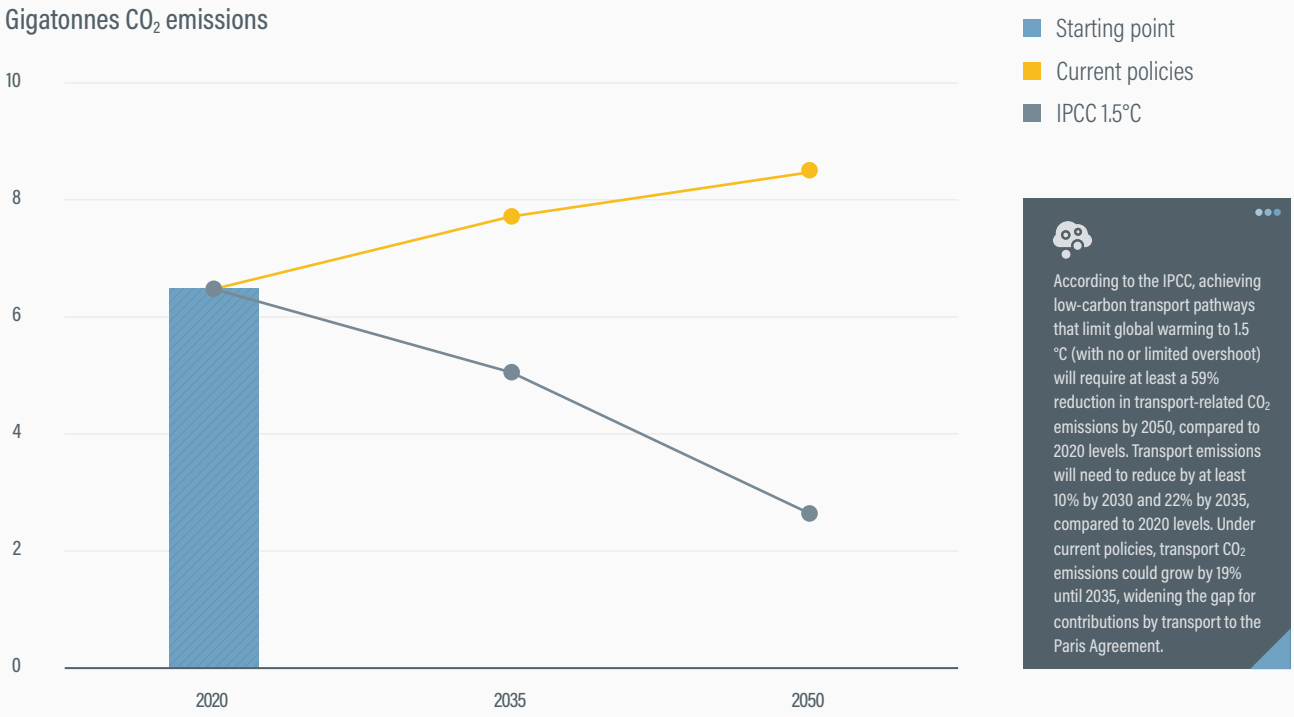
The IPCC has highlighted that total economy-wide greenhouse gas emissions need to peak before 2025 at the latest and to decline 43% by 2030 to limit global warming to 1.5°C (with no or limited overshoot).[152] Because the remaining carbon budget is limited, rapid and deep mitigation of emissions is needed until 2050. Net zero CO_2 emissions are required by 2050 for pathways limiting warming to 1.5°C, and by the early 2070s for pathways limiting warming to 2°C.[153]

According to the IPCC, achieving low-carbon transport pathways that limit global warming to 1.5 °C (with no or limited overshoot) will require at least a 59% reduction in transport-related CO_2 emissions by 2050, compared to 2020 levels.[154] Transport emissions will need to decline at least 10% by 2030 and 22% by 2035, compared to 2020 levels (Figure 4).[155] Yet under current policies, transport CO_2 emissions could grow **19% between 2020 and 2030,** widening the gap in the sector's contributions to the Paris Agreement.[156]

The 2025 NDCs are a major opportunity for countries to implement – through robust transport targets – their agreements under the first Global Stocktake. These include efforts to reduce road transport emissions through a range of pathways, transition away from fossil fuels, triple renewable energy capacity and double the rate of energy efficiency.

Integrating robust transport actions in NDCs offers multi-faceted benefits that extend beyond emission reductions (Figure 5).[157] Countries can boost prosperity, attract investment and create jobs. Cities can become cleaner (through reduced greenhouse gas emissions and improved air quality) and more inclusive, with diversified transport infrastructure and options that enhance access to basic services and better opportunities for all. Greater efficiency in transport systems saves energy, land and public funds. Shifting away from fossil fuels enhances energy security and resilience against global shocks, and

FIGURE 4. Pathways for current policies versus low-carbon pathway for transport CO_2 emissions



According to the IPCC, achieving low-carbon transport pathways that limit global warming to 1.5 °C (with no or limited overshoot) will require at least a 59% reduction in transport-related CO_2 emissions by 2050, compared to 2020 levels. Transport emissions will need to reduce by at least 10% by 2030 and 22% by 2035, compared to 2020 levels. Under current policies, transport CO_2 emissions could grow by 19% until 2035, widening the gap for contributions by transport to the Paris Agreement.

Source: See endnote 155 for this section.

FIGURE 5. Benefits of robust transport actions in new NDCs

Boosted investment and prosperity
- Attract funding through robust NDCs
- Create jobs and drive prosperity

Reduced emissions and cleaner cities
- Cut GHG in passenger and freight transport
- Improve air quality and reduce noise pollution

Inclusive, collaborative approaches
- Bring subnational and non-state actors on board
- Ensure more integrated, unified strategies

Stronger resilience and energy security
- Move away from fossil fuels
- Better resilience against global shocks

Greater efficiency and cost savings
- Save energy, land, and public funds
- Avoid costly reliance on outdated technologies

Diversified infrastructure and wider access
- Enhance services for better opportunities
- Build networks that benefit everyone

Source: See endnote 157 for this section.

reduces bills associated with fuel imports and volatile energy markets. Inclusive and collaborative approaches towards transforming transport – involving sub-national and non-state actors – ensures more integrated and unified strategies. (See 2.1. National Transport Pathways to Reach Climate and Sustainability Goals, and the Spotlight on Transport Ambition in NDCs 3.0.)

As outlined in SLOCAT's Five-Point Plan for Transport in New NDCs, the third-generation NDCs can deliver strong transport emission reductions targets aligned with net zero pathways by 2050, scale up action to accelerate the transformations towards energy-efficient and fossil-free transport, and secure assets by building resilience and adaptation in transport – while catalysing finance and investment in low-carbon, resilient transport solutions and prioritising people both in passenger and freight transport (Figure 6).[158]

A staggering 95% of countries missed the initial deadline of 10 February 2025 for submitting third-generation NDCs to the UNFCCC, resulting in a decision by the UNFCCC to postpone the submission deadline.[159] As of August 2025, 29 third-generation NDCs had been submitted, and in September 2025 several more were scheduled for announcement at related UN proceedings.[160]

The share of third-generation NDCs that included mitigation targets for reducing transport greenhouse gas emissions was the highest among all three NDC generations (34.5%, or 10 out of 29 NDCs, as of August 2025); however, the ambition in these NDCs was still not sufficient to align transport emissions to the required low-carbon pathways.[161] Only around half of the NDCs' mitigation targets for transport emissions commit to reducing absolute emissions, while the remaining NDCs aim to slow the relative growth in emissions.[162] The new NDCs of five large transport emitters – Australia, Canada, Japan, the United Kingdom and the United States (submitted in January 2025) – do not include a target to reduce transport greenhouse gas emissions.[163]

Overall, the actions to reduce transport emissions included in the third-generation NDCs as of August 2025 rarely aim to achieve a holistic, systemic transformation of transport systems (which could be enabled through

FIGURE 6. Five-Point Plan for Transport in New NDCs



Source: See endnote 158 for this section.

the Avoid-Shift-Improve framework[i]**).** This means that countries were not yet implementing what they agreed to in the 2023 first Global Stocktake: to significantly reduce road transport emissions on a range of pathways. Even more so than in the previous NDC rounds, vehicle electrification remains the priority action. As of August 2025, only 11% of the NDC actions were focused on "Avoid" measures that reduce the need for motorised transport, and only 23% were focused on measures to "Shift" to less-carbon intensive modes; meanwhile, 66% of actions focused on measures to "Improve" vehicles technologies and energy performance (most of them aimed at electric vehicles).[164]

Nevertheless, as of August 2025, some of the third-generation NDCs featured inspiring efforts towards systematic approaches.

- Australia's NDC sets actions on sustainable aviation fuels and maritime transport emission reductions.[165]
- Lesotho's NDC contains risk assessment and vulnerability planning of transport assets, and connects transport actions to wider sustainability advancements on health, clean energy, sustainable cities, and responsible consumption and production.[166]
- The NDC of Marshall Islands targets emission reduction and decarbonisation of domestic shipping.[167]
- Singapore's NDC outlines the "Walk-Cycle-Ride" strategy to encourage walking and cycling and prioritise public and shared transport.[168]
- The NDC of the United Arab Emirates sets actions on transport electrification, infrastructure development for walking and cycling, and mixed land-use policies.[169]
- The United Kingdom's NDC is centred on a just transition with a focus on green and clean jobs.[170]
- Uruguay's NDC pursues inter-modality for both freight and passenger transport.[171]

Few countries triangulate their NDCs and climate change policies with equity, and most references to a just transition are vague. The concepts of transport poverty and of sustainable transport that is "accessible and affordable for all, ensuring that disadvantaged communities are not left behind", is not yet at the heart of climate actions (Box 1).[172] The UNFCCC has made significant progress in including gender into its framework and encourages member countries to also do so. However, most national climate change policies still do not apply a gender approach.

Integrating the "Shift" part of the Avoid-Shift-Improve framework into climate and sustainability policies for transport offers good opportunities for improving accessibility and connectivity for women, persons with disabilities, elderly and youth – with measures to promote public and shared transport and to increase active (walking and cycling) transport. So far, few "Improve" policies have addressed equity and inclusion for populations currently underserved by transport systems; however, these policies do present opportunities for diversification of the workforce in the transition to cleaner transport.[173]

The aviation and maritime transport sectors have traditionally received less attention in NDCs, although there is a growing recognition of the need to include them in decarbonisation strategies. As of August 2025, 7 of the 29 third-generation NDCs included specific actions in these areas.[174] The NDCs of Australia, Belize and Marshall Islands provide inspiring efforts to decarbonise shipping, and the NDCs of Australia, Canada and the United States do so on sustainable aviation fuels.[175] (See 2.1 National Transport Pathways to Reach Climate and Sustainability Goals, 4.9 Aviation and 4.10 Shipping.)

Box 1. Climate justice and transport poverty

Climate justice recognises that climate change disproportionately affects certain populations, particularly people in LMICs, low-income communities, and marginalised groups, who often have contributed the least to the problem. It emphasises the need for fair and equitable solutions, recognising historical and systemic inequalities, and ensuring that the benefits and burdens of climate action are distributed justly. Climate justice also highlights the need for those who have contributed the most to climate change to take responsibility for addressing its impacts. Implementing climate justice means putting equity and human rights at the core of decision making and action on climate change. Ultimately, it calls for a more inclusive and sustainable approach to addressing the global climate crisis.

This includes improving transport for those who are currently underserved. The European Commission investigated the concept of transport poverty in a 2024 report and found that it is a multi-dimensional phenomenon influenced by a range of related concepts, such as mobility justice, mobility poverty, transport disadvantage, transport justice, accessibility poverty and transport-related social exclusion. It is found in both rural and urban areas, with poorer households particularly affected. Equity and fairness are key components of justice, and this approach advocates for equitable solutions that prioritise the needs of the most vulnerable and ensure that the burdens of climate action are shared fairly. Transport systems are not neutral infrastructures but rather socially and politically constructed spaces. Transport justice is based on a new paradigm for planning centred on principles of justice. Environmental and social justice in transport are essential for ensuring fair and equitable access to mobility for all.

Source: See endnote 172 for this section.

i The Avoid-Shift-Improve framework has been central to sustainable, low-carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

The **2025 UN Climate Change Conference in Belém, Brazil (COP 30) is a pivotal opportunity to accelerate the transport sector's role in advancing climate and sustainability goals, and to drive co-ordinated action for lasting impact that meets the scale of the challenges. To strengthen transport systems and services that are climate compatible and environmentally responsible, socially inclusive, economically viable, and resilient, SLOCAT has called on participants in COP 30 to prioritise progress in five key areas** (Figure 7).[176]

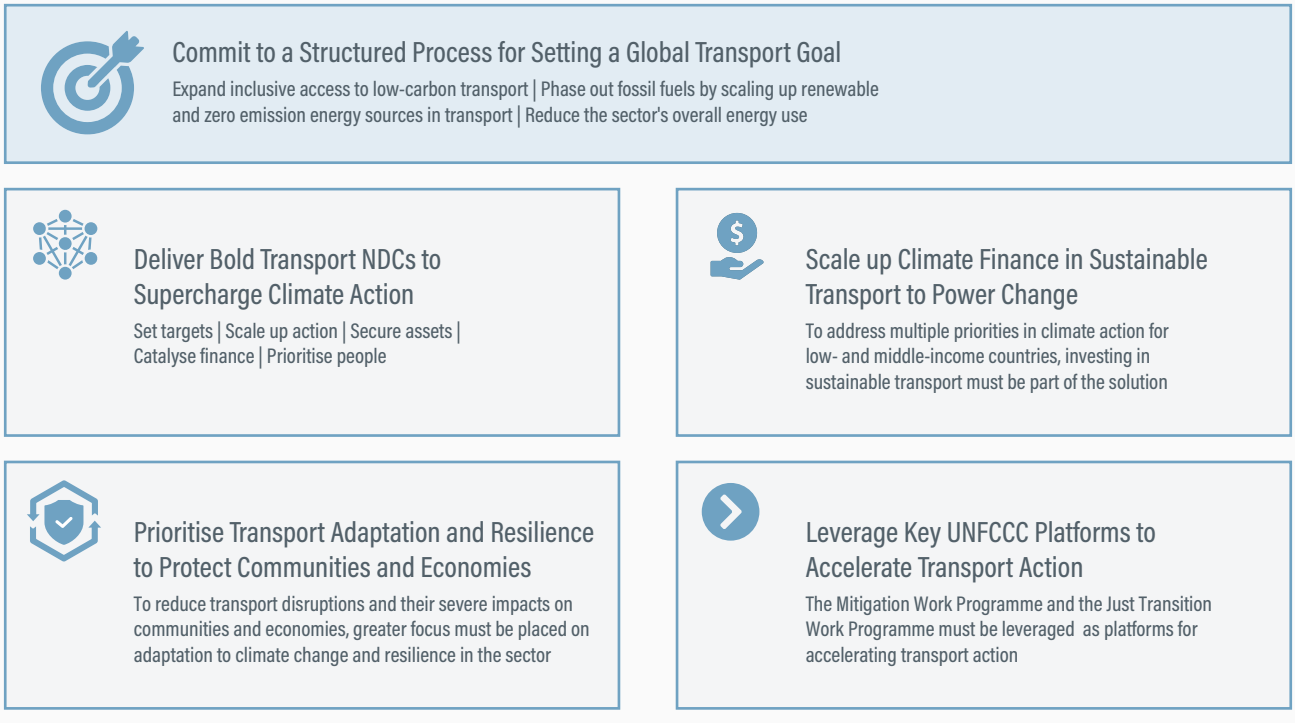
At COP 30, leaders can kick-off a structured process for setting a quantified global goal for the decarbonisation of transport: expanding inclusive access to low-carbon transport, phasing out fossil fuels by scaling up renewable and zero-emission energy sources in transport, and reducing the sector's overall energy use. **While countries may start from different contexts, a global transport goal would bring clarity and shared direction for expanding inclusive, climate-compatible, and resilient transport systems and services worldwide.** It would drive implementation, guide more ambitious NDCs, send a clear signal to industry, enhance international co-operation and reinforce accountability to effectively accelerate sector-wide transformations.

COP 30 marks the first opportunity to assess the collective ambition of new and revised NDCs and set the tone for enhanced climate commitments until 2035, but it will be just as important to focus on the implementation of NDCs. **Going forward, a stocktake of transport in new NDCs will be essential to inform preparations for the second Global Stocktake due for finalisation in 2028, and the first-ever UN Decade of Sustainable Transport (2026-2035).**

As the global community continues to work at COP 30 towards mobilising USD 1.3 trillion annually by 2035 to address multiple priorities in climate action for LMICs, investing in sustainable transport must be part of the solution.[177] The climate finance decisions we take now will shape transport infrastructure and systems for decades.

To protect communities and economies, it is essential to prioritise transport adaptation and resilience both in the monitoring efforts through the UAE-Belém Work Programme and the effective mobilisation of resources through the Loss & Damage Fund.[178]

FIGURE 7. Five transport priorities for climate and sustainability action at COP 30



Source: See endnote 176 for this section.

The UN Decade of Sustainable Transport

The first-ever UN Decade of Sustainable Transport, which was declared in 2023 and runs from 2026 to 2035. It **represents a significant global commitment to advancing sustainable, inclusive, and resilient transport systems and underscores the critical role of transport in achieving both the SDGs and climate ambitions.**[179]

Through resolution A/78/148 on "Strengthening the links between all modes of transport to achieve the Sustainable Development Goals", UN Member States requested the UN's Department of Economic and Social Affairs to develop an Implementation Plan for the UN Decade of Sustainable Transport, in collaboration with UN Regional Commissions and in consultation with Member States, the UN system and relevant stakeholders.[180] The Implementation Plan will be a critical tool in steering global efforts towards sustainable, inclusive and resilient transport systems. By fostering collaboration, mobilising resources, and ensuring effective monitoring, it can shine a light on the critical importance of sustainable transport and contribute greatly to achieving both it and wider climate action goals and the SDGs.[181]

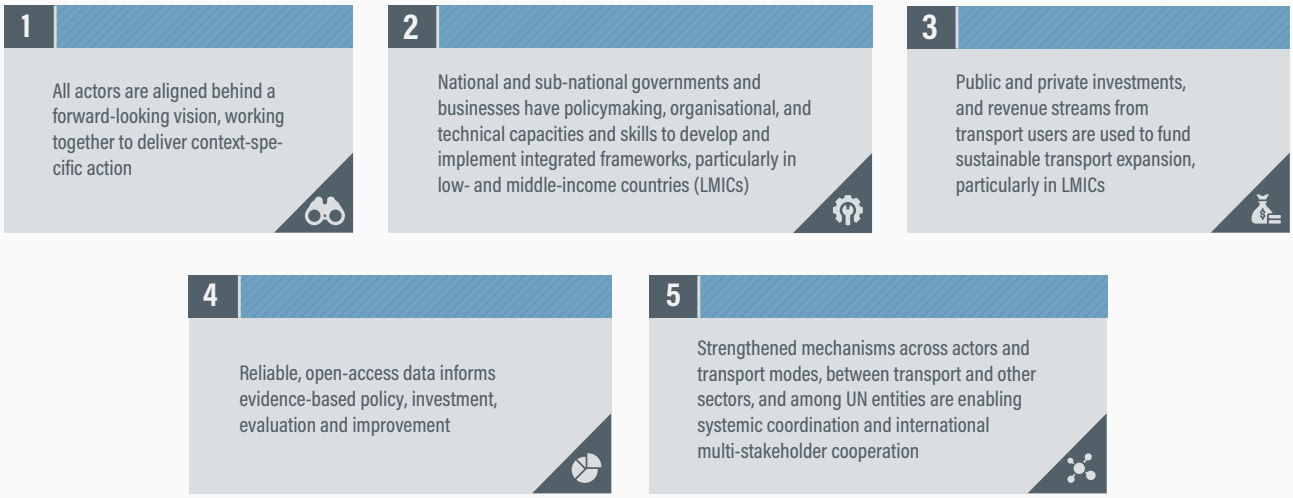
SLOCAT underscores that this UN Decade should serve as a global call to action, encouraging and supporting governments, businesses, users, financiers, civil society and academia to accelerate both individual and collaborative efforts in advancing sustainable transport.[182]

This Decade is also the opportunity to foster multi-stakeholder co-operation at the national, regional and international levels on the many intersections of transport and other sectors (Figure 8).[183]

Monitoring progress will be essential to ensure that the UN Decade becomes a compass for the positive transformation of transport systems and remains focused, responsive and accountable. A robust monitoring framework can support evidence-based decision making, guide investment priorities, help identify areas where additional multi-stakeholder co-operation or corrective action may be needed, and nurture peer-to-peer learning across regions and sectors. Monitoring efforts from the early years of the UN Decade will also support the process towards the post-2030 Agenda on Sustainable Development.

While existing transport-related SDG indicators offer a foundation to reflect the progress and actions carried out by UN Member States, the UN Decade of Sustainable Transport provides an opportunity to explore a more tailored set of indicators to better address specific challenges and opportunities of sustainable transport – such as access (including informal transport and inter-modal options), equity, affordability and other cross-sectoral aspects – particularly across countries with different income levels.[184] Efforts to improve monitoring should consider policy tracking, the integration of sub-national data, and the use of open-access platforms to enhance transparency and accessibility.

FIGURE 8. What can the UN Decade of Sustainable Transport achieve by 2035?



Source: See endnote 183 for this section

Strengthening reliable and open-access data systems and institutional capacities, particularly in countries with limited resources, will be critical. Existing initiatives, such as the Transport Data Commons, offer a basis for further multistakeholder collaboration. [185]

Through adequate and co-ordinated policy and investment efforts, robust monitoring, open-access data platforms, multi-stakeholder collaboration, and peer-to-peer learning, the next 10 years can bring tangible, transformative change across all modes of transport and reduce regional disparities. If harnessed effectively, these 10 years can leave a lasting legacy of socially inclusive, economically viable, environmentally responsible and resilient transport systems for shared prosperity well beyond 2035.



MODULE 1 | 1.2

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The Right to Mobility in a Sustainable and Inclusive Society



KEY FINDINGS



- A critical function of passenger transport (movement of people) is to enable people to access socio-economic opportunities and services such as education, employment, health care, social services, community activities and cultural activities.
- Because different groups of people have different needs as transport users, provisions must be made to ensure that transport systems are accessible to all.
- Mobility is a fundamental right of people. The ability to move freely and to access opportunities is vital for both personal and collective well-being, enhancing quality of life, social inclusion and cohesive societies.
- The absence of reliable and affordable transport places people in situations of transport poverty – particularly low-income residents, marginalised groups, people with disabilities, and people in underserved rural, remote or urban areas. This limits their access to essential services and employment opportunities and bars them from fully participating in society, perpetuating cycles of poverty and exclusion.
- Article 13 of the 1948 United Nations (UN) Declaration of Human Rights recognises freedom of movement as fundamental.
- In recent years, several countries including Brazil, Colombia, and Mexico have incorporated mobility as a constitutional right, reinforcing its importance in promoting social justice and equality.
- Because of the transport sector's high share of greenhouse gas emissions, and transport's critical role in ensuring access to opportunities, mobility rights are deeply interconnected with environmental and economic imperatives, and these cannot be effectively addressed separately.
- By integrating mobility rights into climate policy, as part of a wider approach to a "just transition", societies can better protect individuals from climate-related disruptions and foster climate-resilient communities.
- Several of the UN Sustainable Development Goals (SDGs) recognise the connections between access to mobility, access to opportunities, and environmental and economic imperatives, including SDG 11 on sustainable cities and communities (target 11.2) and SDG 9 on industry, innovation and infrastructure (target 9.1).
- Establishing the right to mobility in a sustainable, inclusive society rests on key foundations: investment in accessible, affordable, and efficient transport, and policies that link mobility rights to social justice, sustainability and economic opportunity. Achieving this right requires co-ordinated action by governments, the private sector, workers and communities to develop transport systems that are both people-centred and environmentally responsible. That said, governments must play a strong role in regulating the transport sector, as a lack of regulation has led to dangerous and chaotic conditions in transport systems.

KEY FINDINGS

Sustainability and climate trends

- Sustainable transport is widely recognised as an essential service that directly affects social justice, economic development, climate action, and sustainability, yet many countries lag in providing inclusive, safe and accessible sustainable transport options.
- As captured in SDG indicator 11.2.1, access to public transport services varied widely across regions and income groups in 2023. In low-income countries, access to public transport averaged 30.2%, compared to 43% and 78% in middle-income and high-income countries respectively. The lowest access (0% to 40%) was found in Africa, South Asia and Central America. In many areas, public transport remains unaffordable for low-income households.
- Globally, around 70% of the rural population lived within two kilometres of a primary, secondary or tertiary all-weather road in 2019. However, regional averages ranged from as high as 99% in Europe to 71% in Latin America and the Caribbean, 68% in Asia and 64% in Africa. When considering only primary and secondary roads, the average rural access index drops to a low of 38.3% globally, with 40.8% for Asia, 35.4% for Latin America and the Caribbean, and only 31.3% for Africa.
- In rural or remote communities, transport availability, accessibility and affordability are often significant challenges.
- So-called informal transport services (also known as popular transport) – which include shared taxis, ride-hailing and informal minibuses – provide mobility access to millions of people, particularly in low- and middle-income countries; these services represent a high share of trips in urban, peri-urban and rural areas that have limited or inexistent mass public transport services.
- Data for different cities in the Global South show that informal modes still represent a large share of passenger transport services, ranging from 11% to 95% of trips in different cities, with an average of 48% of trips. However, these services often face regulatory, operational, and business model challenges, as well as issues related to user safety, worker conditions and environmental impact.
- Many cities lack the necessary pedestrian paths, bike lanes and traffic-calming measures that ensure safe and convenient travel for walkers and cyclists. Public sector staff capacity and cultural barriers also hinder improvements in this area. Investing in infrastructure, policy, capacity and public awareness is crucial to overcome these challenges.



KEY FINDINGS

- Fragmented, lower-density and single-use development patterns greatly increase travel distances and thus the challenges related to transport access and pollution. Between 1990 and 2014, based on a study of 200 cities, three-quarters of incoming urban populations were accommodated in newly built areas of a city, leading to a decline in urban density.
- Compact land-use planning – particularly transit-oriented development that is designed to be compact, walkable and mixed-use to reduce the need for car ownership and use – has a large impact on reducing emissions, in addition to improving heath and equity. Prioritising inclusive, mixed-use, walkable, cyclable and transit-oriented development increases access for all, including vulnerable and marginalised groups.
- Conventional transport systems, particularly those that rely heavily on cars and fossil fuels, generally reproduce existing power structures and have significant negative impacts on social justice, social cohesion, public health and the environment.
- For low-income populations, ensuring the affordability and accessibility of transport is vital. Low-income households typically spend a higher share of their disposable income on transport compared to middle- or high-income populations, which greater impacts their ability to afford other necessities such as food and housing, and traps them into a cycle of poverty.
- In addition to cost, access to transport depends on factors such as the quality and frequency of services, the state of the infrastructure, and accessibility (both digital and physical). Such challenges, coupled with unsustainable mobility systems, lock in negative human and environmental impacts.
- Millions of people with disabilities or reduced mobility remain unable to participate in everyday activities such as riding a bus to reach their jobs or healthcare services, or visiting friends. Making transport infrastructure and services more accessible and safer for these populations makes the transport system better for everyone.
- In many places, unsafe and inadequate transport systems and services continue to hinder the mobility of women and girls and consequently their personal development and full participation in society. Understanding the different travel needs of women is a crucial first step to improving their transport options.
- The positive impacts of inclusive and sustainable transport infrastructure, systems and services include: improved accessibility and inclusion; greater access to socio-economic opportunities; more cohesive and resilient communities; cleaner environment and better public health; and more vibrant economies.



KEY FINDINGS



Policy and investment developments

- Policy and investment developments across many different geographies confirm the inextricable links between improved access to sustainable mobility, better access to socio-economic opportunities, and better environmental and public health.
- Cities that plan with inclusive access to sustainable transport in mind also mitigate the impacts of climate change, because improving access to sustainable transport facilitates shorter and more convenient trips, cleaner air, less reliance on cars and better use of urban space. Cities designed with a focus on accessibility are also better equipped to respond to sudden events and help ensure that no one is left behind.
- A pre-condition to place the right to mobility at the centre of a sustainable transport system is to "plan for people" – recognising the diverse travel needs of different groups of people – in order to better serve everyone. This means listening to people. Brazil stands out as a commendable example of this.
- A complementary framework is the "rights-based approach" that prioritises the promotion and protection of individuals' fundamental rights and freedoms, which duty-bearers (governments, organisations, etc.) have an obligation to respect, protect and fulfill. It shifts the focus of policy and investment from purely efficiency-driven goals to upholding the inherent dignity of all people, particularly the most vulnerable.
- Addressing barriers in access to mobility requires a comprehensive approach focused on affordability, access and coverage, accessibility, safety and inter-modality.
- Governments can deliver affordable transport through subsidies for public transport and reduced fare programmes for people with limited financial resources, and by ensuring that infrastructure and services for lower-cost transport modes (walking, cycling and public transport) reach low-income populations.
- In rural areas, policies and investments focus on expanding and improving rural transport infrastructure, affordable services, demand-responsive transport solutions and community-based transport programmes.
- Facilitating complete communities by ensuring that land use, housing and transport are well integrated and deliver a mix of activities and services at the neighbourhood level is key. This reduces travel distances and costs and thus barriers to social and economic participation for low-income individuals.
- To create universally accessible urban transport systems, a comprehensive approach is necessary, starting with the integration of universal accessibility into policies, legislation and urban development plans. This includes establishing universal design and disability rights as a fundamental component of all planning efforts, rather than as a temporary concern.
- Universal accessibility is the act of designing products, services and (in this case) transport systems so they accommodate all users, including those with disabilities or reduced mobility, without the need for special accommodation or adaptation. Improving universal accessibility includes consideration of three main facets: physical accessibility, social accessibility and economic accessibility.
- Initiatives for people with disabilities are on the rise and include the use of specially designed vehicles, reduced fares and/or free public transport.
- The integration of information and communication technologies holds high potential to deliver universally accessible transport systems, by helping to boost co-ordination among transit operators, improve the clarity of information, and enhance the user experience.
- To support the travel needs of women, authorities (including in transport and other departments), policies, and investments can focus on addressing gender-specific barriers to mobility options and public transport ridership, as well increasing women's representation in the transport workforce.
- Inter-modality and integrating different transport modes – such as buses, trains and bike-sharing services – optimises the use of infrastructure, providing seamless travel experiences for passengers and contributing to climate and sustainability action. Effective integration of services requires good government regulation and management.
- For informal transport services, integrated measures are needed to address regulatory, operational, and business model challenges, as well as issues related to user safety, worker conditions and environmental impact.
- Improving walkability and cyclability requires addressing the infrastructure gaps that hinder non-motorised transport.
- Safety concerns, including the risk of crashes involving vehicles, can be mitigated by redesigning streets to prioritise walking and cycling, implementing effective traffic laws.
- The rights and working conditions of transport workers are critical to the functioning of any transport system. There is a particular need for policies that ensure fair wages and benefits, job security, safe working conditions, better working hours, and training and career development opportunities.



Context, challenges and opportunities

The purpose of transport systems is to allow people, goods, cultural practices and ideas to move from one location to another by connecting individuals, communities and institutions.

A critical function of passenger transport (movement of people) is to enable people to access socio-economic opportunities and services such as education, employment, health care, social services, community activities and cultural activities.[1] **Because different groups of people have different needs as transport users, provisions must be made to ensure that transport systems are accessible to all.** Passenger transport is the primary focus of this chapter. (For movement of goods, see 4.1 Freight Transport and Logistics, and the Spotlight on Logistics for Climate Action).

Mobility is a fundamental right of people. The ability to move freely and to access opportunities is vital for both personal and collective well-being, enhancing quality of life, social inclusion and cohesive societies. Reducing mobility barriers promotes social inclusion, enabling full participation in society —especially for poorer, marginalised groups and people with disabilities. Improved mobility also fosters more cohesive societies, where individuals face fewer geographical, economic and social constraints.

The absence of reliable and affordable transport places people in situations of transport poverty – particularly low-income residents, marginalised groups, people with disabilities, and people in underserved rural, remote or urban areas. This limits their access to essential services and employment opportunities and bars them from fully participating in society, perpetuating cycles of poverty and exclusion.

Article 13 of the 1948 United Nations (UN) Declaration of Human Rights recognises freedom of movement as fundamental, noting that: "Everyone has the right to freedom of movement and residence within the borders of each state."[2]

In recent years, several countries including Brazil, Colombia, and Mexico have incorporated mobility as a constitutional right, reinforcing its importance in promoting social justice and equality.[3] Mobility rights should be perceived as inseparable from other constitutional protections, such as freedom of movement and equal protection under the law.

- Mexico's National Law of Mobility and Road Safety, passed in 2022 primarily to address road safety challenges, calls for establishing the proven and lifesaving "safe systems" approach, which is fully aligned with World Health Organization's Global Plan for the Decade of Action for Road Safety.[4] The law prioritises the safety of the most vulnerable road users and promotes sustainable and equitable mobility for all.[5] It clarifies the government's roles and responsibilities in this regard and calls for the creation of a unified database for licences, number plates and fines.[6]
- The concept of mobility as a fundamental right is rooted in the French constitution, where freedom of movement is seen as a key element of individual liberty.[7]

Because of the transport sector's high share of greenhouse gas emissions, and transport's critical role in ensuring access to opportunities, mobility rights are deeply interconnected with environmental and economic imperatives, and these cannot be effectively addressed separately. (See 2.1 National Transport Pathways to Reach Climate and Sustainability Goals.) Transport, including international aviation and shipping, was the second largest contributor to global greenhouse gas emissions (after the power sector) in 2023, responsible for 15.9% of total emissions.[8] Transport had the highest emission growth among sectors in 2023.[9]

By integrating mobility rights into climate policy, as part of a wider approach to a "just transition", societies can better protect individuals from climate-related disruptions and foster climate-resilient communities. (See 1.6 A Just Transition for Workers in the Transport Sector.) Climate change often exacerbates inequalities, with vulnerable populations facing increased displacement due to extreme weather events such as floods, droughts, and hurricanes, and generally higher susceptibility to the negative health impacts of transport. This calls for the provision of sustainable and resilient transport infrastructure that allows people and goods to move in ways that produce low emissions and minimise environmental harm. More-sustainable transport systems and services can lessen the magnitude of climate change impacts, provide more equitable access to groups most affected by these impacts, and enable opportunities to relocate to safer areas and access vital resources.

Several of the Sustainable Development Goals (SDGs) recognise the connections between access to mobility, access to opportunities, and environmental and economic imperatives, including SDG 11 on sustainable cities and communities (target 11.2) and SDG 9 on industry, innovation and infrastructure (target 9.1). (*For more on the SDGs and the 2030 Sustainability Agenda, see 1.1 10 Years After the Paris Agreement and the 2030 Agenda, on the Path to the UN Decade of Sustainable Transport*).

- Target 11.2 aims to "provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons".[10]
- Target 9.1 is committed to "develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all".[11]

Establishing the right to mobility in a sustainable, inclusive society rests on key foundations: investment in accessible, affordable, and efficient transport, and policies that link mobility rights to social justice, sustainability and economic opportunity. To guarantee access to transport, reduce environmental impact, and promote long-term resilience, investments are essential in: infrastructure and services for accessible, affordable and efficient public transport (especially for marginalised and vulnerable communities); safe walking and cycling; and low-emission vehicles. Policies that link mobility rights to social justice, sustainability, and economic opportunity are key to overcoming income inequality, geographic isolation and social exclusion.

Achieving this right requires co-ordinated action by governments, the private sector, workers and communities to develop transport systems that are both people-centred and environmentally responsible. That said, governments must play a strong role in regulating the transport sector, as a lack of regulation has led to dangerous and chaotic conditions in transport systems. Good trust and collaboration among the multiple players can enable each actor to provide valuable insight to develop solutions that are better for everyone. However, the many modes and services that comprise transport need to operate together as part of a single system, and thoughtful government regulation is required for it to function well. Good guidelines and standards help provide clarity; while to achieve the goal of access, they must focus on people.

Sustainability and climate trends

Sustainable transport is widely recognised as an essential service that directly affects social justice, economic development, climate action, and sustainability, yet many countries lag in providing inclusive, safe and accessible sustainable transport options.[12]

As captured in SDG indicator 11.2.1, access to public transport services varied widely across regions and income groups in 2023. In low-income countries, access

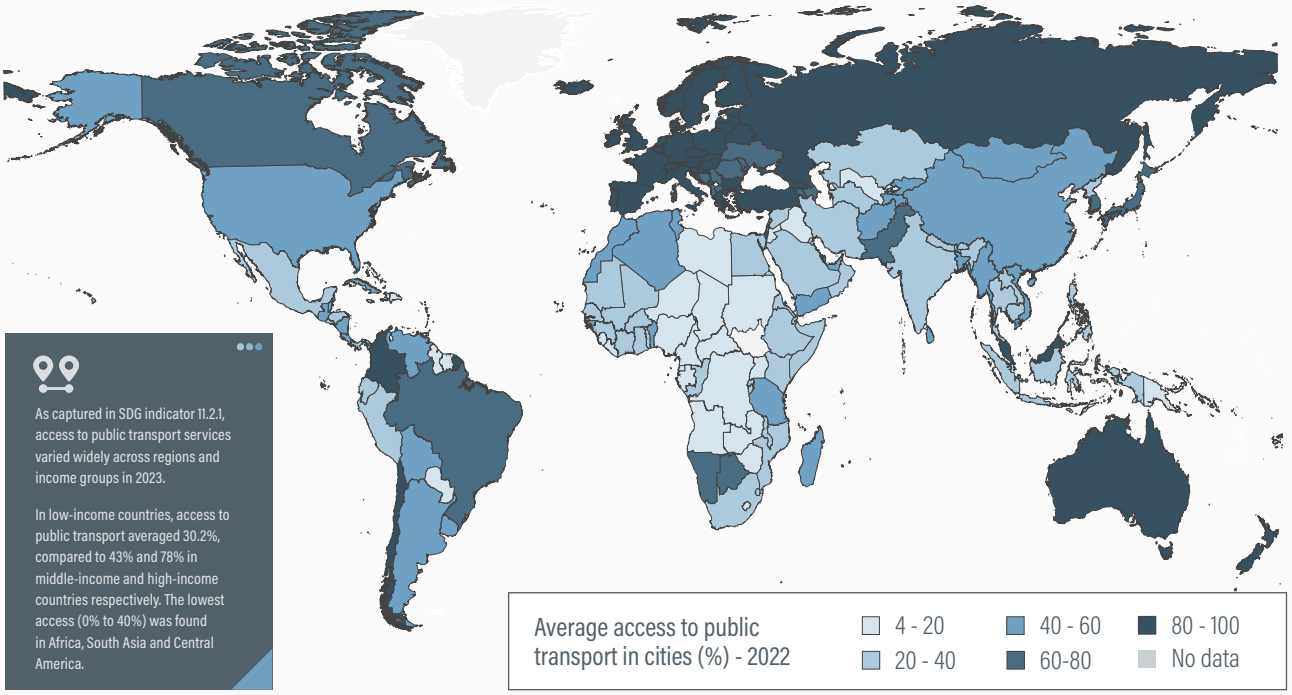
to public transport averaged 30.2%, compared to 43% and 78% in middle-income and high-income countries respectively. The lowest access (0% to 40%) was found in Africa, South Asia and Central America (Figure 1).[13] **In many areas, public transport remains unaffordable for low-income households.** (See 4.5 Public Transport.)

- In many European cities, the poorest residents live in areas with inadequate transport connectivity, resulting in longer commutes and much higher exposure to air pollution and road crashes.[14]
- A 2021 study of 29 African countries showed that people with disabilities represent 10-20% of the regional population.[15] South Africa was identified as having the region's most inclusive transport policies, yet persons with disabilities still travelled 27-66% less than their able-bodied counterparts.[16]

Globally, around 70% of the rural population lived within two kilometres of a primary, secondary or tertiary all-weather road in 2019.[17] **However, regional averages ranged from as high as 99% in Europe to 71% in Latin America and the Caribbean, 68% in Asia and 64% in Africa.**[18] **When considering only primary and secondary roads, the average rural access index drops to a low 38.3% globally, with 69.7% for Europe, 35.4% for Latin America and the Caribbean, 40.8% for Asia, and only 31.3% for Africa** (Figure 2).[19]

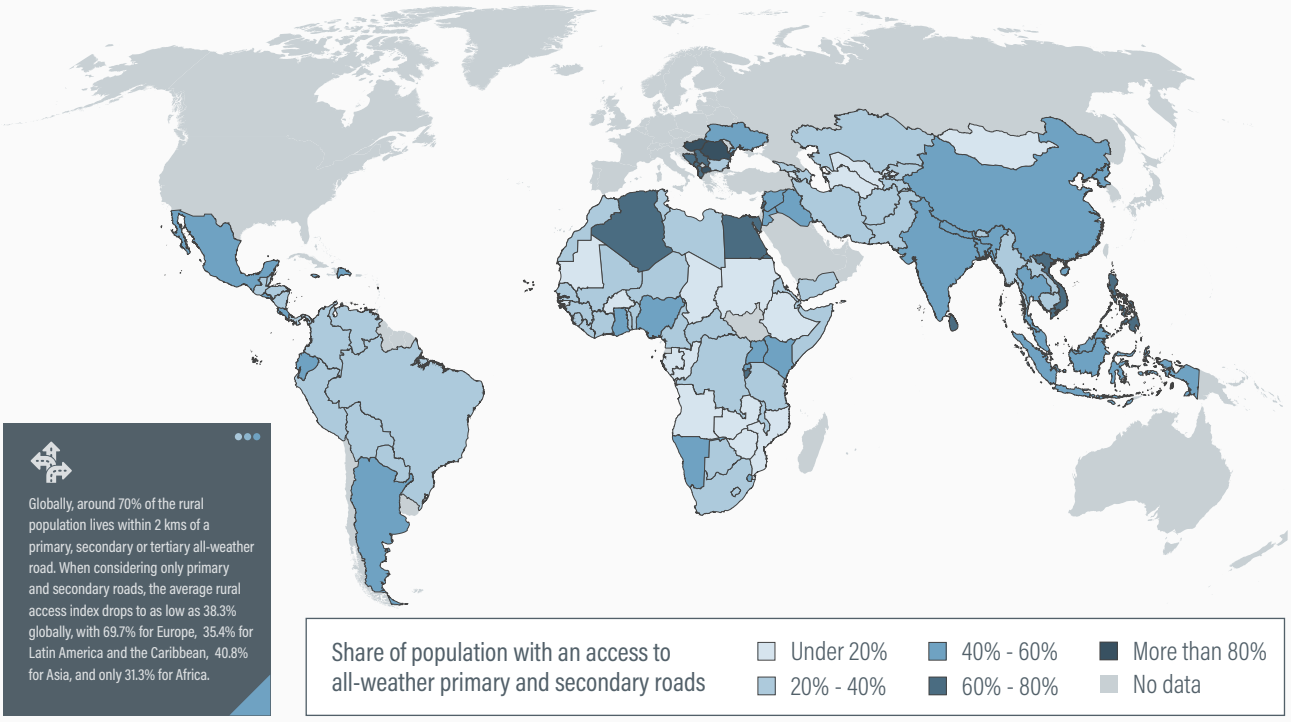
In rural or remote communities, transport availability, accessibility and affordability are often significant challenges. Rural communities typically have higher concentrations of older people with mobility challenges, and the rural population is more likely to have lower incomes. As a result, people have greater concerns about transport accessibility and less access to personal vehicles, and are more reliant on affordable public transport. Transport in rural areas is often severely limited, with many communities lacking reliable and affordable options to access essential services such as health care, education and employment opportunities; this limited access has been correlated with sub-national poverty incidence.[20] Public transport networks in these areas may be underdeveloped or non-existent, leaving many rural populations highly dependent on expensive, informal and often unsafe transport options. Transport poverty in remote

FIGURE 1. Access to convenient public transport, 2023



Source: See endnote 13 for this section.

FIGURE 2. Access to all-weather primary and secondary roads, 2019



Source: See endnote 19 for this section.

areas is perpetuated by the digital divide, as technology has in the recent past been integrated to support public transport information.[21]

So-called informal transport services (also known as popular transport) – which include shared taxis, ride-hailing and informal minibuses – provide mobility access to millions of people, particularly in low- and middle-income countries; these services represent a high share of trips in urban, peri-urban and rural areas that have limited or inexistent mass public transport services.[22] Data for different cities in the Global South show that informal modes still represent a large share of passenger transport services, ranging from 11% to 95% of trips in different cities, with an average of 48% of trips.[23] However, these services often face regulatory, operational, and business model challenges, as well as issues related to safety, worker conditions and environmental impact. (See 4.6 Informal Transport.)

Regulatory barriers often arise from the lack of clear laws that govern informal transport services and limited government capacity to implement existing laws and regulations, leading to confusion and inconsistency. Many services operate with limited oversight through a spectrum of private owner/operators, cartels, co-operatives, and other organisations, with a wide range of training and understanding of formal business practices. Limited regulation often results in intense competition and extremely low profit margins, leading many operators to aggressive driving behaviours to maximise their profits. Environmental impacts are another concern. With limited profit and lower levels of business training, many operators are unable to purchase newer, less polluting vehicles or even to properly maintain existing vehicles. Thus, modes of informal transport tend to contribute greatly to pollution. Addressing precarious working conditions for drivers – such as low wages, lack of benefits and unsafe working hours – is crucial for creating a fair and sustainable labour market. (See 4.6 Informal Transport.)

Many cities lack the necessary pedestrian paths, bike lanes and traffic-calming measures that ensure safe and convenient travel for walkers and cyclists. Public sector staff capacity and cultural barriers also hinder improvements in this area. Investing in infrastructure, policy, capacity and public awareness is crucial to overcome these challenges. A lack of policy and investment support often leaves walkability and cycleability on the back burner, with cities failing to implement comprehensive strategies that integrate these modes into the urban transport system. Even when policies are enacted, limited public sector staff and staff capacity can hinder implementation efforts. Cultural barriers, such as a preference for car ownership and limited social acceptance of cycling, can also impede efforts to promote these sustainable transport options. (See 4.3 Walking and 4.4 Cycling.)

Fragmented, lower-density and single-use development patterns greatly increase travel distances and thus the challenges related to transport access and pollution. Between 1990 and 2014, based on a study of 200 cities, three-quarters of new urban populations were accommodated in newly built areas of a city, leading to a decline in urban density.[24]

Compact land-use planning – particularly transit-oriented development that is designed to be compact, walkable and mixed-use to reduce the need for car ownership and use – has a large impact on reducing emissions, in addition to improving heath and equity. Prioritising inclusive, mixed-use, walkable, cyclable and transit-oriented development increases access for all, including vulnerable and marginalised groups. (See 4.2 Integrated Transport Planning.)

Conventional transport systems, particularly those that rely heavily on cars and fossil fuels, generally reproduce existing power structures and have significant negative impacts on social justice, social cohesion, public health and the environment (Box 1)**.**[25] (See 4.2 Integrated Transport Planning.)

- In cities, public transport schedules are planned around the male-dominated formal work economy and prioritise trips made between peripheral areas and the centre. Yet most trips do not follow this traditional pattern.
- Conventional transport planning often prioritises the movement of cars over other modes, even though that may not be the main way people get around a city.[26] In most regions around the world, the majority of people travel via non-motorised and public or shared transport over private vehicles.[27] Furthermore, males represent the majority of single-occupancy vehicle ownership and ridership.[28]

Box 1. Impacts of conventional mobility systems

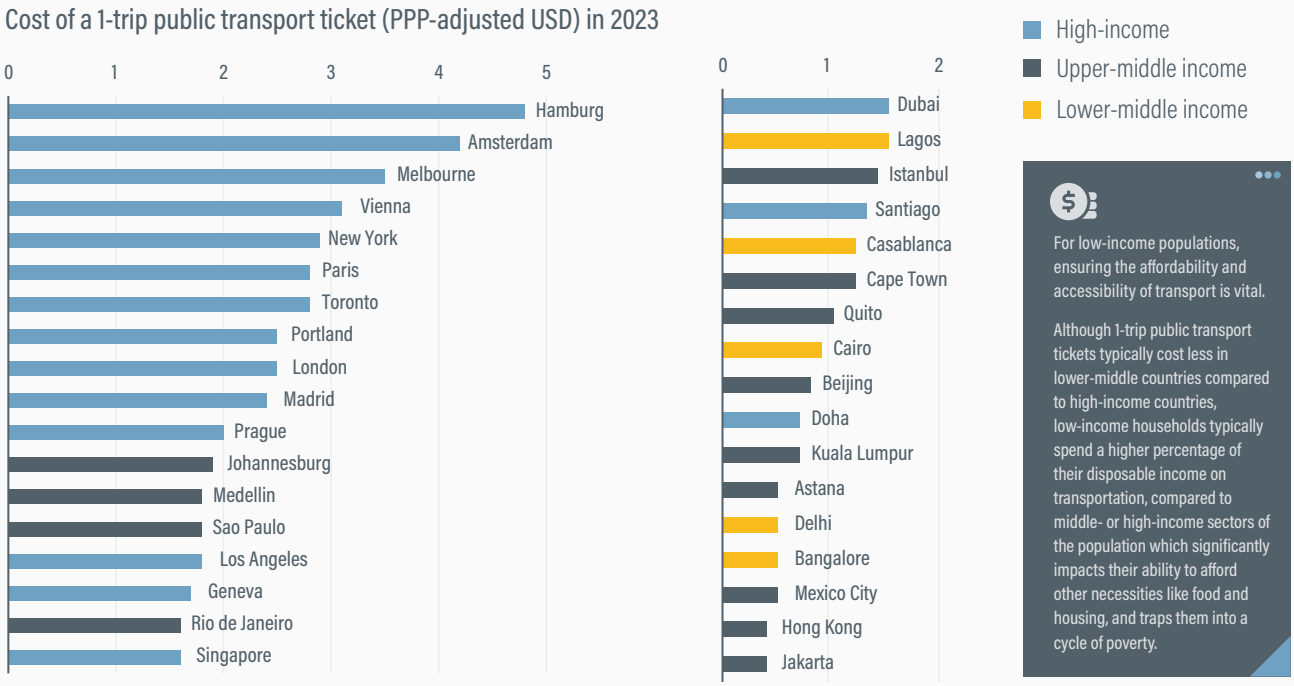
Conventional mobility systems, which tend to rely heavily on cars and fossil fuels, have wide-ranging negative economic, health and environmental impacts.

- Road crashes caused more than 1.19 million **road traffic fatalities** and 50 million injuries annually as of 2021; the total cost of death and injury on the world's roads was an estimated USD 3.6 trillion a year, or the equivalent of 3.7% of **global gross domestic product** (GDP), every year. Most victims are **vulnerable road users** such as pedestrians, cyclists, and drivers or passengers of two- and three-wheelers due to car-centric urban design and infrastructure that creates unsafe conditions. Beyond fatalities, traffic accidents can result in long-term health issues (including injuries and disabilities), straining healthcare systems and reducing people's ability to continue working or to access employment. (See 1.7 Driving Health Forward: The Critical Link Between Transport and Wellbeing.)
- **Pollution and poor air quality** provoked by conventional mobility systems are responsible for millions of **premature deaths** each year, particularly in urban areas, where pollution levels are highest. **Traffic noise** contributes to stress, sleep disruption and other mental health issues. Heavy vehicle traffic can also disrupt social interaction, **weakening community ties.** This is a growing **public health crisis** that also burdens healthcare systems, frays social connections and reduces overall quality of life. (See 1.7 Driving Health Forward: The Critical Link Between Transport and Wellbeing.)
- Reliance on fossil fuels for mobility deepens **oil dependency**, exposing countries to price volatility and supply chain risks, draining foreign reserves and undermining local economies. It also drives climate change due to **greenhouse gas emissions. Fossil fuel subsidies**, often aimed at sheltering people from higher energy costs, create inefficiencies in the transition towards sustainable transport, impose a fiscal burden on countries, strain public budgets and often hinder investment in sustainable transport. In 2023, implicit and explicit subsidies for fossil fuels totalled around USD 7 trillion, equal to 7.2% of global GDP. (See 6.1 Financing Sustainable Transport in Times of Constrained Public Budgets.)

Source: See endnote 25 for this section.

For low-income populations, ensuring the affordability and accessibility of transport is vital. Low-income households typically spend a higher share of their disposable income on transport compared to middle- or high-income populations, which greater impacts their ability to afford other necessities such as food and housing, and traps them into a cycle of poverty (Figure 3)**.**[29]

FIGURE 3. Prices of public transport tickets, 2023



Source: See endnote 29 for this section.

- Studies in South Africa show that low-income individuals can spend upwards of 51% of their net wages on transport.[30] In Cape Town, the lowest income quintile spends 43% of their income on commuting to work by public transport.[31]
- In Addis Ababa (Ethiopia), the financial burden to obtain transport access is unequally distributed. According to a 2021 study, households in the lowest income quintile, who are the most reliant on public transport for their mobility needs, spend around nine times the proportion of their income compared to households in the top income quintile.[32]
- In the European Union (EU), 2.4% of the total population, and 5.8% of those at risk of poverty, could not afford to use public transport regularly as of 2023.[33]
- In 2020, US households spent on average 16% of their annual household expenditure on transport.[34]

In addition to cost, access to transport depends on factors such as the quality and frequency of services, the state of the infrastructure, and accessibility (both digital and physical). Such challenges, coupled with unsustainable mobility systems, lock in negative human and environmental impacts. A 2023 EU report on access to essential services defines access to transport as encompassing availability, affordability, and digital and physical accessibility of transport services.[35]

Millions of people with disabilities or reduced mobility remain unable to participate in everyday activities such as riding a bus to reach their jobs or healthcare services, or visiting friends.[36] Making transport infrastructure and services more accessible and safer for these populations makes the transport system better for everyone. Changes in ability are an inevitable part of the human life cycle. Everyone is likely to experience some form of reduced mobility (temporary or permanent) in their lifetime, and it is important that all people can continue to fully participate in society. While many people live with reduced mobility, these individuals are not always visible in our cities or on our streets. Often it is the environments we have created that most limit mobility. Making environments accessible through universal design benefits people with reduced mobility, pregnant and older people, and caregivers with young children, but it also makes shared public spaces and the transport system work better for everyone.

- In the United Kingdom, nearly half of train stations are still not "reasonably" accessible for disabled users, and the public transport network is characterised by inconsistencies in access. Even with the ambition to improve accessibility for all commuters, Transport for London's 2024 plan for an accessible and inclusive transport network only aims at halving the additional time for step-free access by the end of the 2030s.[37]



- Curb cuts were originally designed for people using wheelchairs, but they now help people pushing strollers, people pulling suitcases and older people who have trouble with large steps.

In many places, unsafe and inadequate transport systems and services continue to hinder the mobility of women and girls and consequently their personal development and full participation in society. Understanding the different travel needs of women is a crucial first step to improving their transport options. Women still bear much of the burden of caregiving and domestic work done to support the functioning of households. This results in women taking more, but shorter, trips and practicing "trip chaining". As such, women more than men tend to travel with children, the elderly, people with disabilities, and with goods, which can be an additional burden as the infrastructure, from sidewalks to buses, may not easily facilitate that. Often, these trips are during off-peak hours, when service is less frequent, and destinations may not be located or integrated to existing transit lines. Women's trips tend to happen consistently throughout the day, during both peak and off-peak times.[38]

The positive impacts of inclusive and sustainable transport infrastructure, systems and services include:

- **Improved accessibility and inclusion:** Universal design in transport, walking and cycling infrastructure enables people with disabilities, older adults, pregnant women, parents with strollers and others with mobility challenges to move independently and safely. By reducing reliance on private cars through public transport, walking, and cycling, mobility becomes more affordable –especially for lower-income households – and cleaner, while promoting healthier lifestyles through walking and cycling.
- **Greater access to socio-economic opportunities:** Affordable, reliable and inclusive transport links communities to essential services, jobs, schools and health care. This fosters participation in work, education, and social life, making societies more equitable for all.
- **More cohesive and resilient communities:** Active and accessible transport promotes social interaction, as well as engagement and collective responsibility with shared spaces. This helps reduce isolation and strengthens local ties and a sense of belonging among residents. People are more likely to connect with others when walking, cycling, or using shared transport, contributing to more welcoming, cohesive, resilient neighbourhoods.
- **Cleaner environment and better public health:** Shifting from private car use to public transport, cycling, and walking cuts emissions, air and noise pollution, and traffic-related health risks. These transport modes support quieter, healthier urban environments. Safer infrastructure and road safety measures that prioritise the protection of vulnerable users – such as traffic calming, better crossings and protected bike lanes – also reduce road injuries and fatalities, lowering healthcare burdens and improving the overall wellbeing of communities.
- **More vibrant economies:** Efficient transport improves access to jobs, education, and services, reducing traffic congestion, making commuting easier and supporting productivity. Investment in active transport infrastructure, such as bike lanes and pedestrian paths, can revitalise urban areas, raise property values and attract tourism. The creation of green jobs in sectors such as public transport, renewable energy and sustainable infrastructure drives long-term economic growth and employment.

Policy and investment developments

Policy and investment developments across many different geographies confirm the inextricable links between improved access to sustainable mobility, better access to socio-economic opportunities, and better environmental and public health. Multiple public transport projects around the world have reduced travel times and costs, eased traffic congestion, lessened air pollution, and increased overall accessibility and inclusion. Examples include the Metro Line 5 project in São Paulo (Brazil) and bus rapid transit projects in Dar es Salaam (Tanzania), Lagos (Nigeria) and Lima (Peru).[39]

Cities that plan with inclusive access to sustainable transport in mind also mitigate the impacts of climate change, because improving access to sustainable transport facilitates shorter and more convenient trips, cleaner air, less reliance on cars and better use of urban space. Cities designed with a focus on accessibility are also better equipped to respond to sudden events and help ensure that no one is left behind.[40]

- In Bogotá (Colombia), Comprehensive Urban Mobility Planning – including interventions such as the Ciclovía (cycleway), integration of cycling and bus rapid transit, public space reclamation, parking reform, and land-use planning, while prioritising children and gender dynamics – has reaped benefits such as reduced carbon dioxide (CO_2) emissions and increased physical activity from walking and cycling.[41]
- The Tianjin Urban Transport Improvement project (2015-2022) in China prioritised the integration of different transport modes to enhance access and connectivity. The project redesigned streets to prioritise safe walking and cycling, and redesigned transfer areas within 96 metro stations to facilitate seamless transitions between metro, buses and shared bicycles.[42] The combination of these changes resulted in an 85% increase in metro ridership levels compared to 2015 levels.[43]

A pre-condition to place the right to mobility at the centre of a sustainable transport system is to "plan for people" – recognising the diverse travel needs of different groups of people – in order to better serve everyone. This means listening to people. Brazil stands out as a commendable example of this, with the National Policy on Urban Mobility enshrining the legal obligation of Brazilian cities to implement public participation since 2012.

- In two Brazilian cities, Favela Santa Marta in Rio de Janeiro and Vila Tronco in Porto Alegre, a study found that diverse spaces for participation (ranging from formal state mechanisms to informal community mobilisations) play a vital role in confronting mobility inequities in informal settlements, enabling residents to shape solutions that reflect their lived realities. In Santa Marta, tactical urbanism (which involves short-term, small-scale, inexpensive, rapid, and low-tech initiatives for long-term change), and localised assemblies created informal but impactful spaces for residents to voice mobility needs such as safer street crossings and improved bus access. In Vila Tronco, participatory planning mobilised local social movements and municipal collaboration to co-design community-led mobility improvements, including street upgrades and enhanced pedestrian infrastructure.[44]
- Development of the Strategic Master Plan in São Paulo (Brazil) – which eliminated parking minimums, encouraged transit-oriented development, and integrated cycling into the city transport network – relied heavily on public engagement, including 114 public hearings and over 25,000 participants (surpassing established legal requirements). To promote accessible participation, all of the schedules, data and other materials were compiled onto a single website, and a draft bill, map and online proposal form were available for public comment.[45]
- In Niterói (Brazil), the local cycling enthusiast group Pedal Sonoro collective helped prepare a Sustainable Urban Mobility Plan (SUMP) through the Bicicleta Nos Plan initiative. Active resident engagement and co-operation among civil society organisations resulted in the creation of the Cycling Infrastructure Manual, which outlines specifications for the design and operation of the cycling network to ensure that suggestions and interventions are in line with the needs of cyclists. Experts and cycling activists have emphasised the significance of fostering a riding culture and altering travel habits to increase the appeal of cycling. Initiatives and programmes to promote bicycles as a regular form of transport include car-free days, inter-cultural cycling tours, and educational campaigns targeted at both the general public and specific demographics such as schoolchildren.[46]
- Public participation is integrated into the SUMP of Florianópolis (Brazil) through workshops, online engagement campaigns, and public surveys for 13 localities within the metropolitan area.

A complementary framework is the "rights-based approach" that prioritises the promotion and protection of individuals' fundamental rights and freedoms, which duty-bearers (governments, organisations, etc.) have an obligation to respect, protect and fulfill. It shifts the focus of policy and investment from purely efficiency-driven goals to upholding the inherent dignity of all people, particularly the most vulnerable. In the context of sustainable transport, this approach is critical for analysing the inequalities and discriminatory practices that lie at the centre of conventional transport systems and often result in groups of people being left behind.[47]

- In the UK, public bodies and organisations are mandated by the Equality Act (2010) to conduct Equality Impact Assessments to make more inclusive decisions, and to ensure that all programmes, policies, and projects, including in the transport sector, are designed and implemented to meet the needs of people with protected characteristics when carrying out public functions.[48]

Addressing barriers in access to mobility requires a comprehensive approach focused on affordability, access and coverage, accessibility, safety and inter-modality.

- Ensuring **affordability** means implementing pricing policies that cater to low-income groups while maintaining the transport system's financial sustainability. Typically, this requires some sort of public subsidy, which can be directed to transport operators as a means of enhancing service in general as well as targeted towards low-income individuals as a means of reducing costs.
- Expanding **public transport access, coverage and service frequency** is essential to reach those in underserved areas, reduce waiting times and ensure that public transport is a viable alternative to private vehicles.
- **Accessibility** must be enhanced by making transport infrastructure, hubs and vehicles easily reachable for people with disabilities and reduced mobility, and transport information clear and intuitively understandable.
- **Safety** can be improved through better lighting, surveillance, and awareness campaigns and training for staff.
- Lastly, enabling **inter-modality** by integrating different transport modes – such as buses, trains, bike-sharing services, other shared mobility services, and walking – optimises the use of infrastructure and provides seamless travel experiences for people. Effectively integrating services, however, requires good government regulation and management.

Governments can deliver affordable transport through subsidies for public transport and reduced fare programmes for people with limited financial resources, and by ensuring that infrastructure and services for



lower-cost transport modes (walking, cycling and public transport) reach low-income populations.[49] Government support and oversight is sometimes extended to improving the quality of public transport services, by ensuring regular frequency and creating an integrated system where a network of connected services covers a metropolitan area with fares that are integrated so that one fare can cover transfers between multiple public transport routes. Policy interventions also include promoting solutions such as bike-sharing programmes that provide travel flexibility while keeping costs low. In addition to transport fare policies, it is important to develop indicators to monitor the affordability of public transport.[50]

- Queensland (Australia) trialled reducing its public transport fares to USD 0.31 cents (AUD 0.50) in August 2024 and then made the programme permanent in February 2025.[51] During the first six months of the programme, the number of public transport users was 18.3% higher than during the same six-month period a year prior and 5% higher than pre-pandemic levels of 2019, and users had saved around USD 112 million (AUD 181 million).[52]
- By early 2024, 106 cities in Brazil were offering universal zero-cost public transport fares, up from less than 20 cities a decade earlier (in 2023 alone, 36 Brazilian cities adopted the policy).[53] The policy has grown in popularity and has increasingly been supported by political leaders.[54]
- Mumbai (India) was among the cities with the cheapest monthly public transport passes in 2023, at USD 15.[55] In 2019, Delhi became the first Indian city to initiate fare-free bus transport for women of all ages and social classes.[56] By 2025, many Indian states were offering free bus fares for women, and a 2023 study showed that the money saved was spent mainly on family welfare needs.[57] Almost all Indian states offer public transport discounts to disadvantaged groups and those with disabilities.[58]

In rural areas, policies and investments focus on expanding and improving rural transport infrastructure, affordable services, demand-responsive transport solutions and community-based transport programmes. Vital measures include expanding bus routes, reducing the cost for transport services (via subsidies), and enhancing road networks to ensure greater connectivity, while providing walking and cycling facilities on busier rural roads. Given the low population density in many rural areas, authorities sometimes apply demand-responsive transport solutions such as shared minibuses and ride-sharing services to provide flexible and cost-effective mobility. Additionally, locals may organise and manage transport services through community-based transport programmes. Addressing transport gaps reduces rural isolation and improves access to economic and social opportunities, ultimately supporting the development of more resilient rural communities.

- In regions such as Africa and Asia, where agriculture accounts for a high share of employment and/or land use, rural roads support improved first- and last-mile access to markets and contribute to poverty alleviation. [59]
- A study of trail bridges built by Bridges to Prosperity indicated high returns on investment, with average annual returns as high as 19% in Nicaragua and 49% in Rwanda.[60]
- Sectoral reviews show that improved transport infrastructure boosts access to health services through increased vaccination rates, attendance at hospitals, use of birth attendants, use of latrines, access to preventative care, access to clean water and reductions in morbidity.[61] In Ghana, a road improvement project showed a 10% increase in post-intervention hospital access.[62]

Facilitating complete communities by ensuring that land use, housing and transport are well integrated and deliver a mix of activities and services at the neighbourhood level is key. This reduces travel distances and costs and thus barriers to social and economic participation for low-income individuals. Land-use and housing policies are crucial to ensure that cities maintain a compact, mixed-use form. Permitting denser development and lower-cost housing options in more desirable areas (such as through subsidised housing) can improve access to transport and consequently to employment and services. By facilitating shorter trips that are more easily made by walking, cycling, and low-cost public transport, people with reduced mobility, who often have lower incomes, can more easily access necessary goods and services. Public transport can enable people with low incomes or reduced mobility to travel longer distances. (See 4.2 Integrated Transport Planning, 4.3 Walking, 4.4 Cycling and 4.5 Public Transport.)

- In 2023, Rwanda adopted a rural road programme to better connect rural populations to broader transport networks, including integrating trail bridges for pedestrians and cyclists to more easily cross rivers, thereby connecting more isolated communities to larger towns and cities to allow for better access to jobs, education and other services.[63]
- In 2024, Uzbekistan expanded its integrated rural development plan, which includes improving roads and transport infrastructure alongside other areas such as education and health care.[64]

To create universally accessible urban transport systems, a comprehensive approach is necessary, starting with the integration of universal accessibility into policies, legislation and urban development plans. This includes establishing universal design and disability rights (Box 2) **as a fundamental component of all planning efforts, rather than as a temporary concern.**[65]

Box 2. Principles of universal access

Universal accessibility is the act of designing products, services and (in this case) transport systems so they accommodate all users, including those with disabilities or reduced mobility, without the need for special accommodation or adaptation. According to the UN Convention on the Rights of Persons with Disabilities, persons with disabilities are "those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others".

Improving universal accessibility includes consideration of three main facets:

- **Physical accessibility** refers primarily to infrastructure and information, which must allow for a complete trip (door to door) to be undertaken by anyone regardless of ability. This spans all infrastructure that is part of a trip – from sidewalks and traffic signals, to public transport, to information about services – while also referring to the quality of the services being provided (are they frequent, safe, etc.).
- **Social accessibility** refers to a social understanding, recognition and acceptance of the diverse travel needs of those with reduced mobility, from including those with disabilities in planning meetings, to the behaviours and attitudes of drivers towards the system users.
- **Economic accessibility** refers to ensuring that accessibility adaptations are spread equitably and are affordable for those who need them, as well as the need to connect people to education and jobs.

Source: See endnote 65 for this section.

Initiatives for people with disabilities are on the rise and include the use of specially designed vehicles, reduced fares and/or free public transport. Policy measures to reduce the financial burden of mobility for people with disabilities include offering affordable, low-to-no-fare transport options. Some local authorities have developed technical standards for accessibility, ensuring that urban and transport planning adhere to disability rights. Leadership has been proven crucial in this area, including appointing persons with disabilities to leadership positions in transport and land-use planning to ensure that decision making reflects their needs. In addition, educational initiatives for leaders and policy makers, transport planners and staff have improved their understanding of disability needs and how to incorporate them into urban mobility systems. In some cases, institutional bodies or dedicated accessibility officers have been established to oversee, monitor and evaluate the mainstreaming of universal accessibility, and dedicated maintenance personnel help to manage pedestrian, cyclist and public transport spaces.

The integration of information and communication technologies holds high potential to deliver universally accessible transport systems, by helping to boost co-ordination among transit operators, improve the clarity of information, and enhance the user experience by offering better trip planning, payment options and real-time updates. Mandatory data collection on population mobility patterns is needed to track progress, helping to measure and improve accessibility over time.[66]

- In 2025, the Philippines introduced the E-Bus for Persons with Disabilities, while the New York / New Jersey PATH introduced the Fare Reduction for Riders with Disabilities.[67]
- In 2018, the Ramp My City organisation was started in India to bridge the gap between accessibility policy (the India Rights of Persons with Disabilities Act of 2016) and implementation.[68]
- EU legislation on rights for travellers with disabilities or reduced mobility who travel by air, rail, waterway or bus stipulates the right to free assistance at terminals and on-board vehicles, as well as the right to information (including on the available specific facilities) in an accessible format.[69]
- In Oslo (Norway), efforts have focused on fostering a culture of social inclusion to make public transport accessible to everyone. The city's "Mind the Gap" initiative involves most employees and nearly all leaders at the public transport authority Ruter, as well as the Board of Directors and owners.[70]

To support the travel needs of women, authorities (including in transport and other departments), policies, and investments can focus on addressing gender-specific barriers to mobility options and public transport ridership, as well increasing women's representation in the transport workforce.

- In India, research has been conducted on the gendered differences in the adoption and use of electric two-wheelers.[71]
- In Peshawar (Pakistan), efforts have been made to address gender equity and employment in bus rapid transit and micromobility, including through separate male and female bus seats.[72]
- In Bogotá (Colombia), Care Blocks – urban neighbourhood zones designed to cluster essential care services such as childcare, training, health, legal aid and recreation within a 20-minute walk of residents – support women by greatly reducing their unpaid care burden through highly accessible services.[73]
- Bogotá's La Rolita women-led e-bus project has increased opportunities for women-driven workforce development in the formal economy while disrupting traditional gender roles.[74]



Inter-modality and integrating different transport modes – such as buses, trains and bike-sharing services – optimises the use of infrastructure, providing seamless travel experiences for passengers and contributing to climate and sustainability action. Effective integration of services requires good government regulation and management.

- In Ireland, the June 2025 National Policy Statement on Shared Mobility and the Provision of Hubs offers people the opportunity to hire a range of transport modes – bicycles, e-bikes, e-scooters, e-cargo bikes and electric vehicles – on a "pay-as-you-go" basis, enabling inclusion for all income groups through affordable travel options, as well as improved accessibility for people with disabilities.[75]
- The European Commission's Passenger Mobility Package, launched in 2023, aims to strengthen passenger rights and provide better travel information services that promote informed, sustainable and seamless multi-modal travel experiences.[76]
- In Mexico City (Mexico), reforms are under way to transition various informal transport services into an integrated public transport system. Minibus operators received bonuses to transition their vehicles to electric models, equipped with GPS and integrated payment systems.[77] Bike taxi associations that comply with new vehicle standards are recognised under the city's integrated transport system.[78]

For informal transport services, integrated measures are needed to address regulatory, operational, and business model challenges, as well as issues related to safety, worker conditions and environmental impact. Ensuring safety and reliability involves more rigorous vehicle inspections, driver training, and clear licencing standards, which help reduce crashes and improve consumer trust. Efforts to improve and better regulate operations and reduce environmental impacts include the addition of subsidies, capacity building, and government support for loans for newer vehicles. Efforts to improve and better regulate operations can also be designed to improve working conditions, as well as making these occupations more attractive to a wider range of people, including women. However, better conditions may drive

up operational costs and thus require ongoing government subsidies. This support can be combined with regulatory frameworks that protect workers' rights and ensure fair pay, to support both the workers and the overall service quality. (See 4.6 Informal Transport.)

Improving walkability and cyclability requires addressing the infrastructure gaps that hinder non-motorised transport. Walking is the oldest, least expensive, and most accessible form of transport, requiring no special vehicle. Many persons with reduced mobility can cycle, as it can be easier than walking or more accessible than taking public transport, and there are many types of non-standard cycles that can provide good options for persons with reduced mobility, such as cargo bikes, tricycles and e-bikes.

Safety concerns, including the risk of crashes involving vehicles, can be mitigated by redesigning streets to prioritise walking and cycling, implementing effective traffic laws. Comfortable and easy-to-use walking and cycling infrastructure facilitates movement by people of all ages and abilities. When street environments are calm (no or low-speed vehicles, low noise levels, see-through building frontages, trees and foliage, and other measures that make streets more pleasant and less dangerous for people), people walking and cycling at various speeds can comfortably reach their destinations. Additionally, strict levels of enforcement protect the walking and cycling infrastructure in place. In many low- and middle-income countries, businesses – both formal and informal – may extend their operations onto walking paths, forcing pedestrians to use the street and increasing the risk of accidents. (See 4.3 Walking and 4.4 Cycling.)

- In Lisbon (Portugal), the programme Mexe-te pela Tua Cidade' (Move for Your City) creates car-free zones around schools, transforming these areas into safer, quieter spaces where children can walk, cycle and interact freely. By reducing car traffic, the initiative not only improves safety but also encourages healthier, more sustainable habits for families.[79]

The rights and working conditions of transport workers are critical to the functioning of any transport system. There is a particular need for policies that ensure fair wages and benefits, job security, safe working conditions, better working hours, and training and career development opportunities. Transport workers face health risks from long working hours, stress and exposure to pollutants that can result in crashes, burn-out and other major health conditions. Comprehensive labour policies ensure a healthier, more motivated workforce, which in turn leads to better, more efficient public transport services for society at large. (See 1.6 A Just Transition for Workers in the Transport Sector.)

Partnerships in action

- **The Institute for Transportation and Development Policy** (**ITDP**) and the **Transformative Urban Mobility Initiative** (**TUMI**) are working together to promote mobility access for people with disabilities, focusing on regions including Africa, Asia and Latin America. The partnership aims to raise awareness about the challenges people with disabilities face and to provide practical guidance for policy makers and planners to advance more inclusive transport through resources and knowledge products aimed at advocating for inclusion and accessibility in urban mobility and other areas of city planning.[80]
- The **Hamburg Charter for Inclusive and Just Mobility,** launched at the 2024 Hamburg Sustainability Conference, sets out global principles to advance equitable access and a just transition to sustainable mobility. The Charter was signed by 25 international, national and sub-national institutions and is grounded in the understanding that mobility is a fundamental human right, and that the transition to low-carbon transport systems should prioritise fairness, dignity, safety and sustainability for all. It sets out eight principles to be implemented at different levels and across multiple actors.[81]
- **Unleashing the Potential of Public Transport in Europe** (**UPPER**) is an ongoing Horizon Europe project co-ordinated by the International Association of Public Transport (UITP) that aims to strengthen the role of public transport as the cornerstone of sustainable and innovative mobility in 10 cities and regions. The project plans to implement a combination of measures looking to push people out of private cars and to pull them closer to public transport in cities across Europe.[82]
- The **JUST STREETS** project is an ongoing international Horizon Europe project that aims to link inclusive streets with supporting climate neutrality goals. The project is focusing on (re)developing streets that are sustainable, safe and inclusive for all. The EU-funded project is being implemented by a consortium of 32 partners, including several in the SLOCAT partnership.[83]
- The ITDP Learning Hub offers a course on **Mobility and Access for Babies, Toddlers, and Their Caregivers.** It is designed for professionals in the planning and transport field or in early childhood development and health, aspiring planners, and decision makers who want to learn more about how transport and the built environment impact young children and caregivers and how to create better cities for them.[84]

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Note: Both 1.3 Transporting Shared Prosperity and 4.1 Freight Transport and Logistics cover content on freight transport, supply chains and logistics. However, 1.3 focuses on these trends in the context of global challenges, with high-level activities towards sustainable, decarbonised supply chains for freight transport on a global and regional level, as well as sustainability and climate trends by mode.

Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet



KEY FINDINGS

Demand, use and access

- As global and regional economies have expanded, the increased demand for products and services has driven greater movement of goods. Between 1950 and 2020, the volume of world trade expanded 4,100%, while its value increased roughly 300 times.
- In 2024, the global value of total trade in goods and services reached USD 33 trillion; goods (and their physical movement) accounted for nearly three-quarters of this, although the share of services has continued to increase.
- The growth in trade has been massive whether measured in traded value, tonnes lifted or tonne-kilometres moved.
- Increasing global trade has been widely associated with beneficial outcomes such as economic development, poverty alleviation and a reduction in the income gap between wealthy and less wealthy nations.
- Studies have shown that in Africa, trade costs are five times the global average, but that a 10% drop in the region's transport costs could increase trade volumes as much as 20%.
- Developing economies have captured a rising share of global trade, with South-South trade more than doubling between 2007 and 2023, to USD 5.6 trillion. This trend could indicate stronger regional integration among low- and middle-income countries as they become less dependent on traditional "unbalanced" commodity trade with the Global North.
- However, doubts have arisen about the unfettered continuation of trade globalisation and its guarantee of economic growth and other benefits.
- A process of "deglobalisation" could potentially harm low-income countries that pursue development strategies aimed at increasing exports of manufactured and other high-value goods.
- At the same time, a weakening or reversal of globalisation could potentially pave the way for new economic development models that emphasise, for example, growth through further trade regionalisation, the reshoring or nearshoring of production, the reorientation of consumer preferences towards locally sourced commodities, and the facilitation of more circular supply chains.
- In 2022, the most traded product by value globally was crude petroleum, followed by cars, refined petroleum and integrated computer circuits; China was the biggest overall exporter, and the United States was the biggest importer. Apart from general trade "imbalances", this points to the high significance of supply chains for the transport sector in the global economy.
- Decarbonising the global economy, including the transport sector, will have deep impacts on global trade and the shipping industry that supports it. As of 2024, more than one-third of the global shipping fleet carried fossil fuels as cargo.



KEY FINDINGS



- Maritime transport was the dominant mode of freight transport globally in 2025, accounting for 79% of total freight tonne-kilometres, followed by rail (11%) and road transport (10%). The volume of freight carried by aviation was comparably tiny but experienced the strongest growth.
- Global trade and transport have experienced increasing volatility since 2010, making it more challenging to predict the near future for global goods movements. The COVID-19 pandemic caused significant disturbances, although by 2024 global trade volumes were up nearly 3% for the year.
- Other events that have caused disruptions to supply chains include military conflicts, inflation, natural disasters, collapse or blockage of key infrastructure, and extreme weather – exposing the increased vulnerabilities of freight systems and their workforce.
- The average distance over which goods are traded continued to increase as of 2022, with the trend towards longer routes potentially contributing to the growing vulnerability of supply chains.
- As of mid-2025, the short-term outlook for global trade and goods movements remained uncertain due to the changing geopolitical situation; this included potentially draconic but still unsettled US interventions in tariff regimes, which could result in ongoing trade conflicts. In June 2025, projections for global economic growth were revised downward to as low as 2.3% for the year.
- A key indicator to assess trade volatility is the Global Supply Chain Stress Index (GSCSI), which measures the magnitude of container shipping disruptions that affect global supply chains. The GSCSI hit an all-time high during the COVID-19 crisis in 2021-2022, which included a months-long closure of the Port of Shanghai (China).
- A further spike in the GSCSI in 2024 reflected both the drought in the Panama Canal and militant attacks on shipping in the Red Sea, which forced shipping lines to detour thousands of kilometres around the Cape of Good Hope in Africa.
- Despite the potential rise in supply chain disturbances in the coming years, projections suggest renewed economic growth, averaging 3.1% globally by 2030 with even higher levels in emerging markets and developing economies.
- Growth in goods transport is also expected to increase substantially: under a "current policies" (business-as-usual) scenario, annual economic growth of 2.8% would lead global freight volumes to double between 2019 and 2050.
- Growth in freight transport is expected to be strongest in low- and middle-income countries in South and South-West Asia, South-East Asia, and Sub-Saharan Africa, where 2050 volumes could rise to more than three times 2019 levels, under current policies.
- Domestic and urban land-based transport are projected to grow faster than global maritime trade by 2050.

KEY FINDINGS

Sustainability and climate trends

- Freight and logistics jointly contributed an estimated 12% of total energy-related CO_2 emissions in 2023, with roughly 85% from freight transport and the rest from the storage and handling of goods.
- In addition, infrastructure systems for freight transport require huge quantities of steel, concrete, and other resources, which release emissions during building and maintenance and often result in harmful intrusions to urban and natural landscapes.
- Supply chains both contribute to and are affected by climate change, particularly the impacts of extreme weather events. Industry leaders have identified hostile weather as the primary risk facing supply chains, causing 27% of supply chain disruptions in 2024 (a share that is predicted to rise).
- Road transport contributed 70% of the CO_2 emissions from freight transport in 2023, despite carrying less global trade by volume than maritime transport and rail. Maritime transport contributed 22% of emissions and aviation accounted for nearly 6%, an outsized share given its small role in freight transport. Railways contributed the lowest share of freight transport emissions at 2.3%.
- These varying emission shares reflect large differences in the average energy efficiency and climate impact across transport modes. By one estimate, aviation emits around 23 times more CO_2 equivalent per tonne-kilometre than railways, while a standard heavy-goods truck with average load emits around 8 times more than a large container ship.
- As road freight transport has gained ground, global CO_2 emissions from heavy-duty trucks increased an estimated 25% between 2010 and 2023. Meanwhile, air freight CO_2 emissions increased an estimated 25% over a much shorter period (2019-2023), due to factors highlighted previously.
- Emissions from global freight could surge nearly 30% between 2019 and 2050 under a "current policies" scenario, in which greener technologies and logistic practices are not introduced at a sufficient pace and scale to curb these emissions. In contrast, in a "high ambitions" scenario, global freight emissions could drop 75% by 2050 even if transport volumes rise 60%.



KEY FINDINGS



Special focus: Urban logistics and e-commerce

- Urban freight and logistics are key in efforts to meet climate change and sustainability goals, even though transport distances in cities are generally short and the shipments small compared to other links in global supply chains.
- Because urban consumers drive much of the demand for goods worldwide, many global supply chains end in cities. The share of the world's people living in cities is expected to increase from 55% in 2020 to 68% by 2050.
- The final link in supply chains, the so-called last mile, accounts for an estimated 41-53% of the total logistics cost of delivering goods to urban areas (especially for packages delivered directly to the consumer); this share can surge to 70% for certain types of goods and channels.
- Urban transport contributed an estimated 28% of the total global CO_2 emissions from freight transport in 2023.
- Within cities, freight transport typically releases around 20-40% of the greenhouse gas emissions from transport and 30-50% of air pollutants, while also accounting for an estimated 15-25% of the vehicle-kilometres travelled and occupying 20-40% of the motorised road space.
- Urban freight flows include business-to-consumer commodities (food, clothing, electronics, etc.), business-to-business products, construction-related transport and waste.
- E-commerce has grown substantially since 2000 to account for an estimated 17-20% of global retail sales by 2025.
- Across 43 assessed countries, the total value of e-commerce increased nearly 60% between 2016 and 2022, to USD 27 trillion, with the strongest growth occurring during the COVID-19 pandemic.
- E-commerce has surged mainly in high-income countries and in China, although it has also expanded rapidly in several low- and middle-income countries.
- Clothing and apparel was a significant e-traded commodity in both the EU and the United States in 2024, based on different indicators for these two major regions (purchasing frequency and trade value, respectively).
- Analysts foresee further substantial increases in e-commerce in the coming years.
- An immediate effect of soaring e-commerce has been an increase in light-commercial vehicle traffic in dense urban areas, with potential impacts on some urban streets and intersections.
- Some studies found that the increase in energy consumption and CO_2 emissions from e-commerce deliveries are more than countered by savings in other areas, including reduced customer travel to retail shops (especially if undertaken by private car). However, the literature is not conclusive: in some circumstances, urban transport emissions may rise, in others fall, due to e-commerce.
- The proliferation of business models such as same-day delivery and quick commerce can undermine potential efficiency gains for last-mile deliveries. Between 2022 and 2023, the average delivery time dropped from 2.36 days to 2.15 days, leading to further increases in last-mile delivery.
- Even with a gradual shift to electric delivery vehicles, CO_2 emissions from e-commerce traffic have been projected to potentially increase 60% by 2030 under a "business as usual" scenario for urban deliveries.
- On a regional scale, some cities have experienced logistics sprawl, as large logistics facilities expand outward to suburbs and peripheral areas where land is cheaper, potentially bringing extra costs associated with longer transport distances.
- Growth in cross-border e-commerce has driven an increased demand for air cargo. Global air cargo contributed an estimated 19% of commercial aviation emissions, or 180 million tonnes of CO_2, in 2023. In 2024, air cargo volumes grew 11%, suggesting an equivalent hike in CO_2 emissions of around 20 million tonnes.
- At the same time, the global proliferation of e-commerce may lead to many potentially positive economic and social benefits. Evidence suggests that women benefit more from digital trade than men, and digital technologies can be important enablers for Indigenous-owned businesses.

KEY FINDINGS

Policy and investment developments

- At a broader level, efforts must be made to ensure that global economic growth, induced by trade and technology, is moderated by sustainability concerns while continuing to meet the needs of ever-more people.
- In a modern world of 9 billion people exploiting, or subject to, the division of labour, it will be essential to have efficient and reliable supply chains that satisfy most human needs.
- Supply chains need to be extended, facilitated, and safeguarded, especially in areas of the world where populations are at risk of having their basic provisions disrupted and where high transport costs or other barriers prohibit them from bringing valuable products to market.
- Supply chains need to be decarbonised and environmentally adapted through a combination of private investments, public regulations and modifications to consumer choices.
- Supply chains need to be made more resilient to disruptions and shocks.
- In 2024, the SLOCAT Partnership and the Kühne Climate Center released a compendium of policy and financing interventions towards achieving a vision of "intermodal, low-carbon, efficient and resilient freight transport and logistics". The compendium identifies complementary "best value" policies and investment approaches to deliver quick wins and initiate long-term transformations in five categories. The suggested interventions are highly complementary and should be implemented in a comprehensive and integrated manner to maximise their effectiveness.



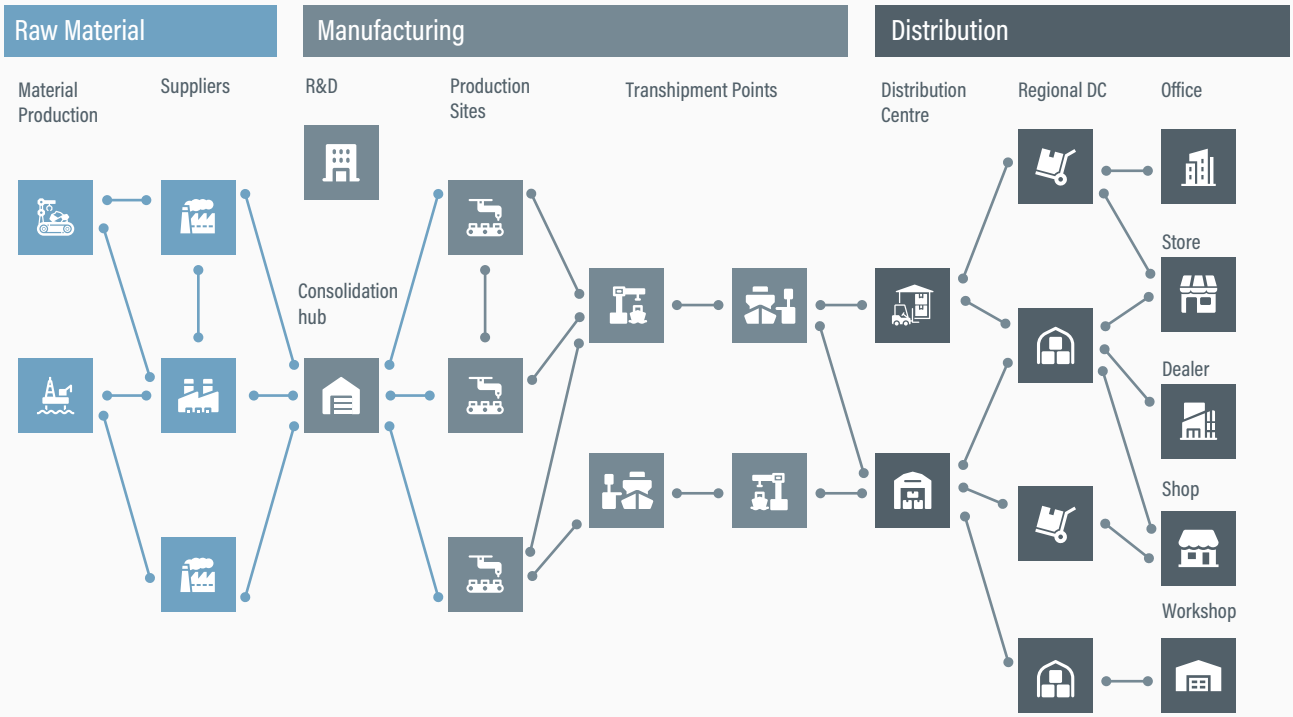
Context, challenges and opportunities

The movement of goods is an essential pre-condition for almost any contemporary economic activity, whether on a local, national or global scale. Agricultural products must be moved from farms to markets and households to feed more than 8 billion people every day. Manufacturing of complex products such as machinery, vehicles and wind turbines involves hundreds of intermediary components sourced from globally distributed locations. Even satisfying "virtual" consumer demand for mobile communication, financial transfers or entertainment is impossible without moving massive flows of material to provide the electronic devices, energy infrastructure, data storage capacity and cooling equipment.[1]

Each economic activity has a physical basis involving supply chains to overcome distance in space and time (Figure 1), harvesting the economic "comparative advantages" of each location.[2] Increasing the capacity and efficiency of local and global supply chains improves the supply and lowers the costs of many products. Trade supported by international supply chains has been a key enabler of economic development, wealth creation and jobs in many parts of the world. An increasingly "open" global economy has fostered opportunities for 1 billion people to lift themselves out of poverty.[3]

Further advancing global supply chains, supported by modern transport systems, is often viewed as essential to fuel trade, economic growth and development.[4] However, the physical basis of supply chains is also an Achilles' heel. Supply chains are always at potential risk of disturbance and disruption for multiple reasons, whether natural, technical or political. Weak, malfunctioning or interrupted supply chains can have a wide range of negative consequences, ranging from delays in the satisfaction of demands, to significant price hikes for key commodities, to outright hunger crises when staple food perishes and/or cannot get to populations in need.[5]

FIGURE 1. The concept of contemporary supply chains



Source: See endnote 2 for this section.

The dual nature of the climate crisis has made this Achilles' heel increasingly evident:

- On the one hand, there is an urgent need to mitigate and eventually eliminate greenhouse gas emissions from the transport systems and logistic operations that drive current supply chains, while avoiding excessive costs for those most susceptible. The "just decarbonisation" and environmental transformation of transport systems have become global imperatives.
- On the other hand, the increasing severity of climate change-induced weather events will escalate the expenses required for climate adaptation of logistic infrastructures and services**.** Resilience has emerged as a key topic for the global discourse on transport and climate change, of similar importance as greenhouse gas mitigation. Both mitigation and adaptation represent increased challenges to, but also new opportunities for, safeguarding essential supply chains.

Moreover, supply chains and logistics may have even wider roles to play in addressing climate change impacts – a contribution that some experts have termed "climate logistics".[6] Although supply chains and logistic operations may enable increased consumption of fossil fuel-based products, they also offer essential levers for the transition of global and local economies towards a climate-neutral and resilient future. Such levers potentially include[7]:

- facilitating the sourcing of goods over distances from countries and locations with low-carbon production footprints;
- re-orienting supply chains to shifts from wasteful and transport-intensive products and consumption patterns towards ones that are lower carbon and less material intensive;
- the proliferation of reverse logistics and recycling that would enable the emergence of circular economies of scale, for example in the building and housing sectors; and
- moving material to build flood defences and deploy carbon dioxide removal at scale.

The simultaneous improvement, consolidation and transformation of supply chains and logistics practices worldwide will be essential in fostering balanced sustainable development. Under this vision, everyone's needs can be met, and new jobs can be offered, in a way that is dependent neither on insufficient or highly unstable supply chains, nor on the continued overexploitation of limited or harmful planetary resources such as fossil fuels. By understanding the critical trends connecting goods, markets, and consumers, it is possible to explore ways to potentially boost sustainable and inclusive growth through transforming global and local supply chains.



Demand, use and access

The movement of goods can be observed at many different scales, from global trade routes to local last-mile deliveries in cities. It can be measured by a range of indicators, highlighting different aspects of trade and their contributions to greenhouse gas emissions (Table 1).

As global and regional economies have expanded, the increased demand for products and services has driven greater movement of goods. Between 1950 and 2020, the volume of world trade expanded 4,100%, while its value increased roughly 300 times.[8] **In 2024, the global value of total trade in goods and services reached USD 33 trillion; goods (and their physical movement) accounted for nearly three-quarters of this, although the share of services has continued to increase.**[9]

The growth in trade has been massive whether measured in traded value, tonnes lifted or tonne-kilometres moved. In recent decades, the demand for products and services has been supported by key tenets of "globalisation": more efficient transport systems that offer lower costs (containerisation, etc.), enhanced communication capabilities, reductions in fuel prices, and political factors such as the removal or modification of trade barriers.[10]

Increasing global trade has been widely associated with beneficial outcomes such as economic development, poverty alleviation and a reduction in the income gap between wealthy and less wealthy nations. Studies have shown that in Africa, trade costs are five times the global average, but that a 10% drop in the region's transport costs could increase trade volumes as much as 20%.[11] The widespread view is that efforts to lower the transport costs of bringing goods to market for poor, disadvantaged or landlocked countries would continue to benefit large numbers of people in need.

Developing economies have captured a rising share of global trade, with South-South trade more than doubling between 2007 and 2023, to USD 5.6 trillion.[12] **This trend could indicate stronger regional integration among low- and middle-income countries as they become less dependent on traditional "unbalanced" commodity trade with the Global North.**[13] Among developing economies, Asian countries (particularly China) account for most of manufacturing trade, whereas other developing regions export mainly agricultural items and natural resources.[14]

However, doubts have arisen about the unfettered continuation of trade globalisation and its guarantee of economic growth and other benefits. In addition to rising concerns about regional job losses and trade-related externalities, these doubts have been reinforced by an upsurge in the frequency and severity of sudden trade disturbances caused by factors such as the COVID-19 pandemic, armed conflicts, and climate-induced extreme weather events, exposing the vulnerability of global supply chains.[15] Another factor is ongoing shifts in the geopolitical context, as major economic powers pursue protectionist and security-oriented market policies that have re-introduced export restrictions and trade barriers.[16] This has led some observers to declare the "death of globalisation".[17]

A process of "deglobalisation" could potentially harm low-income countries that pursue development strategies aimed at increasing exports of manufactured and other

TABLE 1. Key indicators of goods movement

Indicators	Why they are useful
Measures of economic activity (gross domestic product), trade patterns and prices	Critical to explain and predict the global demand for goods movements.
Volumes of different commodities carried by different freight transport modes	Indicate the physical scale (and vulnerability) of the dependence of goods movements, and the overall significance of each transport mode.
Distances covered	Necessary to calculate the transport work in tonne-kilometres per mode, the key indicator of goods transport volumes.
Physical characteristics (bulk, liquid, palleted, etc.) and value of transported goods	Can help explain the split in transport modes and other trends.
Number, type, size, velocity and capacity of vehicles/vessels for each mode	Required to calculate specific levels of traffic along routes and corridors and in nodes such as ports, terminals, canals and other chokepoints.
Type and quantity of energy required to propel each vessel	Allows for calculations of carbon dioxide (CO_2) emissions – ideally by commodity type, transport mode, geography or region, etc.

high-value goods.[18] **At the same time, a weakening or even reversal of globalisation could potentially pave the way for new economic development models that emphasise, for example, growth through further trade regionalisation, the reshoring or nearshoring of production, the reorientation of consumer preferences towards locally sourced commodities, and the facilitation of more circular supply chains.** Such scenarios could eventually entail potential advances towards sustainable development, by overcoming inequalities associated with some facets of globalisation and reducing the carbon footprints of worldwide supply chains. Overall, it is difficult to discern a clear trajectory regarding globalisation and its future impacts on development.[19]

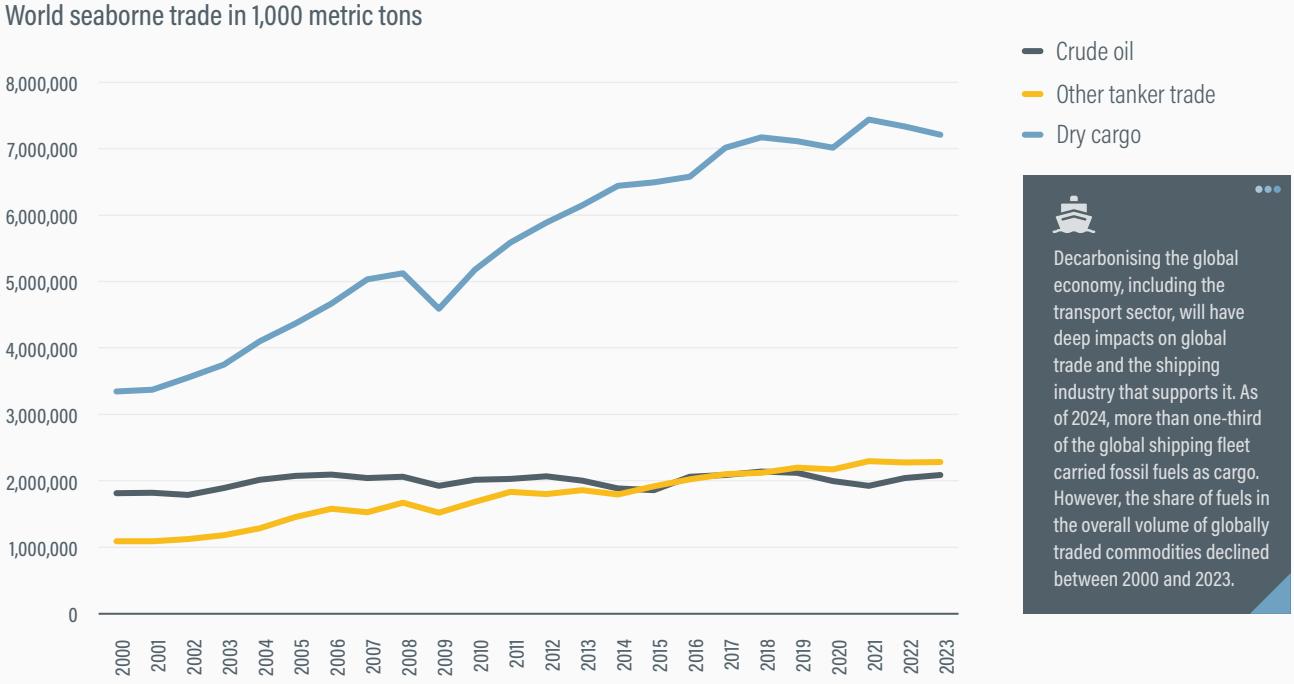
In 2022, the most traded product by value globally was crude petroleum, followed by cars, refined petroleum and integrated computer circuits; China was the biggest overall exporter, and the United States was the biggest importer.[20] **Apart from general trade "imbalances", this points to the high significance of supply chains for the transport sector in the global economy.**

Decarbonising the global economy, including the transport sector, will have deep impacts on global trade and the shipping industry that supports it. As of 2024, more than one-third of the global shipping fleet carried fossil fuels as cargo.[21] However, the share of fuels in the overall volume of globally traded commodities declined between 2000 and 2023 (Figure 2).[22]

Maritime transport was the dominant mode of freight transport globally in 2025, accounting for 79% of total freight tonne-kilometres, followed by rail (11%) and road transport (10%) (Figure 3).[23] **The volume of freight carried by aviation was comparably tiny but experienced the strongest growth.**[24] The growth in air freight compared to maritime transport has been attributed to a decline in the price of air transport relative to ocean freight, higher e-commerce yields from same-day delivery schemes, and delays in maritime transport caused by hostilities.[25] (See 4.1 Freight Transport and Logistics.)

- Global container traffic (included in "dry cargo" in Figure 2) increased 270% between 2000 and 2022.[26]
- For 27 assessed countries in the Organisation for Economic Co-operation and Development (OECD), inland freight transport grew 42% between 2001 and 2021.[27]
- Inland freight expanded even more in other parts of the world, for example by 265% in India between 2001 and 2017, and by 440% in China between 2001 and 2019.[28]

FIGURE 2. Global volumes of three types of freight carried by maritime transport, 2000-2023

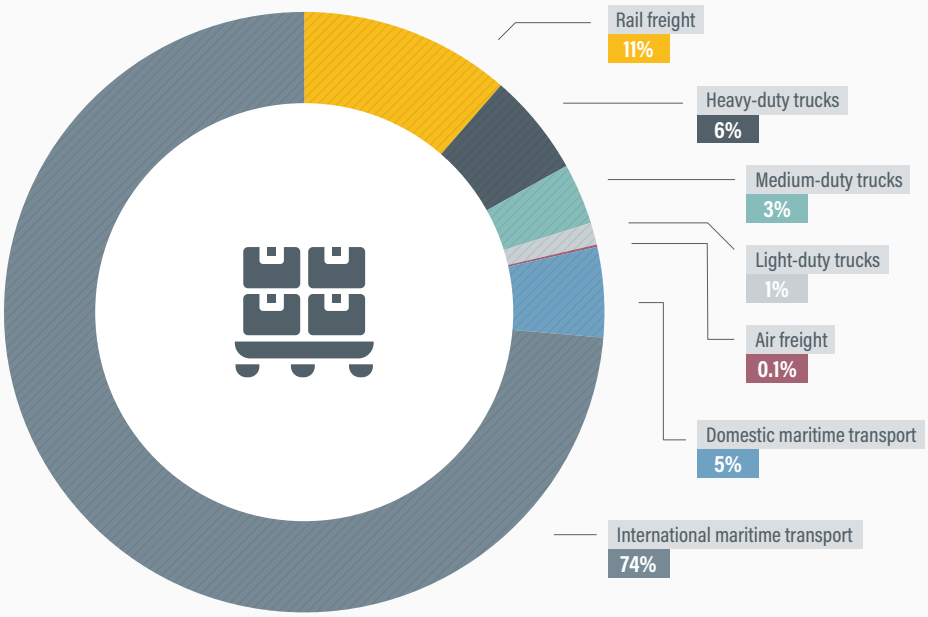


Decarbonising the global economy, including the transport sector, will have deep impacts on global trade and the shipping industry that supports it. As of 2024, more than one-third of the global shipping fleet carried fossil fuels as cargo. However, the share of fuels in the overall volume of globally traded commodities declined between 2000 and 2023.

Source: See endnote 22 for this section.

FIGURE 3. Global freight transport by modal share, based on transport performance, 2025 estimates

Freight transport modes by freight activity in tonnes-kilometers



Maritime transport was the dominant mode of freight transport globally in 2025, accounting for 79% of total freight tonne-kilometres, followed by rail (11%) and road transport (10%). The volume of freight carried by aviation was comparably tiny but experienced the strongest growth.

Source: See endnote 23 for this section.

Global trade and transport have experienced increasing volatility since 2010, making it more challenging to predict the near future for global goods movements. The COVID-19 pandemic caused significant disturbances, although by 2024 global trade volumes were up nearly 3% for the year.[29] The pandemic and related countermeasures led to temporary interruptions to production lines, service facilities, and transport hubs in many countries, and also triggered changes in consumption patterns, such as a shift from (temporarily unavailable) services to durable goods. However, goods movements were generally less affected by the pandemic than passenger transport, and for a shorter period.[30]

Other events that have caused disruptions to supply chains include military conflicts, inflation, natural disasters, collapse or blockage of key infrastructure, and extreme weather - exposing the increased vulnerabilities of freight systems and their workforce. Some of these disruptions are accidental, while others are more deliberate (Box 1).[31] The duration, severity and overall impacts of disturbances to goods flows depend on multiple factors, including the robustness and capacity of specific supply chains and the affected economies.

Box 1. Types of disruptions to transport networks

Disruptions to transport systems can be distinguished between **internal** and **external** disruptions and between **accidental** and **intentional** causes:

- **Internal disruptions** originate from within transport systems and can stem from mistakes and accidents caused by staff or users, technical failures, component breakdowns, faulty construction, overload, etc. They could also be intentional, such as labour market conflicts.
- **External disruptions** may be related to natural phenomena (including extreme weather events and natural hazards), geopolitical tensions, terrorism and pandemics.
- **Accidental disruptions** strike the system mostly at random, whereas **intentional disruptions** take place because one or more actors decide to cause the disruption, such as with geopolitical conflicts or cyberattacks.

For more on disruptions, see 1.4 Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies.

Source: See endnote 31 for this section.

The average distance over which goods are traded continued to increase as of 2022, with the trend towards longer routes potentially contributing to the growing vulnerability of supply chains (see Box 2 on Africa).[32] In some cases, longer detours in routing may be necessary to avoid unstable areas or chokepoints, creating a potential trade-off between direct disruption and increased vulnerability.

As of mid-2025, the short-term outlook for global trade and goods movements remained uncertain due to the changing geopolitical situation; this included potentially draconic but still unsettled US interventions in tariff regimes, which could result in ongoing trade conflicts. In June 2025, projections for global economic growth were revised downward to as low as 2.3% for the year.[33] Signs of impacts on trade and transport were already being observed in shipping trends, which involved both increases in activity due to efforts to expedite shipments in anticipation of higher tariffs, and declines in activity related to expected higher prices and lower demand.[34]



Box 2. Distance and vulnerability of food supply chains in Africa

All supply chains can be disrupted by, among other factors, severe weather events, social and military unrest, and pandemic-related shutdowns. Yet not all supply chains are equally vulnerable, and not all disruptions are equally serious.

In a recent World Bank analysis, researchers studied supply chains for different food items consumed in Africa. Indicators of risk associated with disruptions included the volumes moved of each commodity and the average distance they travelled. Regions with longer transport paths faced greater challenges with disruptions to food supply. In general, the study found that food supply chains in Africa were four times longer than in Europe, with transport costs raising food prices by up to 45%.

Cassava consumption in Africa is mostly local, whereas the demand for rice often outpaces local production, and countries such as Guinea and Sierra Leone depend heavily on imports. In 2022, wheat was Africa's most imported staple, with more than 75% of the supply being shipped in and transport occurring over distances of more than 6,000 kilometres (Figure 4). The analysis identified several critical bottlenecks or chokepoints (e.g., infrastructure deficits) along supply chains in Africa, which could be prioritised for investments in resilience.

Source: See endnote 32 for this section.

FIGURE 4. Average distance for wheat flows across the African continent, 2022

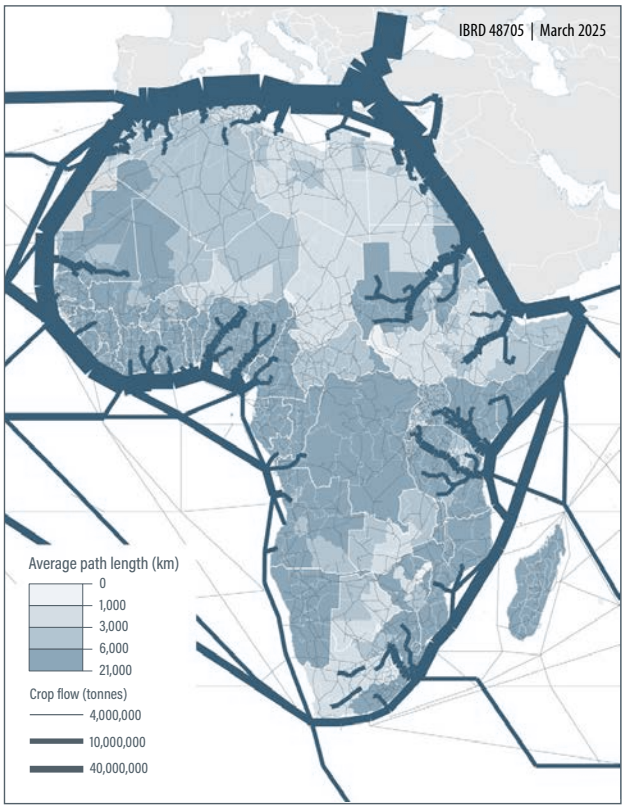
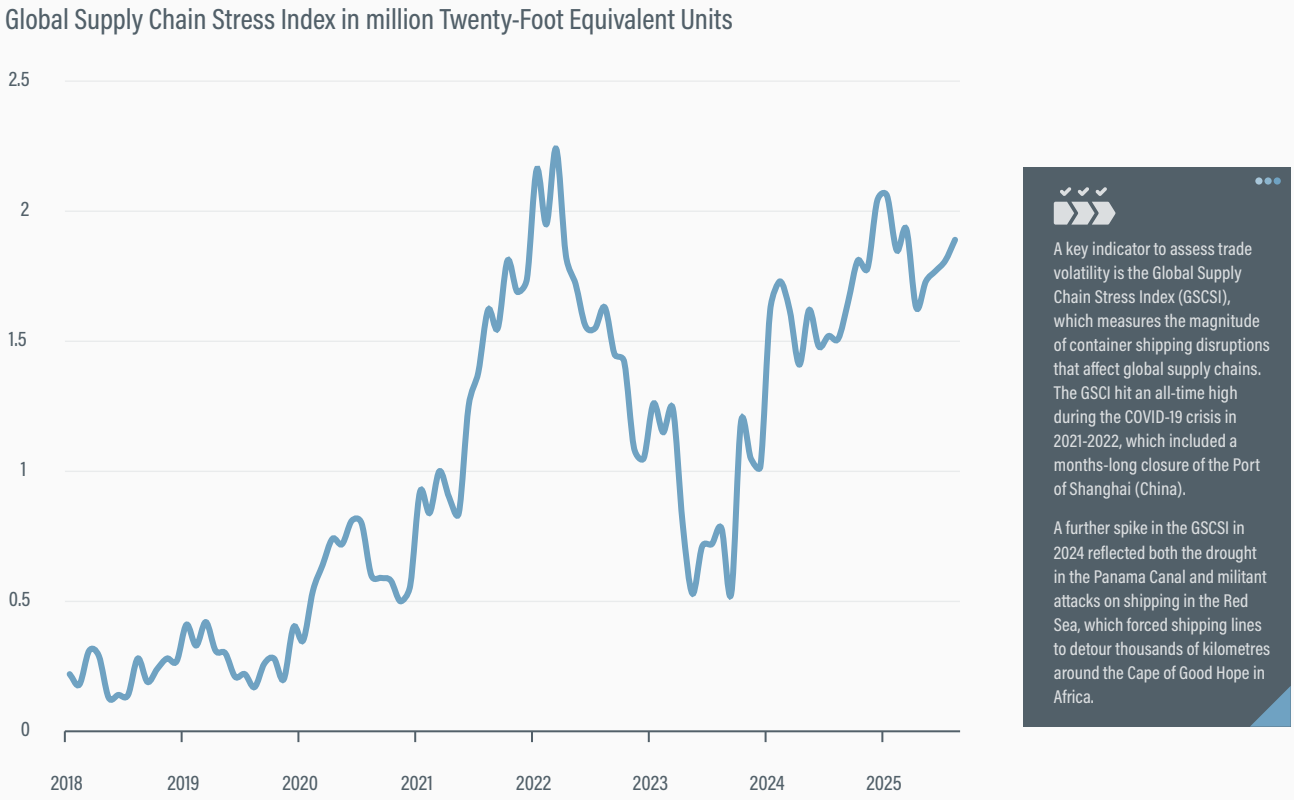


FIGURE 5. Global Supply Chain Stress Index, January 2019 to May 2025



Source: See endnote 36 for this section.

A key indicator to assess trade volatility is the Global Supply Chain Stress Index (GSCSI), which measures the magnitude of container shipping disruptions that affect global supply chains.[35] **The GSCSI hit an all-time high during the COVID-19 crisis in 2021-2022** (Figure 5)**, which included a months-long closure of the Port of Shanghai (China).**[36] The GSCSI calculates delays in container transit time at and between ports compared to the normal range, based on the deviation of equivalent stalled ship capacity measured in twenty-foot equivalent units (TEU).

A further spike in the GSCSI in 2024 reflected both the drought in the Panama Canal and militant attacks on shipping in the Red Sea, which forced shipping lines to detour thousands of kilometres around the Cape of Good Hope in Africa.[37] GSCSI levels continued to remain high as of mid-2025, reflecting the uncertainty and unpredictability of shipping trade due to tariff wars.[38]

Despite the potential rise in supply chain disturbances in the coming years, projections suggest renewed economic growth, averaging 3.1% globally by 2030 with even higher levels in emerging markets and developing economies.[39]

Growth in goods transport is also expected to increase substantially: under a "current policies" (business-as-usual) scenario, annual economic growth of 2.8% would lead global freight volumes to double between 2019 and 2050.[40] A second scenario, which assumes strong policies to reduce global greenhouse gas emissions, still projects a significant (60%) increase in freight volumes between 2019 and 2050.[41] (See 4.1 Freight Transport and Logistics.)

Growth in freight transport is expected to be strongest in low- and middle-income countries in South and South-West Asia, South-East Asia, and Sub-Saharan Africa, where 2050 volumes could rise to more than three times 2019 levels, under current policies.[42]

Domestic and urban land-based transport are projected to grow faster than global maritime trade by 2050.[43] The strongest growth among all modes is projected for non-motorised urban freight solutions, such as cargo bikes, soaring to between 9 and 20 times the 2019 levels, depending on the scenario.[44] Although this would likely not reduce overall global freight volumes, it may offer relief in congested cities.

Sustainability and climate trends

Freight and logistics jointly contributed an estimated 12% of total energy-related CO_2 emissions in 2023, with roughly 85% from freight transport and the rest from the storage and handling of goods.[45] Global supply chains – reflecting transport by ships, trucks, trains and airplanes – are still almost fully propelled by fossil fuels, from the sourcing of raw materials to last-mile distribution in cities. The dependence of global supplies on oil is deeply unsustainable.

In addition, infrastructure systems for freight transport require huge quantities of steel, concrete, and other resources, which release emissions during building and maintenance and often result in harmful intrusions to urban and natural landscapes.[46] The physical movement of goods also contributes to local and regional air pollution, noise, congestion, and the wear and tear of critical infrastructure, sometimes disproportionate to its share of vehicle fleets and traffic volumes.[47]

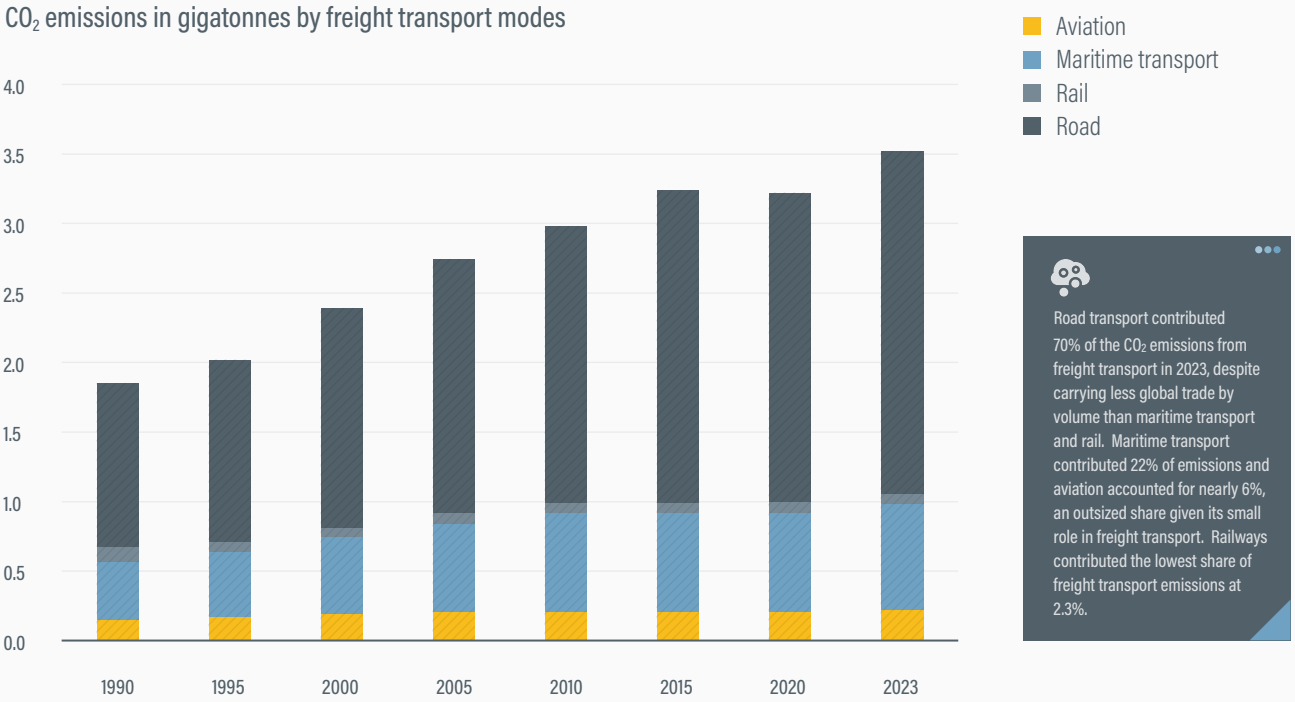
Supply chains both contribute to and are affected by climate change, particularly the impacts of extreme weather events.[48] **Industry leaders have identified hostile weather as the primary risk facing supply chains, causing 27% of supply chain disruptions in 2024 (a share that is predicted to rise).**[49] Disruptions to trade can have severe consequences across regions and commodities, with vulnerable populations most at risk.

- Prolonged drought in the Panama Canal in 2022 and 2023 reduced the canal's transit capacity 50% in the second half of 2023, causing bottlenecks in shipping and impacting global maritime trade.[50]
- On average, extreme weather events – each costing at least USD 1 billion in damages – occurred every three weeks as of 2024, compared to every four months in the 1980s.[51]
- By 2035, the average listed infrastructure and transport company is projected to incur fixed asset losses of USD 50-53 million annually due to climate hazards, equivalent to around 7% of earnings.[52]

Yet the impacts of climate change on logistics systems go beyond physical losses. Climate hazards can interrupt infrastructure services, whether through direct damage or temporary shutdowns, and severely disrupt logistics operations. Storms can lead to port closures for several days, leading to vessel backlogs and cascading impacts throughout supply chains. According to one study, small island developing states and least-developed countries have the highest global exposure to natural disasters, while developing countries are particularly exposed to floods.[53]

Road transport contributed 70% of the CO_2 emissions from freight transport in 2023, despite carrying less global trade by volume than maritime transport and rail (Figure 6)**.**[54] **Maritime transport contributed 22% of emissions and aviation accounted for nearly 6%, an outsized**

FIGURE 6. Freight transport CO_2 by transport mode, 1990-2023



Source: See endnote 54 for this section.

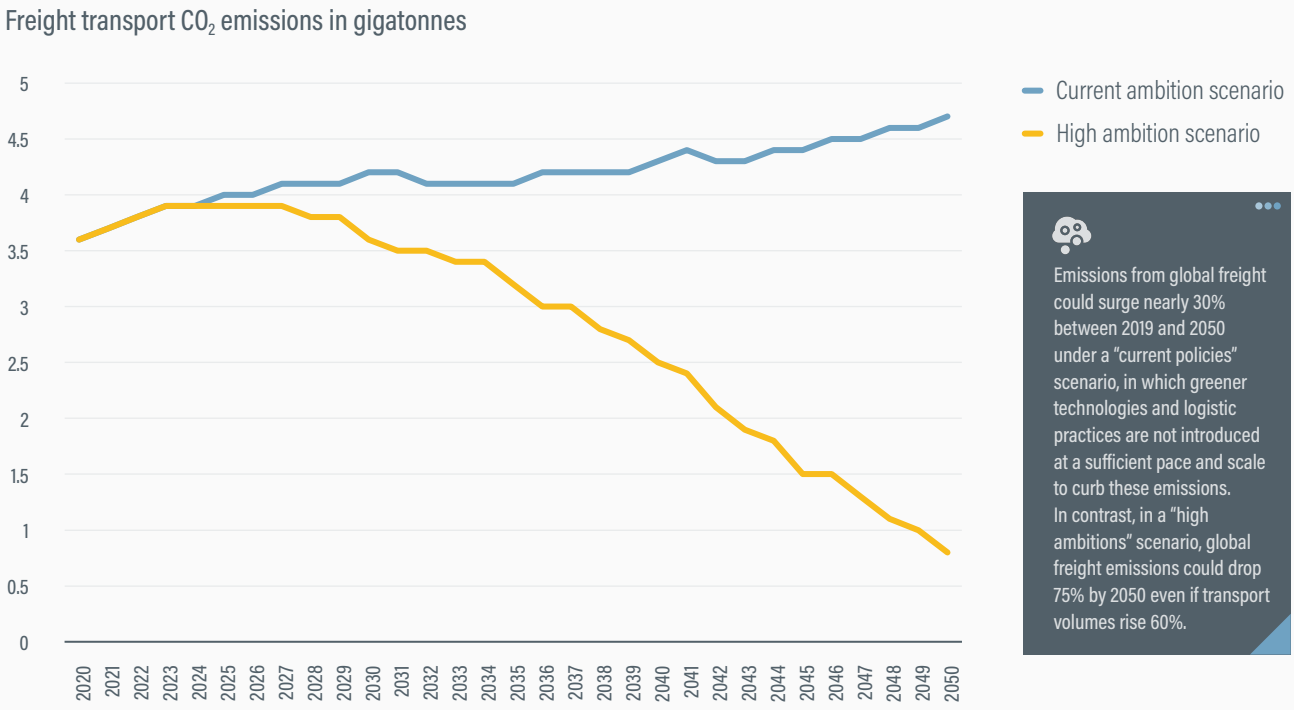
share given its small role in freight transport.[55] Railways contributed the lowest share of freight transport emissions at 2.3%.[56]

These varying emission shares reflect large differences in the average energy efficiency and climate impact across transport modes. By one estimate, aviation emits around 23 times more CO_2 equivalent per tonne-kilometre than railways, while a standard heavy-goods truck with average load emits around 8 times more than a large container ship.[57] However, simply shifting freight to the lowest-carbon modes can be challenging, as different transport modes serve different commodity markets and supply chain segments. (See 4.1 Freight Transport and Logistics.)

As road freight transport has gained ground, global CO_2 emissions from heavy-duty trucks increased an estimated 25% between 2010 and 2023.[58] Meanwhile, air freight CO_2 emissions increased an estimated 25% over a much shorter period (2019-2023), due to factors highlighted previously.[59]

Emissions from global freight could surge nearly 30% between 2019 and 2050 under a "current policies" scenario (Figure 7)**, in which greener technologies and logistic practices are not introduced at a sufficient pace and scale to curb these emissions.[60] In contrast, in a "high ambitions" scenario, global freight emissions could drop 75% by 2050 even if transport volumes rise 60%.[61]** Policies to support emission reductions include a faster transition to zero-emission vehicles and fuels, increasing the load factors of trucks, investments in attractive inter-modal solutions, and slow and smart steaming of ships. A key enabling measure in a high ambitions scenario is a large and increasing carbon tax of USD 130-200 per tonne of CO_2 across all transport modes and regions by 2040.[62]

FIGURE 7. Global freight transport CO_2 emissions in two policy scenarios, 2019-2050



Source: See endnote 60 for this section.



Special focus: Urban logistics and e-commerce

Urban freight and logistics are key in efforts to meet climate change and sustainability goals, even though transport distances in cities are generally short and the shipments small compared to other links in global supply chains. Urban logistics have evolved rapidly in recent years, driven by growth and shifts in e-commerce, diversification into omni-channel retail, the relocation/restructuring of warehousing in urban geographies and the emergence of low-paid "gig economy" workers.[63]

Because urban consumers drive much of the demand for goods worldwide, many global supply chains end in cities. The share of the world's people living in cities is expected to increase from 55% in 2020 to 68% by 2050.[64] In 2010, an estimated 80% of all freight in the United States started or ended in metropolitan areas.[65] Changing consumption patterns and volumes among urban dwellers not only affect the local economy, but also have impacts on global flows of products and services and related transport.

The final link in supply chains, the so-called last mile, accounts for an estimated 41-53% of the total logistics cost of delivering goods to urban areas (especially for packages delivered directly to the consumer); this share can surge to 70% for certain types of goods and channels.[66] For last-mile delivery, bulk consignments are disassembled into many separate deliveries served by individual vehicles and drivers, which then compete for urban roads and parking spaces, imposing high costs in time and energy. E-commerce can entail additional costs from same-day service, failed deliveries and package returns.

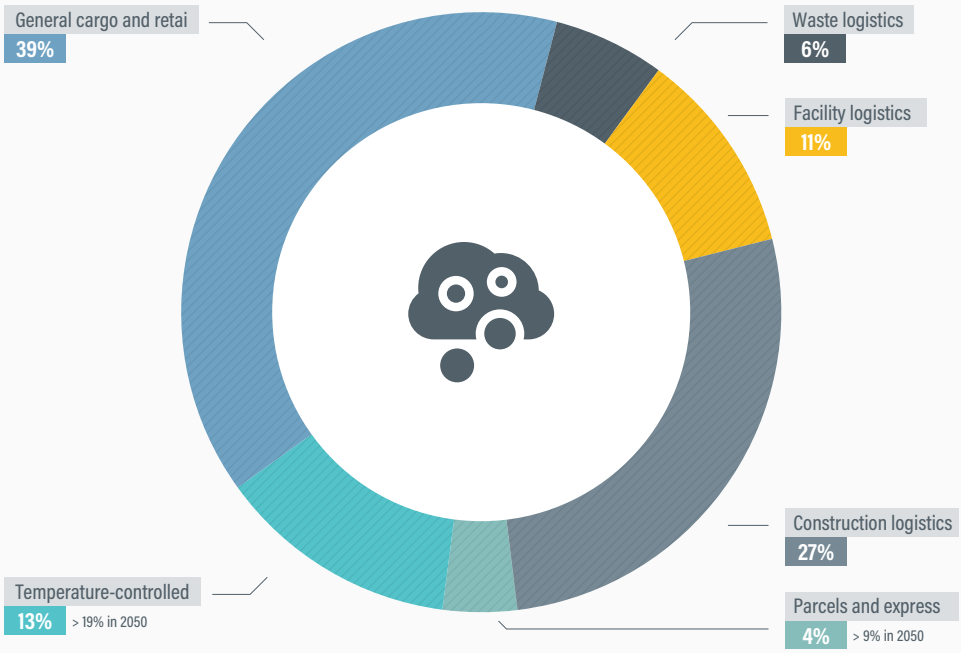
Urban transport contributed an estimated 28% of the total global CO_2 emissions from freight transport in 2023.[67] **Within cities, freight transport typically releases around 20-40% of the greenhouse gas emissions from transport and 30-50% of air pollutants, while also accounting for an estimated 15-25% of the vehicle-kilometres travelled and occupying 20-40% of the motorised road space.**[68] Urban freight vehicles contribute additional impacts at the local and regional levels, including pollution, noise, traffic accidents, and congestion that affect human health, the environment and the economy.

Urban freight flows include business-to-consumer commodities (food, clothing, electronics, etc.), business-to-business products, construction-related transport and waste. These flows and their transport can vary greatly among cities, even within the same country, although data remain scarce.[69]

- In Sweden, food and drink accounted for less than 5% of the goods transported in Gothenburg but more than 12% in Stockholm in 2016; in contrast, transport of motor vehicles and equipment comprised 7% of freight movements in Gothenburg (a car-producing city) and less than 3% in Stockholm.[70]

FIGURE 8. Urban freight transport CO_2 emissions in the Netherlands, by logistic activities, 2015

Total GHG emisions (2015): 3.6 million tonnes



Urban freight flows include business-to-consumer commodities (food, clothing, electronics, etc.), business-to-business products, construction-related transport and waste.

A study in the Netherlands found that in 2015, general cargo and retail contributed the largest share of freight CO_2 emissions (39%) in urban areas, followed by construction logistics (27%). Parcels represented a smaller but growing share. Vans used for services and facilities management accounted for a significant share of business traffic as well as emissions (11%).

Source: See endnote 71 for this section.

- A study in the Netherlands found that in 2015, general cargo and retail contributed the largest share of freight CO_2 emissions (39%) in urban areas, followed by construction logistics (27%) (Figure 8).[71] Parcels represented a smaller but growing share. Vans used for services and facilities management accounted for a significant share of business traffic as well as emissions (11%).[72]

E-commerce has grown substantially since 2000 to account for an estimated 17-20% of global retail sales by 2025.[73] Across 43 assessed countries, the total value of e-commerce increased nearly 60% between 2016 and 2022, to USD 27 trillion, with the strongest growth occurring during the COVID-19 pandemic.[74] E-commerce has had wide-ranging impacts on global and urban supply chains – changing shopping habits, transport volumes and urban geographies. Same-day delivery depends on disciplined logistical regimes, with fulfillment hubs often located in or near urban centres with a high concentration of demand. Such hubs may be closed ("dark shops") or function as retail shops or demo-rooms, catering to omni-channel shopping whereby customers mix physical and online purchases at their leisure.[75]

E-commerce has surged mainly in high-income countries and in China, although it has also expanded rapidly in several low- and middle-income countries. Since spiking during the pandemic, e-commerce growth has returned to its more "moderate" pre-pandemic pace, although this trend varies by country (as revealed, for example, by global credit card transactions).[76]

- In the United States, the value of retail e-commerce grew strongly between 2000 and 2024 with rapid periods of growth in 2020.[77]
- In a 2024 survey, 73% of consumers in the European Union (EU) had used the internet to buy goods and services within the previous three months.[78]
- The share of consumers in low- and middle-income countries making online purchases in 2024 was generally lower than in the EU but still significant (around 50% in Egypt; 36% in Mexico and 17% in Indonesia).[79]
- E-commerce market transactions in Latin American countries increased 39% in 2022 and 20% in 2023, reaching USD 509 billion. (See 3.4 Latin America and the Caribbean Regional Overview.)

Clothing and apparel was a significant e-traded commodity in both the EU and the United States in 2024, based on different indicators for these two major regions (purchasing frequency and trade value, respectively) (Table 2).[80] Purchasing frequency is more indicative of the consumer demands that influence transport movements, whereas trade value illustrates

TABLE 2. Top six e-commerce commodities in the European Union and the United States in 2024, based on purchasing frequency and trade value, respectively

Top EU e-commodities by purchasing frequency	Share	Top US e-commodities by trade (purchase) value	Share
1. Clothes, shoes or accessories	45.6%	1. Computer and consumer electronics	21.2%
2. Restaurants, fast-food, catering	21.3%	2. Apparel and accessories	19.7%
3. Cosmetics, beauty, wellness products	20.3%	3. Furniture and home furnishings	12.5%
4. Furniture, home accessories, gardening	19.4%	4. Health and personal care and beauty	10.7%
5. Sports goods (excluding clothing)	16.6%	5. Auto and parts	8.3%
6. Printed books, magazines, newspapers	15.8%	6. Food and beverage	7.6%

Source: See endnote 80 for this section.

the economic significance of different e-commerce product markets. Globally, no standardised method exists for measuring the global distribution of e-commerce by commodity type.

- The most frequently ordered e-commerce products among EU consumers in 2024 were clothing (45.6%) followed by restaurants and catering (21.3%) and cosmetics (20.3%).[81]
- The three most traded e-commerce product groups by value among US consumers were computer and consumer electronics (21.2%) followed by apparel (19.7%) and furniture (12.5%).[82]
- The US data showed that for two product groups – computer and consumer electronics, and books/music/video – e-commerce sales exceeded physical "brick and mortar" shopping in 2024.[83]

Analysts foresee further substantial increases in e-commerce in the coming years.[84] Drivers of this trend include the enhanced accessibility of cross-border shopping platforms, the proliferation of same-day delivery and free returns, and the expansion of e-commerce into "newer" consumption areas such as groceries, building materials, auto parts and business-to-business deliveries.

An immediate effect of soaring e-commerce has been an increase in light-commercial vehicle traffic in dense urban areas, with potential impacts on some urban streets and intersections. E-commerce has contributed to traffic growth because potential destinations include all private addresses, and delivery routes have shifted to local streets, causing additional congestions, emissions and safety issues.[85] However, the volume of e-commerce-related traffic is generally small compared to total urban traffic flows (estimated at less than 3%).[86]

Some studies found that the increase in energy consumption and CO_2 emissions from e-commerce deliveries are more than countered by savings in other areas, including reduced customer travel to retail shops (especially if undertaken by private car).[87] **However, the literature is not conclusive: in some circumstances, urban transport emissions may rise, in others fall, due to e-commerce.**[88] A shift in e-deliveries from private homes to neighbourhood delivery boxes or convenience stores could bring additional savings in the supply chain, due to greater consolidation of goods and fewer failed deliveries.[89] The impacts will depend on consumer practices and on the support from businesses and local authorities for sustainable logistic services.

The proliferation of business models such as same-day delivery and quick commerce can undermine potential efficiency gains for last-mile deliveries. Between 2022 and 2023, the average delivery time dropped from 2.36 days to 2.15 days, leading to further increases in last-mile delivery.[90] **Even with a gradual shift to electric delivery vehicles, CO_2 emissions from e-commerce traffic have been projected to potentially increase 60% by 2030 under a "business as usual" scenario for urban deliveries.**[91] Although this outcome could potentially be averted through a range of policy measures (see the next section); consumers may not be willing to postpone delivery, use solutions like parcel boxes, or pay extra for zero-emission transport.

On a regional scale, some cities have experienced logistics sprawl, as large logistics facilities expand outward to suburbs and peripheral areas where land is cheaper, potentially bringing extra costs associated with longer transport distances. An early case study in Paris (France) found that such sprawl increased logistic-related CO_2 emissions by thousands of tonnes, far outweighing the



savings associated with logistic experiments focused on the city centre.[92] Since then, extensive research has delivered a more nuanced understanding of the interplay between centralised (consumer-oriented) and decentralised locations of logistic facilities in urban areas.[93] A simple takeaway is that the sustainability of urban transport trends cannot be fully assessed at the local scale.

Growth in cross-border e-commerce has driven an increased demand for air cargo.[94] Global air cargo contributed an estimated 19% of commercial aviation emissions, or 180 million tonnes of CO_2, in 2023.[95] In 2024, air cargo volumes grew 11%, suggesting an equivalent hike in CO_2 emissions of around 20 million tonnes, or roughly 10 times the total emissions of all freight movements in Greater London (United Kingdom) in 2022.[96]

At the same time, the global proliferation of e-commerce may lead to many potentially positive economic and social benefits. Evidence suggests that women benefit more from digital trade than men, and digital technologies can be important enablers for Indigenous-owned businesses.

- A 2017 survey found that in Africa, the comparison between traditional offline trade and cross-border e-commerce indicated a doubling in the share of firms owned by women , with women-owned firms accounting for 75% of firms trading exclusively through e-commerce.[97]
- Several examples suggest that women are relatively more present in online marketplaces and that various e-commerce platforms can empower women's participation, enabling them to overcome time, financial, security and mobility constraints and to reach larger markets than possible offline.[98]
- When an Indigenous-owned micro, small or medium-sized enterprise utilises e-commerce, its likelihood of engaging in exports is six times higher.[99]

Stakeholders and policy makers at all levels face the challenge of how to best harvest the promises of more efficient and expedient supply chains conveyed through digitally assisted trade, while also countering potential negative outcomes with measures that are effective from a holistic point of view.

Policy and investment developments

Around the world, logistic stakeholders and city governments have deployed or explored a broad range of measures to provide for more sustainable urban freight, ranging from planning and partnerships to low-emission policies, shared consolidation sites and automated deliveries (Table 3).[100]

At a broader level, efforts must be made to ensure that global economic growth, induced by trade and technology, is moderated by sustainability concerns while continuing to meet the needs of ever-more people. Globalisation has been driven by technological advancements, capitalist competition, urban consumerism and the removal of trade barriers. This has created opportunities to fulfil more needs (although without necessarily prioritising the most urgent ones) and to integrate low-income countries into the global market economy (although without necessarily prioritising the weakest ones).

Globalisation has made supply chains longer, faster, and more complex, but also potentially more vulnerable to disruptions. Nearly every link in these chains is currently dependent on an unsustainable fossil energy supply that is incompatible with internationally adopted climate imperatives. Rapid digitalisation (or digital enhancement) of supply chains is stimulating and accelerating this expansion, while at the same time offering opportunities for radical efficiencies and substitutions.

As of 2025, the geopolitical shift towards national interests and strategic alliances has challenged key tenets of the international order, as well as the paradigm, practice and trajectory of "conventional" globalisation. In this context, it cannot be assumed that autonomous development or an

TABLE 3. Examples of city logistics measures deployed or explored by private businesses and local authorities

Measures	Private sector roles	Public sector roles	Potential effects
Planning and partnerships	• Engage in planning and partnership with city and other logistic businesses and stakeholders • Share logistic data for planning • Respond to public tenders	• Create and manage urban freight partnership • Adopt Sustainable Urban Logistics Plan or similar framework • Adopt public procurement policy	• Favourable conditions for strategy deployment • Enhanced co-ordination and synergy • Knowledge building for piloting and impact assessment
Zero- and low- emission vans/trucks	• Invest in and use zero- and low-emission vehicles and charging equipment • Use subsidies or favourable leasing arrangements	• Create low- and zero- emission zones and enforce them • Provide for charging infrastructure and grid capacity • Request zero-emission vehicles for public purchases	• Fewer emissions over time, depending on fleet turnover and energy mix • Lower noise impact
Cargo bikes	• Invest in e-cargo bikes for use in last-mile delivery	• Ensure adequate, safe and comprehensive bike infrastructure and car-free/light areas	• Less congestion • Freed space • Less emissions and noise
Shared consolidation sites and micro-hubs	• Collaborate with city and competitors on shared locations • Consolidate deliveries to small/low-emission urban vehicles	• Identify and plan for potential hub locations • Possibly temporary subsidies for pilots	• Fewer kilometres and empty runs • Reduced costs and emissions • Potential for collaborative logistics
Parcel lockers and other pick-up and drop-off points (PUDOs)	• Create and operate lockers/PUDOs • Collaborate with city on locations	• Identify and plan for locations and services for lockers/PUDOs	• Fewer and shorter e-commerce deliveries • Lower emissions if parcels are not picked up by car
Off-peak-delivery concessions/ time windows	• Shift some drop routes to off-hours • Invest in low-noise equipment	• Create regulatory framework allowing off-peak delivery	• Time, kilometre, cost and CO_2 savings in larger congested cities • Risk of noise complaints
Smart kerbside management	• Use app/IT interface to book kerbside access in congested areas and incorporate in route planning	• Identify streets/areas for smart kerbside management • Support app/IT solutions • Communicate and enforce rules	• Less parking circulation/conflicts • Less congestion • Time savings
Automated deliveries (robots; drones, etc.)	• Test solutions in dialogue with customers, citizens	• Create safety regulations • Support and evaluate pilots	• Cost savings • Less congestion • Increased risk of anxiety and accidents

Source: See endnote 100 for this section.

"invisible hand" will deliver the appropriate solutions to ensure that supply chains are being stabilised for all (including the most exposed populations), decarbonised at the necessary pace, or digitalised in ways that are most productive and sustainable. Nor can it be assumed that a simple choice can be made between "globalisation" or "deglobalisation" of supply chains to ensure an optimal result. Strategic interventions must be implemented in a context of uncertainties – about how trade patterns and technologies will unfold, and about the strength of collaborative decision frameworks.

In a modern world of 9 billion people exploiting, or subject to, the division of labour, it will be essential to have efficient and reliable supply chains that satisfy most human needs. Such supply chains are critical for driving social and economic development, with transport systems and logistics operations being key elements in the equation. Three key transformations are needed in relation to supply chains and the connections between goods, markets and consumers:

1. **Supply chains need to be extended, facilitated, and safeguarded, especially in areas of the world where populations are at risk of having their basic provisions disrupted and where high transport costs or other barriers prohibit them from bringing valuable products to market** (or preventing women from even considering a market-oriented trade). In Africa, addressing the long food supply chains and their critical choke points will require investments in critical infrastructure such as all-weather roads, as well as in services and education to fill

meaningful jobs for both men and women in the transport and logistics sector (such as truck driving, port operations, railroad maintenance, retrofitting of internal combustion engine cars to electric vehicles, etc.).

- The Program for Infrastructure Development in Africa (PIDA) supports landlocked African countries by developing regional trade corridors that connect high-productivity agricultural regions to continental markets. The impact of these corridors varies highly, but on average their development has helped reduce trade costs by 5% and travel time by 16%.[101]
- In Argentina, the national government with financial support from the World Bank maintained and rehabilitated more than 24,000 kilometres of secondary road networks through the Contrato de Recuperacion y Mantenimiento (CREMA) system, which enabled better driving conditions that save fuel, reduce the need for vehicle repairs, and connect people and communities living on roads with low traffic volumes.[102]

2. **Supply chains need to be decarbonised and environmentally adapted through a combination of private investments, public regulations and modifications to consumer choices.** This includes efforts at the local level (such as planning in support of zero-emission urban deliveries), at the national level (such as CO_2-differentiated road charges) and at the global level (such as an international tax regime on maritime fuels)

   In theory, climate regulations are most cost-effective at the global level due to the scale of opportunities for adjustments and avoiding the risk of leakage. However, effective global decision-making is notoriously difficult, not least because externalities invite the free riding of countries.[103] Conversely, purely local regulations of global externalities may miss larger impacts elsewhere in the supply chain, suggesting that cities should pay most attention to local effects such as health impacts and congestion. Nevertheless, the urgency of tackling climate change suggests that, rather than waiting for a perfect regime at any level, potentially second-best, yet reasonable and multi-benefit measures should be explored in parallel.

- In January 2025, Denmark implemented a kilometre-based and CO_2-differentiated road toll for all trucks heavier than 12 tonnes.[104] The toll applies to 10,900 kilometres of the national road network and parts of the municipal road network, and will expand to all trucks (3.5 tonnes and above) from January 2027 and then to the entire road network by 2028.[105] The policy aims to support the uptake of zero-emission trucks while reducing Denmark's CO_2 emissions by 300,000 tonnes (17% of all truck emissions in 2023).[106]
- In 2025, 14 Dutch cities (including Amsterdam, Rotterdam, The Hague and Utrecht) implemented zero-emission freight zones, which apply to commercial vehicles and delivery vans; vehicles that meet the Euro 5 emission standard can enter until January 2027, and those that meet the Euro 6 emission standard can enter until January 2028.[107]

3. **Supply chains need to be made more resilient to disruptions and shocks.** A comprehensive range of strategies are available for supply chain operators to limit disruptions to supply chains (*Box 3*).[108]

- In 2021, in response to the impacts of the COVID-19 pandemic, Australia established the Office of Supply Chain Resilience to advise the government on supply chain risks and propose potential improvements and solutions.[109]
- The Climate Risk Vulnerability Assessment (CRVA) methodology provides countries with a tool to assess potential future impacts of climate change and identify actions on the national and sub-national level. One of the indicator themes is accessibility and infrastructure. In Viet Nam, application of the CRVA identified the Mekong Delta as one of the areas most vulnerable to climate change due to becoming unsuitable for rice and maize farming, combined with risk of flooding, sea-level rise and drought.[110]

Box 3. Measures to limit supply chain disruptions

Strategies that supply chain operators can take to limit supply chain disruptions include:

- *Avoid* measures to reduce the probability that the disruption takes place,
- *Coping capacity* measures to ensure that system functions are minimally impacted when disruptions do take place, and
- *Redundancy* measures that allow for alternative capacity in the case of disruptions.

For climate change-induced disruptions, recommendations include: 1) conducting climate risk assessments across supply chains and logistics networks; 2) investing in best-in-class operational resilience by strengthening planning and response capabilities; and 3) strengthening the physical resilience of critical infrastructure.

Source: See endnote 108 for this section.



Partnerships in action

In 2024, the SLOCAT Partnership and the Kühne Climate Center released a compendium of policy and financing interventions towards achieving a vision of "intermodal, low-carbon, efficient and resilient freight transport and logistics".[111] **The compendium identifies complementary "best value" policies and investment approaches to deliver quick wins and initiate long-term transformations in five categories** (Figure 9 and Box 4).[112] It aims to steer global discussions and enable multi-stakeholder actions, leveraging collective intelligence and best practices from stakeholders.

The suggested interventions are highly complementary and should be implemented in a comprehensive and integrated manner to maximise their effectiveness. For example, establishing CO_2 emission reduction targets for freight transport and implementing regulations to achieve 100% new sales of zero-emission medium- and heavy-duty vehicles by 2040 are mutually reinforcing interventions. Technological interventions, on the other hand, are closely related to operational gains and also can (to a lesser degree) contribute to regulatory and economic improvements. Although not all listed interventions can be implemented within a short time frame, their pursuit can result in significant improvements, especially when synergies among them are exploited.

FIGURE 9. Five clusters of interventions to deliver quick wins and initiate long-term transformations in freight transport and logistics



Source: See endnote 112 for this section.

Box 4. Five "best value" interventions, as well as actions that need to be stopped

INTERVENTION 1: Ambitious, science-based targets, regulations, policies, standards

What are 'best value' interventions?



CO_2 emission reduction targets for freight transport supporting overall transport decarbonisation by 2050



Low-carbon freight transport infrastructure, operations, vehicles and alternative fuels



Standards for the resilience of freight transport infrastructure and the adaptation of systems



Shift to the most efficient, low-carbon modes of transport and use of intermodal, low-carbon, efficient and resilient freight transport corridors across borders

What actions need to be stopped?

- Importing and procuring unsafe and polluting vehicles.
- Supporting future stranded assets.
- Applying a narrow assessment of CO_2 transport emissions without considering their wider environmental, economic and social impacts.
- Promoting the use of hydrogen for road transport.

INTERVENTION 2: Economics, Finance And Investment

What are 'best value' interventions?



Pricing and fiscality to reflect the entire costs of each freight transport mode on our societies and the environment, and to guide market forces towards the most sustainable services, across supply chains



Earmarking climate finance for transport to address a country's long-term transport investment needs



Re-use of funds collected from inefficient and polluting services to support efficient, green freight transport and logistics solutions



Financing and funding accessible to formal and informal operators

What actions need to be stopped?

- Investments that are not aligned with the Paris Agreement targets.
- Investments in freight transport operations that ignore external costs.
- Investments that are narrowly focused on a single priority or on a single transport mode (especially road freight transport), or that are not sufficient for significant, long-lasting transformations.
- The introduction of taxonomies that direct financial flows towards fossil fuel-intensive infrastructure and operations.

INTERVENTION 3: Integrated planning and operations

What are 'best value' interventions?



Management of freight transport demand and trade development



Fleet and asset sharing combined with intelligent transport systems



Zero-emission zones or sustainable urban logistics plans



Efficient and resilient multimodal freight transport infrastructure

What actions need to be stopped?

- Sub-optimal truckloads and running empty miles.
- Siloed planning and fragmented policies that miss a system-wide thinking approach.

INTERVENTION 4: Mandatory, standardised and transparent tracking, reporting and evaluation

What are 'best value' interventions?



Standardised approaches for GHG emissions, climate and sustainability impacts accounting for all freight transport modes and across the supply chain



Mandatory disclosure through open data and transparency standards



Indicators on intermodality, low-carbon, efficiency and resilience for all freight transport modes



Evaluation of performance against national, regional and global goals on decarbonisation, sustainability and resilience

What actions need to be stopped?

- Ignoring the carbon footprint of products and services.
- Shifting responsibility for emissions, pollution, health costs and other externalities to other geographies and stakeholders.
- Focusing only on tank-to-wheel emissions instead of well-to-wheel emissions.

INTERVENTION 5: Data, research, technology, innovation and capacity building

What are 'best value' interventions?



Multimodal data-focused interfaces, digital platforms and new approaches, enabling transparency and exchange



Investment in workforce planning and training to build skills for new jobs in low-carbon freight transport and logistics



Multi-stakeholder partnerships (e.g., cargo owners, operators, customers, academia, governments, NGOs) for peer exchange, joint action and resource pooling



Technical assistance for North-South and South-South knowledge and technology transfer and cooperation

What actions need to be stopped?

- Policies or activities that focus solely on technologies.
- Failing to adequately make use of the full spectrum of the Avoid-Shift-Improve framework for sustainable transport.
- Perceiving any partnerships and programmes as additional effort.

Source: See endnote 112 for this section.

Other partnerships:

- The **Sino-German Co-operation on Decarbonising Freight Transport** (**CDFT**), launched in April 2025, aims to host multi-stakeholder working groups, implement joint pilot projects, and conduct policy dialogue and research – all focused on the decarbonisation of long-haul and urban freight.[113] CDFT is funded by Germany's International Climate Initiative (IKI) and implemented by the German Agency for Technical Cooperation (GIZ) in co-operation with Chinese and German ministries and transport research bodies.
- The **Decarbonising UK Freight Transport Network** consists of over 40 academic and industry partners convened by University College London and funded by the UK Engineering and Physical Sciences Research Council (EPSRC) and UK Research and Innovation (UKRI). Activities focus on investment risks, technologies, policy alignment, infrastructure and data-driven freight decarbonisation.[114]

MODULE 1 | S1

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SPOTLIGHT

Logistics for Climate Action

KEY FINDINGS



- Logistics sits at a critical junction in the global response to the climate crisis. Logistics activities are defined here as the inter-connected processes of freight transport, storage, and material handling, together with the digital and managerial systems that govern them.
- The logistics sector must take action to become low carbon and resilient (*climate action in logistics)* as well as having a key role in supporting other sectors to achieve their transition towards equitable, low-carbon and climate-resilient societies (*logistics for climate action*).
- This dual role of the logistics sector in climate action has been summarised in nine main contributions.
- Two of these contributions – to reduce emissions within the sector, and to adapt the sector to be reliable – fall under the heading "climate action in logistics". The freight transport and logistics sector must urgently transform itself to become more resilient and to reduce its substantial greenhouse gas emissions.
- The remaining seven contributions of logistics to an equitable, low-carbon society fall under the heading "logistics for climate action" and are the focus of this Spotlight. They are to: deliver low-carbon products, diffuse low-carbon technologies, facilitate circularity, move carbon dioxide, serve carbon dioxide removal, respond in emergencies and enable adaptation.
- These contributions recognise the ongoing role of logistics as a vital enabler of broader climate action across economies and societies.

KEY FINDINGS



Seven key pillars of logistics for climate action

- The international **trade in low-carbon products** can contribute greatly to global emission reductions. Efficient and low-carbon logistics systems can help to enable the rapid scaling of this trade.
- Efficient logistics systems are critical for accelerating the **diffusion of low-carbon technologies** such as solar panels, batteries, green hydrogen, electric bikes and energy-efficient appliances. By enabling these products to reach global markets at scale and to remain cost competitive against carbon-intensive alternatives, logistics ensures the availability of these low-carbon solutions.
- The diffusion of low-carbon technologies depends on co-ordinated action among governments, enterprises, and consumers, forming a complex adaptive system that must align regulation, investment and market demand with robust global supply chains.
- Logistics is a key **enabler of the circular economy** by providing the systems and capabilities to circulate materials and products efficiently, and with this enable a reduction in greenhouse gas emissions. A 28% reduction in material use, attainable through greater circularity, could cut greenhouse gas emissions an estimated 39%. Reverse logistics is central to this approach, as products are collected from users and returned for re-manufacturing, material recovery or responsible disposal.
- Advanced technologies are helping drive progress in the circular economy. Smart solutions such as the Internet of Things (IoT), blockchain, artificial intelligence, and connected digital platforms are transforming the tracking, sorting and movement of goods across supply chains.
- Despite these advances, integrating logistics with circular models remains at an early stage. Key barriers include fragmented data systems, a lack of standardised performance metrics, and inefficient reverse flows, which limit scalability.
- For circular products, it is essential that they are designed not only to be recyclable or re-usable, but also to be compatible with efficient logistics systems.
- Addressing these barriers to circularity requires investment in digital infrastructure, purpose-built facilities and closer collaboration among manufacturers, distributors, retailers and logistics providers. Policy support and targeted incentives can accelerate this shift by aligning logistics operations with circular economy goals.
- While emissions reduction must remain the priority across all sectors, some industries will require carbon capture technologies to address residual, unavoidable emissions. Logistics is integral to enabling the **movement of liquefied CO_2** from capture points to permanent storage sites. By 2050, permanent storage of 95% of captured CO_2 will require transport infrastructure almost 100 times greater than today's capacity, reinforcing logistics as a core enabler of durable carbon removal.
- Shipping will play a pivotal role where storage reservoirs are remote or offshore. CO_2 shipping, although long-established at a small scale for industrial uses, faces a transition to large-scale deployment.
- Logistics underpins the entire **carbon dioxide removal value chain**, extending beyond the transport of captured CO_2. Both nature-based and engineered approaches depend on integrated freight networks to move biomass, sorbents and other key inputs at scale. Efficiently managing these flows, while minimising emissions and leakage risk, is essential to the viability of CDR methodologies.
- The logistics sector is central to **delivering aid** to affected people, often accounting for a significant share of total humanitarian costs. In 2023, natural disasters, including those driven by climate change, claimed over 74,000 lives globally and generated total economic losses estimated at USD 250 billion – more than double the five-year average of USD 105 billion.
- Emergency relief requires co-ordinated logistics to deliver essential supplies – including food, water and medical equipment – to populations affected by floods, droughts, storms, wildfires and extreme heatwaves. At the same time, resilient and responsive freight systems are not just logistical tools, they are lifelines in crisis scenarios and a major factor in supporting recovery and rebuilding.
- Freight and logistics operations are essential for **adapting systems to climate risks** and for enabling other sectors to adapt as well. Logistics systems are essential for delivering materials and equipment needed to rebuild and protect critical infrastructure (logistics enabling adaptation).

Context, challenges and opportunities

Logistics sits at a critical junction in the global response to the climate crisis. Logistics activities are defined here as the inter-connected processes of freight transport, storage, and material handling, together with the digital and managerial systems that govern them.[1] Logistics is both a high-emission sector and a system integrator that moves materials, goods and technologies through extensive networks. As such, the sector can make a significant contribution to accelerating the climate transition.

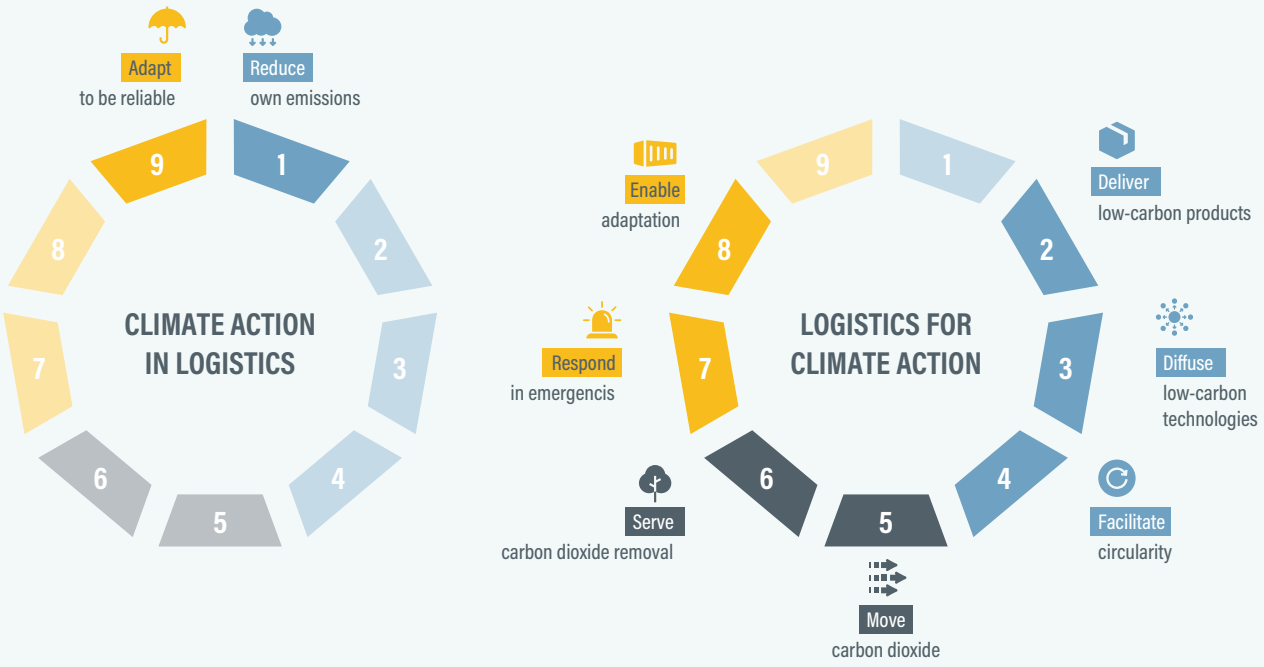
The logistics sector must take action to become low carbon and resilient (climate action in logistics) **as well as having a key role in supporting other sectors to achieve their transition towards equitable, low-carbon and climate-resilient societies** (logistics for climate action)**.**[2] **This dual role of the logistics sector in climate action has been summarised in nine main contributions** (Figure 1)**.**[3]

Two of these contributions – to reduce emissions within the sector (#1) and to adapt the sector to be reliable (#9) – fall under the heading "climate action in logistics". The freight transport and logistics sector must urgently transform itself to become more resilient and to reduce its substantial greenhouse gas emissions. In 2023, the sector contributed around 43% of global transport carbon dioxide (CO_2) emissions and 9.4% of total global CO_2 emissions.[4] These figures likely greatly underestimate the emissions from logistics and do not reflect the release of non-CO_2 climate pollutants such as black carbon and high-altitude aviation emissions, all of which greatly impact global warming.[5]

The remaining seven contributions of logistics to an equitable, low-carbon society fall under the heading "logistics for climate action" and are the focus of this Spotlight. They are to: deliver low-carbon products (#2), diffuse low-carbon technologies (#3), facilitate circularity (#4), move carbon dioxide (#5), serve carbon dioxide removal (#6), respond in emergencies (#7) and enable adaptation (#8).

These contributions recognise the ongoing role of logistics as a vital enabler of broader climate action across economies and societies. The global logistics industry was valued at more than USD 8.7 trillion (EUR 8.4 trillion) in 2021 and is projected to exceed USD 14.2 trillion (EUR 13.7 trillion) by 2027.[6] Global logistics costs exceeded USD 11 trillion in 2023, equivalent to 10.6% of the global gross domestic product (GDP) that year.[7]

FIGURE 1. The 9 contributions of logistics to a low-carbon society



Source: See endnote 3 for this section.



Seven key pillars of *logistics for climate action*

Deliver low-carbon products

The international trade in low-carbon products can contribute greatly to global emission reductions. Efficient and low-carbon logistics systems can help to enable the rapid scaling of this trade.[8] The carbon footprints of high-carbon products (such as steel, cement, glass, etc.) can be reduced by importing low-carbon alternatives. In some cases, local production may be the right solution but will not always contribute to emission reductions, depending on the national context for certain energy-intensive products. For example, a country with a production system heavily reliant on fossil fuels may face significant challenges in producing low-carbon steel. In such cases, importing low-carbon steel or other green construction materials, such as sustainably harvested timber, can be a more effective strategy for reducing the overall emissions released from manufacturers to end users.

- The production of green steel from a plant in Boden (Sweden) – powered entirely by renewable energy – would gain international market share if it were distributed efficiently through global logistics networks.[9]
- Chile, Morocco and Namibia are positioning themselves as exporters of green hydrogen, but these fuels require highly specialised transport infrastructure, including temperature-controlled and pressurised containers, dedicated port facilities and certified shipping routes.[10]

Diffuse low-carbon technologies

Efficient logistics systems are critical for accelerating the diffusion of low-carbon technologies such as solar panels, batteries, green hydrogen, electric bikes and energy-efficient appliances. By enabling these products to reach global markets at scale and to remain cost competitive against carbon-intensive alternatives, logistics ensures the availability of these low-carbon solutions.[11] In such cases, logistics does more than move goods: it ensures that emerging clean technologies are commercially viable, accessible and scalable.

- The global logistics company DHL employs artificial intelligence (AI)-powered route optimisation, advanced materials management systems, and supply chain network design to enhance visibility and reduce costs. Its expertise in transporting oversized cargo – including wind turbine blades, nacelles and solar farm equipment – demonstrates the adaptation of logistics providers to meet the complex requirements of renewable energy technologies.[12]

The diffusion of low-carbon technologies depends on co-ordinated action among governments, enterprises, and consumers, forming a complex adaptive system that must align regulation, investment and market demand with robust global supply chains. Supply chains may encompass local production (with low transport-related emissions) or global production (characterised by higher logistics footprints but greater efficiency and cost-effectiveness). Both approaches should be evaluated to ensure the optimisation of overall climate benefits.[13] (See the Spotlight on Shortening Global Supply Chains as a Key to Decarbonising Transport, in SLOCAT's Transport, Climate and Sustainability Global Status Report – 3rd edition.)

Facilitate circularity

Logistics is a key enabler of the circular economy by providing the systems and capabilities to circulate materials and products efficiently, and with this enable a reduction in greenhouse gas emissions. A 28% reduction in material use, attainable through greater circularity, could cut greenhouse gas emissions an estimated 39%.[14] Functions such as collection, sorting, processing and delivery underpin efforts to recover value from goods at the end of their initial life cycle. Unlike linear supply chains, which move products from production to disposal, circular logistics facilitates the return, re-use, repair, and recycling of goods, ensuring that materials are continually recirculated rather than discarded.[15]

- Since 2002, the Danish company Dansk Retur System (DRS) has operated the national deposit return scheme for bottles and cans, achieving a 93% return rate, with 99.7% of collected items re-used or recycled.[16] This circular system saves around 230,000 tonnes of CO_2 annually, although the company's own emissions stem mainly from transport.[17]
- DRS began electrifying its logistics in 2022 with two electric trucks and has shifted more of its transport of recycled cans to rail. In 2025, the fleet expanded by 19 additional electric trucks, marking the end of new diesel investments, and the company aims to make all trucks electric by 2030.[18]

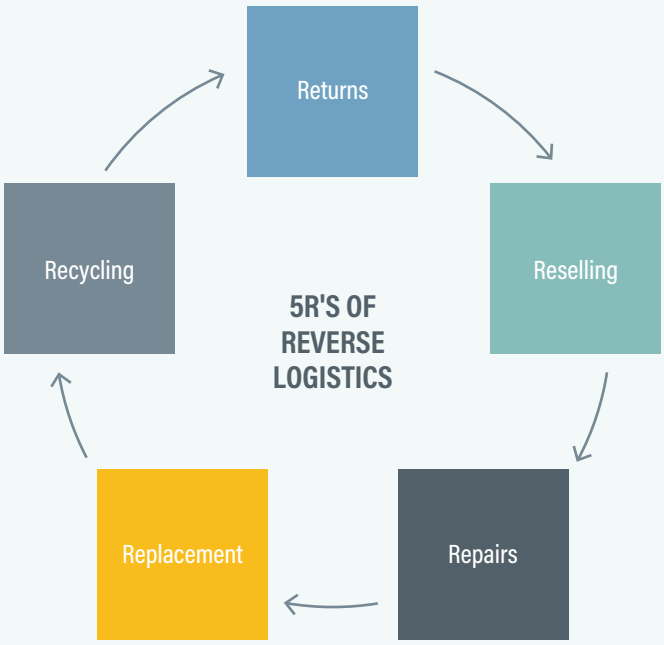
Reverse logistics is central to this approach, as products are collected from users and returned for re-manufacturing, material recovery or responsible disposal (Figure 2).[19]

- In the electronics sector, companies such as SK Tes and Sims Limited enable electronics companies to operate take-back schemes to recover valuable rare earth metals and other materials from discarded devices.[20]
- Automotive manufacturers are developing systems to return and re-purpose batteries and vehicles.
- Global fashion brands are introducing garment collection and textile recycling initiatives to reduce waste and extend product life.[21]

Advanced technologies are helping drive progress in the circular economy. Smart solutions such as the Internet of Things (IoT), blockchain, AI and connected digital platforms are transforming the tracking, sorting and movement of goods across supply chains. Real-time monitoring, predictive analytics and automated warehouse systems minimise waste, optimise inventory and streamline returns – essential for high-waste sectors such as electronics, automotive and fashion that rely on globally distributed networks.[22]

By embedding such technologies, logistics providers are not only improving operational efficiency but also enabling

FIGURE 2. The "5R's" of reverse logistics



Source: See endnote 19 for this section.



entire industries to adopt circular and low-carbon business models. These systems support the secure return, repair, and redistribution of goods, transforming waste streams into valuable resources while reducing environmental impact.

Despite these advances, integrating logistics with circular models remains at an early stage. Key barriers include fragmented data systems, a lack of standardised performance metrics, and inefficient reverse flows, which limit scalability. Most logistics networks are still designed for one-way movement rather than for collecting and reprocessing goods.

- The Kantamanto market in Accra, one of the world's largest re-use and remanufacturing hubs, is at the centre of Ghana's used clothing trade. In 2023 alone, the country imported 143,915 tonnes of second-hand clothing, including 53,970 tonnes from European Union (EU) countries.[23] While some items are re-used or repurposed, large volumes arrive in poor condition and cannot be sold, creating severe environmental problems. With limited municipal funding and infrastructure, textiles accumulate across more than 100 hectares of dumpsites and polluted areas in Accra, over 15 hectares of decommissioned landfills, and along 10 kilometres of coastline.[24] Synthetic garments that take decades to degrade damage coastal habitats, preventing turtles from nesting, while plastic microfibres enter the food chain, harming aquatic life and human health.[25]

For circular products, it is essential that they are designed not only to be recyclable or re-usable, but also to be compatible with efficient logistics systems. Many products are assembled or customised on-site, and if reverse logistics are not considered at the design stage, re-integration into the circular economy can become prohibitively expensive.[26]

Addressing these barriers to circularity requires investment in digital infrastructure, purpose-built facilities and closer collaboration among manufacturers, distributors, retailers and logistics providers. Policy support and targeted incentives can accelerate this shift by aligning logistics operations with circular economy goals. As businesses transition to models such as product-as-a-service, modular design, and shared ownership, logistics must evolve from a background function or secondary activity into a strategic driver of resource efficiency, system resilience and environmental sustainability.[27]

Move CO_2

While emissions reduction must remain the priority across all sectors, some industries will require carbon capture technologies to address residual, unavoidable emissions. Logistics is integral to enabling the movement of liquefied CO_2 from capture points to permanent storage sites. In bioenergy with carbon capture and storage (BECCS), CO_2 absorbed by vegetation is captured during biomass processing, liquefied, and transported by pipeline, ship, rail or road for geological sequestration. **By 2050, permanent storage of 95% of captured CO_2 will require transport infrastructure almost 100 times greater than today's capacity, reinforcing logistics as a core enabler of durable carbon removal.**[28]

Shipping will play a pivotal role where storage reservoirs are remote or offshore. CO_2 shipping, although long-established at a small scale for industrial uses, faces a transition to large-scale deployment. The two main configurations under development are shore-to-shore networks integrated with pipelines, and shore-to-offshore injection directly from vessels or platforms.[29]

- Liquefaction terminals in coastal regions are being established to load CO_2 onto dedicated carriers for delivery to distant storage sites, with sea transport already demonstrating greater viability than new pipelines on routes exceeding 1,000 kilometres.[30]
- Europe alone is projected to require a 15,000-19,000 kilometre transport network by 2050 to link 100-120 carbon capture clusters with roughly 100 storage facilities.[31]
- Scaling direct air carbon capture (DACC) will also generate substantial chemical freight flows. Removing 30 billion tonnes of CO_2 would entail moving around 22 billion tonnes of ammonia, 6.9 billion tonnes of sodium hydroxide and 4.4 billion tonnes of ethylene oxide.[32]

Serve carbon dioxide removal (CDR)

Logistics underpins the entire carbon dioxide removal value chain, extending beyond the transport of captured CO_2. Both nature-based and engineered approaches – including BECCS and direct air carbon capture and storage (DACCS) – depend on integrated freight networks to move biomass, sorbents and other key inputs at scale.[33]

Efficiently managing these flows, while minimising emissions and leakage risk, is essential to the viability of CDR methodologies.

- Approaches such as large-scale afforestation, biochar, and direct air capture with geological storage all require extensive supply chains to move seeds, biomass, sorbents, and captured CO_2 to appropriate sites.[34]
- Ocean Alkalinity Enhancement involves dissolving alkaline minerals in the ocean, tackling ocean acidity and enhancing the ocean's capacity to absorb CO_2; this will require the transport and handling of billions of tonnes of minerals.[35]

Respond during emergencies

The logistics sector is central to delivering aid to affected people, often accounting for a significant share of total humanitarian costs. In 2023, natural disasters, including those driven by climate change, claimed over 74,000 lives globally and generated total economic losses estimated at USD 250 billion – more than double the five-year average of USD 105 billion.[36] In 2018 alone, 108 million people globally required humanitarian aid due to climate-related events.[37]

Emergency relief requires co-ordinated logistics to deliver essential supplies – including food, water and medical equipment – to populations affected by floods, droughts, storms, wildfires and extreme heatwaves. At the same time, resilient and responsive freight systems are not just logistical tools, they are lifelines in crisis scenarios and a major factor in supporting recovery and rebuilding. Innovative solutions, such as drones delivering medicines to remote or flood-isolated areas, enhance access where traditional transport routes are compromised. Logistics also supports critical services including search and rescue, medical care, and the provision of temporary shelter, while facilitating recovery through the supply of materials and equipment for rebuilding.[38]

- In Australia, Fire and Rescue NSW deployed a Remotely Piloted Aircraft System (RPAS) to deliver essential medication to a flood-isolated resident in northern New South Wales, supporting the State Emergency Service-led response to Tropical Cyclone Alfred.[39]

Enable adaptation

Freight and logistics operations are essential for adapting systems to climate risks and for enabling other sectors to adapt as well (Table 1)**.**[40] **Logistics systems are essential for delivering materials and equipment needed to rebuild and protect critical infrastructure (logistics enabling adaptation).**[41]

Logistics enables the delivery of essential materials and services for climate-proofing vulnerable areas. This includes transporting materials for coastal defences – such as large volumes of sand to reinforce flood-prone islands – and relocating critical infrastructure when retrofitting is no longer feasible. Where possible, the use of locally sourced materials

(for example, in rural road construction) reduces costs and dependence on distant supply chains.

- The Port of Rotterdam (Netherlands) has implemented extensive climate adaptation measures, including reinforced dikes and new flood barriers as flood defences, in anticipation of a one-in-1,000-year flood by 2100.[42]
- In the Republic of Nauru, sand transport forms a key component of national adaptation efforts to replenish beaches to protect low-lying coastal areas.[43]

In extreme cases, permanent relocation is increasingly necessary, particularly for small island developing states (SIDS) facing sea-level rise and erosion. With global flood damages projected to reach USD 27 trillion annually by 2100, some studies suggest that in the most exposed regions, relocation may, from an economic perspective, appear less costly than continual investment in protective infrastructure; however such calculations fail to capture the profound social, cultural and ethical stakes for the affected communities.[44]

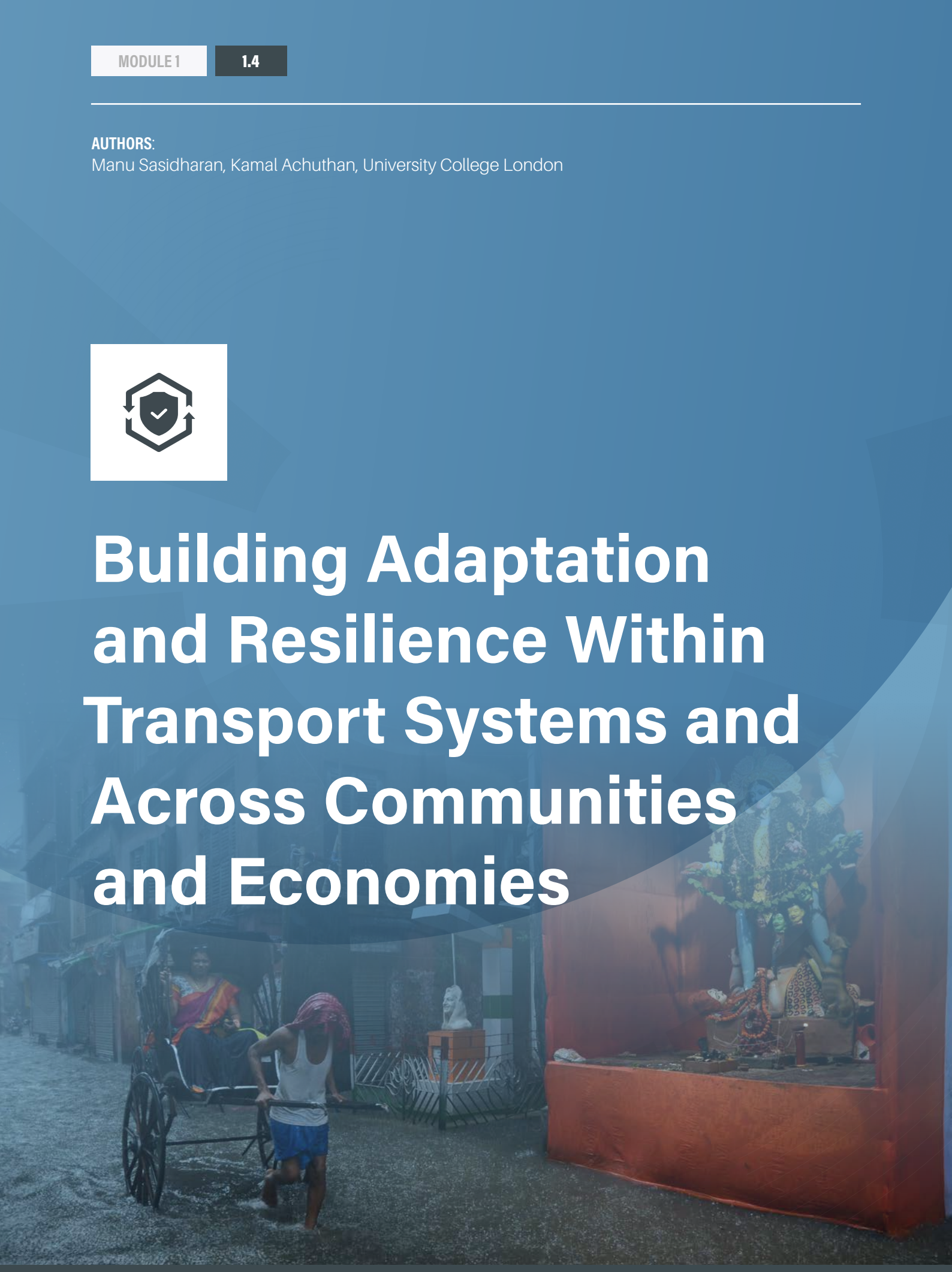
TABLE 1. The dual role of logistics in adapting to a changing climate

Challenge from climate change	How logistics adapts itself (climate action in logistics)	How logistics enables adaptation (logistics for climate action)
Disrupted infrastructure (floods, landslides, heat damage)	• Diversify routes, modes and hubs to maintain service. • Upgrade and climate-proof warehouses, ports and roads.	• Deliver equipment and materials for rebuilding and reinforcement. • Support use of locally available materials (e.g., gravel, stone for rural roads) to avoid vulnerable long-haul supply chains.
Supply chain interruptions	• Build redundancy into networks and inventory. • Use digital tools for real-time monitoring and rerouting.	• Ensure that critical goods (food, medicine, energy) reach affected areas during crises.
Extreme weather events	• Develop emergency logistics plans and pre-position assets. • Train staff for rapid response and risk management.	• Enable humanitarian relief operations and faster restoration of essential services.
Shifts in production and consumption patterns	• Adapt fleet and storage to handle new regional flows. • Incorporate low-carbon and climate-resilient technologies.	• Support relocation or scaling of industries in safer zones. • Facilitate local production–consumption loops to strengthen resilience.

Source: See endnote 40 for this section.

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Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies



KEY FINDINGS



- Well-functioning and secure transport systems are essential for linking people, businesses and services. They not only support the movement of people and freight, but also facilitate evacuations, rescue operations and community recovery in the aftermath of disasters.
- The infrastructure that supports such networks is among a country's most valuable public assets. Yet as extreme weather events become more frequent and more intense, transport networks have become more vulnerable.
- Transport resilience can be investigated through two lenses: resilience of transport systems, and resilience through transport.

Impact of climate change on transport

- Climate change threatens assets across many infrastructure sectors, yet transport faces among the most severe potential impacts. In worst-case scenarios, transport assets could lose up to 98% of their value, underscoring the sector's severe vulnerability to climate-related disruptions.
- In 2023, natural disasters (including climate-induced events) led to more than 74,000 fatalities worldwide and resulted in overall losses totalling USD 250 billion, more than twice the five-year average of USD 105 billion.
- Natural hazards caused around USD 15 billion in annual direct damages to transport systems globally as of 2022, with low- and middle-income countries bearing a disproportionately high share (around USD 8 billion).
- More than one-quarter (27%) of the world's road and rail infrastructure was exposed to at least one natural hazard,

KEY FINDINGS

such as a cyclone, earthquake, or flooding, as of 2019. Around 7.5% of road and railway infrastructure assets globally were exposed to a 1-in-100-year flood event.

- Heatwaves and significant temperature changes have caused roads to warp and rails to buckle, leading to early deterioration of infrastructure and requiring more-frequent maintenance interventions.
- Maritime transport is highly vulnerable to the impacts of externalities. If a container ship must be rerouted, each additional day at sea consumes an estimated 150 tonnes of fuel, costing around USD 75,000.
- Intensified rainfall has led to catastrophic flooding of transport routes, isolating communities, snarling supply chains and hampering emergency response.
- Stronger cyclones and climate-exacerbated wildfires have inflicted direct damage to transport corridors. Each year, major hurricanes and typhoons around the world cause airport closures, port shutdowns and impassable roads due to debris and washouts. Droughts and heat have fuelled larger wildfires with smoke and flames that disrupt transport, leading to highway closures, impeding visibility for aviation and damaging power lines for electrified rail.
- Severe climate-related disruptions have also affected waterway transport.



Impact of non-climate shocks on transport

- Recent non-climate shocks have disrupted transport systems at every scale, from local transit to international trade.
- At the start of the COVID-19 pandemic, public transport ridership collapsed worldwide as governments imposed lockdowns, with public transport networks in numerous cities losing 85-95% of their riders in the early months of 2020.
- Overall, public transport ridership fell by an estimated 75 billion riders globally between 2019 and 2023. The prolonged slump in demand strained city transport agencies worldwide, contributing to financial "fiscal cliffs" and forcing service cuts in some areas.
- In addition to the pandemic, other unexpected crises have reverberated through global transport networks. The blockage of the Suez Canal in 2021 exemplified how a localised mishap can trigger far-reaching disruptions across global supply chains, delaying deliveries worldwide and adding billions in costs.
- Geopolitical disruptions have further shaken the transport logistics sector, fragmenting shipping networks for liquefied natural gas, lessening their robustness and reshaping energy transit routes. The direct impacts to transport operations, although less frequently quantified, have resulted in surging operating costs and compelled stakeholders to rethink supply chains.
- At the national level, widespread strikes across European rail networks in 2023, including in Germany and the United Kingdom, paralysed passenger and freight movement for days, highlighting how labour disputes can rapidly cascade into national-scale mobility crises.
- Such events highlight the vulnerability of transport systems and underscore the need for resilience in both urban mobility and international trade networks. They also show that if transport systems are to maintain essential services – whether at the local level or in a highly interconnected global economy – resilience planning must account for a full spectrum of hazards, including pandemics, geopolitical tensions, economic volatility and operational disruptions.

KEY FINDINGS

Adaptation and resilience trends

Resilience of transport

- Resilience frameworks and practices for transport infrastructure vary greatly between high-income and low- and middle-income countries due to differences in technological capacity, resources and institutional maturity.
- Countries that have stronger economies (higher per capita gross domestic product, GDP, based on 2023 data) tend to face lower risks to physical infrastructure from climate and natural disasters (based on a 0-10 scale for 2025).
- Africa shows the widest range in per capita GDP and infrastructure risk levels. In Asia, some of the best infrastructure profiles, with risk scores near zero, are in high-income economies. European countries generally have very low risk scores for physical infrastructure (often near zero), regardless of variations in GDP per capita. In Latin America and the Caribbean, risk ratings tend to be moderate.
- The United States and Canada represent stable infrastructure environments. In the Oceania region, Australia and New Zealand show relatively low risk, in line with their higher GDPs per capita. However, much higher risk scores are in Papua New Guinea and Solomon Islands, which likely reflects the challenges that smaller or less economically developed island nations face in building and maintaining infrastructure.
- Although much attention is given to the physical resilience of infrastructure, a truly robust transport system also depends on the ability of service operators to maintain essential mobility during crises, and on the readiness of governments to implement reactive measures.
- Countries that have high infrastructure risks and lower GDPs may require targeted investments, international support and policy reforms to bolster infrastructure and reduce vulnerability. Region-specific approaches to infrastructure development – including tailored financing models and capacity building initiatives – can help address regional inequalities.
- In 2023, countries that contributed higher emissions from the transport sector tended to face lower risks to physical infrastructure, due to their well-developed but heavily fossil



KEY FINDINGS

fuel-dependent transport systems. Conversely, countries that have very low transport emissions are often lower-income nations where limited mobility reflects under-developed transport systems and, in some cases, higher physical infrastructure risk.

- This comparative analysis underscores that while higher emissions might typically be expected to indicate adverse environmental impacts, the context of economic and infrastructural capacity plays a critical role in determining the actual risk profile.
- In advanced economies, higher transport emissions are often a by-product of increased mobility, logistic complexity and industrial activity.
- In contrast, many low- and lower-middle-income countries contribute lower emissions because of reduced transport activity, yet suffer from high physical infrastructure risk due to underinvestment and challenges in maintaining existing systems.
- Effective management of urban growth plays a critical role in mitigating infrastructure risks while balancing the environmental impacts of increased transport activity.
- Countries with strong regulatory frameworks and long-term planning tend to decouple high transport emissions from infrastructure risk.
- Countries' physical infrastructure risk levels remained relatively stable or fell slightly between 2016 and 2025, although a strong disparity remained between high-risk and low-risk countries.

Resilience through transport

- Transport systems play a critical role in enhancing access to essential services such as employment, health care, housing, education and economic opportunities. This underscores transport's role in generating additional "resilience dividends", including strengthened economic resilience and broader developmental benefits.
- Operational strategies – such as diversifying supply chains and enabling flexible transport modes (for example, shifting between rail, road and sea) – have proven essential for mitigating disruptions.
- Diverse and flexible multi-modal transport systems have proven equally critical in urban contexts. Urban transport resilience is not only about safeguarding infrastructure, but also about enabling flexible, low-carbon and inclusive transport options that can adapt quickly to shocks.
- Restoring supply chains is critical post-disaster, especially for vital supplies such as food.
- Countries across all income levels are increasingly adopting diverse strategies to ensure the resilience of transport-supported supply chains, based on their unique geographical, economic and infrastructural challenges.
- Flexible regulatory policies in transport are benefiting many economies and serve as models for countries looking to enhance supply chain resilience while transitioning towards more climate-adaptive transport infrastructure.
- To mitigate supply chain risks, minimise economic disruptions, and ensure the continuous flow of essential goods during crises, both high-income and low- and middle-income countries are increasingly adopting best practice strategies such as critical route mapping, multi-modal transport integration, real-time digital monitoring and pre-positioning of resources to safeguard supply chains against disruptions.

Policy and investment trends

- In recent years, more low- and middle-income countries have recognised the need to integrate adaptation and resilience into policy making and transport planning.
- High-income countries across all regions have been implementing comprehensive approaches to support transport adaptation and resilience.
- Some national standards applicable to transport systems have started to incorporate climate adaptation, building on the standards provided by the International Organization for Standardization (ISO).
- The 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28) made major strides on adaptation through the operationalisation of the Loss and Damage Fund and specific targets related to the global goal on adaptation. However, low financial backing for the fund has resulted in several shortcomings and issues.
- At the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29), discussions around the operationalisation of the Loss and Damage Fund continued but without any agreement.
- The 2025 UN Climate Change Conference in Belem, Brazil (COP 30) will be well positioned to lead discussions on this topic. The Loss and Damage Fund should prioritise the effective mobilisation of resources to address transport needs, and engaging transport actors in the development of

KEY FINDINGS

the fund's operations manual will help ensure that it reflects country-specific transport priorities.

- Of the 29 third-generation Nationally Determined Contributions (NDCs) submitted to the UNFCCC as of 1 August 2025, a total of 16 (55%) included content on transport adaptation and resilience.
- The third-generation NDCs as of 1 August 2025 contained a total of 54 transport adaptation actions. Of these, around half (54%, 29 actions) were structural and technical actions, 24% (13 actions) were institutional and regulatory actions, 13% were informational and educational actions, and 9% were other adaptation and resilience actions.
- A generalised review, as of August 2025, found that most of the 74 National Adaptation Plans (NAPs) submitted by countries to the UNFCCC featured transport-relevant content, such as infrastructure resilience, improvements to the built environment and climate-proofing.
- In recent years, countries have recognised the importance of planning for adaptation and resilience. The number of NAPs increased greatly between 2023 and early 2025, during which nearly half (48%) of all NAPs were submitted (35 total, including 23 in 2023 and 2024 and 12 in 2025). Nearly every new submission included content on transport and infrastructure.
- As of June 2025, 10 high-income countries (Austria, Canada, Finland, Germany, Ireland, New Zealand, Netherlands, Spain, United Kingdom and United States) had submitted NAPs to the UNFCCC.
- In 2023, the transport sector received around USD 545 billion from public and private sources for climate mitigation, whereas adaptation financing for transport totalled USD 1.8 billion, or only around 3% of the overall global adaptation financing of USD 65 billion. Emerging economies require an estimated USD 222 billion per year between 2024 and 2030.
- An assessment of 175 climate finance-related transport projects of multilateral development banks found that around 20% were focused on adaptation. Multilateral development banks provided USD 27.7 billion for climate adaptation finance in 2023, of which 89% was committed to low- and middle-income countries. The category with the biggest investment in climate adaptation finance was "energy, transport, and other built environment and infrastructure", at 26% or USD 6,356 million.
- Adaptation efforts in transport and infrastructure provide large social and environmental benefits, induced economic benefits and avoided losses. The economic internal rate of return varies by project country and ranges from 19.3% in China and 23.5% in India, to 30.2% in Brazil and 38.25% in Ethiopia.





Context, challenges and opportunities

Well-functioning and secure transport systems are essential for linking people, businesses and services. They not only support the movement of people and freight, but also facilitate evacuations, rescue operations and community recovery in the aftermath of disasters. The infrastructure that supports such networks is among a country's most valuable public assets. Yet as extreme weather events become more frequent and more intense, transport networks have become more vulnerable.

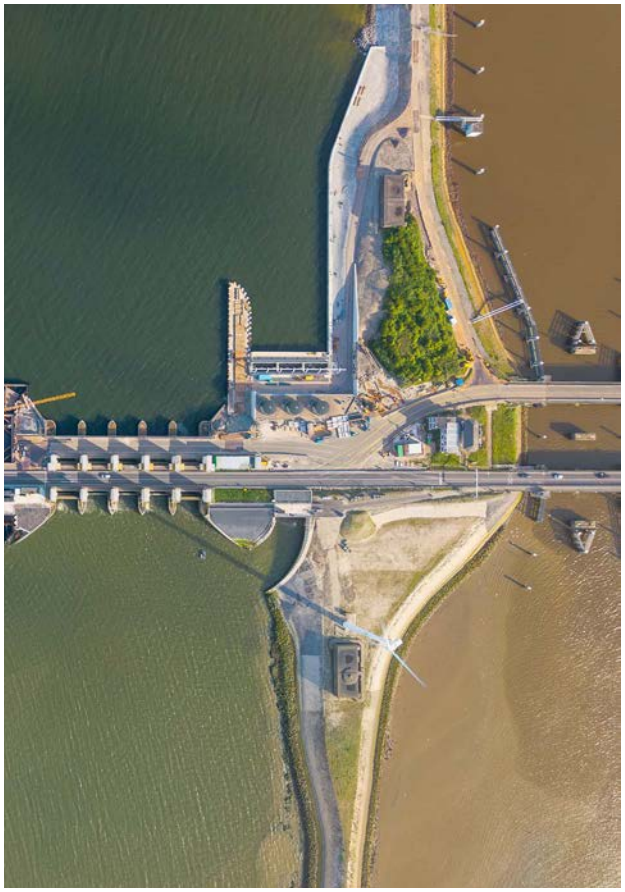
Recent events illustrate that extreme weather disruptions to transport are becoming more frequent and severe. The 2020-25 five-year period has seen some of the hottest years and most damaging storms on record. Transport infrastructure worldwide, much of it ageing and not designed for today's extremes, is straining under these conditions. Protracted events can accelerate the degradation of infrastructure assets, leading to higher maintenance costs, safety risks and environmental impacts. The situation is exacerbated by rising transport demands and budget concerns.

Given the urgent and growing risks, strengthening transport infrastructure and operations against climate change is an immediate priority. National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs) prepared by countries in the framework of the United Nations Framework Convention on Climate Change (UNFCCC) provide essential strategic frameworks for guiding resilience investments and actions in transport sectors. These documents outline national commitments to climate resilience, including explicit targets and measures for infrastructure adaptation, inter-sectoral co-ordination and resource mobilisation. Many countries' NDC updates increasingly recognise transport resilience, promoting integrated, multi-modal approaches that align with global climate goals.

Resilience generally refers to the ability of transport networks to withstand, adapt to, and recover from disruptions, ensuring functionality under a range of conditions. It offers a broad, integrative perspective that accounts for system dynamics and the interplay of pre-event preparation, real-time response, and post-event adaptation, aligning with the strategic goals of maintaining functionality and minimising disruption impacts. Resilience is a multi-dimensional concept that encompasses infrastructure, organisational, inter-organisational, social and economic dimensions. Different organisations prioritise these aspects depending on their operational focus, whether it is disaster risk reduction, infrastructure design or service reliability.

Strengthening resilience also delivers critical equity benefits by ensuring that essential mobility services remain accessible to vulnerable groups, including people with disabilities, older persons, low-income households and those in remote or marginalised communities. Inclusive resilience planning – through barrier-free design, accessible emergency transport services and diverse modal options – helps guarantee that these groups are not disproportionately affected during disruptions and can maintain safe, reliable access to jobs, health care, education and community life.

Resilience overlaps with similar terms but is broader. For example, *robustness* focuses on the inherent strength or capacity of road infrastructure to resist damage or degradation when exposed to stresses or hazards. *Reliability* emphasises the consistency of network performance, ensuring dependable operation under normal or predictable conditions, often measured through parameters such as travel time or service availability. *Recovery* highlights the speed and effectiveness with which road networks can return to acceptable performance levels following a disruption. *Redundancy* refers to the availability of alternative routes, modes, or capacity within the transport network that can be utilised when primary links or services are disrupted, thereby ensuring continuity of movement and reducing the impact of failures.



Transport resilience can be investigated through two lenses: resilience of transport systems, and resilience through transport.

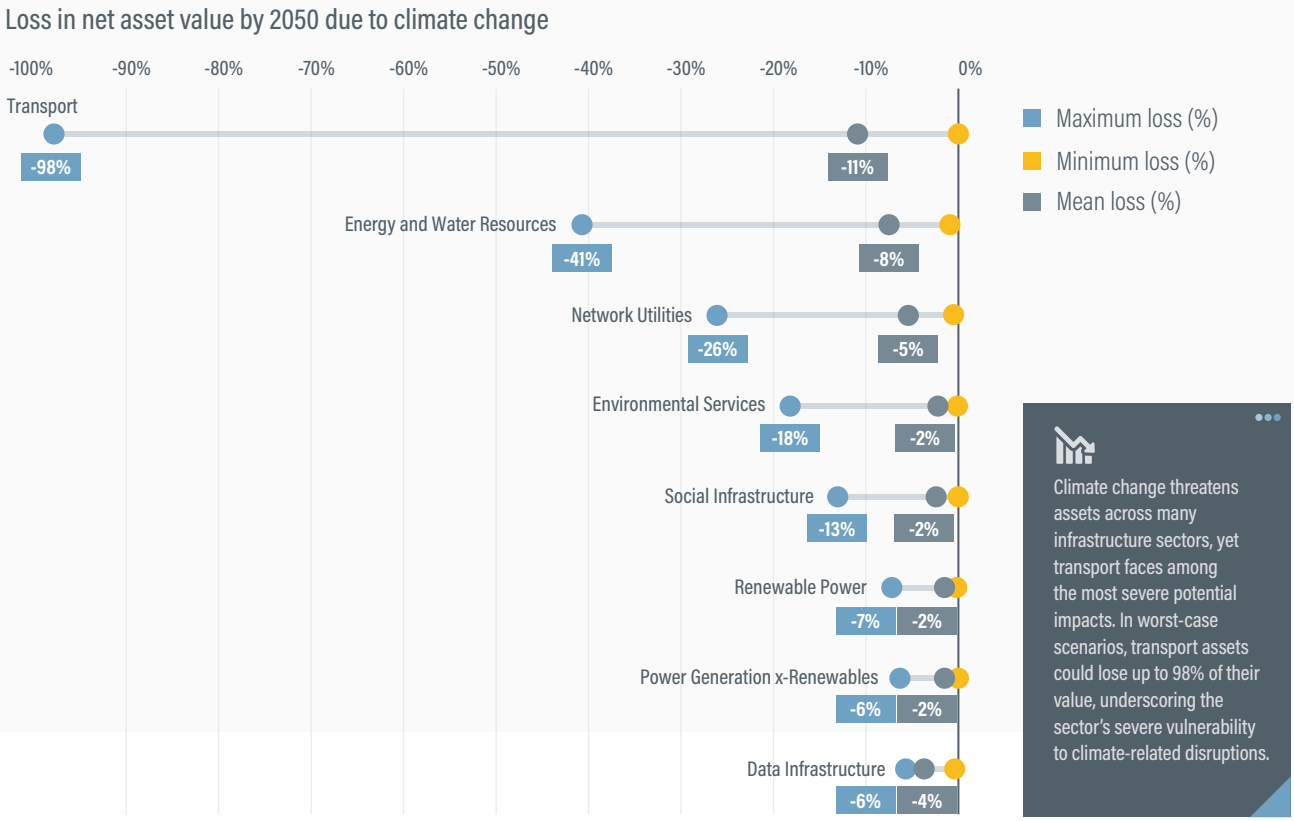
- Resilience of transport systems refers to their capacity to endure, respond to, recover from, and adapt to diverse shocks and stresses, both in the present and over the long term. This encompasses not only the physical robustness of infrastructure but also operational and organisational resilience. Key aspects include ensuring redundancy and providing diverse modal options that cater to communities across varying income levels and geographic locations, and to the transport needs of different types of goods.
- Resilience through transport is the ability to strengthen the resilience of individuals and communities through passenger mobility systems, as well as the resilience of businesses, economies and supply chains through freight transport systems. Resilient transport and mobility networks are designed to ensure continued service provision and deliver critical benefits, particularly to communities most susceptible to the impacts of climate change and to essential supply chain operations.

Impact of climate change on transport

Climate change threatens assets across many infrastructure sectors, yet transport faces among the most severe potential impacts. In worst-case scenarios, transport assets could lose up to 98% of their value, underscoring the sector's severe vulnerability to climate-related disruptions (Figure 1).[1] Rising sea levels, more-frequent severe weather events and shifting regulatory pressures can undermine infrastructure such as ports, roads, railways and airports. Although the assets of other sectors – such as energy and water resources, network utilities and environmental services – face potential losses in value of between 18% and 41%, these declines are less acute than for transport.[2]

In 2023, natural disasters (including climate-induced events) led to more than 74,000 fatalities worldwide and resulted in overall losses totalling USD 250 billion, more than twice the five-year average of USD 105 billion.[3] Natural hazards caused around USD 15 billion in annual direct damages to transport systems globally as of 2022, with low- and middle-income countries bearing a disproportionately high share (around USD 8 billion).[4] Transport infrastructure is highly vulnerable to extreme rainfall and flooding events, which cause closures, delays, and major damage to infrastructure, drainage systems and associated assets such as bridges and culverts.[5]

FIGURE 1. Average impact of physical risk on net asset value within the "current policies" scenario for 2050 for different infrastructure segments



Note: Infrastructure segments are from the Infrastructure Company Classification Standard (TICCS).

Source: See endnote 1 for this section.

More than one-quarter (27%) of the world's road and rail infrastructure was exposed to at least one natural hazard, such as a cyclone, earthquake, or flooding, as of 2019.[6] **Around 7.5% of road and railway infrastructure assets globally were exposed to a 1-in-100-year flood event.**[7] The annual direct costs of damage to road and railway assets from extreme weather events were estimated at between USD 3.1 billion and USD 22 billion, with flooding accounting for 73% of the costs.[8] Landslides and high winds can lead to similar disruptions.[9]

Heatwaves and significant temperature changes have caused roads to warp and rails to buckle, leading to early deterioration of infrastructure and requiring more-frequent maintenance interventions. Infrastructure built for cooler climates is failing under new heat extremes. Overhead electric lines are highly vulnerable to heatwaves, and the buckling of rail tracks may force railway companies to suspend operations. Since 2020, extreme weather, amplified by climate change, has hammered transport networks across the globe.

- A heatwave in Europe in 2022 disrupted intra- and inter-city railway lines in the United Kingdom, spurring Network Rail to create a "resilience taskforce" to develop long-term solutions to heatwave-related disruptions.[10]
- In the 2022 European heatwave, temperatures in France and the United Kingdom exceeded 40 degrees Celsius (°C) for the first time, softening road surfaces and kinking a major highway in Cambridge, forcing its closure.[11] Steel rail tracks in London expanded and buckled under 49°C rail temperatures.[12]

Maritime transport is highly vulnerable to the impacts of externalities. If a container ship must be rerouted, each additional day at sea consumes an estimated 150 tonnes of fuel, costing around USD 75,000.[13] A 2023 analysis found that 86% of ports globally are exposed to more than three (natural) hazards; the hazard risk specific to ports totals an estimated USD 7.5 billion per year, with 32% of the risk attributed to tropical cyclone impacts.[14]

Intensified rainfall has led to catastrophic flooding of transport routes, isolating communities, snarling supply chains and hampering emergency response.

- Unprecedented rains in July 2021 caused devastating

floods in Belgium, Germany, and the Netherlands, washing out roads, bridges and rail lines and resulting in more than 200 deaths.[15] Germany alone faced an estimated USD 4.2 billion (EUR 4.5 billion) in transport infrastructure damage.[16]

- Pakistan's monsoon floods in 2022 submerged one-third of the country, destroying or damaging more than 13,000 kilometres of highways and 439 bridges.[17] In total, 3,127 kilometres of railway track (around 40% of total in-service railways) in the country were destroyed, contributing to estimated infrastructure damages and losses of USD 3.5 billion across the transport sector alone.[18]
- Extreme rains in South Africa in April 2022 triggered floods and mudslides around Durban, disrupting operations for days at the Port of Durban, one of Africa's busiest.[19]
- In 2024, heavy floods across 18 countries in West and Central Africa killed more than 1,500 people and disrupted access to basic social and health services, affecting 7.5 million people; however, estimates of transport damage were not available.[20]
- Between July and August 2025, heavy rainfall in China caused road damage of more than USD 2.2 billion (CNY 16 billion), affecting 23 provinces (more than two-thirds of China's administrative divisions).[21]

Stronger cyclones and climate-exacerbated wildfires have inflicted direct damage to transport corridors. Each year, major hurricanes and typhoons around the world cause airport closures, port shutdowns and impassable roads due to debris and washouts. Droughts and heat have fuelled larger wildfires with smoke and flames that disrupt transport, leading to highway closures, impeding visibility for aviation and damaging power lines for electrified rail.[22] Coastal and island transport links are extremely vulnerable to storm surges and high winds.

- Typhoon Jebi in 2018 flooded Japan's Kansai International Airport, stranding thousands of passengers and closing the major airport for days.[23]
- In September 2022, the storm surge from Hurricane Ian in Florida (United States) destroyed portions of the Sanibel Causeway (a series of bridges), cutting off the island's only road access.[24]
- In the 2025 European heatwave, wildfires raged across France, Greece, Italy, Portugal, Romania, Spain, and elsewhere, destroying around 9,000 square kilometres of land.[25]

Severe climate-related disruptions have also affected waterway transport.

- During 2023-2024, prolonged drought in the Panama Canal region forced authorities to impose vessel draft restrictions and to reduce daily transits, delaying global shipping and raising freight costs.[26]
- Record-low water levels in Germany's Rhine River in 2022 forced cargo vessels to operate at sharply reduced loads, disrupting the transport of coal, fuel and industrial goods across Europe.[27]
- China's Yangtze River experienced its lowest water levels in decades during the 2022 drought, grounding vessels in key stretches and cutting capacity for moving goods between inland manufacturing hubs and coastal ports.[28]

Impact of non-climate shocks on transport

Recent non-climate shocks have disrupted transport systems at every scale, from local transit to international trade.

At the start of the COVID-19 pandemic, public transport ridership collapsed worldwide as governments imposed lockdowns, with public transport networks in numerous cities losing 85-95% of their riders in the early months of 2020.[29] **Overall, public transport ridership fell by an estimated 75 billion riders globally between 2019 and 2023.**[30] **The prolonged slump in demand strained city transport agencies worldwide, contributing to financial "fiscal cliffs" and forcing service cuts in some areas.** (See 4.5 Public Transport.)

- During 2020, public transport ridership fell more than 80% in Bogotá (Colombia), Delhi (India), London (United Kingdom) and New York City (United States).[31] Some of the sharpest declines in Europe occurred in France, with ridership down 92% in Lyon and 85% in Nice during the initial lockdowns in 2020.[32]
- By late 2020, major public transport services across Africa and Asia – from Addis Ababa (Ethiopia), Johannesburg (South Africa), to Ulaanbaatar (Mongolia) – were operating at half capacity or less due to slashed demand.[33]
- In 2023, New York City accounted for nearly half (46%) of all US public transport trips, although ridership in the city was still at only around half its 2019 level.[34]
- European public transport agencies recorded 10% growth in ridership in 2023, although most urban transport systems remained below 2019 levels.[35] In Valencia (Spain), ridership in 2023 was up 17% over 2019 levels, attributed in part to discounted fares.[36]
- Ridership on Singapore's public transport system rose from a pandemic low of 5.0 million passengers daily in 2020, to 7.2 million passengers in 2023 and 7.5 million passengers in 2024 (although still 3% below the 2019 peak of 7.7 million).[37] Urban rail services showed especially strong recovery, with the 3.4 million daily trips in 2024 surpassing 2019 levels (3.38 million).[38]



In addition to the pandemic, other unexpected crises have reverberated through global transport networks. The blockage of the Suez Canal in 2021 exemplified how a localised mishap can trigger far-reaching disruptions across global supply chains, delaying deliveries worldwide and adding billions in costs. In March 2021, the grounding of a single ship in the Suez Canal blocked the vital shipping artery for six days and halted an estimated USD 15-17 billion worth of goods, since roughly 12% of all world trade normally passes through the canal.[39] The backlog grew to hundreds of vessels, and carriers were forced to reroute ships thousands of kilometres around Africa's Cape of Good Hope.

Geopolitical disruptions have further shaken the transport logistics sector, fragmenting shipping networks for liquefied natural gas, lessening their robustness and reshaping energy transit routes. The direct impacts to transport operations, although less frequently quantified, have resulted in surging operating costs and compelled stakeholders to rethink supply chains.

At the national level, widespread strikes across European rail networks in 2023, including in Germany and the United Kingdom, paralysed passenger and freight movement for days, highlighting how labour disputes can rapidly cascade into national-scale mobility crises.[40]

Such events highlight the vulnerability of transport systems and underscore the need for resilience in both urban mobility and international trade networks. They also show that if transport systems are to maintain essential services – whether at the local level or in a highly interconnected global economy – resilience planning must account for a full spectrum of hazards, including pandemics, geopolitical tensions, economic volatility and operational disruptions.

Adaptation and resilience trends

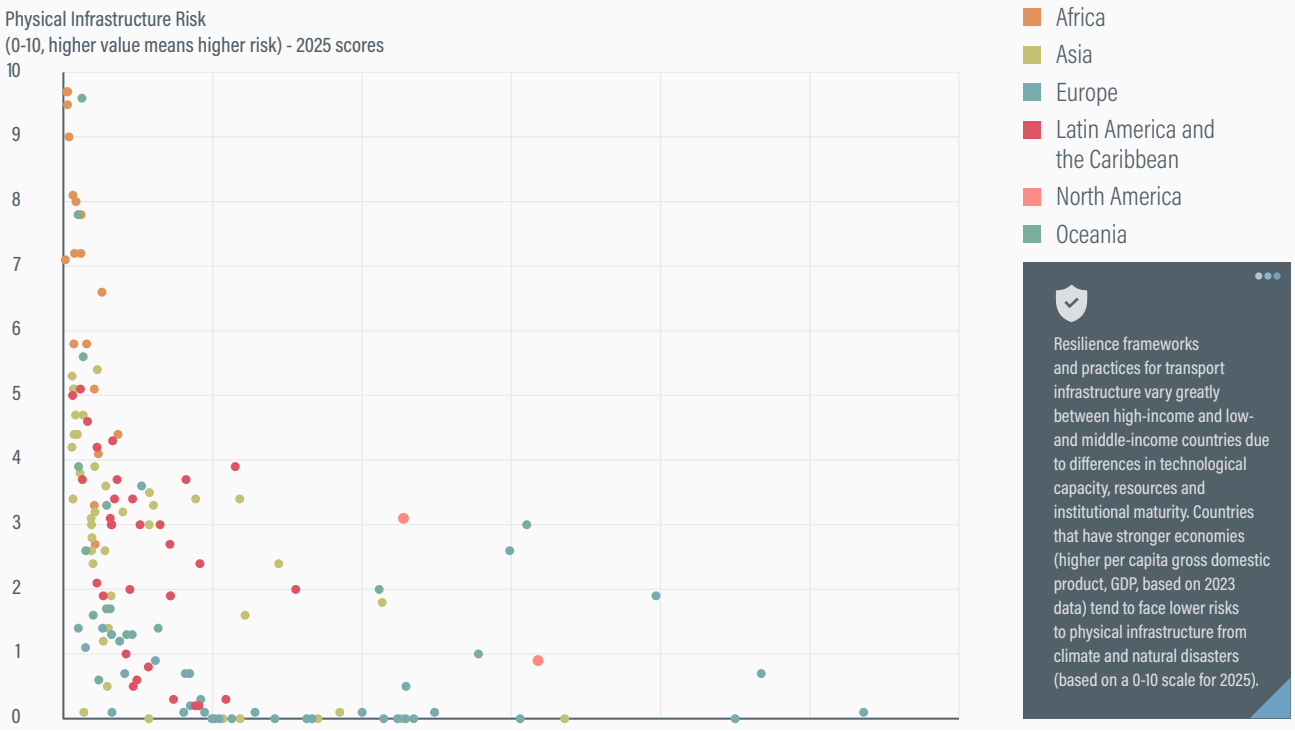
Resilience of transport

The resilience and adaptability of transport systems (both infrastructure and services) are critical to ensure continuity and efficiency in the face of disruptions such as climate change, extreme weather events and other potential shocks.

Resilience frameworks and practices for transport infrastructure vary greatly between high-income and low- and middle-income countries due to differences in technological capacity, resources and institutional maturity. Countries that have stronger economies (higher per capita gross domestic product, GDP, based on 2023 data) tend to face lower risks to physical infrastructure from climate and natural disasters (based on a 0-10 scale for 2025) (Figure 2).[41]

Many high-income countries (in Europe, parts of Asia and North America) report low infrastructure risk values (below 1-2), indicating more-resilient or better-developed physical infrastructure. Meanwhile, many lower-income countries (in Africa, parts of Asia and Oceania) exhibit higher risk ratings (7-10). Even so, some smaller economies have relatively low risk scores due to focused investments or geographic factors that reduce infrastructure vulnerability.

FIGURE 2. Physical infrastructure risk (2025) compared to per capita GDP (2023)



Source: See endnote 41 for this section.

- **Africa shows the widest range in per capita GDP and infrastructure risk levels**, with a large number of countries recording high risk values; however, Mauritius (per capita GDP of USD 11,198) and Seychelles (USD 15,802) report very low risks to physical infrastructure (0.2 and 0.8 respectively).[42] This suggests that while some African countries (often those with higher GDPs per capita) have managed to build stronger physical infrastructure, many still face challenges likely due to underinvestment, conflict or other systemic issues that affect infrastructure development.
- **In Asia, some of the best infrastructure profiles, with risk scores near zero, are in high-income economies** such as Singapore (per capita GDP of USD 67,146; risk 0), Israel (USD 45,302; risk 0) and Japan (USD 37,033; risk 0.1).[43] Moderately higher risks (although still lower than the extreme high-risk cases elsewhere) are in India (USD 2,234; risk 3.8) and Myanmar (USD 1,182; risk 5.3).[44] These low-to-moderate risk levels suggest a robust investment in infrastructure resilience.
- **European countries generally have very low risk scores for physical infrastructure (often near zero), regardless of variations in GDP per capita.**[45] This suggests that European countries generally invest in stable, resilient infrastructure systems, which may be supported by robust institutional frameworks and long-term planning.
- **In Latin America and the Caribbean, risk ratings tend to be moderate.** Argentina (per capita GDP of USD 12,958; risk 3.0) and Brazil (USD 9,277; risk 3.4) fall in the middle of the scale.[46] Risks are lower in relatively wealthier countries, such as Costa Rica (USD 14,354; 1.9), and slightly higher in countries with modest per capita GDP, such as Haiti (USD 1,226; risk 5.0).[47] The region appears to be in a transition phase, with some countries working to improve their infrastructure while economic challenges persist.
- **The United States** (per capita GDP of USD 63,585; risk 0.9) **and Canada** (USD 45,568; risk 3.1) **represent stable infrastructure environments.**[48] Canada's slightly higher risk score might reflect regional differences in infrastructure challenges within the country.
- **In the Oceania region, Australia** (per capita GDP of USD 62,081; risk 3.0) **and New Zealand** (USD 42,306; risk 2.0) **show relatively low risk, in line with their higher GDPs per capita.**[49] **However, much higher risk scores are in Papua New Guinea** (9.6) **and Solomon Islands** (7.8)**, which likely reflects the challenges that smaller or less economically developed island nations face in building and maintaining infrastructure.**[50]

Although much attention is given to the physical resilience

of infrastructure, a truly robust transport system also depends on the ability of service operators to maintain essential mobility during crises, and on the readiness of governments to implement reactive measures. In many countries, the absence of contingency measures can lead to halted or severely reduced transport services. Operators that have diversified fleets, access to emergency fuel reserves, alternative supply routes and flexible staffing arrangements are better able to sustain a minimum level of operations.[51] Key indicators of operational resilience include: mean time to restore basic service (MTTR-BS) after a disruption; percentage of priority routes maintained during crisis conditions; proportion of fleet able to operate on alternative fuels or power sources; availability of strategic stockpiles for fuel, spare parts and critical supplies; and proportion of staff cross-trained for multiple operational roles.

- During the 2022 fuel crisis in Sri Lanka, some bus companies maintained limited services for healthcare workers and students by pooling fuel stocks and prioritising high-demand corridors.[52]
- As of 2025, Bangkok (Thailand) was retrofitting its public transport facilities to be more resilient to flooding by constructing flood barriers and drainage tunnels, installing pumping stations and designating flood retention areas.[53]

Countries that have high infrastructure risks and lower GDPs may require targeted investments, international support and policy reforms to bolster infrastructure and reduce vulnerability. Region-specific approaches to infrastructure development – including tailored financing models and capacity building initiatives – can help address regional inequalities. Countries with moderate-to-high infrastructure risk scores should consider long-term planning to mitigate future vulnerabilities, especially in regions prone to economic volatility or environmental challenges.

- Since 2018, Bangladesh, with support from the World Bank, has pursued the Bangladesh Delta Plan 2100, which establishes a large investment and development framework to ensure resilience and build new infrastructure.[54]
- In 2024, Chile – in co-operation with the UN Office for Disaster Risk Reduction (UNDRR) and the Coalition for Disaster Resilient Infrastructure (CDRI) – drafted a roadmap for infrastructure resilience that outlines gaps, opportunities and priorities for a more resilient infrastructure system.[55]

In 2023, countries that contributed higher emissions from the transport sector tended to face lower risks to physical infrastructure, due to their well-developed but heavily fossil fuel-dependent transport systems (Box 1).[56] **Conversely, countries that have very low transport emissions are often lower-income nations where limited mobility reflects under-developed transport systems and, in some cases, higher physical infrastructure risk.**



Box 1. Relationship between transport emissions and physical infrastructure

Higher transport emissions do not necessarily signal higher physical infrastructure risk (Figure 3). Many countries that have high per capita transport emissions also have well-developed transport networks, with robust and well-maintained infrastructure (i.e., lower risk). High-income countries often contribute high emissions due to intensive motorised vehicle use in passenger and freight transport, yet they score very low on infrastructure risk because of stronger institutional support and higher investment in infrastructure maintenance. In contrast, low emissions in some regions may indicate both lower economic activity and limited transport options, coinciding with poorer infrastructure.

This comparative analysis underscores that while higher emissions might typically be expected to indicate adverse environmental impacts, the context of economic and infrastructural capacity plays a critical role in determining the actual risk profile. Effective infrastructure planning, robust maintenance programmes and strong governance can mitigate the risks associated with intensive transport activity, even in the presence of high per capita emissions. Regional disparities in emissions and risk highlight the influence of economic development, urbanisation and policy frameworks on both environmental outcomes and infrastructure resilience.

In advanced economies, higher transport emissions are often a by-product of increased mobility, logistic complexity and industrial activity. However, these countries also have the economic means and governance structures to support continuous infrastructure upgrades and maintenance, resulting in low risk scores.

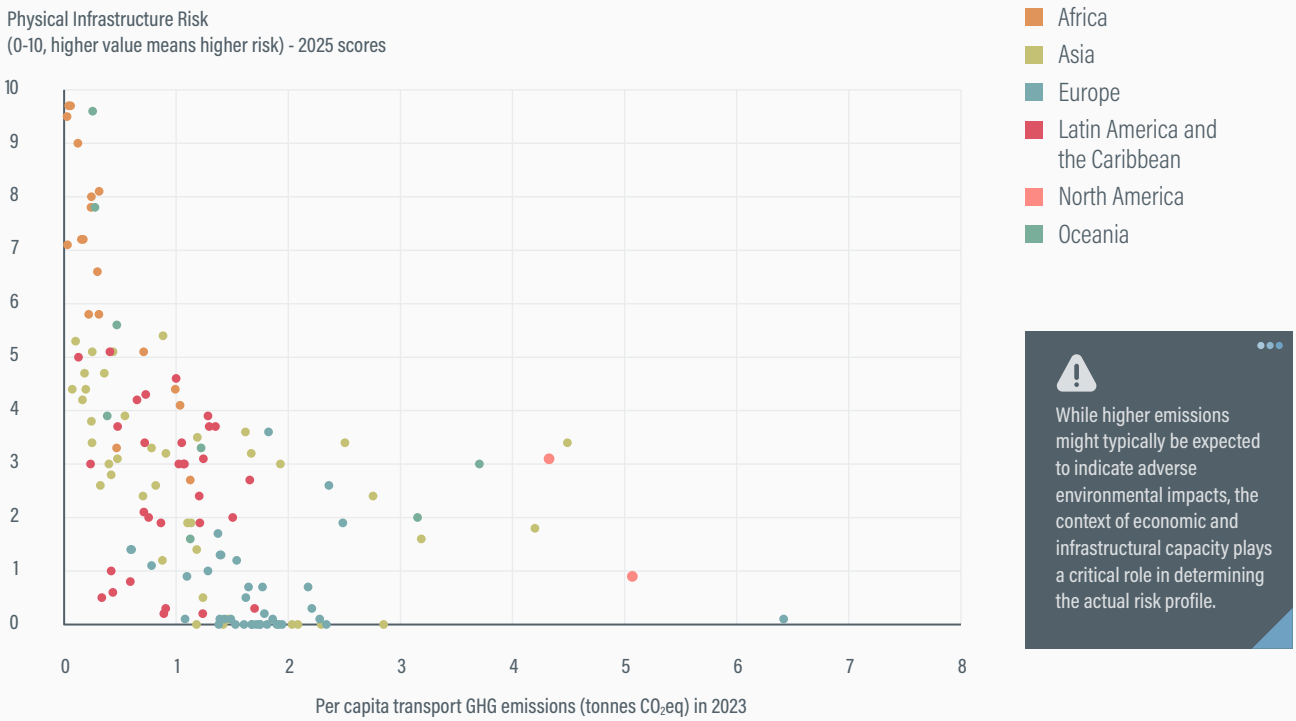
In contrast, many low- and lower-middle-income countries contribute lower emissions because of reduced transport activity, yet suffer from high physical infrastructure risk due to underinvestment and challenges in maintaining existing systems. Resilience efforts in these countries often address vulnerabilities caused by resource constraints and climate change.

Effective management of urban growth plays a critical role in mitigating infrastructure risks while balancing the environmental impacts of increased transport activity. Developed urban centres with dense populations drive up emissions through high vehicle use. Meanwhile, less urbanised or economically constrained regions might have minimal emissions but are handicapped by outdated or insufficient infrastructure, leading to increased risk ratings.

Countries with strong regulatory frameworks and long-term planning tend to decouple high transport emissions from infrastructure risk. In parts of Europe and Asia, deliberate policies focused on infrastructure resilience and maintenance reduce the potential vulnerabilities despite high activity levels.

Source: See endnote 56 for this section.

FIGURE 3. Physical infrastructure risk (2025) compared to transport greenhouse gas emissions (2023)



Countries' physical infrastructure risk levels remained relatively stable or fell slightly between 2016 and 2025, although a strong disparity remained between high-risk and low-risk countries.[57] Europe had the lowest physical infrastructure risk overall, with many countries (Austria, Belgium, Denmark, etc.) showing consistently minimal or zero risk during this period.[58] Many already low-risk countries maintain this status through continual investment, whereas high-risk regions often require more substantial, long-term infrastructural strategies to achieve meaningful reductions in vulnerability.

- In Africa, Burkina Faso, the Central African Republic and Chad had persistently high infrastructure risks, reflecting ongoing structural and investment challenges; meanwhile, some African countries (such as Nigeria) showed modest improvements, indicating some progress in infrastructure resilience.[59]
- In Asia, the risk tends to cluster around mid-range values, with countries such as China and India gradually reducing their scores, pointing to steady development in infrastructure capacity.[60]
- Latin American countries generally have medium-low risk (e.g., Argentina, Brazil and Mexico), although variability exists, with some countries showing small improvements over time.[61]
- North America (United States) and parts of Oceania (Australia) mirrored Europe's low risk profile.[62]

Resilience through transport

Transport systems play a critical role in enhancing access to essential services such as employment, health care, housing, education and economic opportunities. This underscores transport's role in generating additional "resilience dividends", including strengthened economic resilience and broader developmental benefits. Strategies to enhance supply chain resilience, particularly for road infrastructure during and after disruptions, need to consider the interdependencies between critical infrastructure (transport, energy and communications) and to stress the need for preparedness through mapping critical routes, investing in redundancy, pre-positioning resources and incorporating new infrastructure.[63]

Operational strategies – such as diversifying supply chains and enabling flexible transport modes (for example, shifting between rail, road and sea) – have proven essential for mitigating disruptions.[64] Real-time data collection and sharing, along with standardised load units such as containers, further enhance operational efficiency and recovery speed. Data dissemination is critical for autonomous decision making across actors, including the private sector, to make critical interventions in a timely manner. Decentralised systems can be more resilient.

- In 2024, as a best practice approach to increase resilience of operations, DHL shared the four dimensions of supply chain diversification: multi-shoring, multi-sourcing, parallel modes of transport and logistics operation.[65] Hewlett Packard, Lego and Volkswagen are considered examples of multi-shoring because they have production facilities in several regions of the world.[66]
- In 2020, the United States adopted the National Freight Strategic Plan, aiming to enhance the resilience, efficiency and adaptability of the national freight transport system by addressing risks such as congestion, extreme weather and supply chain disruptions. A new, updated strategy was being developed in 2025.[67]

Diverse and flexible multi-modal transport systems have proven equally critical in urban contexts. Urban transport resilience is not only about safeguarding infrastructure, but also about enabling flexible, low-carbon and inclusive transport options that can adapt quickly to shocks. Resilient cities invest in integrated networks that combine electrified public transport, smart urban freight solutions, and infrastructure for walking and cycling. Many public transport operators have business continuity and emergency response plans to maintain minimum service levels during crises.

- During the COVID-19 pandemic, numerous cities – including Berlin (Germany), Bogotá (Colombia) and Paris (France) – rapidly implemented "pop-up" bike lanes to enable social distancing, relieve pressure on public transport and maintain essential mobility.
- A 2025 study on *Crisis Management in Urban Transport* documents a broad range of measures being applied in cities in Germany and elsewhere, from re-allocating road space and expanding electric bus fleets to introducing micro-freight hubs for last-mile delivery.[68]

Restoring supply chains is critical post-disaster, especially for vital supplies such as food. In many countries, the understanding of supply chains, even in normal operational conditions, is poor, in part due to private interest and the need to maintain competitive advantage. In times of need, case studies have shown that these private interests are often put aside, and strong alliances can form between private and public actors. Understanding the dynamics and maintaining key relationships in the supply chain can aid in a quicker recovery. Case studies from across the globe underscore these strategies.

- Scotland's advanced data visualisation systems (such as the government's Rural and Environment Science and Analytical Services, RESAS) highlight the benefits of pro-active planning and technology integration.[69]
- Insights from the US experience with hurricanes showcase the role of decentralised decision making and mutual aid among competitors.[70]


Photo: Debarshi Mukherjee / Climate Visuals Countdown

- In lower-income countries such as Ghana and Tanzania, challenges in resource availability and governance emphasise the need for targeted investments and decentralised disaster management.[71]

Countries across all income levels are increasingly adopting diverse strategies to ensure the resilience of transport-supported supply chains, based on their unique geographical, economic and infrastructural challenges. Germany, Japan and the United States have all focused on high-tech solutions, redundancy planning and multi-modal integration to ensure that supply chains remain uninterrupted during crises.[72] Advanced economies also use pre-positioning strategies, such as Australia's emergency stockpiles and the US Strategic National Stockpile, ensuring that critical supplies are strategically located for immediate deployment during crises.[73] In contrast, low-income countries across Africa, Asia and Latin America have focused mainly on overcoming infrastructure deficits that exacerbate supply chain vulnerabilities, necessitating innovative yet cost-effective solutions.

- Germany has invested in digital freight corridors, leveraging blockchain and Internet of Things technologies to monitor real-time freight movement, allowing rapid response to disruptions.[74]
- In Japan, seismic-resistant highways and reinforced freight corridors are designed to ensure rapid post-earthquake recovery.[75]
- The Netherlands' multi-modal transport system provides redundancy by integrating rail, waterway, and road networks, ensuring that goods can move efficiently even if roads are compromised.[76]
- In the United States, the Federal Emergency Management Agency and the National Response Framework prioritise critical route mapping and emergency road access to maintain supply chain continuity during extreme weather events.[77]
- In Colombia, the integration of transport and environmental agencies has facilitated climate-resilient logistics, allowing for improved road infrastructure planning in flood-prone regions.[78]
- Nature-based solutions protect Haiti's National Road from landslides and storm surge, resulting in lower upfront and maintenance costs, faster implementation and better long-term sustainability.[79]
- In India, the Prime Minister's Gati Shakti master plan facilitates a GIS platform to allow for seamless integration of road, rail, ports and air transport for an efficient multi-modal transport system.[80]
- A World Bank-supported project in Tanzania is deploying GIS-based flood mapping and an Intelligent Transport System (ITS) to the Dar-es-Salaam-Isaka railway line that was found to flood repeatedly.[81]

Flexible regulatory policies in transport are benefiting many economies and serve as models for countries looking to enhance supply chain resilience while transitioning towards more climate-adaptive transport infrastructure.

- The EU's Green Lanes Initiative streamlines border crossings and waives certain transport regulations during crises, ensuring that supply chains for essential goods remain intact.[82]
- During the COVID-19 pandemic, African nations adopted flexible trucking policies to facilitate cross-border trade and prevent supply shortages.[83]

- Climate adaptation efforts in France and New Zealand highlight the increasing global emphasis on sustainable freight solutions, such as electric truck corridors and hybrid road-rail networks.[84]

To mitigate supply chain risks, minimise economic disruptions, and ensure the continuous flow of essential goods during crises, both high-income and low- and middle-income countries are increasingly adopting best practice strategies such as critical route mapping, multi-modal transport integration, real-time digital monitoring and pre-positioning of resources to safeguard supply chains against disruptions. Strengthening institutional capacity, fostering cross-sector collaboration, and leveraging emerging technologies will be key to ensuring long-term resilience, particularly as climate change and geopolitical uncertainties continue to challenge global logistics networks.

Policy and investment trends

Because transport systems are critical for economic activity and community well-being, pro-active adaptation strategies are needed such as investing in resilient infrastructure design, upgrading to low-carbon technologies and diversifying supply chains to mitigate the long-term financial risks posed by climate change.

In recent years, more low- and middle-income countries have recognised the need to integrate adaptation and resilience into policy making and transport planning.

- Bangladesh is prioritising community-based disaster response through its Flood Resilience Measurement of Communities programme and elevated road designs to mitigate monsoon flooding.[85]
- Ethiopia's Climate-Resilient Green Economy strategy recommends building erosion-resistant roads to withstand extreme rainfall.[86]
- India is focused on incorporating road resilience into urban planning through modular road designs and improved flood forecasting systems; the country is building 800 kilometres of climate-resilient highways through the USD 500 million Green National Highways Corridor Project.[87]

High-income countries across all regions have been implementing comprehensive approaches to support transport adaptation and resilience.

- In Asia, Singapore exemplifies urban resilience by integrating smart technologies into its road network, including real-time flood monitoring and adaptive traffic systems.[88]
- Japan leads in earthquake-resistant road designs and emergency recovery plans, reflecting its experience with seismic events.[89]
- In Europe, Sweden employs thermal road insulation and advanced snow-clearing strategies, and the Netherlands integrates roads with water management systems, using elevated highways and porous asphalt to combat flooding.[90]
- In the United Kingdom, resilience frameworks focus on adapting road networks to climate change, including



Photo Credit: Brigitte Leoni / UNISDR

through improved drainage systems and flood-resistant designs outlined in the National Adaptation Programme.[91]

- In Austria and Germany, the public transport operators Hamburger Hochbahn, Stadtwerke München and Wiener Linien apply different measures for crisis management, including business continuity management, emergency response plans, robust procurement and training for staff.[92]
- The United States integrates advanced technologies through programmes such as the Federal Highway Administration's Climate Resilience Pilot Program, emphasising predictive maintenance and real-time traffic monitoring.[93]
- Australia and New Zealand target resilience against natural hazards such as bushfires, cyclones, and earthquakes, using stringent construction codes and redundancy in critical road networks, as seen in New Zealand's Lifelines Council.[94]

Some national standards applicable to transport systems have started to incorporate climate adaptation, building on the standards provided by the International Organization for Standardization (ISO). Since 2017, international standards with guidance on resilience include ISO 31000 on risk management, ISO 14091 on adaptation to climate change and ISO 22316 on organisational resilience.[95]

- National standards include the United Kingdom's BS 8631:2021 (Adaptation to climate change – using adaptation pathways for decision making), the American Society of Civil Engineers' MOP 140 standard focusing on climate-resilient infrastructure adaptive design and risk management, and the Austroads' *Guide to Road Design for Australia and New Zealand*, which accounts for the effects of climate change through the design of drainage for flood waters.[96]
- Brazil uses a hierarchical risk assessment informed by the AdaptaBrasil-MCTI framework as well as the climate risk manual developed by Germany's Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Eurac Research and the United Nations University Institute for Environment and Human Security.[97]
- Canada, New Zealand and the United Kingdom emphasise multiple dimensions of resilience, encompassing infrastructure, organisational structures, inter-organisational collaboration and broader social resilience.[98]
- Canada uses the Public Infrastructure Engineering Vulnerability Committee's (PIEVC) Engineering Protocol, which evaluates infrastructure vulnerabilities and informs future planning.[99]

The 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28) made major strides on adaptation through the operationalisation of the Loss and Damage Fund and specific targets related to the global goal on adaptation.[100] However, low financial backing for the fund has resulted in several shortcomings and issues.

- The Loss and Damage Fund gathered initial pledges of around USD 700 million by the end of COP 28, which was less than 0.2% of the estimated annual requirement of the fund.[101] The fund is also missing an allocation mechanism and simple disbursement procedures.[102]
- The adaptation target related to transport, 9(e), is focused on "increasing the resilience of infrastructure and human settlements to climate change impacts to ensure basic and continuous essential services for all, and minimising climate-related impacts on infrastructure and human settlements".[103]

At the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29), discussions around the operationalisation of the Loss and Damage Fund continued but without any agreement.[104] The 2025 UN Climate Change Conference in Belem, Brazil (COP 30) will be well positioned to lead discussions on this topic. The Loss and Damage Fund should prioritise the effective mobilisation of resources to address transport needs, and engaging transport actors in the development of the fund's operations manual will help ensure that it reflects country-specific transport priorities.

Of the 29 third-generation Nationally Determined Contributions (NDCs) submitted to the UNFCCC as of 1 August 2025, a total of 16 (55%) included content on transport adaptation and resilience. These were from Andorra, Belize, Botswana, Brazil, Canada, Kenya, Lesotho, Maldives, Moldova, Nepal, Niue, Saint Lucia, Somalia, United Arab Emirates, Zambia and Zimbabwe. Only the NDCs from Lesotho and Nepal featured targets on transport adaptation.[105]

- Lesotho's NDC sets a target to strengthen standards to climate-proof roads and critical public infrastructure, with 10 climate-proof codes to be revised by 2025.[106]
- In its NDC, Nepal aims to embed climate-resilient planning for transport infrastructure projects in revised regulations and to equip all major highways with early warning systems by 2030.[107]

The third-generation NDCs as of 1 August 2025 contained a total of 54 transport adaptation actions.[108] Of these, around half (54%, 29 actions) were structural and technical actions, 24% (13 actions) were institutional and regulatory actions, 13% were informational and educational actions, and 9% were other adaptation and resilience actions.[109]


Photo: Sujan Sarkar / Climate Visuals

- Kenya's 2025 NDC commits to guidelines and standards for climate-proof infrastructure across all sectors, the use of resilient building material, as well as the promotion of low-carbon, climate-resilient, efficient, gender-responsive and accessible transport systems through electrification, modal shifts, urban mass rapid transport systems and overall greening.[110]
- Maldives's third-generation NDC highlights enhancing the resilience and climate-proofing of airports and ports to better withstand extreme weather events and sea-level rise caused by climate change.[111]
- The 2025 NDC of Moldova commits to improving rural access to a climate-resilient road system that considers social, age and gender issues. Transport adaptation efforts will increase road redundancy and climate resilience of transport infrastructure, in particular for bridges, viaducts, roads and railways.[112]

A generalised review, as of August 2025, found that most of the 74 National Adaptation Plans (NAPs) submitted by countries to the UNFCCC featured transport-relevant content, such as infrastructure resilience, improvements to the built environment and climate-proofing.[113] Among the NAPs, around one-third (22, or 30%) were from African countries, 17 (23%) from Latin America and the Caribbean, 16 (21%) from Asia, 11 (15%) from Europe, 6 (8%) from Oceania and 2 (3%) from North America.[114] Recent research has highlighted the need for low-income countries in Africa and South Asia to increase consideration of resilience within their NAPs.[115] (See Spotlight on Transport in NAPs.)

- Bangladesh's NAP explicitly integrates transport resilience strategies, emphasising the elevation and reinforcement of critical coastal roads and evacuation routes.[116]
- The NAP of Colombia features risk assessment of transport infrastructure, better climate-proofed design for new roads, bridges, ports and other infrastructure projects, and integrated planning of transport, land use and urban planning with considerations for resilience.[117]
- Ethiopia's NAP incorporates transport infrastructure into broader watershed management programmes, promoting resilient rural roads through water harvesting and run-off management.[118]
- In its NAP, Papua New Guinea echoes its NDC target to build or rehabilitate USD 1.2 billion (PGK 4.2 billion) in transport assets to meet climate-resilient codes and standards.[119] The NAP outlines a plan to conduct rigorous risk and vulnerability assessments of inland road networks and coastal roads and to update road design standards to reflect climate change considerations.[120]

In recent years, countries have recognised the importance of planning for adaptation and resilience. The number of NAPs increased greatly between 2023 and early 2025, during which nearly half (48%) of all NAPs were submitted (35 total, including 23 in 2023 and 2024 and 12 in 2025).[121] **Nearly every new submission included content on transport and infrastructure.**[122] With the exceptions of Burkina Faso and Uruguay, all of these were the first NAP submission by countries.

As of June 2025, 10 high-income countries (Austria, Canada, Finland, Germany, Ireland, New Zealand, Netherlands, Spain, United Kingdom and United States) had submitted NAPs to the UNFCCC.[123] All of the NAPs of high-income countries include references to transport by describing the impact of climate change on transport systems and outlining actions to adapt transport systems and improve transport infrastructure resilience.

- New Zealand commits in its NAP to integrate adaptation into the development process of the National Land Transport Programme. Specific activities focus on ensuring a resilient, reliable and safe rail network; investing in public transport, walking and cycling; and exploring nature-based solutions for emission reduction and transport adaptation.[124]
- The United Kingdom's NAP commits to developing a sectoral transport adaptation strategy, upgrading physical infrastructure by investing in earthworks and drainage systems (mainly rail and roads), and co-ordinating with stakeholders and others to identify risks and align adaptation efforts.[125]

In 2023, the transport sector received around USD 545 billion from public and private sources for climate mitigation, whereas adaptation financing for transport totalled USD 1.8 billion, or only around 3% of the overall global adaptation financing of USD 65 billion.[126] Emerging economies require an estimated USD 222 billion per year between 2024 and 2030.[127]

An assessment of 175 climate finance-related transport projects of multilateral development banks found that around 20% were focused on adaptation.[128] Multilateral development banks provided USD 27.7 billion for climate adaptation finance in 2023, of which 89% was committed to low- and middle-income countries.[129] The category with the biggest investment in climate adaptation finance was "energy, transport, and other built environment and infrastructure", at 26% or USD 6,356 million.[130]

- In 2024, the Asian Development Bank (ADB) announced a target for climate finance to reach 50% of its total annual financing by 2030.[131] Adaptation accounted for 40% (USD 4.9 billion) of the ADB's climate finance that year, with transport accounting for USD 322 million (6.6%, the smallest sector for adaptation).[132]
- The World Bank committed to increase its lending to climate finance from 35% to 45% of its total lending for fiscal year 2025, while ensuring that adaptation represents half the finance volume.[133]

Adaptation efforts in transport and infrastructure provide large social and environmental benefits, induced economic benefits and avoided losses. The economic internal rate of return varies by project country and ranges from 19.3% in China and 23.5% in India, to 30.2% in Brazil and 38.25% in Ethiopia.[134] Investments in adaptation are estimated to yield high returns, with an average economic internal rate of return of 27.2% (that is, every dollar invested results in USD 27.2 in returns).[135]

Box 2. Policy recommendations on enhancing transport adaptation

To improve benchmarking and decision making, governments should adopt **standardised resilience assessment frameworks** that use common metrics and harmonised risk analysis. Integrating systematic quantification of the long-term economic benefits of climate adaptation will guide smarter investment and planning.

Strengthened governance is critical: transport agencies must embed climate adaptation into all levels of decision making, appointing dedicated climate champions and risk managers to oversee resilience initiatives.

Building organisational resilience requires strong leadership commitment, capacity building and robust decision-support tools so that agencies can adapt quickly to disruptions while maintaining essential operations. In 2023, the UN Office for Disaster Risk Reduction proposed transitioning to a systems approach in resilience planning, with a focus on improved co-ordination and co-operation across sectors.

Formalised co-ordination across agencies, the private sector and communities is equally important. Early engagement of private stakeholders and local communities, together with clear governance structures, will align efforts across sectors, prevent fragmented responses and optimise use of resources in a systems-based approach to resilience planning.

Ensuring supply chain continuity is also vital: policy makers should map critical routes, integrate multi-modal transport options, and decentralise logistics decision making to keep goods and services moving during disruptions.

Accelerating technology adoption is a strategic priority. Real-time monitoring systems, digital twins and artificial intelligence-driven predictive maintenance can greatly improve infrastructure surveillance, disaster preparedness and response.

Diversify the energy supply for transport systems to reduce dependence on fossil fuel imports. When transitioning to electric mobility, incorporate redundancies such as backup internal combustion engine fleets, diesel generators and strategic fuel reserves. Even if fossil fuels remain part of the energy mix, establish core networks that can operate for extended periods during fuel shortages and maintain adequate fuel stockpiles.

Strengthen learning and knowledge exchange across regional, national and international levels to share best practices, innovations and lessons learned in transport resilience.

Embed resilience considerations into broader strategic planning frameworks, including Sustainable Urban Mobility Plans, National Transport Policies, and Local Public Transport Plans.

These recommendations provide a high-level overview for pro-active policy and investment decisions. By standardising assessments, strengthening institutional capacity and co-ordination, leveraging advanced technology, and safeguarding supply chains, governments can build robust, sustainable transport systems that withstand the uncertainties of a changing climate.

Source: See endnote 136 for this section.

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Driving Gender Equality: Empowering Women and Transforming Transport



KEY FINDINGS



- Transport systems play a vital role in enabling access to education, employment, health care and social participation. Yet historically, they have been planned and designed without considering the diverse needs and experiences of women, resulting in widespread gender inequities in the sector.
- Women, who rely disproportionately on walking, cycling, and public transport, face multiple challenges such as personal safety, fear of sexual harassment, gender-based violence, socio-cultural restrictions, limited and unaffordable transport options, inadequate transport infrastructure, and poor service quality that ignores the specific needs of women.
- As climate change intensifies and the frequency of extreme weather events such as flooding and heat waves rises, this exacerbates gender disparities in urban mobility, especially for women using low-carbon transport modes.
- The challenges are compounded by institutional barriers such as a lack of gender-disaggregated data on how, why, when, and where women travel, and the under-representation of women in transport planning and leadership.
- As transport systems undergo rapid shifts due to climate pressures and technological transitions, there is a critical opportunity to embed gender equity in future planning and design and to build inclusive transport systems that serve everyone.

Sustainability and climate trends

- Socio-economic barriers often compel women to rely more on low-carbon transport modes such as walking and public transport, with women accounting for 66% of public transport users globally. Although this dependence places women at the heart of sustainable mobility efforts, it also makes them more susceptible to the limitations of poorly designed public transport systems.
- Whereas men make more direct, point-to-point trips, women's travel patterns are more complex, as they are influenced by socio-cultural norms and gendered expectations.
- Through so-called mobility of care, women travel with dependents, manage errands, and carry heavy loads, all of which shape their travel behaviour and needs. Globally, women perform nearly 76% of all care work.
- As women shoulder a greater share of care and household tasks, they are more likely to engage in trip chaining – combining multiple purposes such as work, caregiving and errands within a single journey.
- Traditionally, transport systems have often been designed by and for able-bodied male commuters. Both infrastructure and

KEY FINDINGS

vehicle design typically prioritise men as the default users, neglecting women's different physical and safety needs.

- This design bias is a symptom of a larger structural exclusion. When women are left out of transport planning and decision making, the resulting infrastructure fails to reflect their lived realities.
- Inadequate public transport systems often leave women with no choice but to rely on informal transport options, which are flexible but tend to be more expensive.
- Sexual harassment and gender-based violence are the most pervasive barriers to women's mobility, as women face sexual harassment on public transport and in public spaces.
- As incomes rise, some women shift from public to private transport in response to safety and convenience concerns.
- When transport systems are not designed with women's needs in mind, the consequences extend far beyond mobility and include time poverty, constrained economic opportunities, and diminished access to social and civic life.
- Globally, the lack of safe and accessible transport has been identified as the single greatest barrier preventing women from entering the workforce.
- Women remain greatly under-represented across the transport sector – particularly in leadership roles – and their voices are not heard in decisions about transport.
- On average, women made up 15.6% of the global workforce in transport and storage (and 23% in senior leadership roles) in 2023, with only 5% women's representation in the land transport workforce.
- The transport sector is often perceived to be an unfriendly workplace for women due to the lack of basic facilities.
- Despite immense opportunities for expanding women's employment in the freight and logistics sectors, ongoing barriers have continued to limit participation.
- These workplace challenges are part of a broader ecosystem of systemic barriers that exclude women from transport careers at every level.
- Climate-induced disruptions such as flooding and heat stress, as well as issues such as air pollution, threaten to widen already precarious mobility gaps between men and women.
- Safety and the perception of safety are also impacted by climate-related disruptions.



Policy and investment developments

- Integrating gender-transformative planning with climate-resilient infrastructure, technological innovations, and inclusive policy design is critical to building transport systems that not only withstand climate disruptions, but also enable inclusive growth, equitable access and sustainability.
- In recent years, the focus of gender-responsive mobility has shifted from a protectionist approach to a more pro-active and enabling one. Gender-responsive mobility has increasingly been linked to broader goals such as climate change mitigation, resilience and sustainable development.
- In 2015, the Paris Agreement formally recognised the intersection between gender and climate action. This was followed by some countries adopting frameworks to address gender disparities across sectors such as transport, education and health care.
- The enhanced five-year Lima Work Programme on Gender (LWPG) and its Gender Action Plan were adopted in 2019 at the United Nations Climate Change Conference in Madrid (Spain) (COP 25), underscoring the need for gender-responsive policies, including in transport decarbonisation.
- Focusing on transport infrastructure is a powerful lever to advance Sustainable Development Goal (SDG) 5 on gender equality, by improving women's access to jobs, education, health care, and essential services and thereby supporting their economic empowerment and social inclusion.
- Policy makers increasingly recognise the need to move beyond stand-alone gender and transport policies and to institutionalise gender inclusion across wider visions, objectives and governance structures. This requires gender budgeting, fiscal and non-fiscal incentives, cross-sectoral co-ordination mechanisms, and the appointment of gender experts within transport authorities to ensure that inclusion is intentional and consistent across modes.

KEY FINDINGS

- Capacity building plays a crucial role in operationalising gender-responsive mobility, and policy makers and planners must be equipped to apply a gender lens when designing policies and infrastructure.
- Policies aimed at improving the safety and affordability of transport have become more targeted to address the needs of women and other vulnerable users.
- Digital and climate-smart tools that incorporate gender-responsive perspectives can help prevent the reinforcement of existing inequalities in transport.
- Digital solutions and public campaigns can reinforce safe mobility by helping to raise awareness about different forms of harassment and how to intervene or seek help. However, addressing the gender digital divide requires policies that promote the equitable use of technologies, especially by lower-income women who are frequently excluded from such innovations.
- Such interventions, combined with systemic policy change, address gender-based violence as a structural barrier to mobility, balancing short-term interventions that provide immediate relief (such as women-only transport services) with longer-term strategies that transform the system itself.
- The evolving landscape of work, characterised by the rise of the gig economy and increased female workforce participation, calls for a fundamental rethinking of mobility systems. Increasing women's participation in management, service and operational roles in transport is crucial for sustainable and inclusive mobility.
- Efforts have been made to increase women's participation in the transport workforce, recognising their key role in accelerating the transition to a low-carbon transport sector. Women's inclusion in leadership positions can strengthen decision making by enhancing consideration of social and environmental impacts, which in turn drives greener and more sustainable choices.
- The transition to the fast-growing e-mobility sector offers not only significant decarbonisation benefits but also opportunities to address gender inequities in transport, including for first- and last-mile connectivity.
- Although significant progress has been made in developing gender-responsive mobility systems, implementation remains inconsistent. Evidence-based planning has been hampered by a lack of data capturing the diverse and inter-sectional needs and travel patterns of women.
- In addition to gender-disaggregated data, inclusive transport planning requires active community engagement and a focus on safety, accessibility and reliability.
- Policies that focus on short-term and visible "quick fix" solutions – such as women-only transit services – provide temporary relief yet fail to tackle the more systemic social, cultural and infrastructural barriers that women face in accessing safe and equitable transport.
- Reversing the trend of women shifting to private transport as their incomes rise requires urgent investment in gender-inclusive public transport, to maintain demand for this viable, attractive and low-emission option.
- The Avoid-Shift-Improve framework offers a way to help women continue to choose sustainable transport because it meets their safety, accessibility needs, even as their economic status improves.





Context, challenges and opportunities

Transport systems play a vital role in enabling access to education, employment, health care and social participation. Yet historically, they have been planned and designed without considering the diverse needs and experiences of women, resulting in widespread gender inequities in the sector.[1] These inequities are also shaped by inter-sectionality, with mobility challenges often higher for low-income women, elderly women, women with disabilities, and those in rural or peri-urban areas.

Women, who rely disproportionately on walking, cycling, and public transport, face multiple challenges such as personal safety, fear of sexual harassment, gender-based violence, socio-cultural restrictions, limited and unaffordable transport options, inadequate transport infrastructure and poor service quality that ignores the specific needs of women (Box 1)**.**[2] These barriers not only restrict their mobility but also limit their access to opportunities and participation in the workforce.[3]

As climate change intensifies and the frequency of extreme weather events such as flooding and heat waves rises, this exacerbates gender disparities in urban mobility, especially for women using low-carbon transport modes. Flooded streets and heat exposure can make essential trips more dangerous and time-consuming, especially if public transport services are affected. Adapting to such disruptions often requires preparation, adjustment, and coping strategies, responsibilities that disproportionately fall on women, further affecting their daily mobility.[4]

The challenges are compounded by institutional barriers such as a lack of gender-disaggregated data on how, why, when, and where women travel, and the under-representation of women in transport planning and leadership, perpetuating policies, financial mechanisms and transport systems that fully fail to serve half the population. Addressing these issues requires systemic-level reform: inclusive and participatory planning processes, inter-sectional approaches that reflect diverse identities and experiences, and institutional reforms that challenge entrenched gender norms.

As transport systems undergo rapid shifts due to climate pressures and technological transitions, there is a critical opportunity to embed gender equity in future planning and design and to build inclusive transport systems that serve everyone. Moving towards gender-responsive and climate-conscious transport planning through better infrastructure, inclusive design and active engagement of women is essential for building mobility systems that support both gender justice and environmental resilience.

Box 1. Factors contributing to gender inequities in the transport sector

- **Care responsibilities.** Much of women's travel behaviour is linked to care responsibilities and thus involves trip chaining, shorter distances, and reliance on walking, cycling and public transport. These travel patterns are not inherent to women but are a direct outcome of unequal gender roles and responsibilities.
- **Socio-cultural norms.** Socio-cultural norms greatly influence women's travel needs and transport choices. In conservative societies, more restrictive norms can result in forced mobility and immobility.
- **Personal safety.** Sexual harassment and gender-based violence in public transport and spaces reduce women's sense of safety and restrict their mobility across certain areas and at certain times of the day. An underlying culture of misogyny and entrenched patriarchal norms can exacerbate this issue.
- **Transport design.** Most transport infrastructure and vehicles are designed with male users in mind, making features such as seating, step heights, and grab handles difficult to access, especially for women travelling with children or elderly dependents.
- **Policy and data gaps.** Women remain under-represented in transport decision making, and gender-disaggregated data are rarely collected or used, resulting in gender-blind planning and infrastructure.
- **Economic and access inequities.** High transport costs, lack of reliable services and inadequate last-mile connectivity hinder women's access to jobs, education and essential services, especially among low-income groups.
- **Systemic failures of public transport.** As incomes rise, many women turn to private transport to avoid unsafe and unreliable public systems. Most public transport systems are not designed to accommodate women's travel patterns (e.g., single-fare systems can make it disproportionately expensive for women).
- **Infrastructure development.** Major transport projects often displace low-income communities, with women bearing the brunt of social and economic disruption, further limiting their mobility and access to opportunity.
- **Climate vulnerabilities.** Climate-related disruptions such as extreme heat and flooding disproportionately affect women, reducing the safety, comfort and reliability of modes they rely on most.

Source: See endnote 2 for this section.

Sustainability and climate trends

Transport systems profoundly shape how people move and access opportunities. Yet they have long overlooked women's needs and experiences, leading to significant gender inequities. When women face barriers to safe, reliable, and affordable mobility, their workforce participation and access to education, health care, leisure and other essential services become restricted. This not only limits individual opportunity and well-being but also weakens social and economic resilience at a national and global scale.

Climate change is deepening mobility gaps, and technological innovations are reshaping transport systems at an unprecedented pace. It is essential that these advances do not reinforce existing inequalities in transport planning and design, but instead serve as opportunities for building gender-just and resilient systems.

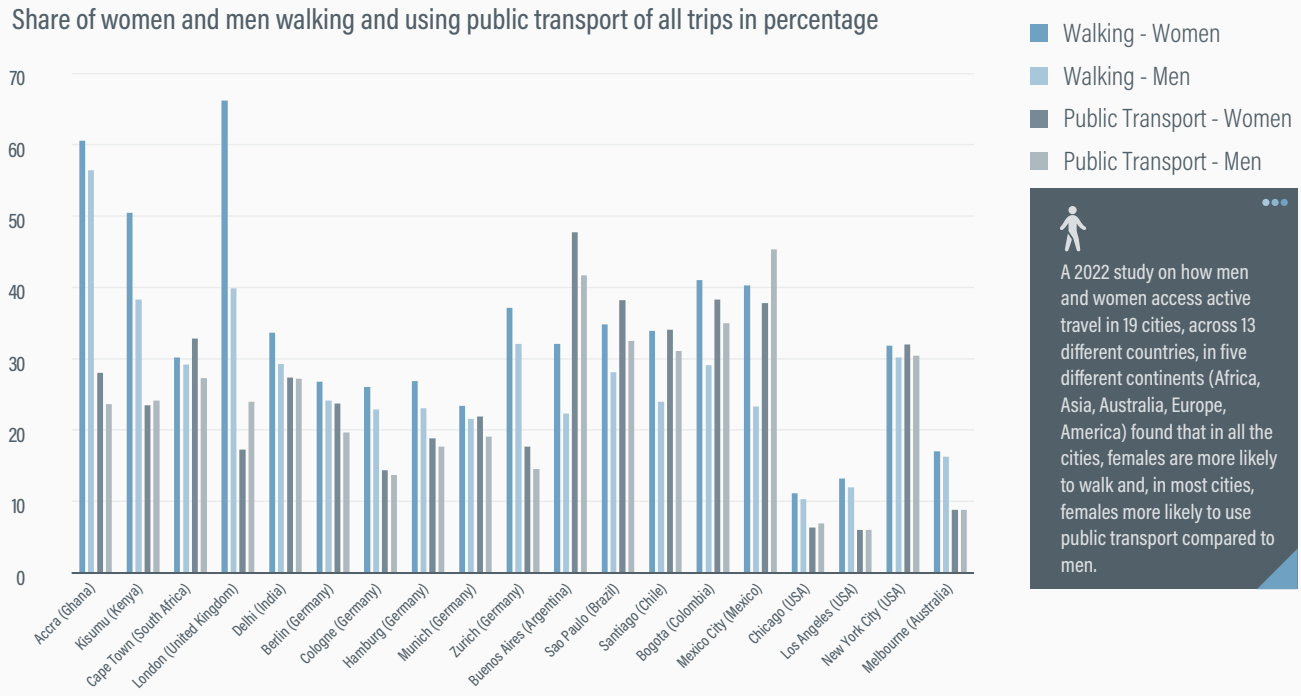
Socio-economic barriers often compel women to rely more on low-carbon transport modes such as walking and public transport, with women accounting for 66% of public transport users globally.[5] Although this dependence places women at the heart of sustainable mobility efforts, it also makes them more susceptible to the limitations of poorly designed public transport systems.

- A 2022 study on how men and women access active travel in 19 cities, across 13 countries on 6 continents (Africa, Asia, Europe, Latin America and the Caribbean, North America, and Oceania) found that in all the cities, women are more likely to walk than men, and in most cities they are more likely to use public transport (Figure 1).[6]
- Women tend to use buses more frequently than rail, although this varies by region and context.[7]
- Women are often less likely to cycle than men, except in high-cycling cities where both genders are equally likely to cycle.[8]

Whereas men make more direct, point-to-point trips, women's travel patterns are more complex, as they are influenced by socio-cultural norms and gendered expectations. Through so-called mobility of care, women travel with dependents, manage errands, and carry heavy loads, all of which shape their travel behaviour and needs.[9] Globally, women perform nearly 76% of all care work.[10] The unequal burden of unpaid care work, such as child and elder care and housework, limits women's participation in public life and access to opportunities, creating significant time poverty.

As women shoulder a greater share of care and household tasks, they are more likely to engage in trip chaining – combining multiple purposes such as work, caregiving and errands within a single journey. Women tend to travel

FIGURE 1. Share of women and men walking and using public transport in selected cities, 2022 study results



Source: See endnote 6 for this section.

shorter distances than men and have limited access to private vehicles.[11] In many contexts, women are forced to adapt their job choices to remain available for care and domestic responsibilities, often working closer to home, opting for home-based employment and taking up part-time work.

Traditionally, transport systems have often been designed by and for able-bodied male commuters. Both infrastructure and vehicle design typically prioritise men as the default users, neglecting women's different physical and safety needs. For example, bus grab handles are often too high for the average woman, nor is there space for strollers or accessible boarding. In cars, the design of standard seatbelts (fitted for male body proportions) increases women's risk of serious injury in crashes by 73%.[12]

This design bias is a symptom of a larger structural exclusion. When women are left out of transport planning and decision making, the resulting infrastructure fails to reflect their lived realities. This not only undermines equity but also limits the overall effectiveness and sustainability of transport systems. Integrating women's perspectives is essential, not just for inclusive access, but also for advancing environmental, economic and social outcomes.

Inadequate public transport systems often leave women with no choice but to rely on informal transport options, which are flexible but tend to be more expensive. Women living in the outskirts of cities are often forced to walk long distances, depend on public transport systems that may be inefficient and unreliable, or use more expensive informal transport – all of which strain their financial resources and impact their daily mobility.[13] In Bogotá (Colombia), low-income women spent 16% more time commuting than low-income men in 2020, highlighting how mobility challenges are amplified by gender and income.[14]

Sexual harassment and gender-based violence are the most pervasive barriers to women's mobility, as women face sexual harassment on public transport and in public spaces. As incomes rise, some women shift from public to private transport in response to safety and convenience concerns.[15]

- A 2020 survey in Indonesia found that four out of five women had experienced sexual harassment in public spaces, including on public transport.[16]
- In Latin America, in 2020, 84% of women in Bogotá (Colombia) reported having experienced sexual harassment, and in Santiago (Chile) and Buenos Aires (Argentina) the share was 89%.[17]

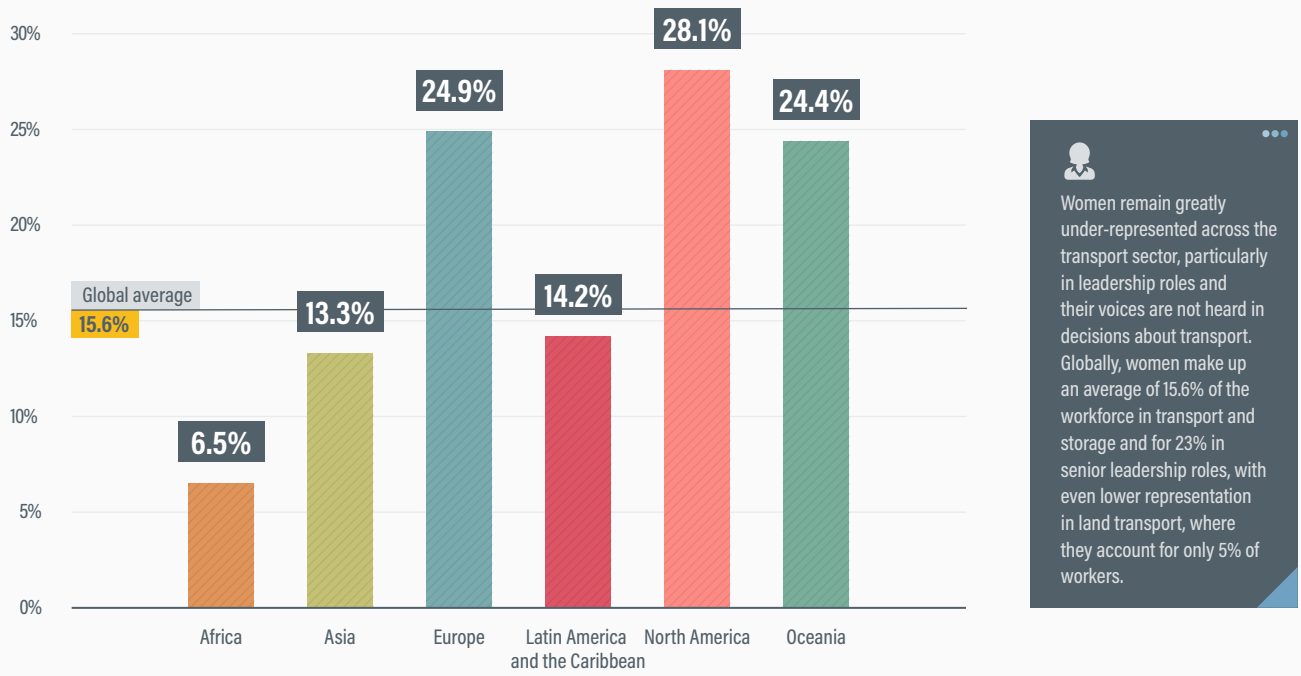
- In Mongolia, 89% of respondents reported witnessing inappropriate behaviour related to sexual harassment on public transport in 2019.[18]
- In 2024, 73% of women in the United States reported having been harassed in a public space, including on mass transport systems (bus, subway, metro, train or plane) or taxi or ride-sharing services.[19]
- Around two-thirds of women in the United Kingdom reported experiencing sexual harassment in a public space in 2021 – an estimate that rises to 86% for women aged 18-34.[20]
- A 2022 study in Rwanda showed that 42% of women were concerned about gender-based violence when commuting during the day, and 55% when commuting at night.[21]

When transport systems are not designed with women's needs in mind, the consequences extend far beyond mobility and include time poverty, constrained economic opportunities, and diminished access to social and civic life. Globally, the lack of safe and accessible transport has been identified as the single greatest barrier preventing women from entering the workforce.[22] Addressing these challenges requires the intentional design of inclusive transport systems that are informed by women's mobility patterns, needs and constraints.[23]

Women remain greatly under-represented across the transport sector – particularly in leadership roles – and their voices are not heard in decisions about transport. On average, women made up 15.6% of the global workforce in transport and storage (and 23% in senior leadership roles) in 2023, with only 5% women's representation in the land transport workforce (Figure 2)**.**[24] Regional disparities are also stark.

- Women comprised 21% of the transport workforce in Europe and Central Asia but only 3% in the Middle East and North Africa in 2023.[25]
- In 2023, North America had the highest shares of women employed in transport among world regions, at more than double the global average.[26] Women comprised 25% of Canada's transport-related workforce and 28.5% of the US transport and storage sector workforce.[27]
- Africa had the lowest share of women employed in transport and storage industries in 2023, at only 6.5% (less than half the global average) – down from 8.2% in 2021.[28]
- The next-lowest shares of women's employment in transport and storage in 2023 were in Asia (13.3%), Latin America and the Caribbean (14.2%), Oceania (24.4%) and Europe (24.9%). [29]

FIGURE 2. Share of women employed in transport and storage, 2023



Source: See endnote 24 for this section.



The transport sector is often perceived to be an unfriendly workplace for women due to the lack of basic facilities such as toilets, resting areas, safety equipment, etc. This is exacerbated for frontline female workers because of entrenched social conditioning that deems driving as men's work, as well as fear of harassment from male colleagues and passengers.[30]

Despite immense opportunities for expanding women's employment in the freight and logistics sectors, ongoing barriers have continued to limit participation. In 2021, there were an estimated 2.6 million truck driver vacancies across the Americas, Asia and Europe.[31] Research highlights that women often possess traits that can make them strong candidates for truck driving, including lower risk-taking tendencies, fewer unsafe driving violations and better focus.[32] Yet persistent barriers include safety concerns, inadequate lighting and resting spaces, unsafe parking facilities and the male-dominated culture of the industry.[33] (See the Spotlight on the Gender-Responsive Freight Sector in Asia.)

These workplace challenges are part of a broader ecosystem of systemic barriers that exclude women from transport careers at every level, beginning with low enrolment in science, technology, engineering and mathematics (STEM) fields and limited participation in technical and vocational education and training, which reduces the number of qualified women entering the sector.[34] The exclusion continues through biased recruitment practices and extends to career progression, where women face leadership stereotypes, exclusion from professional networks, and limited opportunities for promotion despite their qualifications. Workplace policies remain inadequate for women's needs, while persistent wage gaps exist.[35]

Many regions also lack comprehensive legal frameworks including equal pay laws and anti-harassment protections, with some regions enforcing restrictions on women's employment in certain transport jobs. Women also face significant barriers to becoming transport entrepreneurs due to a lack of awareness of and restricted access to finance as well as bureaucratic challenges such as obtaining licences. The lack of gender-disaggregated data collection, analysis and sharing prevents effective policy responses and masks the true extent of gender inequality in the sector.[36]

Climate-induced disruptions such as flooding and heat stress, as well as issues such as air pollution, threaten to widen already precarious mobility gaps between men and women. Although women, like other groups facing inequities, are disproportionately affected, the impacts are shaped by intersecting factors such as socio-economic status, ethnicity, location, etc. Heat stress, flooding and poor air quality have become a part of everyday urban life but have a greater impact on women, who are more exposed than men to environmental stressors.[37] Women face prolonged exposure to air pollution when transport systems are unreliable or unaffordable.[38]

Safety and the perception of safety are also impacted by climate-related disruptions. Heavy rainfall or flooding often

leads to public transport service delays or cancellations, forcing women to board overcrowded vehicles, wait longer at poorly lit or unsafe transit stops, and take longer and potentially unsafe routes. Urban infrastructure typically fails to account for heat stress, with unshaded transit stops and pedestrian walkways making commuting a physically uncomfortable experience.[39]

Policy and investment developments

Integrating gender-transformative planning with climate-resilient infrastructure, technological innovations, and inclusive policy design is critical to building transport systems that not only withstand climate disruptions, but also enable inclusive growth, equitable access and sustainability. Realising the potential of women to transform transport systems requires supportive policies that embed gender equity in e-mobility planning, financing mechanisms that address women's limited access to credit, and targeted training to equip women with the skills needed for new jobs in the sector.

In recent years, the focus of gender-responsive mobility has shifted from a protectionist approach to a more pro-active and enabling one (Box 2)**.**[40] **Gender-responsive mobility has increasingly been linked to broader goals such as climate change mitigation, resilience and sustainable development.**

Box 2. Rising global awareness of the need for gender-responsive mobility

The recognition that urban design and transport infrastructure have primarily responded to the needs of men (and insufficiently to women's needs) began to emerge in the 1970s in the United States and then across Europe by the 1990s. These efforts laid the groundwork for challenging gendered assumptions in mobility systems.

- In 1992, at the Earth Summit in Rio de Janeiro (Brazil), the Women's Agenda 21 was put forward, laying the groundwork for integrating gender parity into development and for wider institutional responses.
- By the late 1990s, safety audits had become a mainstream tool for assessing women's experiences in public spaces, including transport, in selected high-income countries.
- The World Bank's Gender Strategy Action Plan in the 2000s integrated gender into development sectors, including mobility in 2016.

Source: See endnote 40 for this section.

In 2015, the Paris Agreement formally recognised the intersection between gender and climate action.[41] **This was followed by some countries adopting frameworks to address gender disparities across sectors such as transport, education and health care.**

- In the Philippines, the Magna Carta of Women and the Safe Spaces Act (enacted in 2009), together with Department of Transport orders, provide strong institutional backing for policies that ensure equal opportunity, eliminate discrimination and mandate women's representation in governance.[42]
- In Viet Nam, legal reforms including the 2015 amendments to the State Budget Law institutionalised gender-responsive budgeting as a cross-cutting principle in public spending.[43]

The enhanced five-year Lima Work Programme on Gender (LWPG) and its Gender Action Plan were adopted in 2019 at the United Nations Climate Change Conference in Madrid (Spain) (COP 25), underscoring the need for gender-responsive policies, including in transport decarbonisation.[44] The original LWPG on gender-responsive climate policy and action was established in 2014 in alignment with the UN Framework Convention on Climate Change.

Focusing on transport infrastructure is a powerful lever to advance Sustainable Development Goal (SDG) 5 on gender equality, by improving women's access to jobs, education, health care, and essential services and thereby supporting their economic empowerment and social inclusion.[45] Investments in public transit, walkable cities and cycle lanes simultaneously advance both SDG 5 and SDG 13 on climate action. Women's leadership in climate and transport decision making fosters more inclusive and sustainable solutions.

Policy makers increasingly recognise the need to move beyond stand-alone gender and transport policies and to institutionalise gender inclusion across wider visions, objectives and governance structures. This requires gender budgeting, fiscal and non-fiscal incentives, cross-sectoral co-ordination mechanisms, and the appointment of gender experts within transport authorities to ensure that inclusion is intentional and consistent across modes.

Capacity building plays a crucial role in operationalising gender-responsive mobility, and policy makers and planners must be equipped to apply a gender lens when designing policies and infrastructure. Resources that offer guidance across assessment, infrastructure design, service delivery and monitoring include the World Bank's Toolkit for Enabling Gender-Responsive Urban Mobility, the Asian Development Bank's Gender and Transport Toolkit and the International Transport Forum's Gender Analysis Toolkit for Transport Policies.[46]

Policies aimed at improving the safety and affordability of transport have become more targeted to address the needs of women and other vulnerable users. On-the-ground initiatives, such as gender sensitisation training for transport staff, police officers, and security personnel, are also key for gender-responsive transport services.

- In Nakuru County (Kenya), a Public Transport Code of Conduct was developed in 2024, in partnership with Flone Initiative, to establish minimum professional standards among transit operators, with an emphasis on gender and disability inclusion, sexual harassment prevention and environmental sustainability.[47]
- In 2022, the Metro de Santiago (Chile) launched the "Stand Up" campaign against sexual harassment in transit, empowering not just victims but also bystanders to intervene safely.[48]
- India's free bus travel schemes for women, implemented in states including Delhi, Tamil Nadu, and Telangana, have greatly increased women's ridership, with Delhi reporting a 20% increase in women's share of total daily ridership between 2019 and 2023.[49]

Digital and climate-smart tools that incorporate gender-responsive perspectives can help prevent the reinforcement of existing inequalities in transport. Artificial intelligence, intelligent traffic management systems, fleet integration technologies, automated vehicle inspections and digital ticketing systems are already transforming how transport is planned and managed.[50] However, ethical safeguards are needed to protect data privacy and to prevent the reinforcement of harmful gender biases. Using digitalised public transport ticketing data to collect and analyse gender-disaggregated travel patterns can enhance evidence-based planning and policy development.

Digital solutions and public campaigns can reinforce safe mobility by helping to raise awareness about different forms of harassment and how to intervene or seek help. However, addressing the gender digital divide requires policies that promote the equitable use of technologies, especially by lower-income women who are frequently excluded from such innovations.

- In India, the Safetipin app crowdsources safety audits of public spaces, enabling women and city authorities to identify and address unsafe areas.[51]
- In Japan, the Digi Police app allows users to signal harassment with a written message or an audible alert; as of 2019, it was being downloaded around 10,000 times per month.[52]

Such interventions, combined with systemic policy change, address gender-based violence as a structural barrier to mobility, balancing short-term interventions that provide immediate relief (such as women-only transport services) with longer-term strategies that transform the system itself. Incorporating violence reduction as a critical transport policy goal, and recognising reductions in harassment and assault as co-benefits in transport policy appraisal, can help guide investments towards developing systems where everyone can travel safely and with dignity.[53]

The evolving landscape of work, characterised by the rise of the gig economy and increased female workforce participation, calls for a fundamental rethinking of mobility systems. Increasing women's participation in management, service and operational roles in transport is crucial for sustainable and inclusive mobility. Transport policies must support women's economic empowerment by integrating the "mobility of care" and adapting to the needs of a growing female workforce and changing work-related travel patterns. Increasing women's participation in transport leadership enhances focus on gender-specific needs and can contribute to more inclusive, equitable and sustainable systems.

Efforts have been made to increase women's participation in the transport workforce, recognising their key role in accelerating the transition to a low-carbon transport sector. Women's inclusion in leadership positions can strengthen decision making by enhancing consideration of social and environmental impacts, which in turn drives greener and more sustainable choices.[54] More women in front-facing and operational roles can lead to better service quality and increased perception of safety.

- Initiatives are under way in Albania, Armenia, Georgia, Serbia and Türkiye to improve recruitment, training and representation of women in both frontline and leadership roles in transport.[55]
- In Odisha (India), the Capital Region Urban Transport agency has deployed women conductors and is training female and transgender drivers for its electric fleet. Half of all Mo Bus conductors and guides are women, and 100% of Mo E-Ride drivers are women from disadvantaged communities.[56] In addition, the agency implemented measures such as separate washrooms for women workers at bus depots and better lighting at bus shelters – leading to a 200% increase in ridership over 4.5 years.[57]
- In Nepal, the microfinance platform Aloi uses digital tokens to enable informal women entrepreneurs to access credit and build credit histories, helping them to scale green businesses including the purchase of electric vehicles such as Safa Tempos and electric scooters.[58]

The transition to the fast-growing e-mobility sector offers not only significant decarbonisation benefits but also opportunities to address gender inequities in transport,

including for first- and last-mile connectivity. The e-mobility ecosystem requires new skillsets in electrical and digital technologies, where women are not at a disadvantage compared to traditional automotive skills.[59] Research indicates that women passengers often prefer electric two- and three-wheeler services provided by women drivers, enhancing perceptions of safety and reliability.[60]

- Evidence from initiatives in Colombia, India, Kenya, Uganda and Zimbabwe demonstrates how women are already entering roles as electric bus drivers, three-wheeler operators, technicians, entrepreneurs and managers.[61]
- In Bogotá (Colombia), the all-electric public transport operator La Rolita achieved 60% female representation in its driving workforce in 2024, combining gender inclusion with environmental sustainability.[62]
- Case studies such as India's Mo E-Ride, Nepal's Safa Tempo and Zimbabwe's Mobility for Africa illustrate how women-led e-mobility services can simultaneously improve mobility, generate income and enhance women's perception of safety.[63]

Although significant progress has been made in developing gender-responsive mobility systems, implementation remains inconsistent. Evidence-based planning has been hampered by a lack of data capturing the diverse and intersectional needs and travel patterns of women. In addition to gender-disaggregated data, inclusive transport planning requires active community engagement and a focus on safety, accessibility and reliability. Policies risk reinforcing exclusion by catering only to a narrow segment of the female population, rather than addressing broader realities. Moving beyond tokenistic measures, a transformative approach is needed that embeds safety, sustainability, equity, and climate resilience into comprehensive, scalable strategies, recognising that women and other under-served groups are currently not a focus of climate-resilient transport systems.

Policies that focus on short-term and visible "quick fix" solutions – such as women-only transit services – provide temporary relief yet fail to tackle the more systemic social, cultural and infrastructural barriers that women face in accessing safe and equitable transport. Such measures can at times reinforce misconceptions by framing women's safety as a narrow concern, rather than recognising it as a wider systemic challenge that requires institutional accountability and comprehensive policy reforms. Women-only services risk stigmatising women further by segregating them, and they often overlook the varied and complex needs of different groups of women.

Reversing the trend of women shifting to private transport as their incomes rise requires urgent investment in gender-inclusive public transport, to maintain demand for this viable, attractive and low-emission option. Investment in public transport can strengthen integrated transport networks by improving physical, information and fare integration among modes and enabling more efficient transfers that can reduce unnecessary trips and therefore lower emissions.

The Avoid-Shift-Improve framework offers a way to help women continue to choose sustainable transport because it meets their safety and accessibility needs, even as their economic status improves. This framework supports efforts to "avoid" unnecessary travel through better land use planning and digital solutions; "shift" to sustainable modes by making walking, cycling, and public transport safe and attractive; and "improve" system efficiency, comfort, and safety to retain users.

Partnerships in action

- In June 2025, the **Global Alliance for Feminist Transport** initiated **No One Left Behind**, a call for impact that aims to centre equity and inclusion in the UN Decade of Sustainable Transport. The call outlines ten strategic goals to guide governments, funders and practitioners in building mobility systems that are truly inclusive, to address the historical mismatch between mobility systems and the lived realities of many people. It was initiated at the UN Department of Economic and Social Affairs Expert Group Meeting on Sustainable Transport.[64]

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SPOTLIGHT



Gender-Responsive Approaches in Freight Transport in Asia

KEY FINDINGS



- The freight transport and logistics ecosystem is a vital, intricate network encompassing organisations, individuals and processes that facilitate the movement of goods from raw material sources to final consumers.
- Freight transport contributes greatly to a country's gross domestic product and employment, and is the backbone of global trade and economic integration.
- Despite its critical role in supporting economic growth, the freight transport sector remains heavily male-dominated, with significant gender disparities in employment and leadership roles that exacerbate gender inequality.
- Despite the significant limitations that women face in entering and thriving in the freight transport sector, some progress has been made in improving gender inequality in Asia's transport industry overall.
- Strategies for a gender-responsive freight sector include strict policies to address workplace sexual harassment and violence, and government subsidies or employer-sponsorship for inexpensive and good-quality childcare facilities – among many other policies that can be tailored to different country and employer contexts.
- The United Nations Economic and Social Commission for Asia and the Pacific highlights three fundamentals to enhance the inclusiveness of the freight transport sector in Asia-Pacific by promoting women's participation: 1) framing and implementing pro-active strategies and policies to widen women's role in the sector, 2) involving academia and the private sector to provide the required knowledge and skills to women; and 3) encouraging hybrid occupational models such as remote work and other innovations to motivate women to increase their participation in the sector.

Framing and implementing pro-active strategies and policies to widen women's role in the sector

- A key approach to widen women's role in the sector is to apply the principles of universal design to the design of freight transport vehicles and infrastructure.
- This includes incorporating features that enhance the safety and accessibility of public spaces and infrastructure, as these affect women's participation and experiences working as truck drivers, as delivery partners in the gig economy, and in facilities such as container freight stations and bus depots.
- Despite the notable gender gap in women's participation in the freight transport sector, the potential opportunities are tremendous. As of 2021, an estimated 2.6 million truck driver jobs remained unfilled across the Americas, Asia and Europe.
- Private sector involvement is required to effectively eliminate gender pay gaps and wage discrimination, enable labour and social protections, and strengthen corporate policies for handling grievances.
- In the private sector, as well as in public-private partnerships, it is important to highlight the financial and economic benefits of gender equality, in addition to its normative and moral imperatives.
- To improve their effectiveness, policy efforts must first be informed by extensive stakeholder engagement and input, followed by the building of institutional capacity for gender mainstreaming, and clear accountability practices.
- Network and industry associations have played a pivotal role in promoting and attracting more women to seek employment in the freight and transport industry.
- Encouraging hybrid occupational models such as remote work and other innovations motivates women to increase their participation in the freight transport sector.



Context, challenges and opportunities

The freight transport and logistics ecosystem is a vital, intricate network encompassing organisations, individuals and processes that facilitate the movement of goods from raw material sources to final consumers. This dynamic system integrates inter-dependent activities such as transport, warehousing, inventory management, and freight forwarding, engaging a diversity of stakeholders such as manufacturers, suppliers, distributors, logistics providers and customers. Advanced technologies – including transport and warehouse management systems, e-commerce, automation, artificial intelligence and blockchain – continue to shape the sector's evolution, as do innovations such as electric vehicles, autonomous trucks and hyperloop systems.[1] Understanding the role of gender-responsive approaches in this multi-faceted ecosystem is essential to foster inclusivity and optimise efficiency and sustainability.

Freight transport contributes greatly to a country's gross domestic product and employment, and is the backbone of global trade and economic integration. In 2023, freight transport accounted for an estimated 5-7% of global employment, while the wider logistics sector (covering transport, warehousing and storage) accounted for up to 10%.[2] In Asia, the demand for freight transport is projected to triple between 2020 and 2050, while urban freight demand could grow 3.7% annually between 2020 and 2050.[3]

Despite its critical role in supporting economic growth, the freight transport sector remains heavily male-dominated, with significant gender disparities in employment and leadership roles that exacerbate gender inequality. The share of women employed in Asia's transport and storage industries was 13.3% in 2023, well below the levels in North America (28.1%) and Europe (24.9%), and the second lowest share after Africa.[4] Research in 2018 found that 6 of the top 10 jobs traditionally seen as "men's jobs" in transport were related to freight transport.[5] These roles are often more secure and better paid, and they include drivers, airline pilots, security personnel, ship's officers, crane operators and harbourmasters. Meanwhile, the "top 10 roles for women" barely included any roles in the freight transport sector, in addition to being lower paid and precarious.[6]

The freight transport sector also has significant negative externalities, such as the high economic costs and health impacts associated with traffic delays and air pollution. Across Asia, urban freight accounted for only 15% of total freight activity in 2022 but contributed 43% of freight-related carbon dioxide (CO_2) emissions, due to frequent, small-batch deliveries in congested traffic.[7] The need to decouple the projected growth in freight transport activity from the growth in emissions warrants the urgent involvement of all genders in developing effective equitable solutions.

Several regional and national frameworks seek to address the gender gap in employment in the freight transport sector;

however, challenges persist. These include: social and cultural barriers; perceived limitations in physical ability to handle goods or operate large commercial vehicles (often seen as male-dominated roles); personal safety and security risks; gender stereotypes and bias in education, training, recruitment and career advancement; and job loss or insecurity due to the roll-out of advanced technologies such as automation with limited consideration of the gendered impacts.[8] Factors contributing to work-family conflict include rigid work schedules and long hours, long business trips associated with working in the sector, and the absence of family-friendly policies such as childcare support, flexible leave and adaptable shifts.[9] Among world regions, women in Asia work the longest hours globally – averaging 7.7 hours a day, of which only 3.3 hours are paid and the rest is unpaid care work.[10]

Strategies for a gender-responsive freight sector

Despite the significant limitations that women face in entering and thriving in the freight transport sector, some progress has been made in improving gender inequality in Asia's transport industry overall. Examples at the national level include the Philippines' Magna Carta of Women and the Safe Spaces Act (enacted in 2009) and Kazakhstan's 2030 concept of family and gender policy. (See 1.5 Driving Gender Equality: Empowering Women and Transforming Transport.)

Strategies for a gender-responsive freight sector include strict policies to address workplace sexual harassment and violence, and government subsidies or employer-sponsorship for inexpensive and good-quality childcare facilities – among many other policies that can be tailored to different country and employer contexts. These are outlined in a 2024 handbook on Promoting a socially inclusive freight transport sector, published by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), aimed at governments, employers, and industry associations, among other key stakeholders.[11]

UNESCAP highlights three fundamentals to enhance the inclusiveness of the freight transport sector in Asia-Pacific by promoting women's participation: 1) framing and implementing pro-active strategies and policies to widen women's role in the sector, 2) involving academia and the private sector to provide the required knowledge and skills to women; and 3) encouraging hybrid occupational models such as remote work and other innovations to motivate women to increase their participation in the sector.[12]

Framing and implementing pro-active strategies and policies to widen women's role in the sector

The freight sector, particularly urban freight, has been under-emphasised in many national climate and sustainable development strategies.

A key approach to widen women's role in the sector is to apply the principles of universal design to the design of freight transport vehicles and infrastructure. This includes incorporating features that enhance the safety and accessibility of public spaces and infrastructure, as these affect women's participation and experiences working as truck drivers, as delivery partners in the gig economy, and in facilities such as container freight stations and bus depots. Research shows that gender-responsive infrastructure, by adding female users, has the potential to increase the user base of a facility or service, thereby improving its financial outcomes rather than making it more expensive.

- Construction projects that account for accessibility and inclusion standards at the design phase add only an estimated 1% to the total project cost, compared to the much higher expenses of retrofitting.[13]
- A study in India found that female delivery workers using electric two- and three-wheeled vehicles were more likely to stay in their jobs if they had good-quality and safe charging infrastructure, with short waiting times, shaded spaces and waiting areas, and reliable technical information on how to use the chargers.[14] The study also revealed that the female delivery workers preferred the less-heavy two-wheeled vehicles to the heavier models, pointing to the gendered effects of vehicle design.[15]
- The Philippines' Department for Transport integrated universal design principles into projects such as the North-South Commuter Railway Extension, including by providing accessible facilities like multi-purpose toilets, diaper-changing facilities in all restrooms and tactile paths for the visually impaired.[16]

Involving academia and the private sector to provide the required knowledge and skills to women

Despite the notable gender gap in women's participation in the freight transport sector, the potential opportunities are tremendous. As of 2021, an estimated 2.6 million truck driver jobs remained unfilled across the Americas, Asia and Europe.[17] To support greater engagement, the UNESCAP



guidelines on empowering women in freight transport recommend integrated policies focused on industry-oriented education, higher education policy, and women's skills and entrepreneurship development.

- In Sri Lanka, the introduction of a suite of efforts – including the international logistics degree in 2007, the local logistics and transport degree in 2014, the education vertical integration strategy in 2017, and updates to school curricula – led to a more than 20-fold increase in demand for the Logistics and Supply Chain Management degree in the country between 2010 and 2019.[18]
- Logistics companies in China have created attractive work environments for women, with potential to climb the career ladder, through a combination of educational assistance, targeted recruitment programmes and motivational programmes on work-life balance.[19]
- In Japan, unconscious bias trainings are provided to minimise the impact of gender bias in the freight transport sector. Capacity building, including training women who return to the workforce after maternity leave, helps women develop and update their technical skills and improve their resource capacity.[20]

Private sector involvement is required to effectively eliminate gender pay gaps and wage discrimination, enable labour and social protections, and strengthen corporate policies for handling grievances.[21]

- In 2023, Azad Foundation partnered with the European logistics company Baton Transport, under the Trucking for Equality initiative, to create dignified employment opportunities for women drivers by providing competent salaries (on par with male drivers), accommodation and social security.[22] The company also invests in training women for work in the international job market; several women who received the training ranked among Baton's top drivers in 2023.[23]
- In India's two- and three-wheeler industry, private sector initiatives include improving women's access to vehicles through tailored financial products, driver training and support with employment.[24]

In the private sector, as well as in public-private partnerships, it is important to highlight the financial and economic benefits of gender equality, in addition to its normative and moral imperatives.[25] Gender-responsive financial reform should employ financial monitoring tools based on gender-disaggregated data and regular reporting to track progress on Gender Equality, Disability & Social Inclusion (GEDSI) targets.

- The Philippines' Department of Transportation (DOTr) links contractor payments to Gender Equality and Social Inclusion compliance, ensuring that contractors are financially motivated to meet gender goals.

To improve their effectiveness, policy efforts must first be informed by extensive stakeholder engagement and input, followed by the building of institutional capacity for gender mainstreaming, and clear accountability practices. Some good practices of this have been implemented in the passenger transport sector but can also be adopted for freight transport and logistics.

- In 2019, the International Transport Forum and the International Association of Public Transport (UITP) signed a joint agreement to strengthen women's employment in public transport by working with unions and employers in pilot cities. The organisations' "positive employer gender policy" identifies nine cross-cutting key elements for strong policies on women's employment and provides recommendations.[26]

Network and industry associations have played a pivotal role in promoting and attracting more women to seek employment in the freight and transport industry.

- The International Transport Workers' Federation has a specific working sector on "Women", which advocates for equal rights, representation and opportunities for women in the transport sector.[27] This includes work related to freight transport and logistics, such as warehousing, railways, road transport, seafarers, dockers, inland navigation and aviation.[28]

- The non-profit Women in Trucking Association aims to encourage women's employment in the trucking industry, promote their accomplishments and minimise the obstacles they face working in the industry. It hosts a careers centre that provides information on roles available across the sector, and also offers an online networking and career development tool that helps women in the sector find, connect and share experiences with others.[29]
- The Women in Logistics and Transport network, launched in 2013, boasts more than 2,000 members in 20 countries across Africa and Asia. The network seeks to promote the status of women in logistics and transport, to bring together those who support women's talent and career development, and to provide a support network and mentoring opportunities for women in the sector.[30]
- The Women's International Shipping & Trading Association (WISTA International) works globally to connect more than 3,800 female executives and decision makers from all sectors of the maritime industry. Its mission is to attract and support women, at the management level, in the maritime, trading and logistics sectors through: minimising the existing gender leadership gap; building a community by facilitating the exchange of contacts, information and experiences; promoting business relationships; facilitating professional development; and liaising with related institutions and organisations worldwide.[31]

Encouraging hybrid occupational models such as remote work and other innovations to motivate women to increase their participation

Encouraging hybrid occupational models such as remote work and other innovations can motivate women to increase their participation in the freight transport sector.

- India has the highest share of female pilots globally, which is attributed to progressive work policies such as flexible work contracts, maternity leave and provision of childcare facilities. Although these efforts are in the passenger sector, similar policies can be replicated in freight transport, and beyond aviation.[32]
- In Singapore and the Republic of Korea, employers have prioritised care centres and kindergartens at workplaces; proper leave systems and office protocols; and flexible work schedules that allow women to balance parenthood and work.[33]
- The Government of Singapore subsidises businesses for upgrading their virtual infrastructure to accommodate remote work.[34]

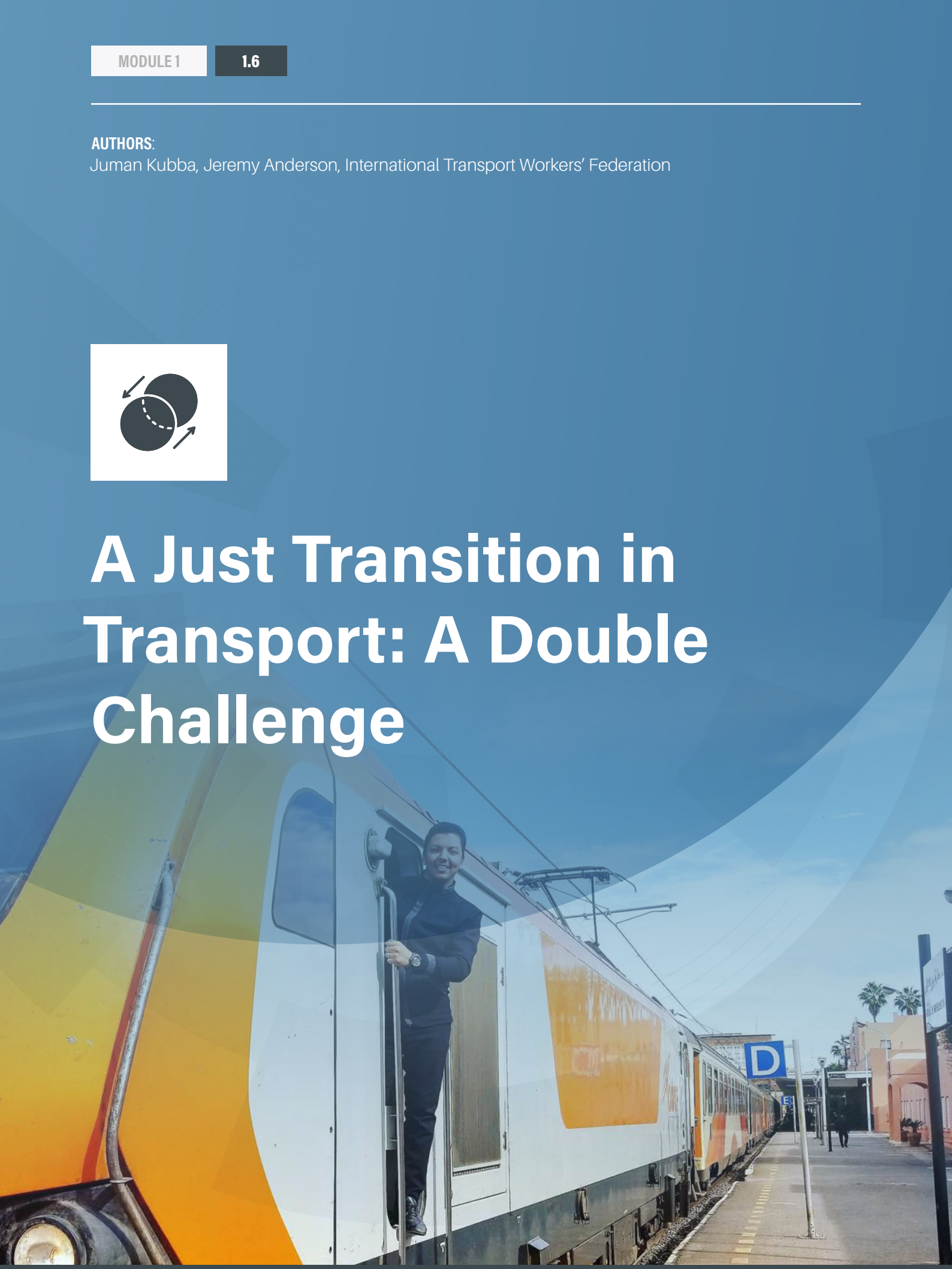


Partnerships in action

- The **NDC Transport Initiative for Asia** (**NDC-TIA**), supported by the International Climate Initiative (IKI) and implemented by several national and international partners, aims to facilitate a shift to zero-emission transport across Asia.[35] The programme supports partner countries China, India and Viet Nam to develop comprehensive decarbonisation strategies and solutions to implement them.[36] The second phase of the programme will have a focus on women in freight transport in Asia.[37]
- The **Women in Transport** (**WiT**) network, launched at Transport and Climate Change Week in 2021, connects women across Asia from different backgrounds to exchange their experiences of working in the transport sector. The network aims to increase the number of women working in the sector and hosts a mentorship programme to advance this objective.[38]
- The network **Supporting Women as Leaders and as Employees** is being established by the World Bank and its development partners – the Asian Development Bank, the European Investment Bank, the German Agency for International Cooperation (GIZ), and the International Transport Forum – to promote women's employment in transport. The network will initially be launched in the Europe and Central Asia region and the Middle East and North Africa region, then potentially expanded over time based on the initial lessons learned.

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A Just Transition in Transport: A Double Challenge



KEY FINDINGS


Kohi Marri

- Globally, the transport sector employed 193 million people in 2021. By specific subsectors, this included 9 million public transport workers (2023), 43 million truck drivers (2024), 11 million aviation workers (2018), 7 million rail workers (2023) and 1.9 million seafarers (2021).
- However, these figures vastly undercount the actual size of the transport workforce, as they do not account for the millions of workers employed in informal transport and platform-based transport services, nor the millions who are indirectly employed by the transport sector.
- Just transition, therefore, increasingly refers to a broad range of issues connected to rights and social justice in the climate transition, including those specific to the transport sector. While acknowledging the importance of all of these areas, the purpose of this chapter is to provide an in-depth exploration of the workforce aspect of just transition in transport.
- Achieving a just transition depends on securing the future and livelihoods of workers and their communities in the shift to a low-carbon economy.

Sustainability and climate trends

- Addressing the challenges that workers and communities face with respect to climate change mitigation and adaptation is crucial for action in the climate sector. However, attention to these issues is at an early stage and has been addressed unevenly within transport sub-sectors.

Cover photo: Ounousse Omar

KEY FINDINGS



Addressing mitigation challenges facing transport workers

- Given the lack of progress in decarbonising the transport sector, it is critical to understand the social as well as the technical challenges related to mitigating transport emissions.
- The availability of an appropriately skilled workforce – including through workforce development and reskilling – is a critical issue in the transport sector, particularly given the high numbers of workers that have left the industry since the COVID-19 pandemic.
- Workers' perspectives on the electrification of public transport highlight the importance of a holistic approach, as efforts to electrify transport systems could displace the existing workforce and reduce job security.
- Without appropriate engagement, planning, and management, efforts to formalise informal transport systems through "clean" initiatives such as bus rapid transit can backfire, adversely impacting livelihoods and increasing access costs to key routes, exacerbating social inequality.
- The use of digital and automation technologies to reduce emissions can lead to negative impacts on workers if these innovations are introduced without proper social dialogue and worker consultation.
- Overall, the structures of the transport industry need to be reviewed to ensure that they do not obstruct a just transition. The fragmentation and informalisation of both freight and passenger transport can be detrimental to the objectives of both decarbonisation and a just transition.



Adaptation and resilience: the worker dimension

- More-frequent extreme weather events – such as storms, floods and landslides – can have devastating consequences on transport infrastructure as well as on workers; impacts include physical and mental challenges, economic hardships, and health and safety concerns.
- Excessive heat alone results in an estimated 23 million occupational injuries and 19,000 deaths every year, with transport and tourism workers among the hardest hit. If measures were introduced to prevent heat-related occupational injuries, an estimated USD 361 billion could be saved globally; however, most countries do not have early warning systems for heat-related illnesses.
- These impacts are not evenly distributed. Informal workers, often already facing economic insecurity, are particularly exposed when climate disasters hit.
- Systemic inequalities and risks to particular groups can exacerbate harms. Women, young people and migrant workers tend to be disproportionately represented in informal and precarious transport work, leaving them more exposed to climate impacts.
- Despite growing recognition of the need to tackle the adaptation and resilience gap in transport infrastructure, greater emphasis is needed on the workforce dimension of these challenges.
- As technological and practical measures are put forward to ensure future-fit transport systems, social dialogue and consultation are critical to identifying and successfully implementing changes to infrastructure and services that protect working conditions and safeguard health and safety.
- There is an operational as well as justice rationale for the social dialogue approach. Transport workers – from airline pilots to rail maintenance workers, from truck drivers to bus station operators – see daily how climate change is affecting the movement of passengers and goods.

KEY FINDINGS



Policy and investment developments

- Measures must be in place to ensure that transport workers do not suffer due to climate mitigation and adaptation policies. Involving workers in the design and implementation of decarbonisation strategies is essential to achieving a just transition.
- Ensuring social dialogue with trade unions and informal workers' organisations is fundamental to all decarbonisation and adaptation measures.
- Including informal workers in policy development and implementation is critical to understanding how climate goals can be achieved while also supporting decent jobs, worker rights and community needs.
- Methodologies such as worker-led labour impact assessments can play a key role in gathering employment data and workers' insights and ensuring social dialogue.
- At the international policy level, the importance of just transition for workers was recognised in international law in 2015 through two significant commitments by the United Nations Framework Convention on Climate Change (UNFCCC) and the International Labour Organization (ILO).
- Of the 169 first- and 154 second-generation Nationally Determined Contributions submitted between 2016 and November 2023 towards reducing greenhouse gas emissions under the Paris Agreement, only 20% referred to a just transition in the transport sector, and only 15% included references to a just transition for workers.
- As of 1 August 2025, a total of 27 of the 29 third-generation NDCs submitted to the UNFCCC included some kind of commitment to a just transition for the workforce.
- In the maritime sector, there has been positive progress on a social dialogue approach to a just transition at both the international and national levels.
- To tackle the challenges related to low-cost tendering for transport services, several countries have introduced "Safe Rates" legislation that lead firms to take supply chain accountability.
- Through social dialogue, transport workforces can provide a source of critical input and political support for investment in low-emission transport modes, such as rail.
- In some cases, technology is being leveraged for positive social and environmental change, including through worker-centric design and environmentally safer technologies.
- Although there are examples of a just transition taking an institutional form, this is not yet widespread. These efforts must be expanded and applied more broadly.



Context, challenges and opportunities

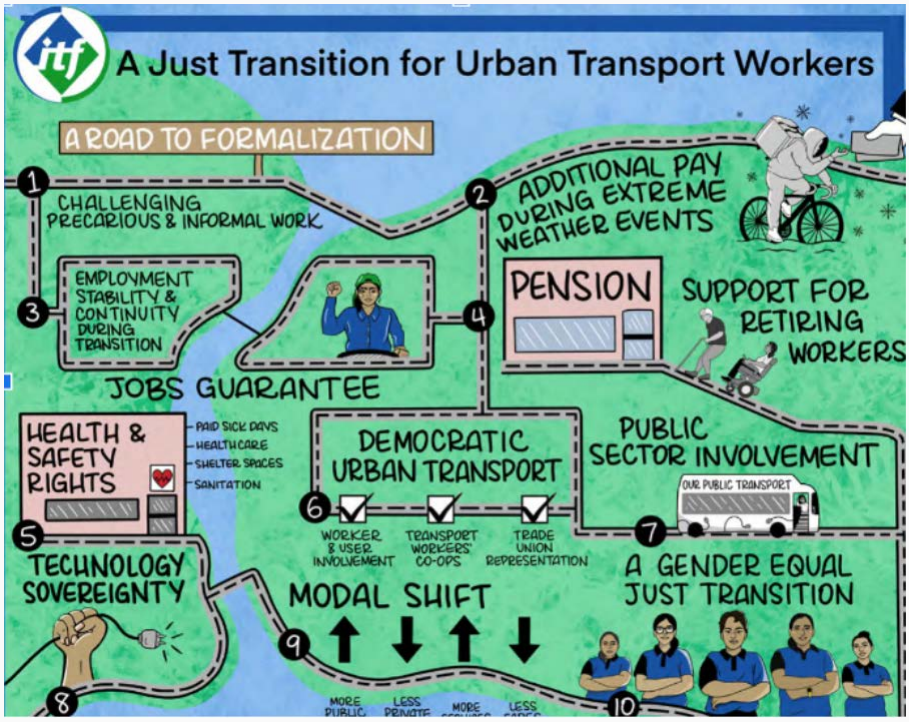
Wholesale transformation of transport is essential to decarbonise and adapt a sector that accounts for 21.9% of carbon dioxide (CO_2) emissions and is particularly exposed to new climate realities. The scale of change needed in the sector creates opportunities and risks for the workers on whom transport systems depend, and for communities around the world. Done well, climate action in transport could open the door to more decent jobs, improved health and safety, and better-connected communities. Done badly, sectoral transformation could undercut rights, cut and downgrade jobs and conditions, and exacerbate social inequalities. In climate policy, the concept of a "just transition" refers to integrating these critical social dimensions – affecting millions of workers – into climate action.

Globally, the transport sector employed 193 million people in 2021. By specific subsectors, this included 9 million public transport workers (2023), 43 million truck drivers (2024), 11 million aviation workers (2018), 7 million rail workers (2023) and 1.9 million seafarers (2021).[1] **However, these figures vastly undercount the actual size of the transport workforce, as they do not account for the millions of workers employed in informal transport and platform-based transport services, nor the millions who are indirectly employed by the transport sector.** This includes workers in train station and airport businesses (both formal and informal) as well as those servicing the sector or who are part of wider supply chains.

Achieving a just transition depends on securing the future and livelihoods of workers and their communities in the shift to a low-carbon economy (Figure 1)**.**[2] This includes the co-creation of just transition plans, underpinned by rights of freedom of association and collective bargaining and facilitated through social dialogue with workers and their unions. It involves consultation with wider communities, including over issues such as access to mobility and priorities for public subsidies. In addition, it requires financial flows in alignment with these objectives; guarantees for intra- and intergenerational equity, gender equity and racial justice; respect for the rights of Indigenous peoples, impacted communities and migrants; and the protection and promotion of human rights and fundamental labour rights.

Just transition, therefore, increasingly refers to a broad range of issues connected to rights and social justice in the climate transition, including those specific to the transport

FIGURE 1. Just transition for urban transport



Joint action on mitigation and adaptation is critical for urban transport (and all transport modes).
Art credit Elizabeth Niarhos @lizar_tistr for ITF.

sector. While acknowledging the importance of all of these areas, the purpose of this chapter is the provide an in-depth exploration of the workforce aspect of just transition in transport.

For transport workers, the just transition is a "double challenge". On the one hand, climate change mitigation measures – such as modal shift, electrification and automation technologies – could, depending on how they are managed, support positive social outcomes, such as good, green jobs and greater accessibility; yet they could also create risks to human and labour rights, jobs, working conditions, and health and safety. On the other hand, in the area of climate adaptation and resilience, as transport systems are adapted to changing weather and extreme weather events, these efforts could prioritise the health, safety, and livelihoods of workers and communities – or these constituencies could be sidelined, exacerbating harms.

Across the transport sector, there are positive examples of how a just transition can be developed and implemented based on the principles of decent work and labour rights; equity for women and young workers; and social dialogue across workers' organisations, employers and governments. Examples range from workplace bargaining over adaptation and mitigation issues, to sector-wide bodies for social dialogue, to national and international policy commitments, including those in Nationally Determined Contributions (NDCs).

Transport industry stakeholders need to build on these positive examples to implement a just transition for workers and communities much more systematically across the transport sector. Just transition principles also need to be applied in key sectors with which transport has interdependent relationships. For example, the shift to electric vehicle production, coupled with a greater focus on manufacturing vehicles for public transport, will require robust just transition plans to ensure that the burdens resulting from these changes are not placed on auto manufacturing workers.

Tackling the double challenge requires concrete initiatives in specific transport sectors. Effective measures necessitate high levels of social dialogue among employers, governments, and workers' organisations (in both the formal and informal sectors), as well as wider consultation. Social dialogue is the foundation for everything from collective bargaining provisions over managing workplace heat stress, to sector-level bodies that agree on long-term workforce development plans.

Sustainability and climate trends

Addressing the challenges that workers and communities face with respect to climate change mitigation and adaptation is crucial for action in the climate sector. However, attention to these issues is at an early stage and has been addressed unevenly within transport sub-sectors. Failure to address concerns related to a just transition will both delay climate action and lead to unjust outcomes and a potential backlash.

Addressing mitigation challenges facing transport workers

Given the lack of progress in decarbonising the transport sector, it is critical to understand the social as well as the technical challenges related to mitigating transport emissions. In 2023, the sector was responsible for 21.9% of carbon dioxide (CO_2) emissions, driven by a staggering 95.4% reliance on fossil fuels. Transport is now the second-largest and fastes- growing contributor to global greenhouse gas emissions.[3] For decarbonisation to be successful, key social aspects to address include commitments to workforce development and redeployment, consultations around the introduction of new technologies, and reforms to ensure that supply chain structures do not overly burden the most vulnerable workers.

The availability of an appropriately skilled workforce – including through workforce development and reskilling – is a critical issue in the transport sector, particularly given the high numbers of workers that have left the industry since the COVID-19 pandemic.[4] For land transport, decarbonisation policies may lead to job losses, as the shifts to electric vehicles and trucks could de-skill occupations such as mechanics. In maritime shipping, decarbonisation depends on the availability of a reskilled seafaring workforce that can crew low-carbon vessels.

"*There are a lot of highly skilled jobs ... and all of those workers are going to have to be retrained. And as you know, we need to ensure that they're guaranteed employment in future ... so they've got a similar job at a similar level... You can't ask mechanics [doing] highly skilled jobs today to do low skilled jobs in the future. They need to be provided with appropriate training so they are able to carry out similar maintenance tasks on electric vehicles.*" —Angelo Piccirillo, General Secretary, FILT CGIL Milan, Italy

Workers' perspectives on the electrification of public transport highlight the importance of a holistic approach, as efforts to electrify transport systems could displace the existing workforce and reduce job security. For example, bus electrification programmes that displace the existing workforce can create political resistance to mitigation policies. Social dialogue processes that include the views of public transport workers on modal shift and electrification therefore have an important role to play. They can help shape actions such as vocational training for electric mobility so that they support existing workers to move into new roles, and also support women and young workers to access new roles. For less-developed public transport systems, efforts to expand the modal share of these systems may be equally or more effective in reducing emissions than a push to electrify these systems – while ensuring better job security and higher service levels for passengers.

"*We need to improve public transport not just by bringing electric buses. We also need more buses on the roads, running more frequently and getting private cars off the street.*" —*App-based worker, Hyderabad, India*

Without appropriate engagement, planning, and management, efforts to formalise informal transport systems through "clean" initiatives such as bus rapid transit can backfire, adversely impacting livelihoods and increasing access costs to key routes, exacerbating social inequality. In many regions, informal transport workers – such as two- and three-wheeler operators, informal bus and minibus drivers, mechanics and vendors, and informal logistics workers – play a vital role in keeping communities moving. However, many locations where such initiatives are effective are not at a stage where formal systems can accommodate the full scale of transport needs.

The use of digital and automation technologies to reduce emissions can lead to negative impacts on workers if these innovations are introduced without proper social dialogue and worker consultation.

- In road freight, the strong focus on emission-reducing technologies – such as "eco-driving" systems – rather than electrification can place additional burdens on workers through increased stress, fatigue and punitive financial measures.
- In the shipping sector, a port automation programme in Auckland (New Zealand) that promised environmental and economic gains was imposed without adequate consultation; problems with the new equipment put workers' lives in jeopardy and ended up costing the economy more than USD 0.67 billion (NZD 1.2 billion) due to supply chain disruptions.[5]

Overall, the structures of the transport industry need to be reviewed to ensure that they do not obstruct a just transition. The fragmentation and informalisation of both freight and passenger transport can be detrimental to the objectives of both decarbonisation and a just transition. In

road freight, widespread sub-contracting based on ultra-low-cost tendering has led to high numbers of poorly capitalised owner-drivers with little choice but to use old, higher-emitting vehicles, take on inefficient loads and endure long waiting times (when vehicles are idling). This both increases emissions and increases safety risks for drivers forced to work long hours.

Adaptation and resilience: the worker dimension

Historically, the importance of climate change adaptation and resilience measures that protect workers has not been strongly associated with a just transition in the transport sector. However, as the severity of climate impacts increases, the need to address impacts on workers is becoming more apparent.

More-frequent extreme weather events – such as storms, floods and landslides – can have devastating consequences on transport infrastructure as well as on workers; impacts include physical and mental challenges, economic hardships, and health and safety concerns. Climate-related events also affect other sectors, as transport provides critical logistic links especially for food and health.

- Transport workers may suffer a physical and mental toll from their direct role in emergency relief, including delivering aid and/or evacuating affected populations.
- Operational disruptions can lead to economic hardship in both the short and long term, as modern supply chain management techniques shift much of the risk for disruptions onto workers themselves. Seafarers may endure longer periods at sea due to port disruptions, and road and rail workers (especially informal workers) may experience income loss.
- Rising sea levels threaten the livelihoods of dock workers and coastal communities, and wildfires and dust storms can endanger the health and safety of transport workers, particularly those outdoors at airports and at sea. Aviation workers' safety is increasingly at risk from more frequent turbulence (Box 1).[6]


Kohi Marri

Box 1. A just transition for aviation: worker insights into adaptation and resilience

Although climate action in the aviation sector typically focuses on reducing greenhouse gas emissions, the changes induced by climate change are also affecting the safety, well-being and job security of aviation workers. Interviews conducted with flight attendants in the United States, ground and terminal crews in South Africa, and air traffic controllers in Thailand provide insights into these growing challenges, and the action needed on adaptation and resilience in aviation.

Changing temperatures and conditions, as well as extreme weather events, are affecting the conditions facing aviation workers. Key climate impacts identified from worker interviews include:

- *Turbulence-related injuries*: Cabin crews report more frequent severe turbulence, causing falls, burns, and musculoskeletal injuries, as well as greater emotional stress from managing frightened passengers.
- *Too hot, too cold*: More-frequent and extreme hot and cold temperatures can cause heat stress, cold stress, life-threatening conditions, hypothermia and extreme fatigue. Ground crews can be particularly exposed, and terminal workers and cabin crew face impacts when infrastructure, systems and uniforms are not fit for new extremes. Temperature impacts on customers can cause additional safety issues.
- *Extreme weather exposure*: Workers face greater risks from wildfires, storms, lightning, and flooding, affecting working conditions and leading to injuries and operational shutdowns. Impacts on terminals and runways also increase workloads for ground and maintenance staff.
- *Air traffic management strain*: Controllers struggle with sudden weather shifts that make routing unpredictable, increasing workload intensity and stress. Poor visibility from wildfires and storms further complicates operations.
- *Job insecurity*: More-frequent flight cancellations and delays affect working hours and lead to unstable incomes and increased pressure on workers, especially those in outsourced or contract roles.



"The most important thing is standard setting. What we have been trying to do is set a standard for temperature in the cabin and make sure the equipment to cool the airplane is available at all airports. The airlines don't really seem to care.... So there need to be standards in place for the temperature on the plane and [for] the equipment." – US flight attendant

Source: See endnote 6 for this section.

Excessive heat alone results in an estimated 23 million occupational injuries and 19,000 deaths every year, with transport and tourism workers among the hardest hit.[7] **If measures were introduced to prevent heat-related occupational injuries, an estimated USD 361 billion could be saved globally; however, most countries do not have early warning systems for heat-related illnesses.**[8]

- Workers in public transport and road transport often deal with extreme heat without adequate ventilation, rest breaks or access to reliable shelters or water – leading to heat-related illnesses such as heatstroke and increasing fatigue [9]
- Rail systems can be severely affected by extreme heat: in France and Germany, heat waves in 2023 and 2024 led to infrastructure impacts such as rail breaks and buckling, signalling failures, and embankment fires – compromising worker safety and mental and physical health.[10]
- Changing temperatures can combine with other hazards such as air pollution, ultraviolet radiation, and vector-borne diseases, magnifying the impacts and increasing the risks of conditions such as respiratory and cardiovascular disease and cancer.[11]

These impacts are not evenly distributed. Informal workers, often already facing economic insecurity, are particularly exposed when climate disasters hit. In Pakistan, the devastating impacts of floods led informal workers at rail stations to lose their livelihoods overnight, with no social protections to provide a safety net.[12] Rail was identified as the hardest-hit sector due to past under-investment, reflecting the social and economic costs of a failure to invest in a future-fit transport system.

Systemic inequalities and risks to particular groups can exacerbate harms. Women, young people and migrant workers tend to be disproportionately represented in informal and precarious transport work, leaving them more exposed to climate impacts such as heat waves or cold snaps, and to livelihood impacts when natural disasters hit. Additional concerns arise for women transport workers and users around safety during climate-related disruptions.

Despite growing recognition of the need to tackle the adaptation and resilience gap in transport infrastructure, greater emphasis is needed on the workforce dimension of these challenges. As technological and practical measures are put forward to ensure future-fit transport systems, social dialogue and consultation are critical to identifying and successfully implementing changes to infrastructure and services that protect working conditions and safeguard health and safety. Applying a social dialogue-based approach to adaptation and resilience includes adopting measures ranging from early warning systems, to plans for dealing with changing temperatures and extreme weather events, to schedules, facilities and remuneration that facilitate appropriate rest, recovery and protection. It also includes scaling up social protections so that the most vulnerable populations can access health and income support when impacted by extreme weather.

"Transport workers have not been involved in city planning. Our needs in the context of climate change are not adequately provided for or give any consideration. [Around] bus terminals, there are no structures which can protect us adequately from heavy rain and extreme heat."

–Informal transport worker, Kenya

There is an operational as well as a justice rationale for the social dialogue approach. Transport workers – from airline pilots to rail maintenance workers, from truck drivers to bus station operators – see daily how climate change is affecting the movement of passengers and goods. They have unique perspectives on the vulnerabilities of transport systems and how to protect their workers, infrastructure and services. It is vital that their insights inform planning and investment, along with wider inputs from transport users and impacted communities.

Policy and investment developments

Measures must be in place to ensure that transport workers do not suffer due to climate mitigation and adaptation policies. Involving workers in the design and implementation of decarbonisation strategies is essential to achieving a just transition.

Ensuring social dialogue with trade unions and informal workers' organisations is fundamental to all decarbonisation and adaptation measures. Transport trade unions in all sectors and regions have an active voice on climate action. Employers and governments must recognise the critical role of workers' organisations as consultative partners and engage with them on all climate plans. High levels of unionisation in the transport sector provide a critical foundation for social dialogue and a just transition going forward.

- In urban transport, union membership stands at around 60% globally.[13]
- The International Transport Workers' Federation comprises 700 trade unions representing 16.5 million workers in 150 countries; this includes many informal workers' organisations across the Global South.[14]

- Levels of unionisation are highest in the aviation, ports, public transport, rail and shipping sectors.[15] Many of these unions are actively involved in advocating and implementing the just transition in transport across their sectors.

Including informal workers in policy development and implementation is critical to understanding how climate goals can be achieved while also supporting decent jobs, worker rights and community needs. There is increasing recognition that informal systems will continue to operate alongside or within other transport modes, including the increasingly significant platform-based transport services. It is crucial that climate policy development and implementation address on-the-ground realities. This means bringing in informal and platform workers to understand how climate goals can be achieved across the board, while simultaneously supporting decent jobs and worker rights, and serving community needs.

Methodologies such as worker-led labour impact assessments can play a key role in gathering employment data and workers' insights and ensuring social dialogue (Box 2).[16] Centring the voices of workers, particularly more marginalised workers, in decarbonisation planning is key to designing inclusive and equitable policies that recognise the vital role of transport workers, safeguard livelihoods, improve working conditions and secure public backing.

Box 2. Bringing worker voices into decarbonisation planning: insights from worker-led pilots

The International Transport Forum and the Global Labour Institute have developed a labour impact assessment (LIA) methodology that shows how the voices of workers who are too often marginalised can instead inform climate action. This LIA model enables direct engagement with informal transport workers – such as drivers, conductors and other occupational groups – to understand the challenges they face and what this means for approaches to decarbonisation in urban areas dominated by informal transport.

This approach has been used in five cities – Abidjan (Côte d'Ivoire), Accra (Ghana), Dakar (Senegal), Kampala (Uganda) and Nairobi (Kenya) – to gather informal workers' concerns and proposals for decarbonisation of urban transport. Results included feedback in the following areas:

- **Job losses and livelihoods** – fears that the introduction of low-carbon technologies, such as electric vehicles or bus rapid transit systems, could displace workers without providing alternative employment opportunities. Many rely on informal transport as their primary source of income and lack access to social safety nets.
- **High costs of transition** – financial barriers to adopting new technologies, such as the high upfront costs of electric vehicles and the lack of access to affordable financing. Without support, informal workers risk being excluded from the green transition.
- **Lack of inclusion in planning** – frustration over informal workers being excluded from decision-making processes. Decarbonisation policies often fail to recognise their knowledge and consider their needs, such as the importance of providing access to facilities, and the role of informal networks in providing affordable transport services.
- **Skills gaps** – fears that new vehicles will require less maintenance and reduce the demand for the services of workers such as mechanics, or require new skills and tools that are not available to them. This underlines the need for retraining programmes and support to achieve a just transition.
- **Health and safety risks** – operating in unsafe conditions, with high levels of air pollution, hot and cold temperatures, storms and other weather events, and road accidents. These issues are exacerbated by old and poorly maintained vehicles and terminals with little shelter from the elements. Although decarbonisation could

address such issues (by improving air quality and providing protection from changing weather), new technologies might introduce risks, such as inadequate training for operating electric vehicles or poor maintenance of charging infrastructure.

- **Gender inequality** – additional challenges facing women who are disproportionately concentrated in informal transport, including harassment, discrimination and barriers to good-quality employment. While a growing number of women are working as, for example, bus drivers and conductors, the majority work informally in and around major transport hubs in roles such as vendors, where they are particularly vulnerable to climate harms and safety risks. Lack of adequate sanitation is a particular concern. Women do not have social protections such as maternity pay and often cannot access training opportunities. Yet they provide valuable services, and their needs must be explicitly considered achieving a just transition.

"The arrival of this new transport system will destroy our business. Where will we go? Who will pay for our children's schooling? These are our worries because we are single mothers who fight every day to ensure the survival of our children." —Women workers focus group, Abidjan

The assessments process served not only to gather insights from informal workers, but also to help inform them of decarbonisation plans so that they could engage more effectively. Key areas to be addressed include identifying and implementing alternatives to the targeted system, training programmes, practical improvements to working conditions in transport workplaces, access to affordable capital for electrification and social protection programmes. Centring worker voices in decarbonisation is key to designing inclusive and equitable policies that safeguard livelihoods, improve working conditions, and secure public backing.

Source: See endnote 16 for this section.



Kohi Marri

At the international policy level, the importance of just transition for workers was recognised in international law in 2015 through two significant commitments by the United Nations Framework Convention on Climate Change (UNFCCC) and the International Labour Organization (ILO) (Box 3).[17]

Box 3. Just transition in international policy

In 2015, both the United Nations Framework Convention on Climate Change (UNFCCC) and the International Labour Organization (ILO) recognised the importance of a just transition for workers.

The preamble of the UNFCCC's 2015 Paris Agreement contains a commitment to a "just transition of the workforce", a recognition that equity for workers is foundational to achieving the Agreement's goals. The UNFCCC later established a work programme on just transition at the 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28), encompassing the just transition of the workforce and the creation of decent work and quality jobs, including through social dialogue, social protection and the recognition of labour rights. Since then, the just transition concept has been integrated across other policy fields. The climate finance goal that emerged from COP 29 in Baku, Azerbaijan recognises the importance of supporting "just transitions in all sectors and thematic areas".

Also in 2015, the ILO published Guidelines for a just transition towards environmentally sustainable economies and societies for all. These were later reaffirmed by governments, employers and unions in a 2023 ILO resolution as "the central reference for policymaking and a basis for action" regarding just transition. The same resolution states that a just transition should be based on effective social dialogue, including collective bargaining, and requires public and private financial flows to align with just transition objectives. It also requires consultation with affected communities, the establishment of a dialogue mechanism for Indigenous and tribal peoples, and gender responsive and inclusive just transition measures.

These commitments to a just transition for the workforce are an important pillar for implementing the UN's Sustainable Development Goals (SDGs), notably SDG 8 to "Promote sustained, and sustainable economic growth, full and productive employment, and decent work for all". Of particular relevance are SDG 8.5 on full employment and decent work for all women and men, as well as young persons and persons with disabilities based on equal pay; and SDG 8.8 on protecting labour rights and safe and secure working environments for all workers.

Source: See endnote 17 for this section.

Of the 169 first- and 154 second-generation Nationally Determined Contributions (NDCs) submitted between 2016 and November 2023 towards reducing greenhouse gas emissions under the Paris Agreement, only 20% referred to a just transition in the transport sector, and only 15% included references to a just transition for workers.[18] NDCs are a key barometer of commitments that countries are making on the just transition generally, and for the transport sector specifically.

As of 1 August 2025, a total of 27 of the 29 third-generation NDCs submitted to the UNFCCC included some kind of commitment to a just transition for the workforce.[19] All governments are due to submit third-generation NDCs (or NDCs 3.0) by November 2025.

- Brazil's third-generation NDC includes just transition as a "transversal strategy", with commitments to reducing inequalities and protecting workers.[20]
- Nepal's new NDC includes important commitments for a just transition for workers generally, including a commitment to upholding workers' rights and job security, social dialogue, and Green Jobs and Green Skill development programmes. Nepal's NDC also commits to Just Transition Impact Assessments for all sectors, including transport.[21]
- The United Kingdom's third-generation NDC highlights that a just transition is central to the national approach and notes that green and clean jobs sourcing new skills and technologies will be created through support from two entities: the Office for Clean Energy Jobs and Skills England.[22]

In the maritime sector, there has been positive progress on a social dialogue approach to a just transition at both the international and national levels. Measures such as worker-centred design and specialised training can help address the health and safety risks that alternative fuels such as ammonia and hydrogen (used to curb shipping emissions) pose to seafarers.[23]

- The Maritime Just Transition Task Force, established in 2021, was the first global body to address the just transition at an industry level, and brings together UN bodies, employers and trade unions to discuss policy and advocacy issues.[24] The Task Force has partnered with training institutions and maritime academies on a new global training curriculum, and proposed that part of the revenue from the new carbon tax on maritime shipping be dedicated to seafarer retraining.[25]
- In Brazil, the seafarers' union Sindmar has negotiated maritime just transition clauses into collective bargaining agreements with major employers. These explicitly recognise the need to integrate maritime workers into the



"Our union, AMOSUP, has been working tirelessly to make sure that Filipino seafarers are ... co-creators of climate solutions. As a union comprising thousands of seafarers, we have initiated a Just Transition Roadmap, from benchmarking of the skills gap of our members to the creation of capacity-building to close those gaps." —Mao Tze Bayotas, AMOSUP, Philippines

Source : Mao Tze Bayotas, AMOSUP Speech at COP28 in Dubai https://www.facebook.com/amosupscofficial/videos/318651824398929

shift to a green and sustainable economy, and require union engagement in transition plans and the adoption of initiatives to achieve a just transition, ensuring that no worker is left behind.[26]

- In the Philippines, unions have developed just transition roadmaps, which can inform social dialogue and lay the foundation to agree on collective approaches.[27]

To tackle the challenges related to low-cost tendering for transport services, several countries have introduced "Safe Rates" legislation that lead firms to take supply chain accountability. Such measures can be modified to also encompass environmental responsibility.

Through social dialogue, transport workforces can provide a source of critical input and political support for investment in low-emission transport modes, such as rail. As awareness rises of the benefits of a modal shift in freight and passenger transport to rail, efforts can be made to engage worker knowledge and experiences to shape planning and investment. This can help ensure that initiatives identify changing skills needs and bring in appropriate training to achieve systems that are reliable and that serve community and business needs.

"What is critical [is] is to upgrade the infrastructure ... It's the infrastructure, the quality of services. Trains must be introduced [that can] handle the climate conditions we are experiencing. And the technology has to be able to detect the climate conditions." —Andrew Dlamini, train driver, Durban, South Africa

"There are concerns about funding and investment.... The rail is well over 175 years old and we still drive on old tracks. The funds are not enough in the long run ... we also have the biggest flood disaster of the post-war period in Germany ... we need a financial ramp-up for local public transport and for railways." — Martin Burkert, Deputy Chairman, EVG, Germany

In some cases, technology is being leveraged for positive social and environmental change, including through worker-centric design and environmentally safer technologies.

- The Technology and Decent Work Charter of the International Transport Workers' Federation sets out conditions for the constructive introduction of technology, such as the right to negotiate over worker-centric co-design.[28]
- In Chile, the federation of subway workers' unions, FESIMETRO, negotiated a just transition clause into its collective bargaining agreement, creating a Just Transition Consultative Committee of employers and workers to be consulted on every major introduction of new technologies and production processes; they recently won a reduction in working hours at no loss of pay, which benefits more than 4,000 metro workers including 1,000 women.[29]

Although there are examples of a just transition taking an institutional form, this is not yet widespread. These efforts must be expanded and applied more broadly. This can be done through:

- Just transition clauses in collective bargaining agreements on issues such as heat stress protocols and protections around the introduction of emission-reducing technologies.
- Labour impact assessments when initiatives are being introduced that will impact larger labour markets, using appropriate methodologies to bring in informal worker insights.[30]
- Sector-level just transition task forces at the national and global levels that bring together key government and international agencies, employers and trade unions with a focus on implementing projects such as workforce development plans.
- Legislation that ensures that supply chains include both human rights and environmental due-diligence.
- Sustainable transport master plans at the national level – and parallel sub-national approaches, such as Sustainable Urban Mobility Plans (SUMPs) – that ensure a whole-of-transport approach to decarbonisation and resilience planning. Such plans should be developed through social dialogue and stakeholder consultations and include key provisions on the just transition for transport workers, including workforce development plans, adaptation and resilience measures that protect the workforce, and an overall commitment to upholding labour rights and promoting decent work. They should be part of broader measures to provide communities with the accessible, reliable and affordable transport they need.
- Inclusion of key just transition provisions for the transport workforce in NDCs and in implementation plans and strategies under NDCs. The third generation of NDCs and the approach taken to their implementation is crucial to setting the right foundation for a just transition in transport.

Partnerships in action

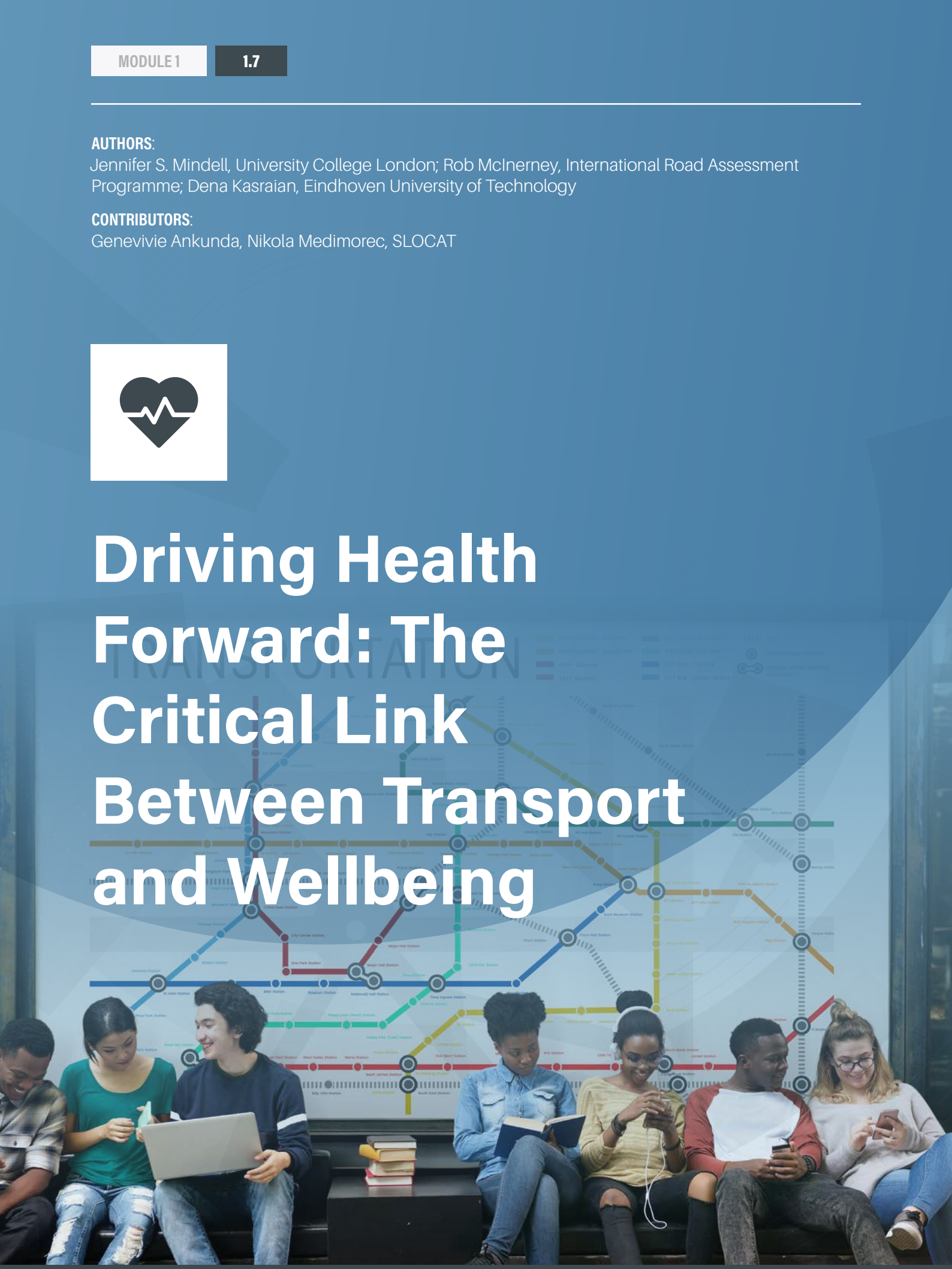
The **Maritime Just Transition Task Force** was established in 2021 by the International Transport Workers' Federation, the International Chamber of Shipping, and three UN bodies: the UN Global Compact, the ILO and the IMO. The Task Force advocates for key initiatives necessary for the just transition for seafarers, such as developing a new global training curriculum for zero- and low-emission vessels, and has proposed that part of the revenue from the new carbon tax on maritime shipping be dedicated to seafarer retraining.[31]

The **International Association of Public Transport (UITP) and the International Transport Workers' Federation** have partnered to carry out the first global review of the public transport workforce in over a decade. The collaboration provides a picture of the numbers, composition, and trends in the workforce, providing a foundation to understand how climate action is affecting the sector and whether and how a just transition is working in practice.[32]

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Driving Health Forward: The Critical Link Between Transport and Wellbeing



KEY FINDINGS



- Transport impacts people's mental and physical health both positively and negatively, and in direct and indirect ways. However, these health impacts tend to be distributed inequitably across populations, regions and transport modes.
- In conventional (i.e., car-dominated) transport systems, the harmful impacts on health and equity tend to outweigh the potential benefits. These impacts affect wellbeing directly (through road crashes and air and noise pollution) and indirectly (through poorer physical and mental health).
- The human and financial costs of fossil fuel-based transport, in terms of poor physical and mental health and wellbeing, are unsustainable.
- The most severe health-related impacts of transport are road crashes and air pollution.
- People with disabilities – including physical (e.g., problems walking), sensory (vision and hearing) and cognitive (long-term learning difficulties or recent cognitive decline) – often face major limitations and difficulties when travelling.
- Health framing is critical for justifying interventions and gaining public and political support, yet it remains insufficiently applied in transport policy.
- Advancing the integration of health into urban and transport planning requires institutional reforms that foster inter-sectoral collaboration, build cross-sectoral alliances, and facilitate stronger engagement between health professionals and the political sphere.



Benefits of transport for health

- The main purpose of transport is to provide access to potentially beneficial services and destinations and to socio-economic opportunities that generally improve wellbeing.
- Being able to travel outside the home is important in preventing social isolation, which can increase mortality by 29%.
- Public transport provides access to the benefits of travel without personal car use. It enables access to opportunities to many people that cannot walk or cycle, particularly if they are carrying goods. However, just 52% of the urban population globally had convenient access to public transport in 2022.
- Access to travel options is much more restricted in low- and middle-income countries and for some user groups, such as people with disabilities.
- Transit-oriented development approaches, as well as compact mixed-used cities, use proximity planning to improve access to healthcare services, encourage walking and cycling, and mitigate the negative health impacts of vehicle emissions.

KEY FINDINGS

- Travel brings opportunities for physical activity, whether during the entire journey (as with walking or cycling) or as part of a journey (such as travel to and from public or collective transport).
- Evidence suggests that active travel can provide the same health and wellbeing benefits as formal sports or exercise, contributing to healthier lifestyles by becoming part of daily life.
- People who commute by active travel modes have been found to have better subjective wellbeing than those who commute by car.
- Travel to and from public transport supports physical activity and can provide benefits to health and wellbeing.
- Attractive environments provide considerable benefits for mental wellbeing, whether people are travelling through them on their journey or have them as the intended destination.



Harms to health provoked by transport

- Traffic noise caused by vehicles with internal combustion engines is a widespread problem across all regions, although data from low- and middle-income countries are limited.
- Noise from roads, trains, and airplanes disrupts wellbeing in several ways, including by directly causing annoyance and disturbance that is associated with poorer mental wellbeing.
- In 2023, transport contributed 15.9% of global greenhouse gas emissions and 21.9% of carbon dioxide (CO_2) emissions. It was the second largest sector for greenhouse gas emissions after the power industry, and the second fastest-growing sector for emissions between 2015 and 2023.
- Road transport contributed three-quarters (74%) of transport greenhouse gas emissions in 2023.
- Due to record-high temperatures, 2024 was the first year that the average annual global temperature likely surpassed the international target of limiting global warming to 1.5 degrees Celsius.
- Between 1990 and 2023, heat-related mortality for people older than 65 years increased 167%.
- Transport infrastructure, as well as the speed and/or volume of traffic, can limit people's ability to cross a road, reducing access to goods, services, and people and resulting in community severance.
- Road building and traffic can create physical barriers to walking and cycling, weaken social networks that are essential for good health and wellbeing, and affect the wellbeing of people with pre-existing chronic diseases.
- Many aspects of travel itself – as well as a lack of affordable, accessible, safe and reliable transport options – cause stress and anxiety that can greatly impair wellbeing, potentially leading to journeys not made and to social isolation.
- Poor people, particularly women, in low- and middle-income countries may have a two-hour walk or more each way to and from work, as public transport may be unaffordable or non-existent.
- Congestion is an often-cited adverse impact of travel on wellbeing, particularly for people sitting in motor vehicles that are moving slowly, if at all. Traffic delays have been found to reduce productivity; increase stress, anger and mental workload; and exacerbate obesity due to prolonged physical inactivity.
- Congestion adds to local air pollution and vehicle emissions, while also causing negative health impacts on people living, walking or cycling nearby.
- There is good evidence that building new roads and widening existing roads does not provide a long-term solution to congestion, as these interventions generate traffic and induce demand.
- Ambient air pollution increases the risk of cardiovascular and respiratory diseases and was responsible for 8.1 million premature deaths in 2021 (61% of them linked to fossil fuel combustion).
- Transport accounted for 6% of air pollution in 2019, linking it to 500,000 air pollution-related premature deaths.
- Air pollution was the second leading cause of death for children under five years in 2021.
- Road freight traffic produces large amounts of air pollution, with strong age-related inequities based on exposure levels. Air travel is also a major contributor to air pollution.
- Concentrations of particulate matter and nitrogen oxides (NOx) tend to mirror the traffic volumes along road networks in cities.

KEY FINDINGS



- Air quality is generally worse in cities in low- and middle-income countries.
- Cyclists potentially inhale higher doses of pollutants, as they breathe more rapidly and deeply; however, studies have found that even in highly polluted environments, the benefits of physical activity outweigh the increased exposure to air pollution, except on the worst-affected days.
- Road runoff is an additional source of travel-related contamination, as heavy metals and other pollutants from vehicles make their way from the road into the environment.
- In cities, the replacement of greenery with pavement has increased the urban heat island effect, contributing to reduced wellbeing and increased mortality, especially during heatwaves.
- The use of streets for parking can impact wellbeing by impairing visual amenities and restricting lines of sight, increasing people's risks when crossing roads.
- Escalating heat exposure poses a major threat to maternal and neonatal health.
- Time spent being sedentary, such as when travelling by private motor vehicle, reduces time spent being physically active. In 2022, one in eight people worldwide were living with obesity – including 890 million adults and 160 million children and young people – and even more were living with overweight.
- Longitudinal studies have shown that people who shift their commuting mode from cars to active travel (walking and/or cycling) lose weight, whereas those who change from active travel to car commuting gain weight.
- Road traffic crashes killed 1.19 million people in 2021, with large disparities by region. The highest per capita road fatalities by region were in Africa (18.8 fatalities per 100,000 people, above the global average of 15 deaths per 100,000 people), although small island developing states as a sub-group had 21 fatalities per 100,000 people.
- As of 2021, low- and middle-income countries were home to 60% of the world's motor vehicles but suffered around 90% of road traffic fatalities.
- More than half of road deaths globally in 2021 occurred among "vulnerable" road users, comprising motorcycle riders (32%), pedestrians (20%) and cyclists (5%).
- Pedestrians accounted for 32% of reported road fatalities in low-income countries in 2021.
- Globally, road traffic injuries were the leading cause of death for children and young adults aged 5-29 years as of 2021.
- Exposure on roads is greater in low- and middle-income countries because many pedestrians have no other existing or affordable transport options and must walk long distances and/or at night, when poor lighting often increases the hazard.
- In addition to fatal crash outcomes, an estimated 50 million people annually suffered life-changing injuries on the world's roads as of 2021.
- Death and injury on the world's roads led to estimated annual costs of USD 3.6 trillion in 2021, or the equivalent of 3.7% of global gross domestic product (GDP). In low- and middle-income countries, the cost of road crashes approached 5% of GDP.

KEY FINDINGS

- In these countries and in rural areas, the consequences of a road crash are often exacerbated by limited access to roadside care, including a lack of emergency services and vehicles to transport injured people.
- The main factors contributing to road crashes are a lack of access to safe public transport, inadequate speed management, poor infrastructure, lack of relevant legislation, and poor road user behaviour, according to the WHO.



Policy and investment developments

- Health considerations remain inadequately embedded in upstream urban and transport policy processes, despite a robust and growing body of empirical evidence and initiatives.
- Detailed targets and key performance indicators for several health pathways (such as access, activity and attractive environments) are often lacking, as are clear health rationales and anticipated health outcomes for proposed measures.
- The Avoid-Shift-Improve (A-S-I) framework is key to achieving safe, healthy and low-carbon transport for both passengers and freight.
- Transport policy can improve health and wellbeing through a broad set of instruments.
- Investments in transport infrastructure – particularly new infrastructure for walking, cycling and public transport networks – are linked to increased physical activity.
- Financial disincentives that have been shown to reduce car use include charges for fuel, parking, or road users, and incentives for alternative transport modes.
- Reallocating space from cars to pedestrians and cyclists, and to attractive green and blue spaces, can encourage physical activity, boost social interaction and reduce stress while contributing to climate change mitigation and resilience.
- Increasingly, calls to action for health emphasise the need for integrated strategies that combine urban planning and design with communication and co-creation. One approach is placemaking, a collaborative and community-driven method to design public spaces to promote health, social interaction and environmental sustainability.
- So-called soft measures – such as providing information on public transport and conducting awareness-raising campaigns – can support behavioural change towards walking, cycling and sustainable travel modes.
- The most impactful policies have been comprehensive packages that combine both incentives (carrots) and restrictions (sticks) and that target different scopes (societal, city-wide, route-based and individual).
- As of 2023, only around 15% of countries had national policies that support the safety of people walking and cycling. To address this challenge, international initiatives and frameworks have increasingly formalised and scaled health-promoting interventions.
- Efforts have been made to link the financial burdens that transport and mobility place on health and insurance systems, with the evidence-based solutions that will reduce these burdens.
- Including the health impacts of transport in economic appraisals, such as the Health Economic Assessment Tool (HEAT), is essential to boost recognition of these impacts in transport policy.
- The Global Plan for the Decade of Action for Road Safety 2021-2030 provides an overarching strategy for reducing road traffic deaths, with national governments and other road safety stakeholders adapting the plan to local needs.
- Importantly, the Global Plan details requirements for implementation, including the need for financing, legal frameworks, speed management, capacity development, a gender perspective in transport planning and adapting technologies to the safe system.
- The Global Ministerial Conference of Road Safety, held in Morocco in February 2025, and the associated Marrakech Declaration urged UN Member States and other actors to accelerate and scale up efforts to implement the Global Plan and associated Global Road Safety Performance Targets.
- The Marrakech Declaration also calls for minimum safety standards in vehicle design and infrastructure; multi-modal mobility and road safety education; and evidence-based interventions, especially in low- and middle-income countries.



Context, challenges and opportunities

Transport impacts people's mental and physical health both positively and negatively, and in direct and indirect ways. However, these health impacts tend to be distributed inequitably across populations, regions and transport modes. Harms and benefits in the transport-health realm can be categorised as the "3 A's and the 9 C's" (Box 1), as elaborated in this section.[1]

In conventional (i.e., car-dominated) transport systems, the harmful impacts on health and equity tend to outweigh the potential benefits. These impacts affect wellbeing directly (through road crashes and air and noise pollution) and indirectly (through poorer physical and mental health). In regions where cars are seen as the norm, the benefits of transport, particularly access, generally accrue to more affluent groups, whereas the harms are borne mainly by more vulnerable and disadvantaged groups, including the young, the old, women, those from minority ethnic groups, those with disabilities, and those living in poverty and lower socio-economic groups.[2] In rural and other areas that have limited or no public transport, car ownership by poor households can be a type of "fuel poverty".[3] Health status also affects a person's ability to travel.[4]

Box 1. The 3 A's and 9 C's of transport and health

The Transport and Health Science Group has used the concept of the benefits (3 A's) and harms (9 C's) of transport and health as a framework for measuring impacts, based on major indicators. The list of indicators is not exhaustive but includes those with sufficient data to enable outlining of global or regional trends.

The benefits of transport for health - the 3 A's:

- **Access** (access to employment, education, people, services, goods, green and blue spaces, and other opportunities for recreation as well as social connectedness): For example, access to public transport and multi-modal transport systems.
- **Activity** (active travel): People walking and cycling
- **Attractive environments** (both public and private spaces): Planning and proximity of public spaces

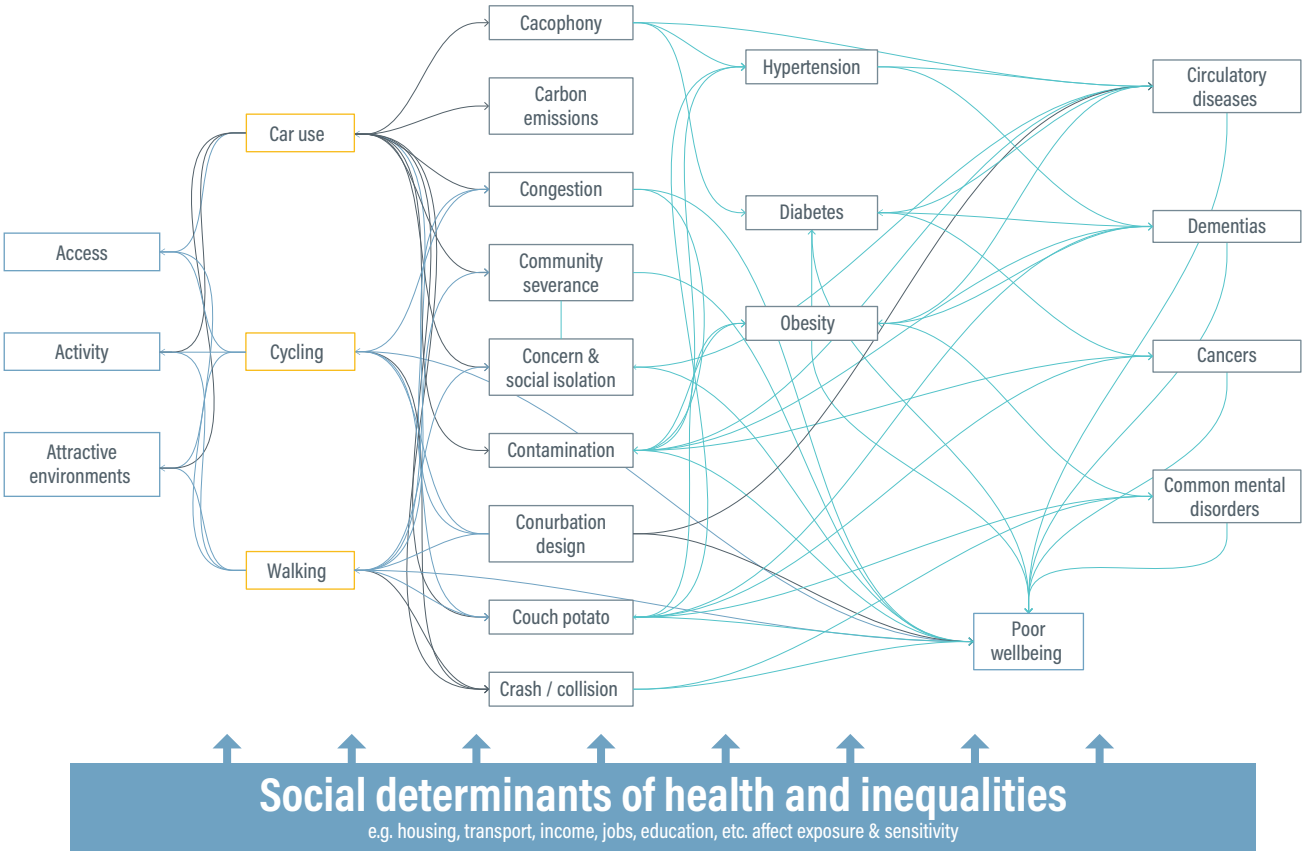
The harms to health provoked by transport - the 9 C's:

- **Cacophony** (transport-related noise): People's exposure to traffic noise
- **Carbon emissions** (impacting global climate change): Greenhouse gas emissions and contribution by transport mode
- **Community severance** (the barrier effect of transport and busy roads)
- **Concern** (stress and anxiety caused by transport)
- **Congestion** (pollution and noise, stress and anxiety): Delays for commuters
- **Contamination** (harm from ingestion): Air pollution (such as particulate matter)
- **Conurbation disruption** (sprawl causing long distances and fragmentation): Heat island effect
- **Couch potatoes** (sedentary lifestyles): Limited or lack of physical activity
- **Crashes and casualties** (traffic injuries and road safety): Road fatalities and injuries

Source: See endnote 1 for this section.

The health impacts from freight transport and personal travel, particularly the harms caused to other people, typically depend on the specific transport mode (and the design and weight of the vehicle), rather than on what is being carried (Figure 1).[5] In addition, people involved in freight transport, particularly drivers of heavy-goods vehicles, face occupational health issues (not covered in this section).[6]

FIGURE 1. The links between the benefits (3 A's) and harms (9 C's) of road transport by travel mode: car use, cycling and walking



Note: The arrows indicate common consequences but not the relative importance of different sequelae nor of the health effects of different modes. Public transport is omitted from the figure as it causes less air and noise pollution and community severance than private car use but more than walking and cycling; and often provides some physical activity but less than walking or cycling do.

Source: See endnote 5 for this section.

The human and financial costs of fossil fuel-based transport, in terms of poor physical and mental health and wellbeing[i], are unsustainable. Facilitating a shift to more sustainable transport modes reduces inequities as well as greenhouse gas and other emissions, benefiting the health and wellbeing of people and the environment.

The most severe health-related impacts of transport are road crashes and air pollution. People in low- and middle-income countries – particularly those who are walking, cycling, and taking collective transport (public transport and informal transport) – face the strongest impacts from unsafe, polluted roads. Globally, 1.19 million people died on roads in 2021, and air pollution caused 8.1 million deaths; in 2019, transport was responsible for an estimated 6% of air pollution.[7]

People with disabilities – including physical (e.g., problems walking), sensory (vision and hearing) and cognitive (long-term learning difficulties or recent cognitive decline) – often face major limitations and difficulties when travelling. This has substantial negative impacts on wellbeing, both from journeys not made because of the constraints of inadequate transport options and from the difficulties and anxieties experienced when planning and executing a journey.[8]

Health framing is critical for justifying interventions and gaining public and political support, yet it remains insufficiently applied in transport policy. Advancing the integration of health into urban and transport planning requires institutional reforms that foster inter-sectoral collaboration, build cross-sectoral alliances, and facilitate stronger engagement between health professionals and the political sphere.[9] The limited integration of health and transport is attributed to different interpretations of health and evidence across sectors, difficulties in translating research into policy, fragmented decision making in government departments, competing policy agendas and short-term political cycles.[10]

i Well-being is closely connected to mental health. The World Health Organization (WHO) defines wellbeing as "a positive state experienced by individuals and societies. Similar to health, it is a resource for daily life and is determined by social, economic and environmental conditions." It encompasses quality of life as well as the ability of people to contribute to the world. WHO (2021), Health Promotion Glossary of Terms 2021, https://www.who.int/publications/i/item/9789240038349.

Benefits of transport for health: the 3 A's

Access

The main purpose of transport is to provide access to potentially beneficial services and destinations and to socio-economic opportunities that generally improve wellbeing. Being able to travel outside the home is important in preventing social isolation, which can increase mortality by 29%.[11] Beneficial travel destinations include education, services, shops, leisure, and social contacts and networks, including work, friends, family and acquaintances. Although some jobs can harm health or wellbeing, being unemployed is generally worse for wellbeing, as insufficient income is a major contributor to poor health and wellbeing and premature death.[12] (See 1.2 Advancing the Right to Mobility for Sustainable and Inclusive Societies, and 4.2 Integrated Transport Planning.)

- Globally, 41% of people live within one-kilometre walking distance of a healthcare facility and 44% live within a one-kilometre radius of an educational facility.[13]
- Just 33% of people live within a one-kilometre radius of both health and educational facilities.[14]

Public transport provides access to the benefits of travel without personal car use. It enables access to opportunities to many people that cannot walk or cycle, particularly if they are carrying goods. However, just 52% of the urban population globally had convenient access to public transport in 2022.[15] In many low- and middle-income countries, informal public transport – including motorcycle taxis and private minibuses and microbuses – provides mobility options and thus access to services and socio-economic opportunities for millions.[16] By replacing private car use, public transport reduces the adverse impacts of car users on other people. Safe, accessible and affordable public transport is central to improving health and equity. (See 4.5 Public Transport and 4.6 Informal Transport.)

Access to travel options is much more restricted in low- and middle-income countries and for some user groups, such as people with disabilities.[17] In 2022, only 30% of the urban population (both able-bodied and people with disabilities) in low-income countries and 43% in middle-income countries had convenient access to public transport, on average, compared with 78% in high-income countries.[18]

- In South Africa, people with disabilities travel between 27% and 66% less than their able-bodied, adult counterparts.[19]
- In Australia, the share of people with disabilities who are able to use all forms of public transport with no difficulty fell from 66% in 2018 to 63% in 2022.[20]
- A survey in South Africa found that the main reasons people chose to use bus rapid transit were safety from crime as well as cost savings.[21]
- In Medellin (Colombia), poorer households and those in informal settlements live farther from public transport stops than do other household groups, despite the city's extensive investment in public transport (including cable cars) to promote access and reduce inequity.[22]

Transit-oriented development approaches, as well as compact mixed-used cities, use proximity planning to improve access to healthcare services, encourage walking and cycling, and mitigate the negative health impacts of vehicle emissions.[23] In 15-, 20-, or 45-minute cities, residents can access essential services including housing, work, commerce, health care, education and entertainment on foot or by bicycle within no more than 15, 20, or 45 minutes, respectively. (See 1.2 Advancing the Right to Mobility for Sustainable and Inclusive Societies, and 4.2 Integrated Transport Planning).

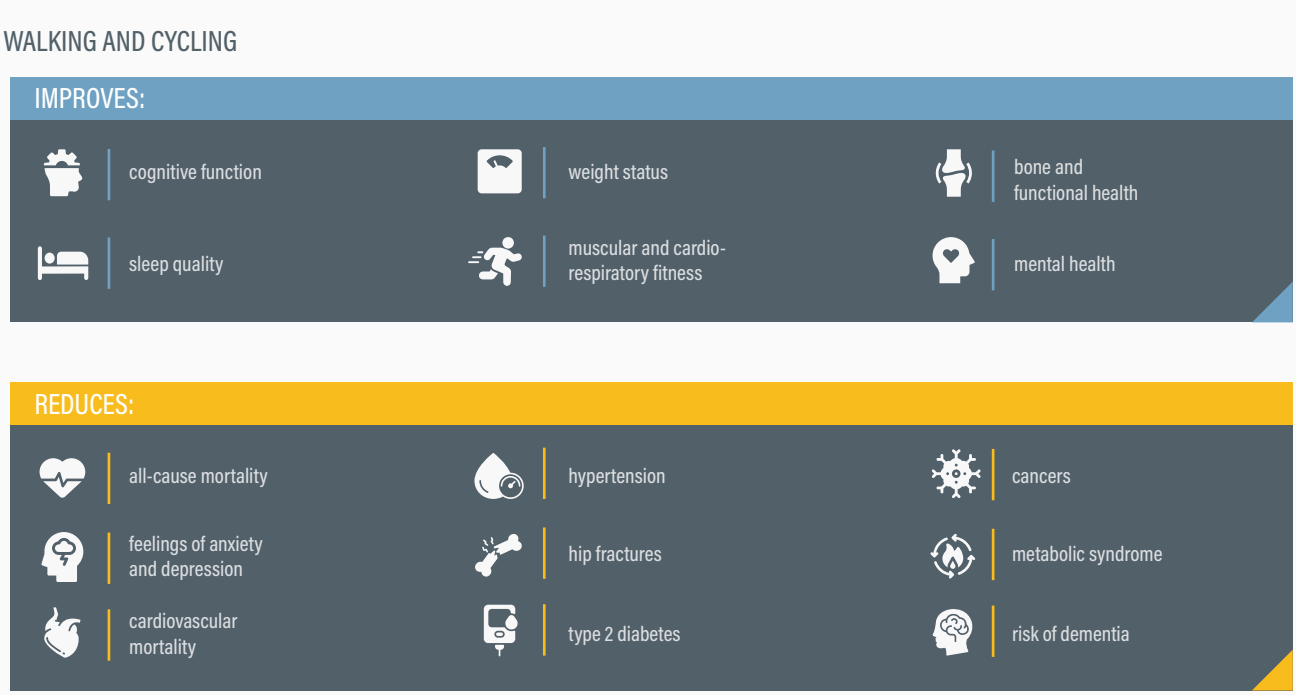
- Cities that have implemented such approaches – recognising that public transport, walking and cycling can greatly reduce transport emissions and create vibrant urban spaces – include Arlington (United States), Curitiba (Brazil), Denver (United States), Hong Kong (China), Melbourne (Australia), Seoul (Republic of Korea) and Stockholm (Sweden).[24]
- In Bogotá (Colombia), neighbourhood zones known as Care Blocks cluster essential care services – such as childcare, training, health, legal aid and recreation – within a 20-minute walk of residents; these highly accessible services help women by greatly reducing their unpaid care burden.

Activity

Travel brings opportunities for physical activity, whether during the entire journey (as with walking or cycling) or as part of a journey (such as travel to and from public or collective transport).[25] **Evidence suggests that active travel can provide the same health and wellbeing benefits as formal sports or exercise, contributing to healthier lifestyles by becoming part of daily life.**[26] Physical and mental health benefits of active travel include reductions in the likelihood of developing or dying from certain diseases and their severity – such as depression, obesity, diabetes, hypertension, circulatory diseases (particularly heart attacks and stroke), dementia and various types of cancer (Figure 2).[27]

- Walking and cycling for travel can provide sufficient physical activity to meet current recommendations for 150 minutes per week of moderate intensity activity.[28]
- A survey in seven European countries found that cycling and walking were associated with better mental health and wellbeing.[29]

FIGURE 2. Health benefits of walking and cycling



Source: See endnote 28 for this section.

- Even in highly polluted cities such as Beijing (China), the benefits of physical activity outweigh the harms from air pollution exposure, except on the most highly polluted days.[30]

People who commute by active travel modes have been found to have better subjective wellbeing than those who commute by car.[31] A Scottish Longitudinal Study between 2001 and 2018 showed that commuting by bicycle or on foot had lower risks for all-cause mortality, hospitalisation, cardiovascular diseases, cancer and mental health problems.[32]

Active travel can reduce the lifecycle carbon emissions from transport, especially when it substitutes for motor vehicle use rather than being used for additional trips (see 4.3 Walking and 4.4 Cycling).[33] It is also more flexible (providing door-to-door access without timetables), more affordable and generally more age-independent than other travel modes. Active travel has fewer adverse impacts on other people's wellbeing and health and provides more overall societal benefits than costs (e.g., less need for healthcare services, lower costs to build and maintain cycling infrastructure versus general road infrastructure). Designing urban areas for active travel contributes to more liveable, cohesive cities.

Travel to and from public transport supports physical activity and can provide benefits to health and wellbeing.[34] However, public transport's impact on wellbeing vary, with some studies finding that it has more adverse effects than car use (for example, if time-consuming commutes by public transport reduce leisure time and work-family balance), and other studies finding that its wellbeing impacts are somewhere between those for active travel and car use.[35]

- Public transport often entails walking or cycling to and/or from train stations and bus and tram stops and is thus less sedentary than door-to-door car use.[36]
- For older people in the United Kingdom, frequent bus use helped delay reductions in walking speed, which is predictive of long-term health and mortality.[37]

Attractive environments

Attractive environments provide considerable benefits for mental wellbeing, whether people are travelling through them on their journey or have them as the intended destination.[38] These include, in particular, "blue" spaces (rivers, sea, lakes, ponds) and "green" spaces (parks, countryside, urban planted spaces, including street vegetation). People tend to walk more often and farther in attractive green and blue environments and to gain more health benefits from exposure to nature.[39]

- Research shows that spending around 15 minutes per day in nature can greatly improve health and wellbeing.[40]
- In cities, living near green spaces is associated with lower probabilities of cardiovascular disease, obesity, diabetes, and asthma in adults, and lower risks of obesity and myopia in children.[41]

Harms to health provoked by transport: the 9 C's

Cacophony (transport-related noise)

Traffic noise caused by vehicles with internal combustion engines is a widespread problem across all regions, although data from low- and middle-income countries are limited.

- In western Europe, around 1 million healthy life years were lost from traffic-related noise in 2011.[42]
- A 2023 report noted that at least 20% of European Union (EU) residents are exposed to harmful levels of traffic noise, as are the majority of cyclists in Ho Chi Minh City (Viet Nam), and public transit users in New York City (United States).[43]
- In Hong Kong (China), exposure to excessive noise was found to be higher among poorer residents.[44]

Noise from roads, trains, and airplanes disrupts wellbeing in several ways, including by directly causing annoyance and disturbance that is associated with poorer mental wellbeing.[45] Disturbed sleep from noise affects mental wellbeing and also increases the risk of developing obesity.[46] Transport noise can affect concentration, interfering with work and with children's educational attainment (a key predictor of adult health).[47] Noise increases blood pressure and the risk of non-communicable diseases such as hypertension and circulatory diseases, heart disease and strokes.[48] Noise also contributes to diseases including breast cancer, dementia, heart failure and tinnitus.[49] Most studies suggest that the impacts of noise are independent from air pollution impacts, despite potential confounding factors.[50]

- Children exposed to higher levels of aircraft noise in the Netherlands, Spain and the United Kingdom had lower reading comprehension skills, independent of other relevant factors.[51]
- In Europe, around 12,000 premature deaths and 48,000 new cases of coronary heart disease annually were attributable to traffic noise exposure as of 2022.[52] More than 100 million European residents were exposed to noise pollution from transport (mainly road traffic) that year, despite policies and regulations targeting motor vehicle sound levels and aircraft noise management.[53]
- Studies in Africa found that the effects of noise on health included noise-induced hearing loss or hearing impairment, irritations, and inhibition of speech intelligibility, as well as other impacts such as cardiovascular diseases, tinnitus, sleep disturbances and adverse social behaviour.[54]

Carbon emissions (impacting global climate change)

In 2023, transport contributed 15.9% of global greenhouse gas emissions and 21.9% of carbon dioxide (CO_2) emissions.[55] **It was the second largest sector for greenhouse gas emissions after the power industry, and the second fastest-growing sector for emissions between 2015 and 2023.**[56] **Road transport contributed three-quarters (74%) of transport greenhouse gas emissions in 2023.**[57]

Due to record-high temperatures, 2024 was the first year that the average annual global temperature likely surpassed the international target of limiting global warming to 1.5 degrees Celsius.[58] (See 1.1 10 Years On: Paris Agreement and SDGs Reflections Ahead of the UN Decade of Sustainable Transport.) **Between 1990 and 2023, heat-related mortality for people older than 65 years increased 167%.**[59] These trends make it critical to prioritise and facilitate low-emission transport options for both freight and people.

- For freight transport, maritime transport was found to be the most sustainable mode from a life-cycle perspective, and air travel the least.[60] Both road and air freight transport cause much greater noise and air pollution than rail transport.[61] (See 4.1 Freight Transport and Logistics, 4.7 Rail, 4.9 Aviation and 4.10 Maritime Transport.)
- For passenger transport, walking, cycling, public transport and rail are more environmentally friendly than other modes due to lower energy demand and lower carbon intensity per kilometre travelled than cars.[62] (See 4.3 Walking, 4.4 Cycling, 4.5 Public Transport and 4.7 Rail.)

Community severance (the barrier effect of transport and busy roads)

Transport infrastructure, as well as the speed and/or volume of traffic, can limit people's ability to cross a road, reducing access to goods, services, and people and resulting in community severance.[63] The Street Mobility and Network Accessibility Project in England (2014-2016) defined transport-related community severance as the "negative impact of the presence of transport infrastructure or motorised traffic on the perceptions, behaviour, and wellbeing of people who use the surrounding areas or need to make trips along or across that infrastructure or traffic flow."[64]

Road building and traffic can create physical barriers to walking and cycling, weaken social networks that are essential for good health and wellbeing, and affect the wellbeing of people with pre-existing chronic diseases.[65] In low- and middle-income countries, road building often results in wider roads for pedestrians to cross, usually with little or poor-quality pedestrian infrastructure, even where walking is the main travel mode. Too few pedestrian crossings and insufficient time allowed at signalised crossings can worsen the disruptions to healthy living. Pedestrians face barriers both from improved road surfaces (which encourage speeding) and from poor road surfaces, including mud.[21] Perceptions of traffic speed and volume are adversely associated with wellbeing.[66]

- A review of community severance in Africa found that urbanisation, motorisation and population growth were outpacing access to transport and the provision of multi-modal infrastructure; problems included congestion and poor enforcement of speed limits in lower-traffic, high-speed areas.[67]
- After a new motorway was built in Dakar (Senegal), 81% of people surveyed reported that visits to other people were "rare", compared to only 26% before construction.[68]
- In a UK study, the negative impact of motorised road traffic on neighbourhoods, social interactions and local economies resulted in a loss of at least 1.6% of gross domestic product (GDP) as of 2022.[69]
- In Brazil, Ireland, South Africa, Switzerland, and the United Kingdom, the large majority of people aged 65 and older walk more slowly than the 1.2 metres per second used to determine signalised crossing timings.[70]

Concern (stress and anxiety)

Many aspects of travel itself – as well as a lack of affordable, accessible, safe and reliable transport options – cause stress and anxiety that can greatly impair wellbeing, potentially leading to journeys not made and to social isolation.[71] Tripping (such as over uneven pavements) can cause injuries or death, and older people who have suffered a fall may restrict their activities and lose independence.[72] Fear of injury or crime, including "stranger danger", also impairs wellbeing and can lead to social isolation, even where perceptions of fear are disproportionate to actual risks.[73] In addition, traffic noise contributes to stress, and gender-based violence in the street or on public transport is a real concern.[74]

- The absence of reliable and affordable transport can create situations of "transport poverty" for low-income residents, marginalised groups, people with disabilities, and people in underserved rural, remote or urban areas.[75] This limits their access to essential services and employment opportunities and bars them from fully participating in society, perpetuating cycles of poverty and exclusion.
- Globally, the most important enabler of a high modal share for cycling continues to be the presence of good-quality paved roads and safe cycling infrastructure, particularly with features that separate cyclists from vehicle traffic.[76]

Poor people, particularly women, in low- and middle-income countries may have a two-hour walk or more each way to and from work, as public transport may be unaffordable or non-existent. This can result in substantial adverse impacts on mental wellbeing as well as opportunity costs of the time unavailable for domestic and family responsibilities or personal time.

- Most travel surveys focus mainly on journey-to-work trips and record only the primary mode of transport, typically excluding journeys shorter than 500 metres.[77] Thus, these surveys capture only around one-quarter of the actual walking that takes place because they tend to under-represent the walking done by public transport users and to overlook many short but essential trips made by young people, older adults, women and people with disabilities.[78]
- In all regions, women feel less safe than men when walking alone at night where they live. For the period 2020-2022, this difference was 9 percentage points in Sub-Saharan Africa and 18 percentage points in Northern Africa and Western Asia.[79] Among regions, women and men in Latin America and the Caribbean felt the least safe walking alone in their neighbourhood after dark (37-52% safe).[80]
- In Africa, walking is the primary mode of transport, with 78% of people travelling on foot every day to access health care, education, shops, jobs and public transport as of 2022.[81] On average, people in Africa spent 56 minutes per day walking or cycling for transport in 2022, with women showing 29% higher rates of engagement in these forms of transport than men.[82]



Congestion

Congestion is an often-cited adverse impact of travel on wellbeing, particularly for people sitting in motor vehicles that are moving slowly, if at all. Traffic delays have been found to reduce productivity; increase stress, anger and mental workload; and exacerbate obesity due to prolonged physical inactivity.[83] **Congestion adds to local air pollution and vehicle emissions, while also causing negative health impacts on people living, walking or cycling nearby.**[84] When evaluating proposed road projects, many countries include the costs of drivers' time but tend to undervalue the time of pedestrians and cyclists. (See 4.8 Road Transport and Module 3 Regional Overviews.)

- A study in Dar es Salaam (Tanzania) reported traffic delays of 30-60 minutes when comparing journey times (in practice) with free-flow situations.[85]
- A study in Tunisia estimated the cost of congestion at USD 13.2 million (TND 42 million), depending on how time was valued and once externalities were internalised (such as the impacts of road transport on health).[86] Of this total, USD 8.8 million (TND 28 million) was for congestion externalities and USD 7.5 million (TND 24 million) was for social losses (injuries and fatalities).[87]
- In a congested road condition, carbon monoxide exhaust increases four-fold, hydrocarbons three-fold and nitrogen oxides two-fold compared to uncongested conditions.[88]

There is good evidence that building new roads and widening existing roads does not provide a long-term solution to congestion, as these interventions generate traffic and induce demand.[89] Such infrastructure changes shift bottlenecks to the start and end of the new/wider road. They also release suppressed demand for car use among people who may have been discouraged from driving due to the congestion, until a new steady-state equilibrium is reached. Effective ways to reduce congestion and its negative economic, social and environmental impacts include reducing the need to travel and providing high-quality, non-car options such as walking, cycling and public transport.[90] (See the Avoid-Shift-Improve framework in 4.2 Integrated Transport Planning.)

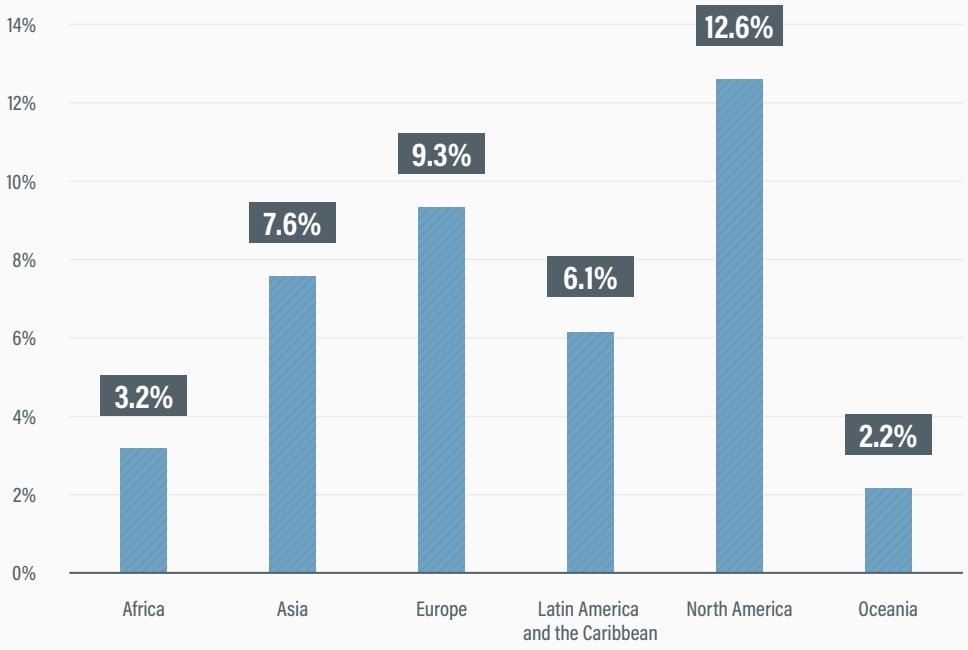
Regions with the most built-up road networks tend to show the highest levels of private motorisation and congestion. As of 2024, three of the world's ten most congested cities were in the United States, which also had the world's highest private motorisation rate at 822 vehicles per 1,000 people, compared to the global average of 219 vehicles per 1,000 people.[91]

Contamination

Travel-related contamination includes both air pollution and road runoff. Air pollution is a complex mixture of gases and particulate matter, including fine particles with an aerodynamic diameter of 2.5 or smaller. In the human body, air pollutants first interact with the lungs but can have impacts on nearly all

FIGURE 3. Contribution of transport to air pollution in 2019

Average contribution of transport to air pollution per region, 2019



2019 estimates show that transport is responsible for 6% of air pollution, making it responsible for half million of air pollution-related premature deaths. However, the extent of this contribution varies significantly amongst regions, ranging from 12.6% in North America, to only 2% in Oceania.

organs, including the heart, brain and reproductive system.[92]

Ambient air pollution increases the risk of cardiovascular and respiratory diseases and was responsible for 8.1 million premature deaths in 2021 (61% of them linked to fossil fuel combustion).[93] **Transport accounted for 6% of air pollution in 2019, linking it to 500,000 air pollution-related premature deaths.**[94] **Air pollution was the second leading cause of death for children under five years in 2021.**[95] In 2021, transport's contribution to air pollution ranged from 12.6% in North America, to 9% in Europe, 8% in Asia, 6.1% in Latin America and the Caribbean, 3.2% in Africa and only 2% in Oceania (Figure 3).[96]

Road freight traffic produces large amounts of air pollution, with strong age-related inequities based on exposure levels.[97] **Air travel is also a major contributor to air pollution**, both from the aircraft itself and (even more so, for some pollutants) from travel to and from airports.[98]

Concentrations of particulate matter and nitrogen oxides (NO_x) tend to mirror the traffic volumes along road networks in cities.[99] Ozone remains more common in rural areas because of transport of emitted pollutants that react with sunlight.[100]

- Particulate matter causes and exacerbates asthma and circulatory diseases (particularly heart disease and strokes) as well as lung cancer (although to a much lesser extent than smoking).[101]
- NOx exacerbates asthma.[102] In 2023, the death from asthma of a nine-year-old girl who lived along a major arterial road in London (United Kingdom) was the first death formally ascribed by a coroner to air pollution.[103]
- In addition to increasing mortality and hospital admission rates, air pollution results in time off school or work, impacting education and income especially among racial and ethnic minorities.[104]

Air quality is generally worse in cities in low- and middle-income countries. As of 2021, 7.3 billion people worldwide – 80% of them in low- and middle-income countries – were exposed to annual particulate matter (PM2.5) levels above the World Health Organization's (WHO) threshold.[105]

- Globally, 716 million people living on less than USD 1.90 day were exposed to harmful air pollution levels (from transport and other sources) as of 2021, particularly in Sub-Saharan Africa.[106] Air pollution was the second largest cause of death in Africa in 2022.[107]
- In South Asia, transport-related air pollution is a leading contributor to public health issues such as wheezing among children, chronic obstructive pulmonary disease,



respiratory infections, heart attacks, strokes, and lung cancer, while imposing substantial economic burdens on affected populations.[108] In India, air pollution is linked to a higher disease burden than tobacco use.[109]

Cyclists potentially inhale higher doses of pollutants, as they breathe more rapidly and deeply; however, studies have found that even in highly polluted environments, the benefits of physical activity outweigh the increased exposure to air pollution, except on the worst-affected days.[110] In general, pollutant concentrations are higher inside vehicles than outside them; lower near pavements and by roadsides; and even lower on traffic-free routes and farther from roadways.[111]

Road runoff is an additional source of travel-related contamination, as heavy metals and other pollutants from vehicles make their way from the road into the environment. After being deposited on road surfaces, vehicle pollutants – including fuel, oils, particulate matter, microplastics and carcinogenic polycyclic aromatic hydrocarbons – can be re-suspended into the air (exacerbating air pollution) and washed off by rain into water sources (affecting drinking water and agricultural produce).[112] This contamination mainly affects physical health, but it can also impact wellbeing both through the impact of disease on quality of life and through concerns about exposure to pollution.

Conurbation disruption (sprawl causing long distances and fragmentation)

In cities, the replacement of greenery with pavement has increased the urban heat island effect, contributing to reduced wellbeing and increased mortality, especially during heatwaves.[113] As the built environment in cities expands faster than urban populations, the decline in urban density exacerbates this effect.[114] Heat islands are concentrations of structures such as buildings, roads, and other infrastructure that absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies, creating "islands" of higher temperatures relative to outlying areas. The impact is especially high in cities in East Asia, South Asia, and Sub-Saharan Africa, home to an estimated 220 million people in 2020.[115]

The use of streets for parking can impact wellbeing by impairing visual amenities and restricting lines of sight, increasing people's risks when crossing roads. In addition, research has shown that in densely built and heavily occupied areas, high concentrations of parked vehicles can modify solar absorption and surface temperatures, due to specific thermal and radiative properties of vehicles.[116]

Escalating heat exposure poses a major threat to maternal and neonatal health, increasing the risks of pre-term birth, stillbirths, congenital anomalies, gestational diabetes mellitus and general obstetric complications.[117]

Couch potatoes (sedentary lifestyles)

Time spent being sedentary, such as when travelling by private motor vehicle, reduces time spent being physically active. In 2022, one in eight people worldwide were living with obesity – including 890 million adults and 160 million children and young people – and even more were living with overweight.[118] Physical inactivity increases the risks of developing and dying from certain diseases.[8]

Longitudinal studies have shown that people who shift their commuting mode from cars to active travel (walking and/or cycling) lose weight, whereas those who change from active travel to car commuting gain weight, with predictable consequences on obesity rates.[119] Public transport users fall between active and sedentary commuters, as they often walk or cycle to and from public transport stops or stations.[120]

Crashes and casualties (traffic injuries and road safety)

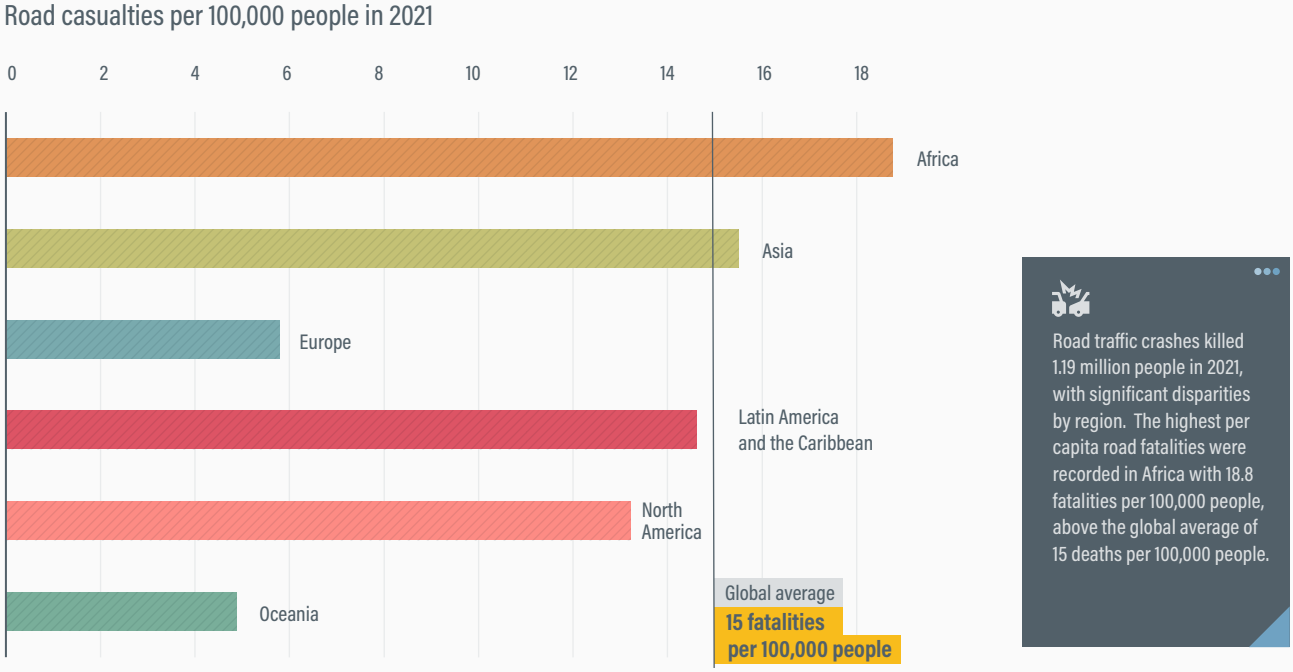
Road traffic crashes killed 1.19 million people in 2021, with large disparities by region (Figure 4).[121] **The highest per capita road fatalities by region were in Africa (18.8 fatalities per 100,000 people, above the global average of 15 deaths per 100,000 people), although small island developing states as a sub-group had 21 fatalities per 100,000 people.**[122] **As of 2021, low- and middle-income countries were home to 60% of the world's motor vehicles but suffered around 90% of road traffic fatalities.**[123]

More than half of road deaths globally in 2021 occurred among "vulnerable" road users, comprising motorcycle riders (32%), pedestrians (20%) and cyclists (5%).[124] **Pedestrians accounted for 32% of reported road fatalities in low-income countries in 2021.**[125] **Globally, road traffic injuries were the leading cause of death for children and young adults aged 5-29 years as of 2021.**[126]

Exposure on roads is greater in **low- and middle-income countries because many pedestrians have no other existing or affordable transport options and must walk long distances and/or at night, when poor lighting often increases the hazard.** Additionally, some people work on or near roads, selling goods to drivers.[127] In many countries the lack of pedestrian infrastructure exacerbates the risk of putting pedestrians in the path of motor vehicles.[128]

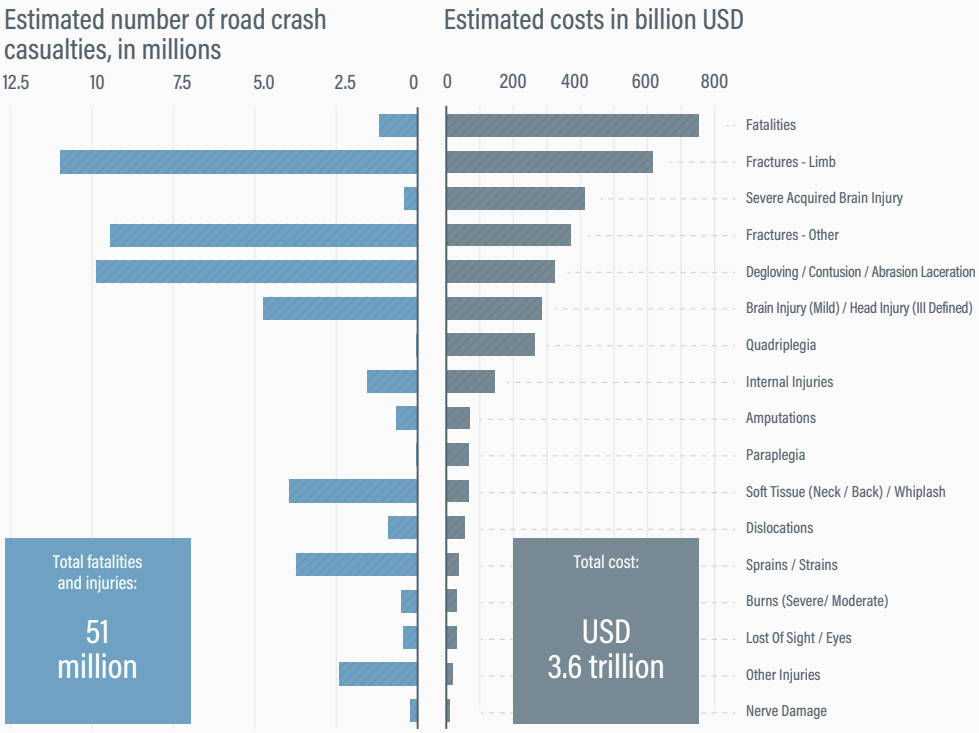
- Freight and construction vehicles kill and injure a disproportionate number of pedestrians and cyclists,

FIGURE 4. Road traffic casualties per 100,000 people, by region, 2021



Source: See endnote 121 for this section.

FIGURE 5. The human impact of road traffic injuries



As of 2021, the total cost of death and injury on the world's roads was an estimated USD 3.6 trillion a year, or the equivalent of 3.7% of global GDP.

In low- and middle-income countries, the cost of road crashes approached 5% of GDP. In these countries and in rural areas worldwide, the consequences of a road crash are often exacerbated by the paucity of roadside or other emergency care, including a lack of emergency services and vehicles to transport injured people.

Source: See endnote 133 for this section.

both because of a greater likelihood of collision (due to difficulties seeing vulnerable travellers) and because of the far greater consequences (as the shape and mass of the vehicles cause more extensive injuries).[129]

- In Africa, only 3% of roads used by pedestrians had formal sidewalks as of 2021, leaving people with little choice but to walk on the roadway itself.[130]

In addition to fatal crash outcomes, an estimated 50 million people annually suffered life-changing injuries on the world's roads as of 2021.[131] This includes 20 million people with limb and other fractures, more than 5 million people with brain injuries, and more than 2 million people with amputations and spinal and internal injuries.[132]

Death and injury on the world's roads led to estimated annual costs of USD 3.6 trillion in 2021, or the equivalent of 3.7% of global gross domestic product (GDP) (Figure 5).[133] **In low- and middle-income countries, the cost of road crashes approached 5% of GDP.**[134] **In these countries and in rural areas, the consequences of a road crash are often exacerbated by limited access to roadside care, including a lack of emergency services and vehicles to transport injured people.**[135]

The main factors contributing to road crashes are a lack of access to safe public transport, inadequate speed management, poor infrastructure, lack of relevant legislation, and poor road user behaviour, according to the WHO.[136]

- As of 2023, only 58 countries met the WHO's best practice for speed management.[137]
- Only 21-23% of assessed road infrastructure worldwide as of 2023 met the three-star or better performance standards for pedestrians, cyclists and motorcyclists agreed by United Nations Member States.[138]
- Most countries lack legislation specifying standards for core vehicle safety equipment.[139]
- As of 2023, 52 countries met WHO best practice in relation to drink driving and 54 countries in relation to motorcycle helmets; 12-47% of drivers reported not using seatbelts, and 29-52% reported using handheld phones.[140]
- Utility vehicles used for informal transport in Africa and South America often carry large numbers of passengers – many standing unprotected and unsupported on open platforms – resulting in high risks of collisions and serious and fatal injuries.[141]

- In Africa, the factors that increase community severance also contribute to increased risks of road traffic injuries, particularly for vulnerable road users, who have higher case fatality rates.[21] This is exacerbated in low- and middle-income countries, where public transport is limited and walking is often the only option.

Policy and investment developments

Health considerations remain inadequately embedded in upstream urban and transport policy processes, despite a robust and growing body of empirical evidence and initiatives.[142] **Detailed targets and key performance indicators for several health pathways (such as access, activity and attractive environments) are often lacking, as are clear health rationales and anticipated health outcomes for proposed measures. The Avoid-Shift-Improve (A-S-I) framework is key to achieving safe, healthy and low-carbon transport for both passengers and freight.** (See 4.2 Integrated Transport Planning.)

- A recent assessment found that Sustainable Urban Mobility Plans (SUMPs) focus mainly on mitigating the harmful effects of transport (such as air pollution and injuries) rather than positioning transport as a pro-active driver of health promotion.[143]
- One framework to support public health agencies working on transport, health and equity outlines three central elements – determinants of travel, context of travel and outcomes of travel – that are affected by cross-cutting components including health equity, interventions and policies, and the macro-level socio-environmental context.[144]

Transport policy can improve health and wellbeing through a broad set of instruments. Importantly, policy influences both accessibility (the extent to which transport and land-use systems allow people to participate in specific activities) and how goods are being transported.[145] It also impacts transport volumes, modal split, technology, energy sources, efficiency of using vehicles, and driving behaviour, all of which have implications for health.

- Regulatory measures such as daytime running lights and speed limit zones (e.g., 30 kilometres per hour) help reduce crashes and casualties.[146]
- Emission standards for both passenger and freight vehicles can improve air quality, lowering the risk of diseases.
- Regulations such as restrictions on night-time deliveries and the use of quieter vehicle technologies can reduce transport-related noise exposure.[147]
- Regulatory measures that mandate improved visibility for heavy-goods vehicles, refuse trucks, and construction vehicles could reduce the disproportionate impact of large vehicles on vulnerable road users.
- Urban planning and design interventions across scales are instrumental in shaping travel behaviour and health outcomes.
- Integrated land-use and transport strategies – such as transit-oriented development and the compact or "15-minute city" planning approach (enabling most day-to-day trips to be made on foot or by bicycle) – could promote walking and cycling and reduce car use.[148]
- **Investments in transport infrastructure – particularly new infrastructure for walking, cycling and public transport networks – are linked to increased physical activity.**[149]

Financial disincentives that have been shown to reduce car use include charges for fuel, parking, or road users, and incentives for alternative transport modes.[150] In freight transport, financial disincentives include distance-based tolls for heavy-goods vehicles and differentiated charges based on emissions, which can incentivise cleaner technologies and mode shifts (e.g., from road to rail or inland waterways). Between 2003 and 2019, a link was found in the United States between rising fuel prices and greater use of public transport, walking and cycling – mainly in urban areas, as rural commuters often lack access to public transport networks.[151]

Reallocating space from cars to pedestrians and cyclists, and to attractive green and blue spaces, can encourage physical activity, boost social interaction and reduce stress while contributing to climate change mitigation and resilience. In low- and middle-income countries, road reallocation is important to provide adequate space to the majority of travellers who are not car users. Creating safe, attractive and socially engaging streets and public spaces – such as "living streets" and green corridors where walking, cycling, play and community interaction are prioritised – can improve wellbeing and health; they can also increase footfall, perceived safety, and the viability of local shops and businesses, as those visiting by non-car modes spend more in the local economy over time.[152] Green and blue infrastructure helps lower urban transport emissions, reduce urban temperatures, and decrease energy demand for cooling, while strengthening climate resilience by reducing heat and flood risks.

- Superblocks – a model for transforming public space in Barcelona (Spain) that scaled up small-scale initiatives to a network of pedestrian-oriented green hubs and squares – are being considered in Switzerland.[153]
- In 2020, Utrecht (Netherlands) restored the Catharijnesingel canal, which was filled in the 1970s to accommodate a 12-lane motorway.[154]

- The Indian cities of Chennai and Kochi are improving and expanding blue and green infrastructure, which can encourage walking and cycling and improve wellbeing.
- Strategies in many Middle Eastern cities, such as designing the built environment to provide shade and reduce heat islands, are key to enabling walking and cycling in increasingly hot climates.[43]

Increasingly, calls to action for health emphasise the need for integrated strategies that combine urban planning and design with communication and co-creation.[155] **One approach is placemaking, a collaborative and community-driven method to design public spaces to promote health, social interaction and environmental sustainability.**

- Through the Kool Routes to School programme in Santiago (Chile), children, schools and communities partnered with local government to improve the built environment around schools and enable walking and cycling to and from school.[156]
- In Viet Nam, the Star Rating for Schools partnership used a combination of big data, youth engagement and urban planning to prioritise and enhance the safety of active trips to school.[157]

So-called soft measures – such as providing information on public transport and conducting awareness-fraising campaigns – can support behavioural change towards walking, cycling and sustainable travel modes. These interventions, which rely on information sharing, public education, and persuasion techniques, are most effective when combined with infrastructure interventions.[158] (See 4.5 Public Transport)

The most impactful policies have been comprehensive packages that combine both incentives (carrots) and restrictions (sticks) and that target different scopes (societal, city-wide, route-based and individual).[159] In an international review, packages integrating cycling infrastructure, pro-bicycle initiatives, supportive land-use planning and restrictions on car use were found to effectively increase bicycle uptake and use.[160]

- Evidence from the "mini-Hollands" programme in London (United Kingdom) showed that interventions that combine low-traffic neighbourhoods (which use various physical/virtual barriers to limit motor traffic in a linked set of local streets) with access to active mobility infrastructure greatly increase walking and cycling, reduce car ownership, and yield substantial health and economic benefits over time.[161]
- Paris (France) has implemented a range of measures to curb car use and prioritise walking, cycling, and public transport use, including pedestrianising the quayside along the Seine River, reducing car access to major streets, expanding urban green spaces, and lowering speed limits to enhance safety and liveability. As of 2024, cycling overtook private car use in Central Paris to become the third most popular transport mode after walking and public transport use (see 4.4 Cycling).[162]

As of 2023, only around 15% of countries had national policies that support the safety of people walking and cycling.[163] **To address this challenge, international initiatives and frameworks have increasingly formalised and scaled health-promoting interventions** (see 4.3 Walking and 4.4 Cycling).

Efforts have been made to link the financial burdens that transport and mobility place on health and insurance systems, with the evidence-based solutions that will reduce these burdens.[164] This is enabling more active pursuit of the potential for sustainability-linked financing and impact investing to bridge the gap in investment in healthy and sustainable transport.

- The International Road Assessment Programme (iRAP) estimates that USD 1,500 billion in investment is required to meet the UN target for 75% of travel for all road users to meet the three-star or better standard, with every USD 1 invested bringing more than USD 8 of benefits.[37]
- The Global Road Safety Facility estimates that in low- and middle-income countries, USD 400-800 billion in additional road safety investments are required to meet the Sustainable Development Goal (SDG) target to halve road deaths and injuries by 2030.[165]

Including the health impacts of transport in economic appraisals, such as the Health Economic Assessment Tool (HEAT), is essential to boost recognition of these impacts in transport policy.[166] Comprehensive assessments that quantify and monetise transport costs and benefits to health (and health care) convey urgency by illustrating both the scale of the health losses imposed through transport, as well as the potential health gains from taking into account various transport pathways. Where feasible, assessment should include multiple health pathways and capture both mortality and morbidity outcomes, using local data and established methods.[167] (See Spotlight on Evolving the Economic Appraisals for Land Transport Investments.)

The Global Plan for the Decade of Action for Road Safety 2021-2030 provides an overarching strategy for reducing road traffic deaths, with national governments and other road safety stakeholders adapting the plan to local needs.[168] The Global Plan is based on the safe system approach and recommends actions across five key areas: multi-modal transport and land-use planning, safe road infrastructure, vehicle safety, safe road use and post-crash response.[169] It was developed by the WHO and UN regional commissions in co-operation with the UN Road Safety Collaboration.

Importantly, the Global Plan details requirements for implementation, including the need for financing, legal frameworks, speed management, capacity development, a gender perspective in transport planning and adapting technologies to the safe system, with a focus on low-and-middle-income countries. To support measurement, monitoring, and evaluation, it outlines the roles of various stakeholders (government, academia, civil society, youth, the private sector, funders and the United Nations) and provides 12 voluntary performance targets for all safe system action areas agreed by UN Member States. Vehicle safety, such as updating the cab designs of heavy-goods vehicles, should include consideration of both occupants and other road users.

The Global Ministerial Conference of Road Safety, held in Morocco in February 2025, and the associated Marrakech Declaration urged UN Member States and other actors to accelerate and scale up efforts to implement the Global Plan and associated Global Road Safety Performance Targets.[170] The Declaration calls for countries to make road safety a political priority and to ensure its integration into the sustainable transport agenda.[171] Member States are encouraged to make tangible national commitments that address financing, strategies for implementation and reporting, inter-ministerial co-ordination, and the adoption of comprehensive legislation addressing key risk factors.

The Marrakech Declaration also calls for minimum safety standards in vehicle design and infrastructure; multi-modal mobility and road safety education; and evidence-based interventions, especially in low- and middle-income countries. Needed measures to reduce road crashes and casualties in these countries include: improving the availability, affordability and safety of public transport; providing and maintaining adequate pedestrian and cycling infrastructure; enacting and enforcing legislation to reduce road dangers (such as speed limits and vehicle roadworthiness); and improving emergency healthcare and rehabilitation following road traffic collisions.

- Namibia has a compulsory Motor Vehicle Accident Fund that can provide finances for rehabilitation, although the availability of services is sparse outside the capital city.[172]
- In Latin America, the new Movernos Seguros initiative supports government initiatives to establish or enhance mandatory vehicle insurance that can be used to help prevent road crashes and provide comprehensive support systems for road crash victims.[173]
- A major World Bank programme in low- and middle-income countries is financing structural improvements to roads combined with education measures, such as slower speeds.[174]

Partnerships in action

The **Partnership for Active Travel and Health (PATH)** has outlined six key measures to improve the safety and experience of walking and cycling, as part of the UN Decade of Action on Sustainable Transport (2026-2035). These are: adopting tools to measure user experience; implementing speed zones of 30 kilometres per hour in high-use areas; linking walking and cycling to climate, equity and health agendas; capacity building and training; commitments to investment and action; and setting targets for safe walking and cycling aligned with the UN Member State targets for 75% of travel to meet the three-star or better global standard or equivalent.[175]

The **Streets for Life initiative**, aligned with the UN SDGs, outlines a 2030 Manifesto aiming for every child and adolescent to have a safe and healthy journey to school. Key measures include default speed limits of 30 kilometres per hour on streets used by children, viable footpaths, protected at-grade crossings and ambitious targets for protected cycle lanes in every city.[176]

The **Sustainable Mobility for All** partnership – involving partners from global development agencies, government, industry and non-governmental organisations – focuses on four main policy goals associated with Universal Access, Efficiency, Safety and the Environmental Footprint of Mobility.[177] The consortium captures the policy priorities linked to SDG Target 3.6 (to halve road deaths and injuries) and Target 11.2 (to provide safe and sustainable transport systems for all) and the associated tools to support decision making for sustainable mobility.[178]

The **Transport and Health Science Group** provides recommendations including: reducing both car use and the need to travel (except short, local journeys); implementing "living streets"; improving public transport, particularly bus services suitable for trip-chaining (as needed by those with domestic/caring responsibilities); improving and maintaining safe and pleasant facilities for pedestrians and cyclists; and collecting data on passenger-trips instead of vehicle-kilometres.[179]

The **World Health Organization** leads a range of global efforts to address health in transport policies, including the Global Plan for the Decade of Action for Road Safety 2021-2030 and *Promoting Walking and Cycling: A Toolkit of Policy Options*.[180] The toolkit highlights the significant improvements in both physical and mental health from walking and cycling.

Transport Pathways to Reach Climate and Sustainability Goals

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION

MODULE 2

2.1 National Transport Pathways to Reach Climate and Sustainability Goals 161

Transport Ambition in NDCs 3.0 181

Transport in National Adaptation Plans 195

Assessing Progress: The Transport Decarbonisation Index 204

2.2 Sub-National Transport Pathways to Reach Climate and Sustainability Goals 211

2.3 The Role of Business in Delivering Climate and Sustainability Goals in Transport 228

LIST OF FIGURES

National Transport Pathways to Reach Climate and Sustainability Goals

Figure 1. Relevant SDG targets for transport . . . 177
Figure 2. What can the UN Decade of Sustainable Transport achieve by 2035? . . . 179
Figure 3. Sustainable transport is the lifeline of thriving communities and economies . . . 180

Transport Ambition in NDCs 3.0

Figure 1. Benefits of robust transport actions in new NDCs . . . 184
Figure 2. Shares of greenhouse gas emissions covered by third-generation NDCs, as of August 2025 . . . 186
Figure 3. Transport targets included in each generation of NDCs, as of August 2025 . . . 187
Figure 4. Non-greenhouse gas transport targets in third-generation NDCs, as of August 2025 . . . 188
Figure 5. Emission mitigation actions in third-generation NDCs compared to second-generation NDCs, as of August 2025 . . . 189
Figure 6. Mitigation actions by Avoid, Shift and Improve in third-generation NDCs, as of August 2025 . . . 190
Figure 7. Modes referenced in transport actions in third-generation NDCs, as of August 2025 . . . 191
Figure 8. Transport adaptation actions in third-generation NDCs, as of August 2025 . . . 192
Figure 9. SLOCAT's five-point plan for transport in third-generation NDCs . . . 193
Figure 10. Documents supporting stronger transport actions and commitments in third-generation NDCs . . . 194

Transport in National Adaptation Plans

Figure 1. NAP submissions by region, as of August 2025 . . . 199
Figure 2. Adaptation projects in countries with NAPs, as of 15 July 2025 . . . 200

Assessing Progress: The Transport Decarbonisation Index

Figure 1. The five elements of the TDI's methodological framework . . . 206
Figure 2. Snapshot of the Transport Decarbonisation Index (TDI) Spreadsheet Toolkit . . . 207
Figure 3. TDI dimension scores for pilot countries in South Asia and Africa . . . 209

Sub-National Transport Pathways to Reach Climate and Sustainability Goals

Figure 1. Share of urban transport in total transport emissions, 2023 . . . 219
Figure 2. Signatories of the Zero Emission Vehicles Declaration, by region, as of 2025 . . . 222

The Role of Business in Delivering Climate and Sustainability Goals in Transport

Figure 1. Relationships among private sector actors in the transport system . . . 233
Figure 2. The 4 A's of Climate Leadership . . . 234
Figure 3. Share of automakers setting reduction targets for Scope 1, 2, and 3 emissions, 2021 and 2023 . . . 236
Figure 4. Projected gap in global electric vehicle sales, 2020-2035 . . . 241
Figure 5. Lithium-ion battery manufacturing capacity by region of manufacturer headquarters, 2023 . . . 244
Figure 6. Number of key indicators included in Climate Transition Plans of transport service companies . . . 245
Figure 7. World Benchmarking Alliance scores for policy engagement of transport manufacturers . . . 247
Figure 8. SBTi net zero commitments across transport industry sub-sectors, 2023-2025 . . . 249

LIST OF TABLES

National Transport Pathways to Reach Climate and Sustainability Goals

Table 1. Mitigation targets for transport greenhouse gas emissions in third-generation NDCs, as of August 2025 . . . **170**
Table 2. LT-LEDS transport targets submitted by countries as of August 2025. . . . . **172**
Table 3. 2030 Climate Solutions for Transport **174**

Transport Ambition in NDCs 3.0

Table 1. Transport greenhouse gas emission mitigation targets in third-generation NDCs, as of August 2025 . . . . . **188**

Transport in National Adaptation Plans

Table 1. Recent publications on transport adaptation and resilience. **203**

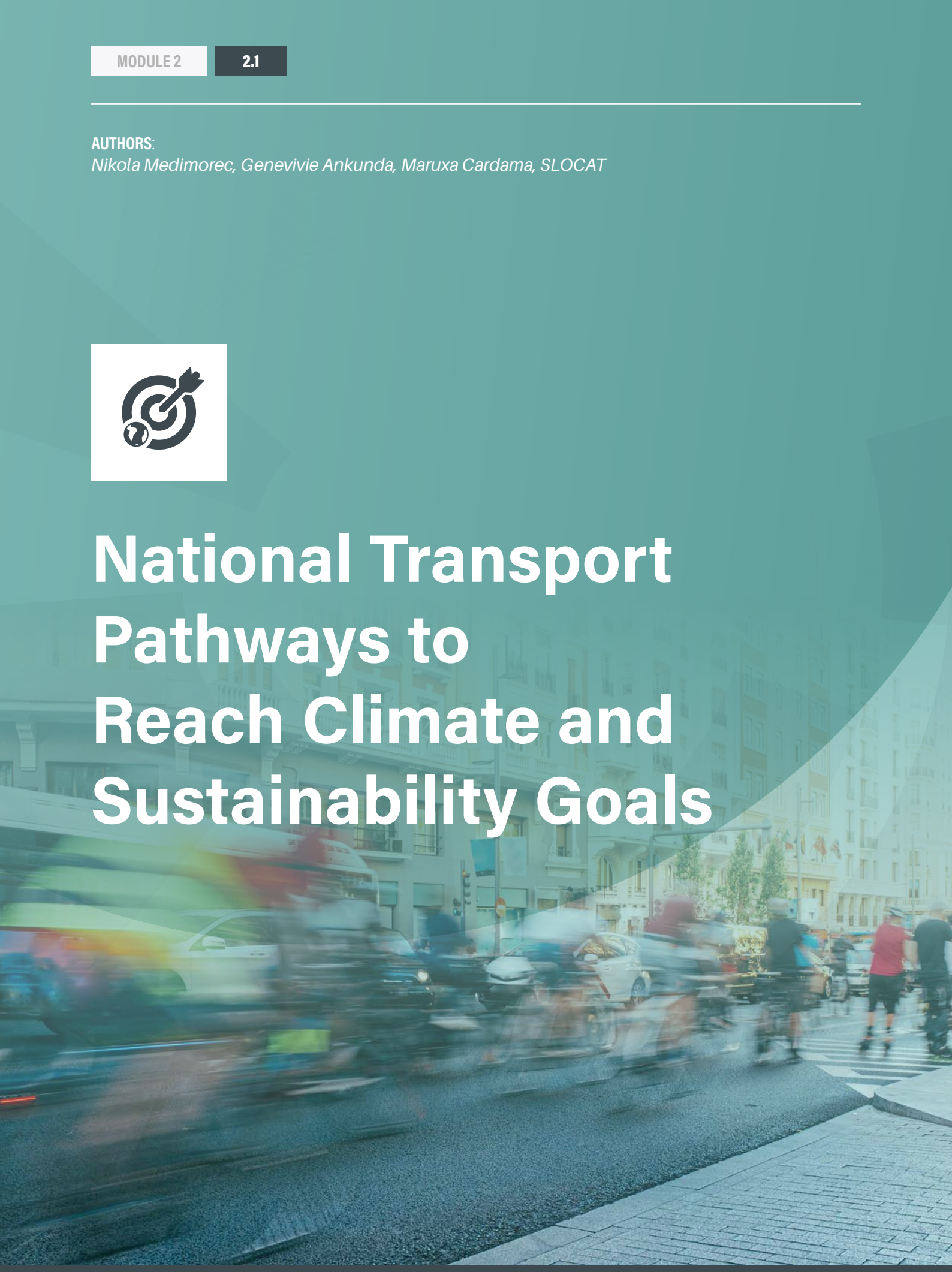
The Role of Business in Delivering Climate and Sustainability Goals in Transport

Table 1. Commitment to downstream emission targets by major auto manufacturers, as of 2023 . . . . . **237**
Table 2. Net zero targets and SBTi status of global rail manufacturers **239**
Table 3. Summary of the "4 A's" of selected coalitions and alliances in the transport sector **250**

MODULE 2 | 2.1

AUTHORS:
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National Transport Pathways to Reach Climate and Sustainability Goals



KEY FINDINGS



Context, challenges and opportunities

- Expanding efficient, accessible, affordable, safe, sustainable, and resilient passenger and freight transport services is one of the most impactful actions to enable inclusive communities and shared prosperity on a liveable planet, while also advancing global climate, sustainability and resilience goals.
- Countries will need to accelerate transformation of the transport sector if they wish to achieve the objectives of key international agreements that aim for improved sustainability and resilience by 2030 and decarbonisation by 2050: the Paris Agreement on Climate Change, the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015-2030.
- Overall, countries are not on track to achieve these global agendas. Efforts to implement these global agendas – as well as climate, sustainability and resilience efforts in transport – are unfolding at a time of heightened geopolitical tension, domestic challenges in many countries, and increased scrutiny of public spending on climate and sustainability action.
- It remains critical to strengthen the linkages between national transport policies and the mechanisms for implementing and tracking progress on the Paris Agreement, the 2030 Agenda and the Sendai Framework. This can help assure that progress towards climate change mitigation and adaptation, as well as sustainability in transport, is anchored in and connected to efforts to achieve social inclusion, shared and resilient prosperity, and health and environmental protection.

National transport policies in support of sustainable, low-carbon transport

- National transport policies form the backbone of efforts to transform the transport sector. Countries outline their commitments to transport development through national master plans, infrastructure development strategies and broader economic policy documents. However, not all transport measures support sustainability, resilience or climate action.
- The number of countries with dedicated national strategies for sustainable, zero-emission transport increased between 2023 and 2025.

KEY FINDINGS

Outcomes of the first Global Stocktake on the implementation of the Paris Agreement

- In 2023, the UN Climate Change Conference in Dubai, United Arab Emirates (COP 28) concluded with a decision on the first Global Stocktake (GST) to scale up climate action by 2030 and extend efforts to 2035. The GST highlighted the urgency of decarbonising the transport sector, calling on countries to accelerate efforts towards "the reduction of emissions from road transport on a range of pathways, including through development of infrastructure and rapid deployment of zero- and low-emission vehicles".

- The GST underscores the need for integrated strategies that take into account transport demand management; proximity planning; shifts to less polluting transport modes; multi-modal infrastructure and services for public and collective transport, rail, walking, cycling, and freight transport and logistics; and technological innovation for cleaner, safer, more resilient and accessible transport systems. Such strategies are increasingly urgent as transport demand continues to grow and as hundreds of millions of people in low- and middle-income countries seek to gain access to transport services.

- Through the first GST, nearly every country in the world agreed (for the first time) to "transition away" from all fossil fuels to achieve net-zero greenhouse gas emissions. Other key actions of the first GST that are expected to greatly transform transport include tripling renewable energy capacity, doubling energy efficiency improvements and phasing out inefficient fossil fuel subsidies.

Nationally Determined Contributions under the Paris Agreement

- Most countries (95%) missed the initial deadline of 10 February 2025 for submitting third-generation NDCs to the UNFCCC. The UNFCCC later extended the deadline to September 2025 to give countries more time to outline their climate actions to 2035.

- As of 1 August 2025, only 29 third-generation NDCs had been submitted to the UNFCCC. The third-generation NDCs submitted as of August 2025 continued the trend of an increasing share of mitigation targets for transport greenhouse gas emissions within each NDC generation.

- So far, the third-generation NDCs have embraced a wider portfolio of transport emission mitigation actions but focused heavily on electrification; the 29 NDCs submitted as of August 2025 featured 7.9 transport emission mitigation actions each on average, up 36% from 5.8 actions each on average in the second-generation NDCs.



KEY FINDINGS

- As of August 2025, only two third-generation NDCs (Lesotho and Nepal) included targets for transport adaptation. By comparison, six second-generation NDCs had transport adaptation targets.
- A parallel assessment of 22 third-generation NDCs as of June 2025 found that the featured commitments would result in greenhouse gas emissions of 51.1 gigatonnes of CO_2 equivalent by 2035 (around 36% from transport if accounting for the current NDC submissions). Although this represents a reduction of 1.4 gigatonnes of CO_2 equivalent compared to 2030 levels, it is still well above the emission levels required to limit warming to 2 degrees Celsius (°C) (36 gigatonnes) or 1.5°C (25 gigatonnes) by 2035.
- The second generation of NDCs, completed in 2024, comprised 154 submissions (153 countries plus the 27-member European Union), enabling a complete picture of countries' transport climate actions to 2030.
- Studies from October 2024 found that the commitments in second-generation NDCs were insufficient to meet the Paris Agreement target of keeping global warming to 2°C and were still far from achieving the 1.5°C limit. The ambitions in second-generation NDCs would still result in global warming of 2.1°C to 2.8°C by the end of the century, depending on underlying assumptions and major uncertainties. Even if all NDC commitments were implemented, the carbon budget to stay within 1.5°C would be used up by 2032.

Long-Term Low Emission Development Strategies under the Paris Agreement

- As of August 2025, 78 LT-LEDS (Long-Term Low Emission Development Strategies) had been submitted to the UNFCCC; however, only 3 were from low-income countries (Burkina Faso, Ethiopia and Gambia), indicating an ongoing gap among countries in laying out their long-term climate ambitions.
- A total of 21 LT-LEDS (27%) were submitted in 2023 and 2024, with 4 more (Burkina Faso, Equatorial Guinea, Lebanon and Peru) submitted in 2025 (as of August). All of the LT-LEDS submitted between 2023 and August 2025 featured transport actions.
- Among the 78 LT-LEDS submitted as of August 2025, 23 (30%) outlined transport greenhouse gas mitigation targets. New LT-LEDS with transport emission targets were from Armenia, Belize, Burkina Faso, Ireland, Nigeria, Oman, Peru, Serbia, Solomon Islands, the United Arab Emirates and Vanuatu.
- Only 19 of the 78 LT-LEDS as of August 2025 (24%) featured transport adaptation actions, including 9 LT-LEDS submitted between 2023 and August 2025.
- The ambition levels in countries' LT-LEDS are not sufficient to meet all global warming goals under the Paris Agreement. An assessment of the 68 LT-LEDS



KEY FINDINGS

submissions as of 25 September 2023 found that even if all of the actions were fully implemented and delivered on time, the greenhouse gas emissions from submitting countries would fall only 63% below 2019 levels by 2050.

- A key shortcoming of NDCs and LT-LEDS is the delayed timing of emission reductions: as of 2023, two-thirds of the planned reductions were for the period 2030-2050, making it impossible to remain within the 1.5°C global warming limit as the carbon budget to stay within 1.5°C would be used up by 2032.

Commitments and initiatives at recent United Nations climate conferences

- The 2021 UN Climate Change Conference in Glasgow, United Kingdom (COP 26) kicked off an unprecedented number of commitments and initiatives on sustainable, low-carbon transport. These efforts have continued to develop and grow, with every subsequent UN Climate Change Conference adding new initiatives or multilateral agreements.
- In the lead-up to the 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28), a group of organisations launched a call to double the share of energy-efficient and fossil-free forms of land transport by 2030, with the goal of fossil-free land transport by 2050. The call to action attracted more than 60 multi-stakeholder signatories (including Chile and Colombia) and emphasised shifts towards public transport, walking, cycling, and rail freight, as well as electric vehicles and railways, while drastically scaling up the use of renewable and zero-emission energy sources.
- Building on the call to action and other multi-stakeholder efforts, the Climate Champions Team launched the Avoid and Shift Breakthrough at the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29).
- Since COP 28, Colombia, Costa Rica and Nigeria have signed the ZEV Declaration of the Accelerating to Zero Coalition (A2Z).
- During 2023 and 2024, five new countries – Cabo Verde, Ethiopia, Ghana, Mozambique and Seychelles – joined the Global MOU, committing to 30% sales of zero-emission new trucks and buses by 2030 and 100% by 2040.
- Transport initiatives launched during COP 28 included: the Alliance for Cycling and Walking Towards International Vitality (ACTIVE), the Call to Action for Transformative Urban Planning / 15MC (15-minute cities), Cargo Owners for Zero Emission Vessels (coZEV), the Coalition for High Ambition Multilevel Partnerships (CHAMP), the Future is Public Transport Coalition and the Green Maritime Africa Coalition (GMAC).
- At COP 28, the UN Climate Change High-Level Champions and the Marrakech Partnership for Global Climate Action released the 2030 Climate Solutions, which laid out near-term milestones and actions for various sectors (including transport) and enablers (finance, technology, planning and capacity building).

National Adaptation Plans under the UNFCCC

- National Adaptation Plans (NAPs) were initially developed as a tool for least developed and developing countries to identify, address and review their priorities, actions and activities on climate change adaptation. Burkina Faso and Cameroon submitted the first NAPs to the UNFCCC in October 2015, and since 2023 high-income countries have also been invited to submit NAPs.
- Unlike NDCs, which are time-bound, NAPs offer greater flexibility in setting out adaptation strategies, including in the transport sector, which is highly vulnerable to climate impacts. As of 2019, natural hazards caused around USD 15 billion in direct damages to transport systems annually, mainly in lower-income economies.
- As of 1 August 2025, a total of 74 countries had submitted NAPs, of which 58 (78%) were from low- and middle-income countries. The number of NAPs increased significantly between 2023 and August 2025, with nearly half (48%) of submissions occurring during this period (35 total, including 23 in 2023 and 2024 and 12 in 2025).
- Transport features prominently in many NAPs, with countries outlining activities for enhanced infrastructure resilience and transport system adaptation.

Sendai Framework for Disaster Risk Reduction 2015-2030

- The Sendai Framework for Disaster Risk Reduction 2015-2030 is an agreement to raise a country's resilience against natural hazards and extreme weather events.
- A 2023 mid-term review of the Sendai Framework noted the high unlikelihood of achieving the framework's goals by 2030, given trends in disaster risk reduction and limited progress in achieving other global agreements.
- As of October 2024, a total of 163 countries had reported on the global targets through the Sendai Framework Monitor; 81 countries had reported on all seven targets,

KEY FINDINGS

and 107 countries had reported on all targets related to the UN Sustainable Development Goals (SDGs). None of these assessments highlighted specific insights on transport systems and infrastructure.

Voluntary National Reviews under the 2030 Agenda for Sustainable Development

- The UN 2030 Agenda for Sustainable Development is a cross-cutting, interconnected agenda, wherein the achievement of one of the 17 SDGs is often dependent on the achievement of others. Although no stand-alone SDG is focused on sustainable, low-carbon mobility, the successful implementation of efficient, accessible, affordable, safe, sustainable, and resilient passenger and freight transport services supports the achievement of almost every SDG.
- As of 2025, effectively every country involved in the SDG process had submitted a Voluntary National Review (VNR) and in some cases multiple VNRs.
- Since the first High-Level Political Forum in 2016, countries have reported on transport as a vital sector to implement the SDGs, showcasing on-the-ground implementation and best practices. VNRs from the period 2016-2022 revealed consensus on transport's role as a key contributor to SDG implementation.
- As of mid-2025, only 18% of the SDG targets that had sufficient data coverage (139 out of 169 total targets) were on track to be achieved by 2030; a further 17% showed moderate progress, 31% showed marginal progress, 17% had stagnated, and 18% had regressed below the 2015 baseline.
- Of the SDG targets with sufficient data coverage and most relevant to transport, target 3.6 on reducing road traffic crashes and target 9.1 on access to all-weather roads recorded marginal progress, indicating that significant acceleration is needed. Although the UN data to assess progress on target 11.2 (access to public transport systems) are insufficient, other data show that 52% of the urban population on average had convenient access to public transport during 2020-2022.
- In Africa, analysis from 2023 found that both target 3.6 and target 9.1 had regressed in the region. Overall, Africa had made progress on 13 of the 17 SDGs but was lagging on 4 key goals: SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). Of the 115 SDG targets with sufficient data coverage, only 4 showed moderate progress.
- In the Asia-Pacific region, all SDGs except SDG 13 (Climate Action) recorded progress as of 2024, although at the current pace the region would not achieve all SDGs before 2062. A benchmarking of the transport sector in Asia-Pacific against other regions, based on 20 SDG-related indicators, found that Asia-Pacific performed better in nine indicators.
- For Latin America and the Caribbean, a 2024 study projected that only 23% of the 132 SDG targets with sufficient data coverage would be achieved by 2030. Target 9.1 (the only transport-relevant target that could be assessed in the region due to insufficient data) showed a positive trend but was unlikely to be achieved by 2030.

World Sustainable Transport Day

- The first annual World Sustainable Transport Day, as designated by UN General Assembly resolution A/RES/77/286, was celebrated on 26 November 2023.

United Nations Decade of Sustainable Transport 2026-2035

- The first-ever UN Decade of Sustainable Transport was declared in 2023 through UN General Assembly resolution A/78/148 and runs from 2026 to 2035. SLOCAT advocates for this UN Decade to serve as a global call to action, encouraging and supporting governments, businesses, users, financiers, civil society and academia to accelerate both individual and collaborative efforts in advancing sustainable transport.
- The UN Decade must foster inclusive, co-ordinated and transformative progress to strengthen transport systems and services that are socially inclusive, economically viable, environmentally responsible and resilient.

Context, challenges and opportunities

Expanding efficient, accessible, affordable, safe, sustainable, and resilient passenger and freight transport services is one of the most impactful actions to enable inclusive communities and shared prosperity on a liveable planet, while also advancing global climate, sustainability and resilience goals. Countries will need to accelerate transformation of the transport sector if they wish to achieve the objectives of key international agreements that aim for improved sustainability and resilience by 2030 and decarbonisation by 2050: the Paris Agreement on Climate Change, the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015-2030.

Varying mechanisms under these agreements provide countries with framework pathways for setting their transport ambitions, targets, and actions, and for learning from one other. Under the Paris Agreement, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) (hereafter "countries") are required to submit Nationally Determined Contributions (NDCs) that outline targets and actions to reduce greenhouse gas emissions and adapt to climate change.[1] The year 2025 marks the beginning of a new five-year cycle for NDC submissions (the third cycle so far), with countries developing targets and actions up to 2035. The UNFCCC provides several additional mechanisms for countries to outline their ambitions and plans for climate change mitigation and adaptation – including Long-Term Low-Emission Development Strategies (LT-LEDS or LTS) and National Adaptation Plans (NAPs).[2]

NDCs, LT-LEDS and NAPs are central components for implementing the Paris Agreement's goal of limiting the average global temperature rise to well below 2 degrees Celsius (°C), with efforts to limit warming to 1.5°C.[3] NDCs allow countries to highlight where they need support through climate finance, technical assistance and capacity building. NAPs are a tool to identify, address and review adaptation priorities, actions and activities. To complement NDCs, the Paris Agreement invites (but does not require) countries to formulate and communicate LT-LEDS to help them establish low-carbon trajectories to 2050 and outline how they will achieve decarbonisation of their economies.[4]

Through the Marrakech Partnership for Global Climate Action, the Paris Agreement provides a mechanism for collaboration between national governments and non-Party stakeholders (such as cities, regions, businesses, investors, and civil society, including youth, Indigenous Peoples and local communities).[5] The main mission of the Marrakech Partnership is to strengthen collaboration among these actors to lower emissions and increase resilience against climate impacts, promoting higher ambition to collectively strive for the 1.5 °C temperature goal and a climate-neutral and resilient world.[6]

Countries use so-called Voluntary National Reviews (VNRs) to track their progress (in transport and other areas) towards achieving the UN Sustainable Development Goals (SDGs) under the 2030 Agenda for Sustainable Development.[7]

The Sendai Framework for Disaster Risk Reduction 2015-2030 is an agreement to raise a country's resilience against natural hazards and extreme weather events. The Sendai Framework has the ambition to prevent new and reduce existing disaster risk, increase preparedness for response and recovery, and strengthen resilience by 2030.[8] Progress on implementing the Sendai Framework is captured through its Global Assessment Report.[9]

Overall, countries are not on track to achieve these global agendas. Studies show that implementing the NDCs submitted as of October 2024 could still result in global warming of 2.1°C to 2.8°C by the end of the century, depending on underlying assumptions and major uncertainties.[10] Climate change threatens many infrastructure sectors, with transport facing the most severe potential impacts.[11] Moreover, as of 2025 only 18% of the 139 Sustainable Development Goal (SDG) targets with assessable data were on track to be achieved by the 2030 target year.[12]

Efforts to implement these global agendas – as well as climate, sustainability and resilience efforts in transport – are unfolding at a time of heightened geopolitical tension, domestic challenges in many countries, and increased scrutiny of public spending on climate and sustainability action. In 2024, more than 60 national elections were held worldwide, a record high, with several resulting in the rise of right-wing populist movements that have rolled back domestic climate and sustainability actions in transport.[13] Scepticism of climate science has grown, fuelled by misinformation, political polarisation and heightened resistance to transformative policy changes.

It remains critical to strengthen the linkages between national transport policies and the mechanisms for implementing and tracking progress on the Paris Agreement, the 2030 Agenda and the Sendai Framework. This can help assure that progress towards climate change mitigation and adaptation, as well as sustainability in transport, is anchored in and connected to efforts to achieve social inclusion, shared and resilient prosperity, and health and environmental protection.

National transport policies in support of sustainable, low-carbon transport

National transport policies form the backbone of efforts to transform the transport sector. Countries outline their commitments to transport development through national master plans, infrastructure development strategies and broader economic policy documents. However, not all transport measures support sustainability, resilience or climate action. Similarly, NDCs, LT-LEDS, NAPs and VNRs do not provide a complete picture of transport-related activities in a country.

Reviews of national policies versus NDCs in Asia-Pacific and Latin America and the Caribbean have shown that NDCs are often not aligned to national policies, and that climate-related actions in national transport policies are often not reflected in NDCs.[14] A 2024 review of 25 Asia-Pacific countries found that only 10% of the transport-related climate actions set in national policy documents were also featured in NDCs.[15] Even so, national transport strategies have given growing attention to climate action since the adoption of the Paris Agreement in 2015.[16]

The number of countries with dedicated national strategies for sustainable, zero-emission transport increased between 2023 and 2025. National transport decarbonisation strategies identified since 2023 include the following (see also Module 3. Regional Overviews for country policies by region):

- Brazil's Mobility and Innovation for the Automotive Sector (Mover) programme, launched in 2023, aims to accelerate the transition to low-emission vehicles and to improve the sustainability of domestic manufacturing.[17]
- Ecuador's National Sustainable Urban Mobility Policy 2023-2030 commits to ensuring that passenger and freight transport projects reduce their environmental impact and strive to cut emissions.[18]
- As of February 2024, Ethiopia became the first country in the world to ban imports of fossil fuel vehicles.[19] The country's draft national strategy for electric vehicles was approved in May 2025.[20]
- France's Ecological Plan of 2023 aims to reduce transport greenhouse gas emissions 32% below 2019 levels by 2030, based on 50 levers across different sectors (for transport, the measures focus on electrification, mode shift, car sharing, teleworking, and fuel efficiency, among others).[21]
- In 2023, Ghana launched a National Electric Vehicle Policy that commits to a 35% electric vehicle sales share by 2035 and no new sales or imports of diesel and petrol vehicles by 2045.[22]
- Mexico's 2024 National Strategy of Mobility and Road Safety outlines the transition to accessible, efficient, environmentally friendly and socially inclusive transport systems.[23] Also in 2024, Mexico adopted the National Public Collective Urban Transport Policy (PNTPCU), which aims to promote cleaner alternatives, reduce environmental impact, decrease car dependence, and improve accessibility, sustainability, safety and governance.[24]
- Spain released a Transport Decarbonisation Strategy in 2023, outlining tools and measures to achieve carbon neutrality by 2050 in the transport sector through the Avoid-Shift-Improve[i] framework.[25]
- Thailand's Thirteenth National Economic and Social Development Plan (2023-2027) aims to reduce transport-induced air pollution (particulate matter 2.5) and greenhouse gas emissions 4% annually by 2027.[26]
- In January 2023, the United States released its inter-agency National Blueprint for Transportation Decarbonization, a landmark strategy to drastically reduce transport greenhouse gas emissions towards net zero by 2050. The strategy outlines how to "deliver safe, effective, affordable, and sustainable solutions to existing and emerging challenges" and lays out targets and actions for 2030, 2040 and 2050.[27]
- In March 2025, Uruguay enacted the regulatory framework for its National Sustainable Urban Mobility Policy, which includes reforms to subsidies, taxes and other incentives to align the tax system with sustainable mobility objectives, and aims to advance regulations on energy efficiency and the safety of electric vehicles.[28]
- Viet Nam announced in 2024 a target for 30% of cars and 22% of motorbikes to be electric by 2030.[29] The country's National Programme for Transition to Electric Transport Vehicles outlines a strategic framework and mandates that all road vehicles use electricity or clean energy sources by 2050.[30]

i The Avoid-Shift-Improve framework has been central to sustainable, low-carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

Outcomes of the first Global Stocktake on the implementation of the Paris Agreement

In 2023, the UN Climate Change Conference in Dubai, United Arab Emirates (COP 28) concluded with a decision on the first Global Stocktake (GST) to scale up climate action by 2030 and extend efforts to 2035. The GST highlighted the urgency of decarbonising the transport sector, calling on countries to accelerate efforts towards "the reduction of emissions from road transport on a range of pathways, including through development of infrastructure and rapid deployment of zero- and low-emission vehicles".[31]

The GST underscores the need for integrated strategies that take into account transport demand management; proximity planning; shifts to less polluting transport modes; multi-modal infrastructure and services for public and collective transport, rail, walking, cycling, and freight transport and logistics; and technological innovation for cleaner, safer, more resilient and accessible transport systems. Such strategies are increasingly urgent as transport demand continues to grow and as hundreds of millions of people in low- and middle-income countries seek to gain access to transport services (and therefore to economic opportunities and to basic services such as health care and education). Globally, 1 billion people still lived more than 2 kilometres from an all-weather road as of 2019, and only half of the world's urban population had convenient access to public transport in 2022.[32]

Through the first GST, nearly every country in the world agreed (for the first time) to "transition away" from all fossil fuels to achieve net-zero greenhouse gas emissions.[33] **Other key actions of the first GST that are expected to greatly transform transport include tripling renewable energy capacity, doubling energy efficiency improvements and phasing out inefficient fossil fuel subsidies.**[34]

Such actions are critical given that fossil fuels continue to dominate global energy consumption in the transport sector. In 2023, renewable energy sources (including biofuels and renewable electricity) accounted for only 4.6% of transport energy demand, a share that has barely changed over the past decade.[35] Global energy use for transport grew 20.6% between 2010 and 2023, due to global economic growth, rising personal mobility rates in low- and middle-income economies, increased freight transport volumes, and the continued reliance on energy-intensive transport modes despite efficiency improvements in vehicle technologies.[36] Key steps forward include expanding energy-efficient transport modes and shifting towards widespread electrification.

Nationally Determined Contributions under the Paris Agreement

Under UNFCCC guidelines, countries must submit new or updated climate action plans (Nationally Determined Contributions or NDCs) every five years. Whereas the second generation of NDCs laid out activities until 2030, the third generation of NDCs – to be submitted in 2025 – is expected to strengthen the 2030 targets and actions and to lay out additional content and ambition towards 2035. To ensure progress, every new NDC must be more ambitious than the last. Strengthening NDCs is essential to achieve the goals of the Paris Agreement.

Most countries (95%) missed the initial deadline of 10 February 2025 for submitting third-generation NDCs to the UNFCCC.[37] **The UNFCCC later extended the deadline to September 2025 to give countries more time to outline their climate actions to 2035.**[38] (See Spotlight on Transport Ambition in NDCs 3.0.)

- **As of 1 August 2025, only 29 third-generation NDCs had been submitted to the UNFCCC.** (Note that SLOCAT considers any NDC submission since November 2024 to be a third-generation NDC, regardless of its official title or version number. For example, although Botswana's December 2024 NDC is titled "Second NDC", it was deemed a third-generation submission due to the submission date.[39])
- Niue and Somalia were the only low-income countries to submit a third-generation NDC as of 1 August 2025; additionally, 15 NDCs (51.7%) were from middle-income countries and 12 (41.4%) were from high-income countries.[40]
- The 29 NDC submissions were distributed across regions, with seven NDCs from Europe (24.2%), six from Africa (20.7%), six from Latin America and the Caribbean (20.7%), five from Asia (17.2%), three from Oceania (10.3%) and two from North America (6.9%).[41]

The third-generation NDCs submitted as of August 2025 continued the trend of an increasing share of mitigation targets for transport greenhouse gas emissions within each NDC generation.[42] However, due to the low number of overall submissions, it was difficult to identify trends in third-generation NDCs.

- In total, 34.5% of the third-generation NDCs (10 out of 29) featured mitigation targets for transport emissions; this was up from only 11% of first-generation NDCs (18 out of 169) and 19% of second-generation NDCs (28 out of 154).[43]

- Among the 10 NDCs with transport emission mitigation targets, 4 had unconditional targets[ii], 2 had conditional targets, 1 had a combination of conditional and unconditional targets, and 3 had unclear conditions (Table 1).[44] The target years were 2030 (three countries), 2035 (five countries) and 2050 (two countries).[45]
- Whereas Andorra's second-generation NDC targeted road transport, its third-generation submission refers to domestic transport.[46]
- Between its second- and third-generation NDCs, the United Arab Emirates upgraded its mitigation target from 14% below business-as-usual levels by 2030 to 20% below 2019 levels by 2035.[47]

So far, the third-generation NDCs have embraced a wider portfolio of transport emission mitigation actions but focused heavily on electrification; the 29 NDCs submitted as of August 2025 featured 7.9 transport emission mitigation actions each on average, up 36% from 5.8 actions each on average in the second-generation NDCs.[48]

- Mitigation actions in the third-generation NDCs targeted mainly mode shift and demand management (29.7%, 68 actions) and electrification (27.9%, 64 actions).[49] In contrast, only 6.1% (14) of the mitigation actions addressed domestic and international aviation and shipping, highlighting a gap also seen in second-generation NDCs.[50]
- Electrification continued to gain traction as a viable technological solution, with nearly half of the electrification actions that cited a specific transport mode having a focus on road transport vehicles (mainly bus fleets and passenger cars); however, half of all electrification actions did not explicitly mention a transport mode.[51]

TABLE 1. Mitigation targets for transport greenhouse gas emissions in third-generation NDCs, as of August 2025

Country	Targeted reductions in transport emissions	Type of target
Andorra	50% below business-as-usual levels in domestic transport emissions by 2030	Unclear conditionality
Belize	127 gigagrams of CO_2 equivalent less by 2030 and 312 of CO_2 equivalent less by 2035	Conditional
Botswana	429 gigagrams of CO_2 equivalent less by 2030 (of which 146.78 gigagrams are conditional)	Unconditional, conditional
Marshall Islands	40% below 2010 levels in domestic shipping emissions by 2030 and complete decarbonisation by 2050	Unclear conditionality
Nepal	1,426.22 gigagrams of CO_2 equivalent less by 2030 and 2,731.57 gigagrams of CO_2 equivalent less by 2035	Conditional
Republic of Moldova	52% below 1990 levels by 2030	Unconditional
Saint Lucia	22% below 2010 levels by 2035 in transport and energy	Unconditional
Somalia	33% below business-as-usual levels by 2035	Unclear conditionality
Switzerland	41% below 1990 levels by 2035, 57% by 2040 and 100% by 2050	Unconditional
United Arab Emirates	20% below 2019 levels by 2035, reaching 24.2 million tonnes of CO_2 equivalent	Unconditional

Source: See endnote 44 for this section.

ii When a target or action is indicated as unconditional in an NDC, a country can pursue it without international support. In contrast, conditional targets or actions require international, external support in the form of financial assistance, capacity building or technology transfer. (See Spotlight on Transport Ambition in NDCs 3.0 for detailed explanations of UNFCCC terms.)

As of August 2025, only two third-generation NDCs (Lesotho and Nepal) included targets for transport adaptation.[52] By comparison, six second-generation NDCs had transport adaptation targets (Antigua and Barbuda, Burundi, Cambodia, Kenya, Liberia and Papua New Guinea), although Kenya was the only one of these countries to later submit a third-generation NDC (as of mid-2025).[53] Adaptation targets relate to climate-proof infrastructure as well as the deployment of public transport, walking and cycling to support more robust and resilient transport systems.[54]

- Lesotho's NDC sets a target to strengthen standards to climate-proof roads and critical public infrastructure, with 10 climate-proof codes to be revised by 2025.[55]
- In its NDC, Nepal aims to embed climate-resilient planning for transport infrastructure projects in revised regulations and to equip all major highways with early warning systems by 2030.[56]

A parallel assessment of 22 third-generation NDCs as of June 2025 found that the featured commitments would result in greenhouse gas emissions of 51.1 gigatonnes of CO_2 equivalent by 2035 (around 36% from transport if accounting for the current NDC submissions).[57] Although this represents a reduction of 1.4 gigatonnes of CO_2 equivalent compared to 2030 levels, it is still well above the emission levels required to limit warming to 2°C (36 gigatonnes) or 1.5°C (25 gigatonnes) by 2035.[58]

The second generation of NDCs, completed in 2024, comprised 154 submissions (153 countries plus the 27-member European Union, EU), enabling a complete picture of countries' transport climate actions to 2030.[59] These NDCs featured major improvements in target setting for transport greenhouse gas emission mitigation as well as other transport targets. Second-generation NDCs also initiated the greater focus on electrification and the stronger role for transport adaptation.[60]

Studies from October 2024 found that the commitments in second-generation NDCs were insufficient to meet the Paris Agreement target of keeping global warming to 2°C and were still far from achieving the 1.5°C limit.[61] The ambitions in second-generation NDCs would still result in global warming of 2.1°C to 2.8°C by the end of the century, depending on underlying assumptions and major uncertainties.[62] Even if all NDC commitments were implemented, the carbon budget to stay within 1.5°C would be used up by 2032.[63] The 2024 UNFCCC NDC Synthesis Report noted a large gap between the ambition levels of second-generation NDCs (considering both unconditional and conditional targets) and required emission reductions. For 2030, the gap totalled 11.3 gigatonnes of CO_2 equivalent to meet the 2°C scenario and 19.2 gigatonnes of CO_2 equivalent to meet the 1.5°C scenario.[64]

Long-Term Low Emission Development Strategies under the Paris Agreement

As of August 2025, 78 LT-LEDS had been submitted to the UNFCCC; however, only 3 were from low-income countries (Burkina Faso, Ethiopia and Gambia), indicating an ongoing gap among countries in laying out their long-term climate ambitions.[65]

- The majority of LT-LEDS submissions (38%) were from European countries, which included submissions from the EU overall and from 19 individual EU Member States.[66]
- Of the 78 total submissions, 38 were from middle-income countries and 36 were from high-income countries, together comprising 95% of submissions.[67]

A total of 21 LT-LEDS (27%) were submitted in 2023 and 2024, with 4 more (Burkina Faso, Equatorial Guinea, Lebanon and Peru) submitted in 2025 (as of August).[68] All of the LT-LEDS submitted between 2023 and August 2025 featured transport actions.

- Eleven countries submitted their first LT-LEDS in 2023: Belize, Bhutan, Bosnia and Herzegovina, Cyprus, Ethiopia, Georgia, Ireland (updated in 2024), Oman, Solomon Islands, Sri Lanka (updated in 2024) and Vanuatu.[69]
- Seven countries submitted LT-LEDS in 2024: Armenia, Equatorial Guinea, Kazakhstan, Panama, Serbia, Türkiye and the United Arab Emirates.[70]
- Although no formal update process exists for LT-LEDS under the UNFCCC, four countries submitted updated strategies or status updates in 2023 and 2024: Australia, Ireland, Nigeria and Sri Lanka.[71]
- In 2025, Burkina Faso, Lebanon and Peru submitted their first LT-LEDS, and Equatorial Guinea updated its LT-LEDS from 2024; Switzerland added its third-generation NDC as a supplement to its LT-LEDS.[72]

Among the 78 LT-LEDS submitted as of August 2025, 23 (30%) outlined transport greenhouse gas mitigation targets (Table 2)**.[73] New LT-LEDS with transport emission targets were from Armenia, Belize, Burkina Faso, Ireland, Nigeria, Oman, Peru, Serbia, Solomon Islands, the United Arab Emirates and Vanuatu.[74]** In their LT-LEDS submissions, Belize, Ireland, Oman and the United Arab Emirates commit to achieving carbon neutrality or net zero transport greenhouse gas emissions by 2050.[75]

Only 19 of the 78 LT-LEDS as of August 2025 (24%) featured transport adaptation actions, including 9 LT-LEDS submitted between 2023 and August 2025.[76] Most countries continued to disregard synergies between decarbonisation and adaptation. In contrast, 55% of the third-generation NDCs

TABLE 2. LT-LEDS transport targets submitted by countries as of August 2025

LT-LEDS	Targeted reductions in CO_2-equivalent transport emissions
Armenia	4,492 gigagrams (or 2,769 gigagrams in a high-ambition scenario) annually by 2050
Australia	Net zero by 2050
Belgium	Zero emissions for passenger and freight transport by 2050
Belize	Carbon neutrality (95% below 2050 business as usual)
Burkina Faso	41.1% below 2050 business as usual
The Gambia	From 1,026 gigagrams in 2020 to 315 gigagrams in 2050
Germany	40-42% below 1990 levels by 2030 (reductions of around 95-98 million tonnes)
Ireland	6 million tonnes of CO_2 equivalent annually by 2030 (50% below 2018 levels); carbon neutral by 2050
Lithuania	At least 14% below 2005 levels by 2030; 90% by 2050
New Zealand	Net zero by 2050
Nigeria	Limit growth to 224 million tonnes of CO_2 equivalent (gas economy scenario) or 107 million tonnes of CO_2 equivalent (renewable energy scenario) by 2060
Oman	3% below 2021 levels by 2030; 34% by 2040; 100% by 2050
Peru	41% for land freight transport and 11% for rail transport below 2019 baseline by 2050*
Portugal	43-46% below 2005 levels by 2030; 84-85% by 2040; 98% by 2050
Serbia	Limit emission growth to 10% to 2030; reduce emissions 30-54% by 2050 (range of 4,731-3,091 kilotonnes of CO_2 equivalent)
Slovenia	90-99% below 2005 levels by 2050
Solomon Islands	40% of domestic shipping emissions by 2030; 100% by 2050
Spain	30% below business as usual by 2030
Sweden	70% below 2010 levels by 2030 (excluding domestic aviation)
Switzerland	Zero domestic land transport emissions by 2050 (with few exceptions); net zero international aviation emissions by 2050
United Arab Emirates	1% below 2019 levels by 2030 (42 million tonnes of CO_2 equivalent); 40% by 2040 (25 million tonnes of CO_2 equivalent); 100% by 2050 (zero emissions)
United Kingdom	Net zero domestic aviation and shipping emissions by 2050
Vanuatu	50% below business as usual by 2050

*** The sub-sectoral target in Peru's LT-LEDS lacks clarity and is subject to error.**

Source: See endnote 73 for this section.

submitted as of August 2025 and 42% of all second-generation NDCs featured transport adaptation.[77]

- Nigeria's updated 2024 LT-LEDS contains a comprehensive set of adaptation measures, including the provision of several transport options to strengthen the system, and goals to improve public and private investments in climate-proofed and resilient transport infrastructure.[78]
- Türkiye's 2024 LT-LEDS outlines detailed transport adaptation and infrastructure resilience actions. They include implementing design and technical engineering approaches to enhance the preparedness and resilience of critical infrastructure; ensuring flood protection for railways and maritime transport; establishing early warning systems by installing weather sensors along major transport routes; and using dedicated bus lanes in cities for emergency services.[79]

The ambition levels in countries' LT-LEDS are not sufficient to meet all global warming goals under the Paris Agreement. An assessment of the 68 LT-LEDS submissions as of 25 September 2023 found that even if all of the actions were fully implemented and delivered on time, the greenhouse gas emissions from submitting countries would fall only 63% below 2019 levels by 2050.[80] Overall, a lack of clarity remains regarding the scope and coverage of long-term goals outlined in LT-LEDS.

A key shortcoming of NDCs and LT-LEDS is the delayed timing of emission reductions: as of 2023, two-thirds of the planned reductions were for the period 2030-2050, making it impossible to remain within the 1.5°C global warming limit as the carbon budget to stay within 1.5°C would be used up by 2032.[81] The combined ambition from LT-LEDS and long-term targets in NDCs would result in estimated economy-wide per capita greenhouse gas emissions of 2.3 tonnes of CO_2 equivalent by 2050.[82] While this is consistent with scenarios limiting warming to below 2°C (with 67% probability), it exceeds the level compatible with the 1.5°C limit (1.3 tonnes per person by 2050).[83]

Commitments and initiatives at recent United Nations climate conferences

The 2021 UN Climate Change Conference in Glasgow, United Kingdom (COP 26) kicked off an unprecedented number of commitments and initiatives on sustainable, low-carbon transport.[84] These efforts support countries' climate ambitions through non-binding actions and agreements. Transport initiatives included the Breakthrough Agenda on Transport, the Clydebank Declaration for Green Shipping Corridors, the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU), the International Aviation Climate Ambition Coalition and the Zero Emission Vehicles Declaration (which later became the Accelerating to Zero Coalition at COP 27).[85]

These efforts have continued to develop and grow, with every subsequent UN Climate Change Conference adding new initiatives or multilateral agreements. A comprehensive review of transport initiatives launched at UN climate conference events identified 19 such initiatives as of December 2024.[86] Key developments in 2023 and 2024 included the following:

- **In the lead-up to the 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28), a group of organisations launched a call to double the share of energy-efficient and fossil-free forms of land transport by 2030, with the goal of fossil-free land transport by 2050.**[87] **The call to action attracted more than 60 multi-stakeholder signatories (including Chile and Colombia) and emphasised shifts towards public transport, walking, cycling, and rail freight, as well as electric vehicles and railways, while drastically scaling up the use of renewable and zero-emission energy sources.**[88] While each country will adopt a nationally determined approach, the call outlines a series of universal enablers to meet this target. The call to action was issued by SLOCAT and REN21, jointly with the Institute for Sustainable Development and International Relations (IDDRI), the Institute for Transportation and Development Policy (ITDP), the International Union of Railways (UIC), the International Association of Public Transport (UITP) and the World Resources Institute (WRI).



- **Building on the call to action and other multi-stakeholder efforts, the Climate Champions Team launched the Avoid and Shift Breakthrough at the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29).**[89] The Breakthrough features the same doubling goal for land transport and seeks to strengthen transport

targets that focus on "Avoid" and "Shift" measures in complementarity with other initiatives that favour "Improve" measures.[90]

- **Since COP 28, Colombia, Costa Rica and Nigeria have signed the ZEV Declaration of the Accelerating to Zero Coalition (A2Z)**, which aims for all sales of new cars and vans to be zero emission globally by 2040 and in leading markets by 2035.[91]
- **During 2023 and 2024, five new countries – Cabo Verde, Ethiopia, Ghana, Mozambique and Seychelles – joined the Global MOU, committing to 30% sales of zero-emission new trucks and buses by 2030 and 100% by 2040.**[92]
- **Transport initiatives launched during COP 28 included: the Alliance for Cycling and Walking Towards International Vitality (ACTIVE), the Call to Action for Transformative Urban Planning / 15MC (15-minute cities), Cargo Owners for Zero Emission Vessels (coZEV), the Coalition for High Ambition Multilevel Partnerships (CHAMP), the Future is Public Transport Coalition and the Green Maritime Africa Coalition (GMAC).**[93]

At COP 28, the UN Climate Change High-Level Champions and the Marrakech Partnership for Global Climate Action released the 2030 Climate Solutions, which laid out near-term milestones and actions for various sectors (including transport) and enablers (finance, technology, planning and capacity building).[94] Targets from previous initiatives as well as the Breakthrough Agenda were compiled through this process (Table 3).[95]

TABLE 3. 2030 Climate Solutions for Transport

Transport area	2030 targets	Reference
Road transport (passenger vehicles and vans)	Zero-emission vehicles (ZEV) are the new normal – accessible, affordable and sustainable in all regions by 2030. ZEVs make up 100% of all global passenger vehicles and vans sales by 2030 (in key markets).	Breakthrough Agenda 2030 Breakthroughs
Road transport (buses and heavy-duty vehicles)	ZEVs are the new normal – accessible, affordable and sustainable in all regions by 2030. Battery electric vehicles (and fuel cell electric vehicles) make up 60% of global bus sales and 35-40% of global heavy goods vehicle sales by 2030.	Breakthrough Agenda 2030 Breakthroughs
Resilient transport	Transport infrastructure is resilient to climate hazards through the adoption of new technology, design and materials.	Sharm El Sheikh Adaptation Agenda
Green shipping	Zero-emission fuels make up at least 5% (aiming for 10%) of international shipping fuels and 15% of domestic shipping fuels by 2030.	2030 Breakthroughs
Resilient shipping	450,000 seafarers receive upskilling and retraining by 2030. 30% of trade moves through climate-adapting ports by 2030.	2030 Breakthroughs
Aviation	Sustainable aviation fuels (SAF) make up 13-15% of fuels globally by 2030.	2030 Breakthroughs
Avoid and shift	Double the share of energy-efficient and fossil-free land transport for people and goods, with a focus on shifts to public transport, walking, cycling, and rail freight, as well as electric vehicles and railways.	2030 Breakthroughs
Transport accessibility and affordability	Target still being developed.	Sharm El Sheikh Adaptation Agenda 2030 Breakthroughs

Source: See endnote 95 for this section.

National Adaptation Plans under the UNFCCC

National Adaptation Plans (NAPs) were initially developed as a tool for least developed and developing countries to identify, address and review their priorities, actions and activities on climate change adaptation.[96] **Burkina Faso and Cameroon submitted the first NAPs to the UNFCCC in October 2015, and since 2023 high-income countries have also been invited to submit NAPs.**[97] The NAP process predates the Paris Agreement, having been established at the 2010 UN Climate Change Conference in Cancun, Mexico (COP 16).[98] (See Spotlight on Transport in NAPs.)

Unlike NDCs, which are time-bound, NAPs offer greater flexibility in setting out adaptation strategies, including in the transport sector, which is highly vulnerable to climate impacts. As of 2019, natural hazards caused around USD 15 billion in direct damages to transport systems annually, mainly in lower-income economies. (See 1.4 Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies.)

As of 1 August 2025, a total of 74 countries had submitted NAPs, of which 58 (78%) were from low- and middle-income countries.[99] **The number of NAPs increased significantly between 2023 and August 2025, with nearly half (48%) of submissions occurring during this period (35 total, including 23 in 2023 and 2024 and 12 in 2025).**[100] With the exceptions of Burkina Faso and Uruguay, all were first-time NAP submissions, meaning that one in three NAPs was submitted in this three-year period.

- Submissions from low- and middle-income countries in 2025 came from Burkina Faso, Jordan and Mongolia.[101]
- New submissions from high-income countries between January and 1 August of 2025 included Antigua and Barbuda, Austria, Finland, Germany, Ireland, Israel, the Netherlands, the United Kingdom and the United States.[102]

Transport features prominently in many NAPs, with countries outlining activities for enhanced infrastructure resilience and transport system adaptation, as seen in examples from 2023 to mid-2025**.**

- In Africa, Burkina Faso and Burundi are investing in climate-resilient infrastructure and road network maintenance, and Mozambique and Morocco are integrating risk assessments and resilience planning into national strategies.[103]
- In Asia, Bhutan and the Philippines have laid out detailed transport-related actions, including climate-resilient road development and the integration of climate risk into infrastructure planning.[104]
- Moldova and Serbia in Europe have developed comprehensive approaches that include updated technical standards, climate-proofing of transport assets and institutional reforms.[105]
- In Latin America and the Caribbean, Argentina and Haiti are enhancing infrastructure resilience and promoting low-emission, adaptive transport systems.[106]
- North American submissions highlight transport-specific risks such as melting ice roads in Canada and systemic resilience strategies in the United States.[107]
- In Oceania, NAPs from New Zealand and Papua New Guinea focus on embedding resilience into land transport systems and updating infrastructure codes.[108]



Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 is an agreement to raise a country's resilience against natural hazards and extreme weather events. It aims to prevent new and reduce existing disaster risk, increase preparedness for response and recovery, and strengthen overall resilience.[109]

A 2023 mid-term review of the Sendai Framework noted the high unlikelihood of achieving the framework's goals by 2030, given trends in disaster risk reduction and limited progress in achieving other global agreements (such as the 2030 Agenda, the Paris Agreement and the Global Biodiversity Framework)**.**[110] **As of October 2024, a total of 163 countries had reported on the global targets through the Sendai Framework Monitor** (Box 1)**; 81 countries had reported on all seven targets, and 107 countries had reported on all targets related to the UN Sustainable Development Goals (SDGs).**[111] **None of these assessments highlighted specific insights on transport systems and infrastructure.**

Box 1. Global targets of the Sendai Framework for Disaster Risk Reduction 2015-2030

Target A: Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 people for 2020-2030 compared to 2005-2015.

Target B: Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 people for 2020-2030 compared to 2005-2015.

Target C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.

Target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.

Target E: Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.

Target F: Substantially enhance international co-operation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.

Target G: Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

Source: See endnote 111 for this section.

In June 2025, at the eighth session of the Global Platform for Disaster Risk Reduction (the first session since the mid-term review), participants highlighted that global mortality has halved over the past 25 years and that reporting on national and local disaster risk reduction strategies has doubled.[112] The session concluded with the Geneva Call for Disaster Risk Reduction, asking for more concrete actions in the next five years to sustain progress and to achieve the Sendai Framework 2030.[113]

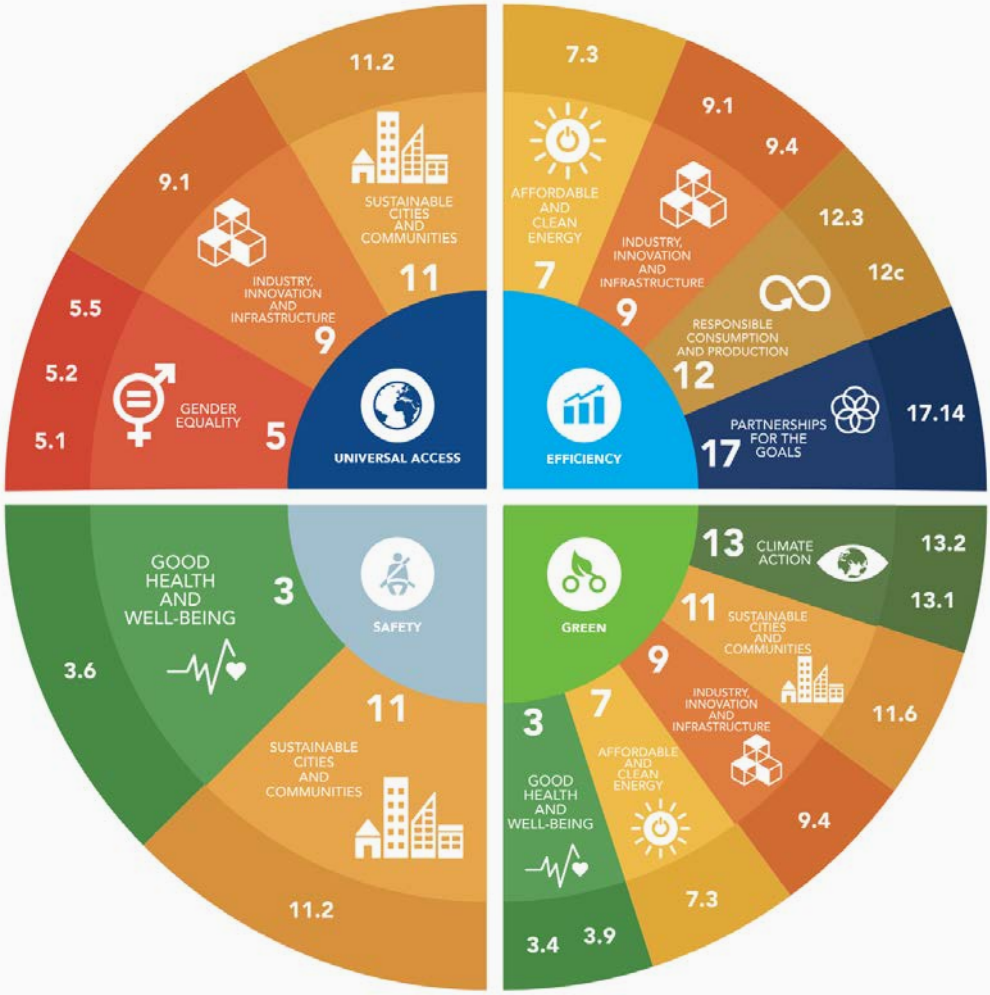
Voluntary National Reviews under the 2030 Agenda for Sustainable Development

The UN 2030 Agenda for Sustainable Development is a cross-cutting, interconnected agenda, wherein the achievement of one of the 17 Sustainable Development Goals is often dependent on the achievement of others. Although no stand-alone SDG is focused on sustainable, low-carbon mobility, the successful implementation of efficient, accessible, affordable, safe, sustainable, and resilient passenger and freight transport services supports the achievement of almost every SDG.[114] Out of the 169 SDG targets, only 3 relate directly to transport (target 3.6 on road safety, target 9.1 on access to all-weather roads and target 11.2 on public transport access); however, another 15 targets relate indirectly to transport, and adequate transport action can contribute to their achievement .[115]

As of 2025, effectively every country involved in the SDG process had submitted a Voluntary National Review (VNR) and in some cases multiple VNRs. The 2030 Agenda encourages UN Member States to submit VNRs to the annual UN High-Level Political Forum on Sustainable Development. The VNR process facilitates sharing of successes and challenges, with a view towards accelerating implementation of the 2030 Agenda. Overall, more than 406 VNRs had been submitted by 190 countries and the EU as of 2025, including 39 in 2023, 36 in 2024 and 37 in 2025.[116] A total of 152 countries had reported twice or more times on their sustainable actions in support of the 2030 Agenda.[117]

Since the first High-Level Political Forum in 2016, countries have reported on transport as a vital sector to implement the SDGs, showcasing on-the-ground implementation and best practices. VNRs from the period 2016-2022 (during which SLOCAT conducted annual assessments of VNRs) **revealed consensus on transport's role as a key contributor to SDG implementation.**[118] This role was consistent throughout the years, with only minor deviations depending on which SDG was the focus of the High-Level Political Forum in a particular year.

FIGURE 1. Relevant SDG targets for transport



Source: See endnote 115 for this section.

- More than 90% of the VNR submissions highlighted progress in the transport sector, indicating that transport was well featured in countries' sustainability activities across all regions and income groups.[119]
- Around a fifth of VNRs between 2016 and 2022 reported specific targets to advance sustainable transport, with the majority of targets aimed at the short to medium terms (2020 and 2030).[120] Targets were focused on electrification, freight, road safety, and renewable energy, among others.[121]
- Palau's 2024 VNR outlined challenges in reducing dependency on private motor vehicles. In 2024, the country launched an initiative to introduce electrified public transport and to encourage walking and cycling.[122]
- Rwanda's 2023 VNR commits to establishing inclusive transport infrastructure, including increasing the share of the population with access to all-weather roads and convenient public transport. As rural roads have been paved, urban roads have been upgraded with considerations for walking, cycling and the mobility needs of persons with disabilities.[123]
- The 2023 VNR by Uzbekistan highlights transport activities related to SDG 9 (Industry, Innovation and Infrastructure) and SDG 11 (Sustainable Cities and Communities). The country intends to improve inter-city travel, increase the share of electrified railway to 60%, expand public transport (networks, facilities and services) and increase cross-country freight performance.[124]



Benchmarking progress on SDGs, globally and regionally

As of mid-2025, only 18% of the SDG targets that had sufficient data coverage (139 out of 169 total targets) were on track to be achieved by 2030; a further 17% showed moderate progress, 31% showed marginal progress, 17% had stagnated, and 18% had regressed below the 2015 baseline.[125] **Of the SDG targets with sufficient data coverage and most relevant to transport, target 3.6 on reducing road traffic crashes and target 9.1 on access to all-weather roads recorded marginal progress, indicating that significant acceleration is needed. Although the UN data to assess progress on target 11.2 (access to public transport systems) are insufficient, other data show that 52% of the urban population on average had convenient access to public transport during 2020-2022** (see Module 3 Regional Overviews and 4.5 Public Transport).[126]

- **In Africa, analysis from 2023 found that both target 3.6 and target 9.1 had regressed in the region.**[127] **Overall, Africa had made progress on 13 of the 17 SDGs but was lagging on 4 key goals: SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).**[128] **Of the 115 SDG targets with sufficient data coverage, only 4 showed moderate progress.**[129]
- **In the Asia-Pacific region, all SDGs except SDG 13 (Climate Action) recorded progress as of 2024, although at the current pace the region would not achieve all SDGs before 2062.**[130] **A benchmarking of the transport sector in Asia-Pacific against other regions, based on 20 SDG-related indicators, found that Asia-Pacific performed better in nine indicators** (transport energy intensity, road transport nitrogen oxide emissions, road fatalities, multi-hazard exposure, railway infrastructure, road infrastructure, gross value-added by transport, growth in renewable energy and access to all-weather roads for the rural population). Other regions outperformed Asia-Pacific in indicators such as power grid carbon intensity, air pollution, energy consumption, bus imports, transport employment, access to public transport, removal of fossil fuel subsidies and imports of electric vehicles.[131]
- **For Latin America and the Caribbean, a 2024 study projected that only 23% of the 132 SDG targets with sufficient data coverage would be achieved by 2030.**[132] **Target 9.1 (the only transport-relevant target that could be assessed in the region due to insufficient data) showed a positive trend but was unlikely to be achieved by 2030.**[133] Overall, 64% of the targets indicated positive trends, while 41% of target-related measures required accelerated progress.[134]

World Sustainable Transport Day

The first annual World Sustainable Transport Day, as designated by UN General Assembly resolution A/RES/77/286, was celebrated on 26 November 2023. The event recognises the "important role of safe, affordable, accessible and sustainable transport systems for all in supporting sustainable economic growth, improving the social welfare of people and enhancing international cooperation and trade among countries".[135]



United Nations Decade of Sustainable Transport 2026-2035

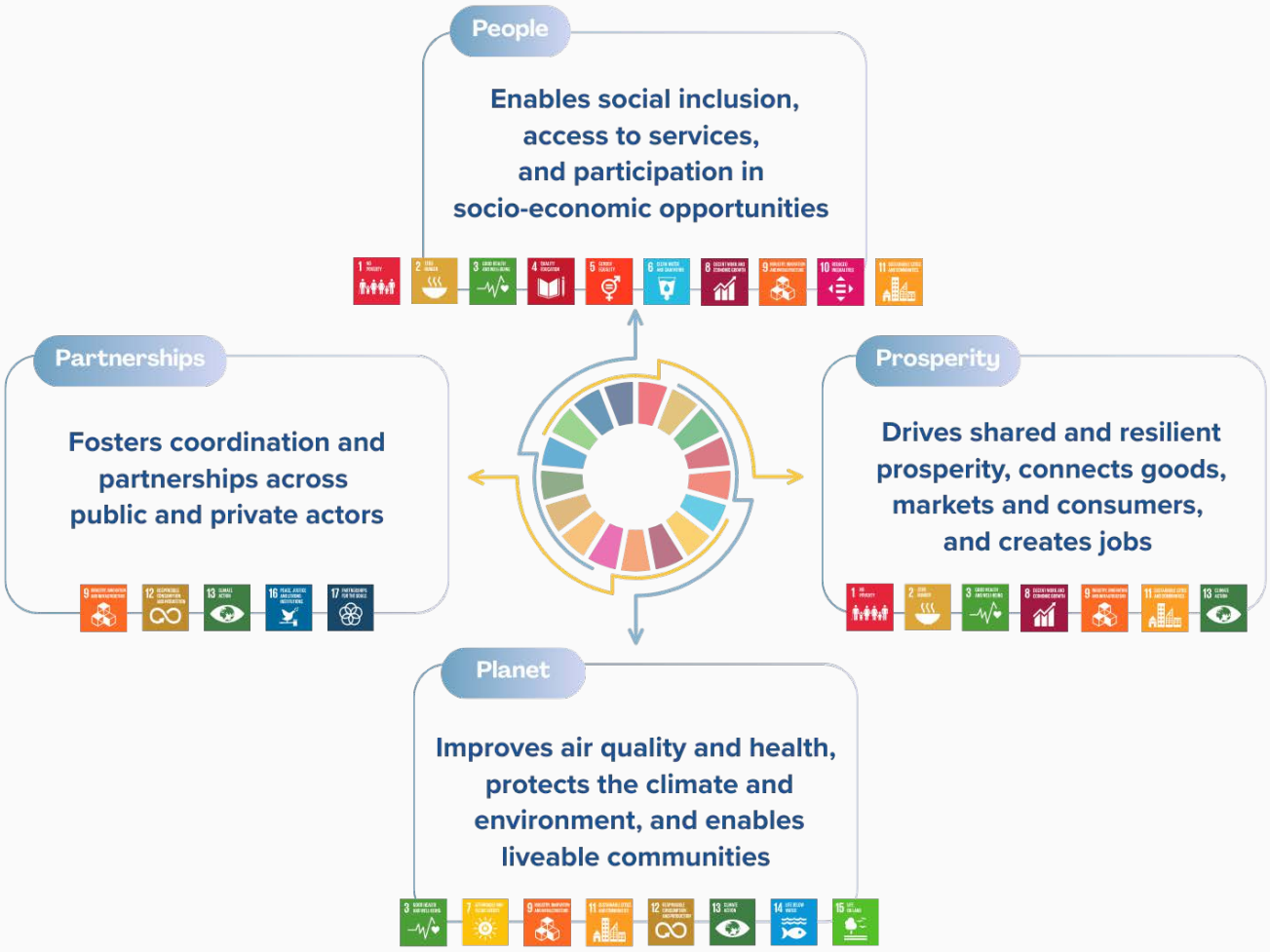
The first-ever UN Decade of Sustainable Transport was declared in 2023 through UN General Assembly resolution A/78/148 and runs from 2026 to 2035. SLOCAT advocates for this UN Decade to serve as a global call to action, encouraging and supporting governments, businesses, users, financiers, civil society and academia to accelerate both individual and collaborative efforts in advancing sustainable transport. The UN Decade must foster inclusive, co-ordinated and transformative progress to strengthen transport systems and services that are socially inclusive, economically viable, environmentally responsible and resilient (Figures 2 and 3).[136]

FIGURE 2. What can the UN Decade of Sustainable Transport achieve by 2035?

1. All actors are aligned behind a forward-looking vision, working together to deliver context-specific action
2. National and sub-national governments and businesses have policymaking, organisational, and technical capacities and skills to develop and implement integrated frameworks, particularly in low- and middle-income countries (LMICs)
3. Public and private investments, and revenue streams from transport users are used to fund sustainable transport expansion, particularly in LMICs
4. Reliable, open-access data informs evidence-based policy, investment, evaluation and improvement
5. Strengthened mechanisms across actors and transport modes, between transport and other sectors, and among UN entities are enabling systemic coordination and international multi-stakeholder cooperation

Source: See endnote 136 for this section.

FIGURE 3. Sustainable transport is the lifeline of thriving communities and economies



Source: See endnote 136 for this section.

The UN Department of Economic and Social Affairs, in collaboration with UN Regional Commissions, is tasked with preparing an Implementation Plan for the UN Decade, in consultation with "Member States, specialised agencies, funds, programmes and bodies of the United Nations, as well as other intergovernmental organisations, non-governmental organisations and relevant stakeholders".[137] The UN General Assembly resolution also recognises "the need for continued cooperation and coordination between the United Nations and existing partnerships on sustainable transport issues such as (...) SLOCAT", among others.[138]

Building on the 2024 paper *Inputs to the UN Process,* released in collaboration with the UK-funded High Volume Transport Applied Research Programme, SLOCAT published a paper in May 2025 outlining what the UN Decade of Sustainable Transport can achieve, as well as priority areas and critical levers of change for the coming decade.[139] The paper is intended to support the ongoing work on the UN Implementation Plan for the UN Decade and is informed by discussions from an April 2025 workshop co-organised by SLOCAT, the UK Foreign, Commonwealth and Development Office, and Canada's International Development Research Centre, in collaboration with the FIA Foundation, Kühne Climate Center and WRI. The workshop brought together participants from diverse professional backgrounds, geographies, and transport development contexts, and contributed thought leadership and stakeholder engagement in preparations towards the UN Decade of Sustainable Transport.[140]

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SPOTLIGHT

3.0

Transport Ambition in NDCs 3.0

KEY FINDINGS



- As of August 2025, a total of 29 third-generation NDCs had been submitted to the United Nations Framework Convention on Climate Change (UNFCCC). The submissions were distributed equally across regions when considering the relative number of countries per region. Niue and Somalia were the only low-income countries with a third-generation NDC. NDCs from low- and middle-income countries are important because future transport demand growth is projected to occur mainly in these country income groups.
- The countries that submitted third-generation NDCs as of August 2025 contributed 20.3% of the world's economy-wide greenhouse gas emissions and 36.1% of global transport emissions in 2023 (excluding international aviation and shipping). This high share of transport emissions was driven by major emitters such as Brazil, Canada, Japan, the United Kingdom and the United States.
- Progress has been made in transport target-setting over the three generations of NDCs. Of the third-generation NDCs submitted as of August 2025, 34.5% (10 in total) featured explicit targets for mitigating transport greenhouse gas emissions; this was up from only 11% (18 total) of first-generation NDCs and 19% (28 total) of second-generation NDCs.
- In total, 32 non-greenhouse gas transport targets were included in third-generation NDCs as of August 2025. As with second-generation NDCs, the most common type of non-greenhouse gas transport target was for zero-emission vehicles, accounting for 44% of the total.
- The third-generation NDCs as of August 2025 embraced a wider portfolio of actions for reducing transport emissions than did previous generations, although a strong focus on electrification persisted.
- The full potential of a balanced Avoid-Shift-Improve (A-S-I) framework for mitigating transport emissions remains untapped, as 66% of the transport mitigation actions in third-generation NDCs as of August 2025 focused on "Improve" actions.
- Despite freight transport's large contribution to both transport and overall greenhouse gas emissions, the sector remained overlooked in NDCs, with few of the third-generation NDCs as of August 2025 featuring activities to mitigate these emissions. Freight activity is projected to more than double from 2020 to 2050, bringing rapidly rising emissions from freight transport. The increase in climate-induced disasters threatens global supply chains and freight operations, making it crucial to boost resilience efforts in freight transport and to adapt to changing environments. In a major gap, no third-generation NDCs as of August 2025 included freight transport adaptation actions.
- Only seven of the third-generation NDCs (Belize, Canada, the Marshall Islands, Monaco, Niue, the United Kingdom and the United States) as of August 2025 included specific actions to mitigate emissions from domestic and international aviation and/or shipping. Aviation contributed 14% of global transport greenhouse gas emissions in 2023, while maritime transport was responsible for 8%. In many countries, the growth in aviation-related emissions has outpaced overall emission

KEY FINDINGS

reductions. Decarbonising maritime transport is also seen as crucial, but progress is slow.

- The scope of third-generation NDCs has widened to cover sustainability topics such as a just transition, air quality and public health. Lesotho and the United Kingdom have used third-generation NDCs to reinforce linkages between their climate and broader sustainability commitments.
- Most of the transport actions in third-generation NDCs as of August 2025 did not mention specific transport modes. Where modes were mentioned, the focus was largely on road vehicles. Transport adaptation actions in particular have missed the opportunity to refer to specific modes.
- Only two of the third-generation NDCs as of August 2025 featured transport adaptation targets, both of them from least developed countries (Lesotho and Nepal).
- NDC content on adaptation can draw on NAPs to strengthen the vital connections between mitigation and adaptation efforts, supporting inclusive, low-carbon and resilient connectivity and economic growth. Adaptation and mitigation efforts are mutually reinforcing, as adaptation helps to cope with the unavoidable effects and creates the resilient foundation for mitigation action and sustainable development.
- Sixteen of the third-generation NDCs (55% of the total) as of August 2025 contained transport adaptation actions, an improvement from the 42% of second-generation NDCs with such actions. As with earlier NDCs, the transport adaptation actions in third-generation NDCs had a strong focus on structural and technical actions, followed by institutional and regulatory actions.
- Although it is too early to assess the collective impact of the 29 third-generation NDCs submitted as of 1 August 2025, initial reviews suggest that the ambition remains insufficient to meet the Paris Agreement goal of limiting global warming to 1.5°C. A parallel assessment of 22 third-generation NDCs as of June 2025 found that the new commitments would result in greenhouse gas emissions of 51.1 gigatonnes of CO_2 equivalent by 2035 (around 36% from transport, if accounting for the current NDC submissions). Although this represents a reduction of 1.4 gigatonnes of CO_2 equivalent compared to 2030 levels, it is still well above the emission levels required to limit warming to 2°C (36 gigatonnes) or 1.5°C (25 gigatonnes) by 2035.
- Studies based on NDC submissions as of October 2024 showed that the commitments made in second-generation NDCs were also insufficient to meet the Paris Agreement targets of keeping global warming to 2°C, and were still far from achieving the 1.5°C limits. The ambition levels in second-generation NDCs could result in global warming of 2.1°C to 2.8°C by the end of the century, depending on underlying assumptions and major uncertainties. Even if all NDC commitments of the second-generation NDCs were implemented, the carbon budget to stay within 1.5°C would be used up by 2032.
- As stakeholders collectively work to update and raise ambition in the third generation of NDCs, SLOCAT has developed a five-point plan for transport in third-generation NDCs that outlines key recommendations and related case studies.
- To support stronger transport actions and commitments in third-generation NDCs, specialised transport organisations have developed a range of guiding documents.
- In the lead-up to the 2023 UN Climate Change Conference in Dubai, United Arab Emirates (COP 28), a group of organisations launched a call to double the share of energy-efficient and fossil-free forms of land transport by 2030, with the goal of fossil-free land transport by 2050. The call to action attracted more than 60 multi-stakeholder signatories (including Chile and Colombia) and emphasised shifts towards public transport, walking, cycling, and rail freight, as well as electric vehicles and railways, while drastically scaling up the use of renewable and zero-emission energy sources.
- Building on the call to action and other multi-stakeholder efforts, the Climate Champions Team launched the Avoid and Shift Breakthrough at the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29).



Context, challenges and opportunities

Transport is the second largest and fastest growing sector for greenhouse gas emissions, accounting for 21.9% of global carbon dioxide (CO_2) emissions in 2023, due largely to its high dependence (95.4%) on fossil fuels for energy use.[1] The Intergovernmental Panel on Climate Change (IPCC) has noted that swift action is essential to align the transport sector with the climate goals of the Paris Agreement. To achieve scenarios that limit global warming to 1.5 degrees Celsius (1.5°C), global transport CO_2 emissions must be reduced by at least 59% by 2050, compared to 2020 levels.[2]

The Global Stocktake (GST) on the implementation of the Paris Agreement, agreed at the 2024 United Nations (UN) Climate Change Conference in the United Arab Emirates (COP 28), called on countries to urgently reduce emissions from road transport through a range of pathways, including investing in infrastructure and services as well as scaling up zero- and low-emission vehicles.[3] The GST also asked countries to phase out inefficient fossil fuel subsidies and to transition away from fossil energy use in a just, orderly, and equitable manner, accelerating action in this crucial decade to meet the goal of net zero emissions by 2050.[4]

The year 2025 is a critical opportunity to accelerate the transport sector's key role in achieving climate and sustainability goals and to deliver co-ordinated action for long-lasting impact. Against a shifting geopolitical backdrop, 2025 marks:

- the tenth anniversary of the Paris Agreement;
- the elaboration by countries of new Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, with targets and actions for 2035;
- the five-year countdown to the implementation deadline for the UN Sustainable Development Goals (SDGs) and the IPCC target to reduce economy-wide greenhouse gas emissions 43% to limit global warming to 1.5°C; and
- the eve of the UN Decade of Sustainable Transport 2026-2035, set to start in January 2026.[5]

However, 95% of the Parties to the Paris Agreement missed the initial deadline of 10 February 2025 to submit new NDCs outlining their targets and actions for 2035.[6] Ahead of the November 2025 UN Climate Change Conference in Belém, Brazil (COP 30), countries are expected to have set enhanced targets and actions for 2035 in their new NDCs. Submissions of new NDCs are required by September 2025 to be featured in the NDC Synthesis Report of the UN Framework Convention on Climate Change (UNFCCC).[7] The new NDCs are officially called NDCs 3.0 and are referred to here as "third-generation NDCs" to cover a broader scope, as defined below.

The new NDCs come at a crucial juncture for countries to act on limiting global warming to 1.5°C by advancing ambitious 2035 targets and actions on sustainable, low-carbon transport that align with GST recommendations (Figure 1).[8] The NDCs are also an opportunity for integrated action with national transport strategies, co-ordination across national and sub-national governments, and stronger public-private partnerships for effective implementation over the five-year period 2025-2030.

FIGURE 1. Benefits of robust transport actions in new NDCs



Source: See endnote 8 for this section.

Overview and scope

This spotlight provides a comprehensive assessment of transport in third-generation NDCs, taking into account any submissions up to 1 August 2025. GIZ and SLOCAT will release more detailed assessments covering all NDCs submitted in the run-up to COP 30 in November 2025 and make them accessible in SLOCAT's NDC Library. [9] In this spotlight, any NDCs submitted since November 2024 are considered third-generation NDCs, regardless of the document title or version number (Box 1). This methodology is defined through the NDC Transport Tracker developed by GIZ and SLOCAT, and the NDCs are sourced from the UNFCCC's NDC Registry.[10]

Because the number of submitted third-generation NDCs remains very low – with 29 submissions as of August 2025 – pinpointing clear trends is difficult. This is why the figures included in this spotlight convey both percentage shares and absolute numbers. Where relevant, third-generation NDCs are compared to the first- and second-generation NDCs to identify any progress and persistent gaps in transport ambition.

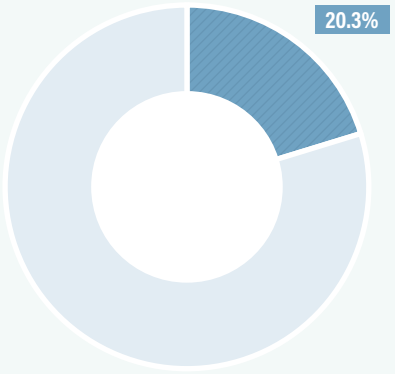


Box 1. Key terms used by NDCs and in this assessment

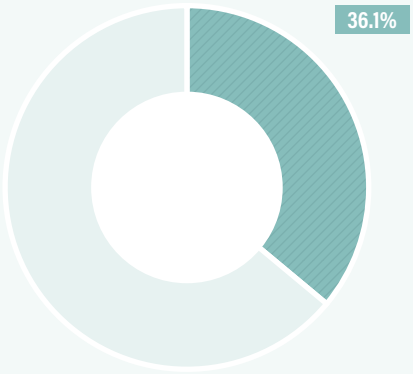
- **Third-generation NDC:** Any NDC submission since November 2024 is regarded as part of the third generation of NDCs. First-generation NDCs refer to the intended NDCs and first ratified NDCs of 2015-2018. Second-generation NDCs, submitted between 2019 and 2024, were mostly updates to a first or second NDC.
- **Conditionality in NDCs:** When a target or action is indicated as *unconditional* in an NDC, a country can pursue it without international support. In contrast, *conditional* targets or actions require international, external support in the form of financial assistance, capacity building or technology transfer.
- **Target:** A *target* is defined as any future commitment that features a quantitative value to be achieved by a certain year. A *non-greenhouse gas target* is a quantified target in an NDC that is not directly aimed at greenhouse gas emissions (for example, a target to shift the amount of goods moved by rail 20% by 2035). Another potential non-greenhouse gas target is an *Avoid target*, which focuses on reducing motorised transport overall (such as reducing the use of private vehicles 15% by 2035 through remote work or compact city planning). An NDC can include multiple non-greenhouse gas targets.
- **Adaptation and mitigation:** Climate action is mainly categorised as mitigation or adaptation. In this assessment, adaptation comprises any activities that a country intends to pursue to adapt to the changing climate and to raise the resilience of transport systems and infrastructure against climate-exacerbated weather events. Mitigation covers any activities to reduce the environmental impact of transport.
- **National Adaptation Plans (NAPs):** NAPs are the main mechanism for low- and middle-income countries to develop adaptation and resilience efforts under the UNFCCC. They were developed specifically for least developed countries at COP 16 in Cancun, Mexico in 2010, although other developing countries also were invited to elaborate NAPs. High-income countries have been invited to develop NAPs since 2023, through a call to all countries in the first outcome of the Global Stocktake. (See Spotlight on Transport in National Adaptation Plans.)

FIGURE 2. Shares of greenhouse gas emissions covered by third-generation NDCs, as of August 2025

Share of total greenhouse gas emissions covered by 29 third-generation NDCs



Share of transport greenhouse gas emissions covered by 29 third-generation NDCs



The countries that submitted third-generation NDCs as of August 2025 contributed 20.3% of the world's economy-wide greenhouse gas emissions and 36.1% of global transport emissions in 2023 (excluding international aviation and shipping). This high share of transport emissions was driven by major emitters such as Brazil, Canada, Japan, the United Kingdom and the United States.

Note: Calculations exclude emissions from international aviation and shipping.

Source: See endnote 17 for this section.

As of August 2025, a total of 29 third-generation NDCs had been submitted to the UNFCCC.[11] The submissions were distributed equally across regions when considering the relative number of countries per region. Niue and Somalia were the only low-income countries with a third-generation NDC.[12] NDCs from low- and middle-income countries are important because future transport demand growth is projected to occur mainly in these country income groups. In previous periods, 169 first-generation NDCs were submitted from 2015 to 2018, and 154 second-generation NDCs were submitted from 2019 to 2024 (not reflecting any revised NDCs within each generation).[13]

- The third-generation submissions as of August 2025 included seven NDCs from Europe (24.2%), six NDCs each (20.7%) from Africa and Latin America and the Caribbean, five from Asia (17.2%), three (10.3%) from Oceania and two (6.9%) from North America.[14]
- Among the 29 total, 15 NDCs (51.7%) were from middle-income countries and 12 (41.4%) were from high-income countries.[15]
- The submissions from least developed countries were from Nepal, Somalia and Zambia.[16]

NDCs are an opportunity to express the need for international support for climate action. Low- and middle-income countries benefit from submitting new NDCs outlining conditional targets and actions because it could increase their access to international climate finance, technical assistance and co-operation.

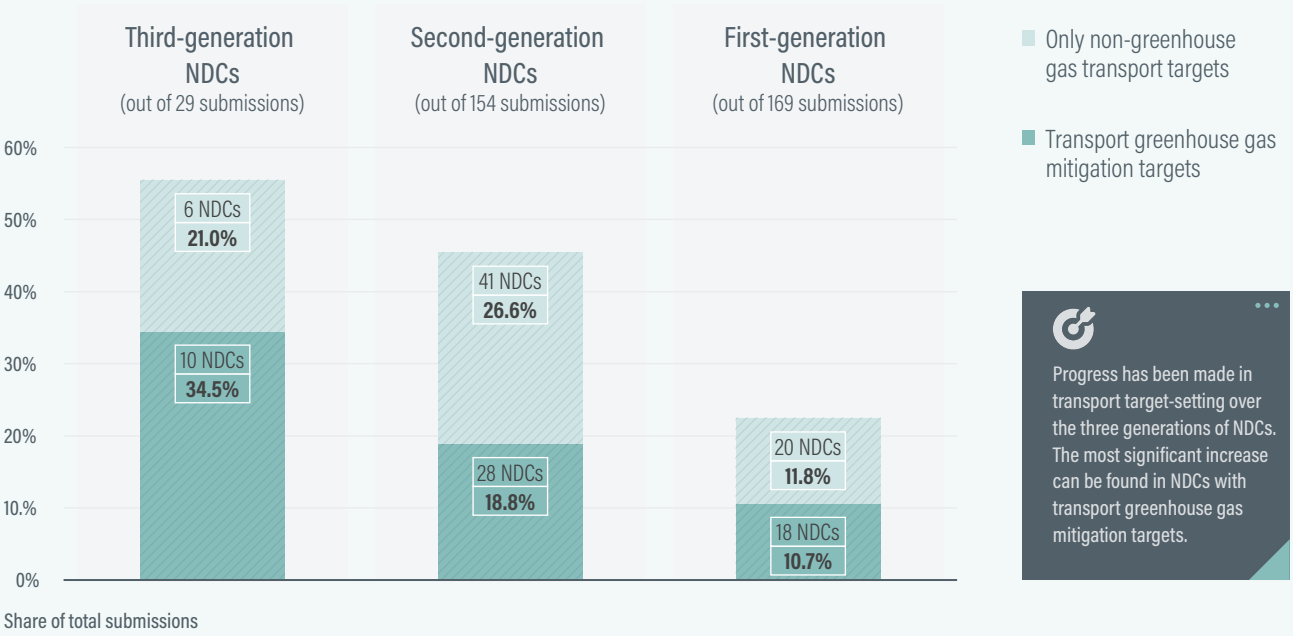
The countries that submitted third-generation NDCs as of August 2025 contributed 20.3% of the world's economy-wide greenhouse gas emissions and 36.1% of global transport emissions in 2023 (excluding international aviation and shipping) (Figure 2)**.[17] This high share of transport emissions was driven by major emitters such as Brazil, Canada, Japan, the United Kingdom and the United States.[18]**

Assessment of transport in third-generation NDCs

Progress has been made in transport target-setting over the three generations of NDCs. Of the third-generation NDCs submitted as of August 2025, 34.5% (10 in total) featured explicit targets for mitigating transport greenhouse gas emissions; this was up from only 11% (18 total) of first-generation NDCs and 19% (28 total) of second-generation NDCs (Figure 3)**.[19]** More broadly, transport targets of all kinds (including non-greenhouse gas targets) were featured in 55% of third-generation NDCs, compared with 23% of first-generation NDCs and 46% of second-generation NDCs.[20]

Of the 10 third-generation NDCs that contained transport

FIGURE 3. Transport targets included in each generation of NDCs, as of August 2025



Progress has been made in transport target-setting over the three generations of NDCs. The most significant increase can be found in NDCs with transport greenhouse gas mitigation targets.

Source: See endnote 19 for this section.

greenhouse gas mitigation targets as of August 2025, 4 had unconditional targets, 2 had conditional targets, 1 had a combination of conditional and unconditional targets, and 3 had unclear conditions (Table 1).[21] The targeted years were 2030 (three countries), 2035 (five countries) and 2050 (two countries).[22]

In total, 32 non-greenhouse gas transport targets were included in third-generation NDCs as of August 2025.[23] As with second-generation NDCs, the most common type of non-greenhouse gas transport target was for zero-emission vehicles, accounting for 44% of the total (Figure 4).[24]

The third-generation NDCs as of August 2025 embraced a wider portfolio of actions for reducing transport emissions than did previous generations, although a strong focus on electrification persisted.[25] Each third-generation NDC submission included an average of 7.9 actions for mitigating transport emissions, up from 5.8 actions on average in second-generation NDCs – indicating a growing emphasis on emission mitigation in the transport sector.[26]

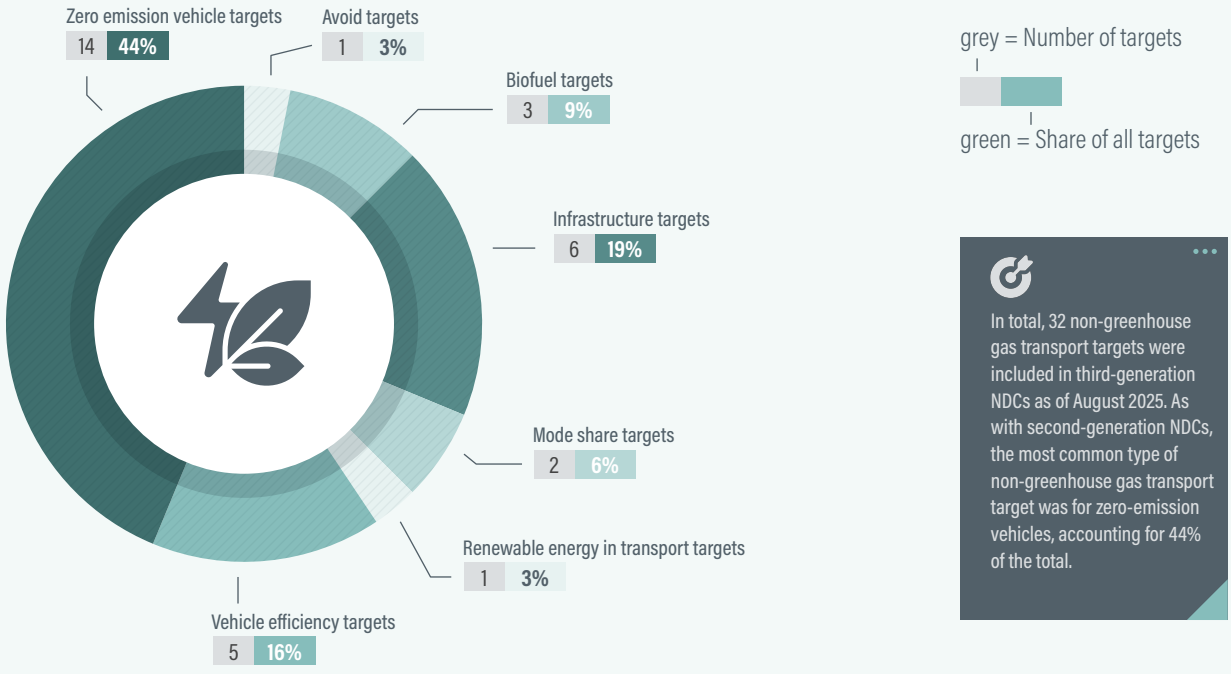
- In the third-generation NDCs, emission mitigation measures for transport focused mainly on mode shift and demand management (68 actions, or 29.7%) as well as electrification (64 actions, or 27.9%) (Figure 5).[27]
- Electrification continued to gain traction as a viable technological solution, with nearly half of the electrification actions that cited a specific transport mode having a focus on road transport vehicles (mainly bus fleets and passenger cars); however, half of all electrification actions did not explicitly mention a transport mode.[28]
- Only 14 mitigation actions (6.1%) were related to aviation and maritime transport (domestic and international), reflecting a gap also observed in second-generation NDCs.[29] This gap may exist because the international dimensions of aviation and shipping are under the scope of other international processes (outside the UNFCCC, which governs the NDCs), and because decarbonising these sectors remains technically, financially and politically challenging.
- The third-generation NDC of the United Arab Emirates (UAE) contains a broad portfolio of actions covering infrastructure development, land use policies, vehicle regulations and fuel efficiency standards. The UAE has implemented a national policy for electric vehicles, expansion of charging stations, and smart mobility; and several cities plan to electrify public transport, taxis and government fleets in the coming decades. Abu Dhabi, Dubai and other cities aim to pursue sustainable urban planning with a focus on mixed land-use and development of walking and cycling infrastructure.[30]

TABLE 1. Transport greenhouse gas emission mitigation targets in third-generation NDCs, as of August 2025

Country	Targeted reductions in transport emissions	Type of target
Andorra	50% below business-as-usual levels in domestic transport emissions by 2030	Unclear conditionality
Belize	127 gigagrams of CO_2 equivalent less by 2030 and 312 gigagrams of CO_2 equivalent by 2035	Conditional
Botswana	429 gigagrams of CO_2 equivalent less by 2030 (of which 146.78 gigagrams are conditional)	Unconditional, conditional
Marshall Islands	40% below 2010 levels in domestic shipping emissions by 2030 and complete decarbonisation by 2050	Unclear conditionality
Nepal	1,426.22 gigagrams of CO_2 equivalent less by 2030 and 2,731.57 gigagrams of CO_2 equivalent by 2035	Conditional
Republic of Moldova	52% below 1990 levels by 2030	Unconditional
Saint Lucia	22% below 2010 levels by 2035 in transport and energy	Unconditional
Somalia	33% below business-as-usual levels by 2035	Unclear conditionality
Switzerland	41% below 1990 levels by 2035, 57% by 2040 and 100% by 2050	Unconditional
United Arab Emirates	20% below 2019 levels by 2035, reaching 24.2 million tonnes of CO_2 equivalent	Unconditional

Source: See endnote 21 for this section.

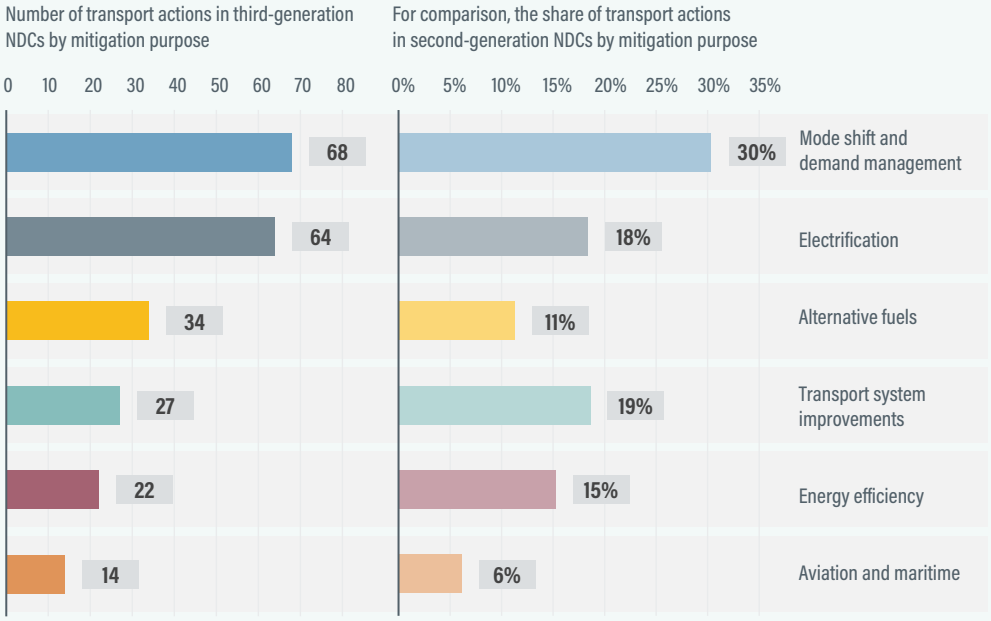
FIGURE 4. Non-greenhouse gas transport targets in third-generation NDCs, as of August 2025



In total, 32 non-greenhouse gas transport targets were included in third-generation NDCs as of August 2025. As with second-generation NDCs, the most common type of non-greenhouse gas transport target was for zero-emission vehicles, accounting for 44% of the total.

Source: See endnote 24 for this section.

FIGURE 5. Emission mitigation actions in third-generation NDCs compared to second-generation NDCs, as of August 2025



Comparing the second- and third-generation NDCs, as of August 2025, shows that electrification keeps gaining traction, with nearly half of all actions focusing on electrification.

Source: See endnote 27 for this section.

The full potential of a balanced Avoid-Shift-Improve (A-S-I)[i] framework for sustainable transport remains untapped, as 66% of the transport mitigation actions in third-generation NDCs as of August 2025 focused on "Improve" actions.[31] By comparison, 23.1% of the transport emission mitigation actions focused on "Shift" and only 10.5% on "Avoid" (Figure 6).[32] This strong emphasis on "Improve" measures has been a persistent trend since the first-generation NDCs, indicating that the transformative potential of more balanced A-S-I strategies remained largely underutilised. "Avoid" and "Shift" strategies can account for major emission reductions in the transport sector, at much lower costs than "Improve" strategies.[33]

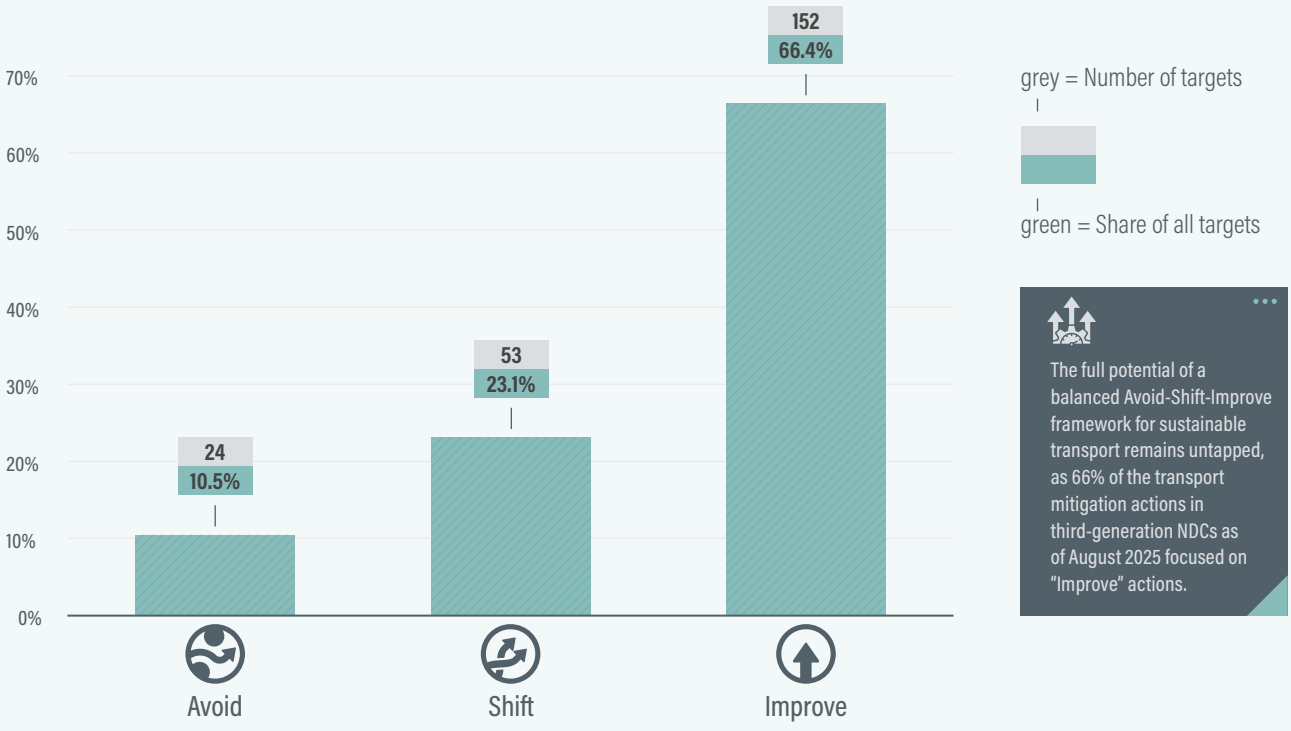
Singapore's NDC leverages the potential of Avoid and Shift actions. Through its "Walk-Cycle-Ride" strategy, Singapore commits to encouraging active mobility and prioritises public and shared transport as the primary modes of travel. The cycling infrastructure and metro system are to be expanded while ensuring access to the metro system through better walkways.[34]

Despite freight transport's large contribution to both transport and overall greenhouse gas emissions, the sector remained overlooked in NDCs, with few of the third-generation NDCs as of August 2025 featuring activities to mitigate these emissions. Freight activity is projected to more than double from 2020 to 2050, bringing rapidly rising emissions from freight transport.[35] **The increase in climate-induced disasters threatens global supply chains and freight operations, making it crucial to boost resilience efforts in freight transport and to adapt to changing environments. In a major gap, no third-generation NDCs as of August 2025 included freight transport adaptation actions.**[36] (See 4.1 Freight Transport and Logistics.)

- Of the 29 third-generation NDCs as of August 2025, only 9 (Brazil, Canada, Maldives, Monaco, Montenegro, Niue, Republic of Moldova, Uruguay and the United States) included mitigation actions covering freight or a combination of freight and passenger transport.[37]
- The NDC of the United States mentions establishing

i The Avoid-Shift-Improve framework has been central to sustainable, low-carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

FIGURE 6. Mitigation actions by Avoid, Shift and Improve in third-generation NDCs, as of August 2025



Source: See endnote 32 for this section.

zero-emission freight hubs and corridors and expanding intermodal freight operations through improved collaboration with stakeholders.[38]

- Uruguay's NDC includes pursuing intramodality for freight and passenger transport.[39]
- The NDCs of Brazil, Canada, Maldives and Montenegro focus on vehicle efficiency or electrification of heavy-duty vehicles.[40]

Only seven of the third-generation NDCs (Belize, Canada, the Marshall Islands, Monaco, Niue, the United Kingdom and the United States) as of August 2025 included specific actions to mitigate emissions from domestic and international aviation and/or shipping.[41] Aviation contributed 14% of global transport greenhouse gas emissions in 2023, while maritime transport was responsible for 8%.[42] In many countries, the growth in aviation-related emissions has outpaced overall emission reductions. Decarbonising maritime transport is also seen as crucial, but progress is slow. (See 4.9 Aviation and 4.10 Shipping.)

- Marshall Islands' NDC sets a target to reduce greenhouse gas emissions from domestic shipping 40% below 2010 levels by 2030, aiming for full decarbonisation by 2050.[43] The NDC highlights pilot projects on low-emission vessels, wind-assisted propulsion, fuel-efficient engines and the use of solar power.[44]
- Belize's NDC highlights the importance of maritime transport for the economy, and a pilot project aims to improve the fuel efficiency of vessels and reduce port infrastructure emissions by 2035.[45]
- The NDCs of both Canada and the United States reference sustainable aviation fuels.[46]

The scope of third-generation NDCs has widened to cover sustainability topics such as a just transition, air quality and public health. Lesotho and the United Kingdom have used third-generation NDCs to reinforce linkages between their climate and broader sustainability commitments.[47]

- Lesotho's NDC connects transport actions to various SDGs, including SDG 3 (Good Health and Well-Being), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).[48]
- The United Kingdom's NDC highlights that a just transition is central to the national approach and notes that green and clean jobs sourcing new skills and technologies will be created through support from two entities: the Office for Clean Energy Jobs and Skills England.[49]

Most of the transport actions in third-generation NDCs as of August 2025 did not mention specific transport modes. Where modes were mentioned, the focus was largely on road vehicles (Figure 7)**.**[50] **Transport adaptation actions in particular have missed the opportunity to refer to specific modes.**[51]

Only two of the third-generation NDCs as of August 2025 featured transport adaptation targets, both of them from least developed countries (Lesotho and Nepal).[52] By comparison, eight second-generation NDCs (5% of the total) featured transport adaptation targets.[53] A potential reason could be that more countries are outlining their specific adaptation and resilience actions through National Adaptation Plans (NAPs) (See Spotlight on Transport in National Adaptation Plans).

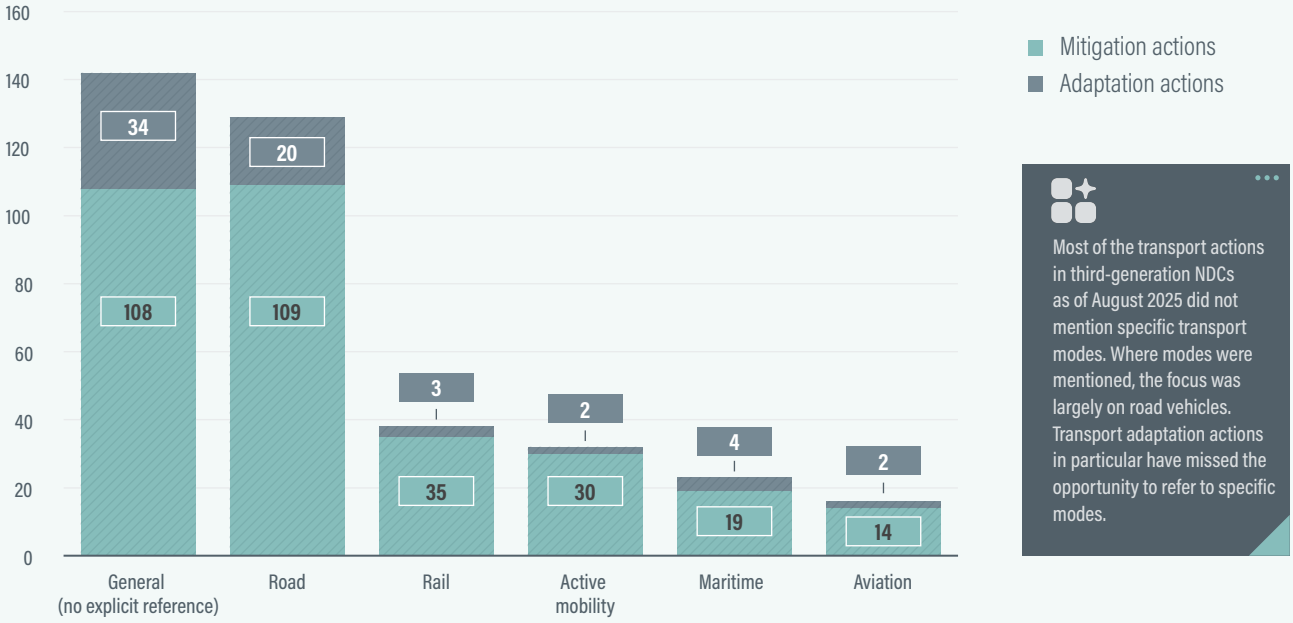
- Lesotho's NDC sets a target to strengthen standards to climate-proof roads and critical public infrastructure, with 10 climate-proof codes to be revised by 2025.[54]
- In its NDC, Nepal aims to embed climate-resilient planning for transport infrastructure projects in revised regulations and to equip all major highways with early warning systems by 2030.[55]

NDC content on adaptation can draw on NAPs to strengthen the vital connections between mitigation and adaptation efforts, supporting inclusive, low-carbon and resilient connectivity and economic growth. Adaptation and mitigation efforts are mutually reinforcing, as adaptation helps to cope with the unavoidable effects and creates the resilient foundation for mitigation action and sustainable development.

In addition to its significant contribution to climate change, the transport sector is increasingly exposed to its consequences.[56] Transport disruptions have severe impacts on communities and economies. Climate-induced disasters and extreme weather events caused around USD 15 billion in direct damages to transport systems annually, with low- and middle-income countries bearing a disproportionately high share (around USD 8 billion) relative to their gross domestic product (GDP).[57] (See 1.4 Building Adaptation and Resilience Within Transport Systems and Across Communities and economies.)

Sixteen of the third-generation NDCs (55% of the total) as of August 2025 contained transport adaptation actions, an improvement from the 42% of second-generation NDCs with such actions.[58] **As with earlier NDCs, the transport adaptation actions in third-generation NDCs had a strong focus on structural and technical actions** (54% of the NDCs, 29 actions)**, followed by institutional and regulatory actions** (24%, 13 actions) (Figure 8).[59]

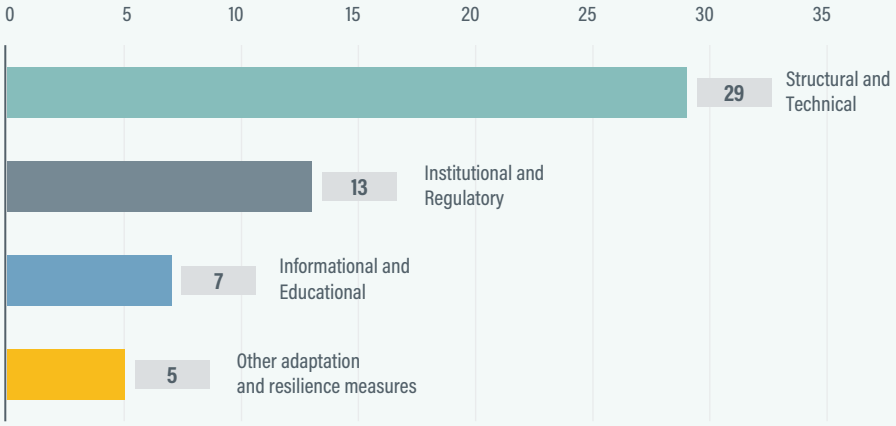
FIGURE 7. Modes referenced in transport actions in third-generation NDCs, as of August 2025



Most of the transport actions in third-generation NDCs as of August 2025 did not mention specific transport modes. Where modes were mentioned, the focus was largely on road vehicles. Transport adaptation actions in particular have missed the opportunity to refer to specific modes.

Source: See endnote 51 for this section.

FIGURE 8. Transport adaptation actions in third-generation NDCs, as of August 2025



As with earlier NDCs, the transport adaptation actions in third-generation NDCs had a strong focus on structural and technical actions (54% of the NDCs, 29 actions), followed by institutional and regulatory actions (24%, 13 actions).

Source: See endnote 60 for this section.

- Brazil's NDC points to several adaptation-focused plans and initiatives in place or under development, such as the National Adaptation and Mitigation Strategies, AdaptaBrasil, and the Green and Resilient Cities Plan.[60]
- Kenya's NDC features efforts to adopt guidelines for better design and construction of climate-proof infrastructure.[61]
- Maldives' NDC commits to enhancing the resilience and climate-proofing of critical transport infrastructure such as airports and maritime ports to better withstand extreme weather events and sea-level rise linked to climate change.[62]
- Niue's NDC outlines resource mobilisation for the provision of climate-resilient utilities for road infrastructure, with specific activities focused on comprehensive risk assessments, disaster management plans and integrated village development.[63]

Way forward to enhance transport in NDCs

Although it is too early to assess the collective impact of the 29 third-generation NDCs submitted as of 1 August 2025, initial reviews suggest that the ambition remains insufficient to meet the Paris Agreement goal of limiting global warming to 1.5°C. A parallel assessment of 22 third-generation NDCs as of June 2025 found that the new commitments would result in greenhouse gas emissions of 51.1 gigatonnes of CO_2 equivalent by 2035 (around 36% from transport, if accounting for the current NDC submissions).[64] Although this represents a reduction of 1.4 gigatonnes of CO_2 equivalent compared to 2030 levels, it is still well above the emission levels required to limit warming to 2°C (36 gigatonnes) or 1.5°C (25 gigatonnes) by 2035.[65] (See 2.1 National Transport Pathways to Reach Climate and Sustainability Goals.)

- Japan's third-generation NDC includes economy-wide targets for 60% emission reduction by 2035 and 73% by 2040 (compared to 2013 levels).[66] According to the Climate Action Tracker, this falls short of a 1.5°C-compatible pathway because Japan would need to cut emissions 81% below 2013 levels by 2035.[67]
- Although the UAE's third-generation NDC increases both economy-wide and sectoral ambitions for 2035, the absence of updated 2030 targets raises concerns about the feasibility of achieving these goals.[68]

Studies based on NDC submissions as of October 2024 showed that the commitments made in second-generation NDCs were also insufficient to meet the Paris Agreement targets of keeping global warming to 2°C, and were still far from achieving the 1.5°C limits.[69] The ambition levels in second-generation NDCs could result in global warming of 2.1°C to 2.8°C by the end of the century, depending on underlying assumptions and major uncertainties. Even if all NDC commitments of the second-generation NDCs were implemented, the carbon budget to stay within 1.5°C would be used up by 2032.[70]

As stakeholders collectively work to update and raise

ambition in the third generation of NDCs, SLOCAT has developed a five-point plan for transport in third-generation NDCs that outlines key recommendations and related case studies (Figure 9).[71] The plan was inspired by similar efforts by the World Resources Institute (WRI) and builds on SLOCAT's 2020 recommendations.[72]

To support stronger transport actions and commitments in third-generation NDCs, specialised transport organisations have developed a range of guiding documents (Figure 10)**.**[73] These resources either offer general guidance or focus on specific topics such as active mobility, popular transport, public transport and rail. The UN Economic Commission for Europe is developing a guidance document on inland transport in NDCs.[74] Such resources aim to help policy makers enhance the role of transport in NDCs by offering illustrative examples on setting a vision, defining targets and policies, and sharing best practices.

In the lead-up to the 2023 UN Climate Change Conference in Dubai, UAE (COP 28), a group of organisations launched a call to double the share of energy-efficient and fossil-free forms of land transport by 2030, with the goal of fossil-free land transport by 2050.[75] **The call to action attracted more than 60 multi-stakeholder signatories (including Chile and Colombia) and emphasised shifts towards public transport, walking, cycling, and rail freight, as well as electric vehicles and railways, while drastically scaling up the use of renewable and zero-emission energy sources.**[76] While each country will adopt a nationally determined approach, the call outlines a series of universal enablers to meet this target. The call to action was issued by SLOCAT and REN21, jointly with the Institute for Sustainable Development and International Relations (IDDRI), the Institute for Transportation and Development Policy (ITDP), the International Union of Railways (UIC), the International Association of Public Transport (UITP) and WRI.

Building on the call to action and other multi-stakeholder efforts, the Climate Champions Team launched the Avoid and Shift Breakthrough at the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29).[77] The Breakthrough features the same doubling goal for land transport and seeks to strengthen transport targets that focus on "Avoid" and "Shift" measures in complementarity with other initiatives that favour "Improve" measures.[78]

Additional resources for third-generation NDCs have been developed by the Climate and Clean Air Coalition, the Climate Action Network, Climate Action Tracker, the NDC Partnership, UN-Habitat and WRI.[79]

FIGURE 9. SLOCAT's five-point plan for transport in third-generation NDCs

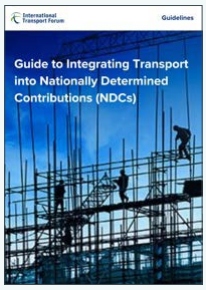


Source: See endnote 71 for this section.

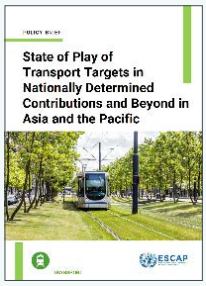
FIGURE 10. Documents supporting stronger transport actions and commitments in third-generation NDCs

General transport guidance







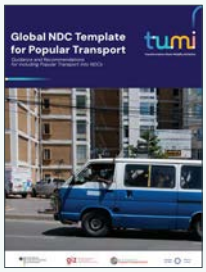


Mode-specific guidance

Active mobility



Popular transport



Public transport



Railways





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SPOTLIGHT



Transport in National Adaptation Plans

KEY FINDINGS



- The need for adaptation planning in transport is increasingly urgent as the sector has experienced among the most severe impacts of climate change.
- In 2023, insurance companies lost an estimated USD 250 billion in combined assets due to natural disasters, or more than double the five-year average of USD 105 billion (2018-2023). Climate-induced disasters and extreme weather events already cause around USD 15 billion a year in direct damages to transport systems, with low- and middle-income countries bearing a high share (around USD 8 billion) relative to their gross domestic product (GDP).
- The main mechanism for developing adaptation and resilience efforts under the United Nations Framework Convention on Climate Change (UNFCCC) is National Adaptation Plans (NAPs). Because NAPs are not time-bound, they allow countries to engage in medium- to long-term planning. This spotlight draws on countries' most recent NAP submissions to the UNFCCC (from 2023 to 1 August 2025).
- As of 1 August 2025, a total of 74 NAPs had been submitted to the UNFCCC. Of these, one-third (22, or 30%) were from African countries, 17 (23%) from Latin America and the Caribbean, 16 (21%) from Asia, 11 (15%) from Europe, 6 (8%) from Oceania and 2 (3%) from North America.
- The first NAPs (Burkina Faso and Cameroon) date back to 2015, but submissions accelerated greatly in the period 2023-2025, during which nearly half (48%) of all NAPs were submitted (35 total, including 23 in 2023 and 2024 and 12 in 2025). With a few exceptions (Burkina Faso and Uruguay), the submissions during 2023-2025 represented the first and only NAPs from countries.
- Developed country Parties began submitting NAPs to the UNFCCC starting in December 2023, and as of 1 August 2025 ten of these countries had completed the process. This process was supported through the outcome of the first Global Stocktake of 2023, which called on countries to have in place their NAPs, policies, and planning by 2025, with implementation by 2030.
- The UNFCCC's tracking tools reveal a gap between the ambition of NAPs and the actual implementation of adaptation projects. Although most NAPs contain content on transport, few adaptation projects were implemented as of 15 July 2025 in support of transport adaptation and resilience. In some cases, transport activities may be featured in other categories such as infrastructure and the built environment, buildings, cities, industries and appliances.
- Between 2023 and August 2025, six African countries (Burkina Faso, Burundi, Morocco, Mozambique, Zambia and Zimbabwe) submitted NAPs; all of these contain actions to enhance transport adaptation and resilience efforts. A common action area is a focus on climate-resilient standards and codes for the construction of transport infrastructure.
- Nine Asian countries – Azerbaijan, Bangladesh, Bhutan, Israel, Jordan, Mongolia, Pakistan, the Philippines and Thailand – submitted NAPs to the UNFCCC during the period from 2023 to August 2025.
- In Europe, nine countries submitted NAPs between 2023 and August 2025: Austria, Finland, Germany, Ireland, Moldova, the Netherlands, Serbia, Spain and the United Kingdom.
- Six countries in Latin America and the Caribbean submitted NAPs between 2023 and August 2025, including Antigua and Barbuda, Argentina, Ecuador, Haiti, Trinidad and Tobago, and Uruguay; in total, 17 NAPs have been submitted in the region since 2015.
- In North America, Canada submitted a NAP in 2024 and the United States submitted one in early 2025 (in the final weeks of the Biden administration).
- In Oceania, six countries (Fiji, Kiribati, Marshall Islands, New Zealand, Papua New Guinea and Tonga) had submitted NAPs to the UNFCCC as of 1 August 2025; however, only three of these – Marshall Islands, New Zealand and Papua New Guinea – were new submissions between 2023 and mid-2025.
- In contrast to NDCs, very few resources exist for NAPs that provide tailored guidance on incorporating transport content into adaptation plans. Although the UNFCCC maintains a library of supplementary materials to support NAP development, very few focus on specific sectors or thematic areas.
- As of August 2025, no dedicated guidance was available on transport and infrastructure within NAPs.
- Making adaptation and resilience efforts more consistent and effective will require maximising existing synergies between the elaboration and implementation of national transport policies, NAPs, the Sendai Framework for Disaster Risk Reduction, and SDG targets related to resilience and transport.

Context, challenges and opportunities

The world is not on track to meet the Paris Agreement goal of limiting global warming to 1.5 degrees Celsius (°C) by the end of the century. Countries must urgently define pathways to strengthen the resilience and adaptation of their economies and societies to the impacts of climate change. The year 2024 was the warmest in recorded history, with the global mean near-surface temperature reaching 1.55°C (± 0.13°C) above the pre-industrial average.[1] The forecast for 2025-2029 projects that global warming will reach an estimated 1.44°C, with a 90% confidence range of 1.22-1.54°C.[2]

The need for adaptation planning in transport is increasingly urgent as the sector has experienced among the most severe impacts of climate change. In 2023, insurance companies lost an estimated USD 250 billion in combined assets due to natural disasters, or more than double the five-year average of USD 105 billion (2018-2023).[3] Climate-induced disasters and extreme weather events already cause around USD 15 billion a year in direct damages to transport systems, with low- and middle-income countries bearing a high share (around USD 8 billion) relative to their gross domestic product (GDP) (Box 1).[4]

Box 1. Costs of damages to transport assets

Estimates of the costs associated with climate-induced disasters and extreme weather events vary widely, depending on the underlying assumptions and their scope.

Global cost estimates (see 1.4 Building Adaptation and Resilience Within Transport Systems and Across Communities and Economies)

- **Transport systems:** USD 15 billion in direct damages in 2022, including USD 8 billion in low- and middle-income countries.
- **Road and railway assets:** USD 3.1 billion to USD 22 billion per year in direct damages (around 73% caused by flooding) as of 2019.
- **Disruptions to ports from climate extremes:** USD 81 billion in global trade and at least USD 122 billion in economic activity at risk annually, based on 2023 averages.

Regional cost estimates (see Module 3. Regional Overviews: Trends and Policy Development)

- **Africa:** An estimated USD 7-15 billion annually from climate-induced disasters as of 2022, possibly rising to USD 50 billion by 2030, representing up to 7% of Africa's GDP on average for that year.
- **Asia-Pacific:** An estimated USD 12 billion in yearly damage to roads, railways, and ports from hazards related to climate change, according to research from 2019 and 2023. Railways shoulder around 25% of these losses, despite accounting for only around 2% of Asia's total transport infrastructure in 2023.
- **Europe:** Projected annual costs from climate change-induced hazards exceeding USD 10.35 billion annually by the 2080s, up 20-fold from 2024. Heat waves already have led to road melting, failures of railway assets, and speed restrictions to prevent track buckling, causing major disruptions and impeding connectivity. Ports, especially in northern and western Europe, are particularly vulnerable to sea-level rise, storm surges and changes in wave agitation.
- **North America**: The United States registered a record high of 28 climate-induced disasters in 2023 (costing USD 96 billion in damages) and 27 events in 2024 (costing USD 182.7 billion). Climate change threatens the supply networks of Canada's Indigenous populations, with around 50 communities (56,000 people) relying on a 6,000-kilometre winter road network.
- **Oceania:** Many Pacific small island developing states (SIDS) are in the world's most natural disaster-prone areas. SIDS comprise two-thirds of the countries that suffer the highest relative losses from natural disasters – between 1% and 9% of their GDP each year. With their small economies, they can incur GDP losses of up to 200% from a single climate-exacerbated disaster, undermining progress towards sustainable development and climate goals.

Source: See endnote 4 for this section.

The main mechanism for developing adaptation and resilience efforts under the United Nations Framework Convention on Climate Change (UNFCCC) is National Adaptation Plans (NAPs). The NAP process builds on the UNFCCC's previous national adaptation programmes of action.[5] The process was developed specifically for least developed countries at the UN Climate Change Conference (COP 16) in Cancun, Mexico in 2010, although other developing countries (mainly low- and middle-income countries) also were invited to elaborate NAPs.[6] Developed country Parties under the UNFCCC have been invited to develop NAPs since 2023, through a call to all countries issued in the first outcome of the Global Stocktake.[7]

Because NAPs are not time-bound, they allow countries to engage in medium- to long-term planning. For example, Nepal's NAP covers the period from 2021 to 2050.[8] This is different from the time frames established under the UNFCCC for Nationally Determined Contributions (NDCs), which reflect five-year cycles (with the current round of NDC submissions for 2025 covering targets and actions up to 2035).[9]


Photo: Debarshi Mukherjee / Climate Visuals Countdown

Most NAPs recognise the crucial role of the transport sector in enhancing resilience and supporting adaptation to climate change impacts. In their NAPs, countries outline detailed activities aimed at strengthening the resilience of transport infrastructure and adapting transport systems. Many NAPs exceed 100 pages and include plans and activities across the economy, including investment and financing needs.

In countries' NDCs, in contrast, adaptation is only one of the three pillars, alongside mitigation and finance. The NDC submissions between 2018 and 2024 (so-called second-generation NDCs) included stronger content on adaptation compared to the third-generation submissions, which (as of 1 August 2025) contained fewer adaptation actions on transport and infrastructure.[10] However, given the low number of third-generation NDCs submitted overall by mid-2025, it is difficult to establish a clear trend. With high-income countries invited to elaborate and submit NAPs, several third-generation NDCs omit details on climate change adaptation and instead refer readers to countries' NAPs for further guidance. (See Spotlight on Transport Ambition in NDCs.)

Key challenges facing NAPs include a lack of overall submissions, as well as knowledge gaps within existing plans. As of mid-2025, ten years after the first NAP was submitted in 2015, half of all countries still had not submitted a plan. Moreover, existing plans reveal clear gaps in knowledge and guidance related to transport. In general, knowledge products on adaptation and resilience in transport are less abundant than products on mitigation. As of mid-2025, no dedicated NAP guidance documents were available to help countries develop robust transport targets and actions.

In the quest to make adaptation and resilience efforts more consistent and effective, there is room to improve synergies across the elaboration and implementation of national transport policies, NAPs, the Sendai Framework for Disaster Risk Reduction, and targets in the UN Sustainable Development Goals (SDGs) related to resilience and transport (e.g., target 9.1 on access to all-season roads).[11]

Trends and coverage of NAPs

This spotlight draws on countries' most recent NAP submissions to the UNFCCC (from 2023 to 1 August 2025). It is based on a review of content related to transport, vehicles and associated areas such as infrastructure resilience as well as urban areas, drainage systems, energy for transport and more. As of mid-2025, more detailed assessment of transport in NAPs was not feasible due to the absence of dedicated assessment typologies and tools. In contrast, extensive assessment has been undertaken for NDCs through use of the NDC Transport Tracker by GIZ and SLOCAT, which systematically evaluates each NDC and long-term low emission development strategies (LT-LEDS) based on specific parameters (See Spotlight on Transport Ambition in NDCs).[12]

Global overview

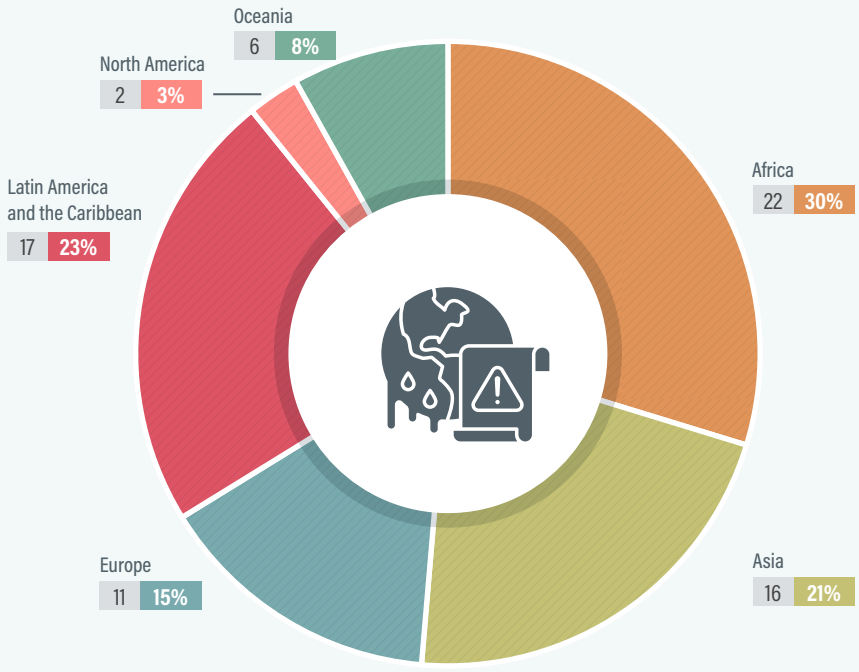
As of 1 August 2025, a total of 74 NAPs had been submitted to the UNFCCC.[13] Of these, one-third (22, or 30%) were from African countries, 17 (23%) from Latin America and the Caribbean, 16 (21%) from Asia, 11 (15%) from Europe, 6 (8%) from Oceania and 2 (3%) from North America (Figure 1).[14] NAPs have been submitted by 16 landlocked developing countries, 22 least developed countries and 13 SIDS.[15] An additional 67 NAPs were in development, and 5 were under draft review (Brunei Darussalam, Kyrgyz Republic, Lesotho, Mali and Somalia), according to the 15 July 2025 update of the UNFCCC's NAP Tracking Tool; only 5 low- and middle-income countries had not initiated the process (Botswana, Djibouti, Libya, Solomon Islands and Yemen).[16] For 14 countries, no information on NAPs was available.[17]

The first NAPs (Burkina Faso and Cameroon) date back to 2015, but submissions accelerated greatly in the period 2023-2025, during which nearly half (48%) of all NAPs were submitted (35 total, including 23 in 2023 and 2024 and 12 in 2025).[18] With a few exceptions (Burkina Faso and Uruguay), the submissions during 2023-2025 represented the first and only NAPs from countries.

Developed country Parties began submitting NAPs to the UNFCCC starting in December 2023, and as of 1 August 2025 ten of these countries had completed the process (Austria, Canada, Finland, Germany, Ireland, the Netherlands, New Zealand, Spain, the United Kingdom and the United States).[19] **This process was supported through the outcome of the first Global Stocktake of 2023, which called on countries to have in place their NAPs, policies, and planning by 2025, with implementation by 2030.**[20]

The UNFCCC's tracking tools reveal a gap between the ambition of NAPs and the actual implementation of adaptation projects (Figure 2).[21] **Although most NAPs contain content on transport, few adaptation projects were implemented as of 15 July 2025 in support of transport adaptation and resilience.**[22] **In some cases, transport activities may be featured in other categories such as infrastructure and the built environment, buildings, cities, industries and appliances.** Although transport is mentioned in nearly every NAP, very few projects focus specifically on adaptation and resilience in transport, and the result area low-emission transport represents the smallest number of approved adaptation projects.[23] (See 6.1 Financing Sustainable Transport in Times of Constrained Public Budgets.)

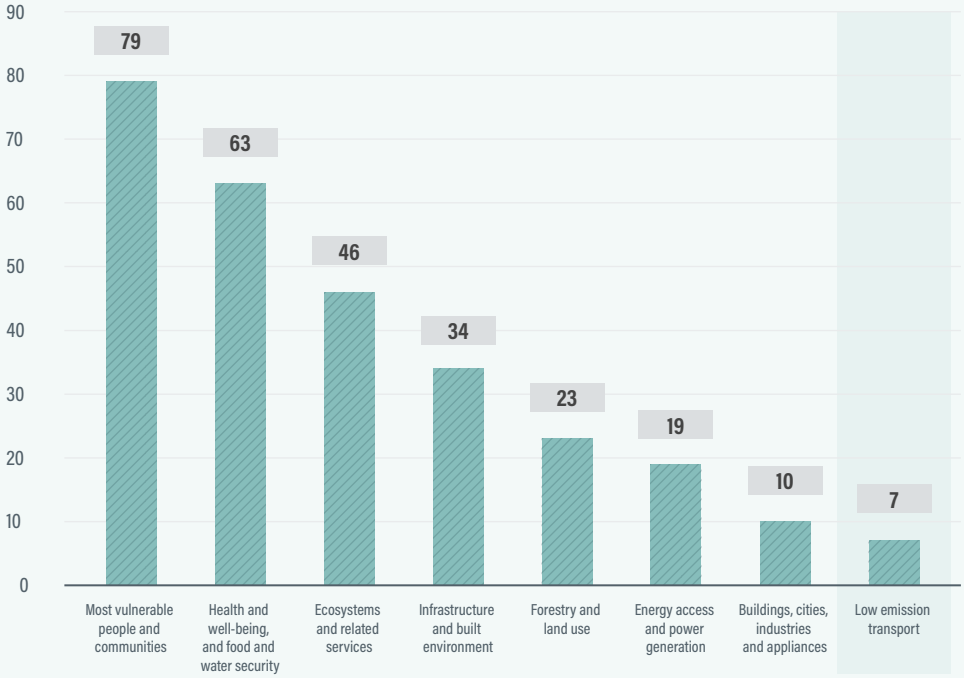
FIGURE 1. NAP submissions by region, as of August 2025



As of 1 August 2025, a total of 74 NAPs had been submitted to the UNFCCC. An additional 67 NAPs were in development, and 5 were under draft review.

Source: See endnote 14 for this section.

FIGURE 2. Adaptation projects in countries with NAPs, as of 15 July 2025



While most NAPs include transport, few adaptation projects had been implemented for transport resilience as of 15 July 2025. Despite being well represented in NAPs, low-emission transport accounts for the fewest approved adaptation projects in countries with NAPs.

Source: See endnote 21 for this section.

Regional examples

Between 2023 and August 2025, six African countries (Burkina Faso, Burundi, Morocco, Mozambique, Zambia and Zimbabwe) submitted NAPs; all of these contain actions to enhance transport adaptation and resilience efforts.[24] **A common action area is a focus on climate-resilient standards and codes for the construction of transport infrastructure.** (See 3.1 Africa Regional Overview.)

- Burkina Faso's NAP commits to increasing the share of "good condition" roads from 28.7% to 65% between 2023 and 2028; increasing the share of all-weather rural roads from 37.1% to 41.38% over the same period; and equipping urban roads with drainage systems and vegetation to provide shade.[25]
- Burundi's 2023 NAP outlines transport adaptation actions focused on inland water transport, including dredging, river training, and the protection of access channels and port basins. It highlights the rehabilitation and maintenance of existing roads to improve resilience to climate change impacts.[26]
- Morocco's 2024 NAP prioritises the development of a vulnerability assessment methodology as a foundation for city adaptation strategies and measures. The assessment will be supported by urban sustainability indicators relating to infrastructure, mobility and other sectors. The NAP also promotes integrating climate change adaptation into all local activities and advancing research to strengthen transport adaptation, including improved understanding of climate change impacts on the sector.[27]
- Mozambique's 2023 NAP identifies floods and tropical cyclones as the highest risks to transport infrastructure, with sea-level rise and temperature changes considered medium risks.[28] Proposed resilience measures include mapping and vulnerability/risk assessment of disaster-prone infrastructure and improving climate insurance. Mozambique also adapted the 2017-2030 Disaster Risk Reduction Master Plan and the SADC Infrastructure Master Plan.[29]

Nine Asian countries – Azerbaijan, Bangladesh, Bhutan, Israel, Jordan, Mongolia, Pakistan, the Philippines and Thailand – submitted NAPs to the UNFCCC during the period from 2023 to August 2025.[30] In the cases of Azerbaijan, Jordan, and Mongolia, transport is mentioned in the NAPs, but no specific actions are outlined. (See 3.2 Asia Regional Overview.)

- Bhutan's 2023 NAP outlines the development of a transport master plan for Thimphu, the construction of climate-resilient road infrastructure, risk assessments (particularly for landslides) and the stabilisation of landslide-prone areas.[31]



Photo Credit: Brigitte Leoni / UNISDR

- The Philippines' 2024 NAP highlights comprehensive planning and response mechanisms and adequate institutional capacity as key adaptation priorities to ensure resilient, adequate and sustainable transport infrastructure and related services. Measures include integrating climate risk into the planning of roadways and transport hubs, and climate-proofing critical transport infrastructure (e.g., through landslide protection measures).[32]
- Thailand's 2024 NAP emphasises mixed-use developments to reduce reliance on long-distance transport.[33]

In Europe, nine countries submitted NAPs between 2023 and August 2025: Austria, Finland, Germany, Ireland, Moldova, the Netherlands, Serbia, Spain and the United Kingdom.[34]

- Moldova's 2024 NAP contains extensive transport content, including commitments to road construction and maintenance, upgrading technical standards, improving financial assessment mechanisms, climate-proofing transport infrastructure (roads, bridges and railways) and modernising drainage systems.[35] A key enabler will be directing funding to adaptation to support risk research, impact assessment, planning and capacity building. The NAP also details provisions on regulatory and institutional frameworks, including laws and codes for aviation, road transport and railways.[36]
- Serbia's 2024 NAP outlines the impacts of climate hazards on road transport, including reduced safety and functionality, extreme damage and increased restoration needs.[37] By 2026, Serbia aims to develop a methodology for climate change vulnerability and risk assessment for road infrastructure.[38]

Six countries in Latin America and the Caribbean submitted NAPs between 2023 and August 2025, including Antigua and Barbuda, Argentina, Ecuador, Haiti, Trinidad and Tobago, and Uruguay; in total, 17 NAPs have been submitted in the region since 2015.[39]

- Uruguay has issued several specialised NAPs with thematic focuses on cities and infrastructure (2021), agriculture (2021), coastal adaptation (2021) and energy (2024).[40]
- Argentina's 2023 NAP aims to adapt transport infrastructure and operations to climate change by promoting sustainable urban transport, strengthening railways and waterways, and improving transport energy efficiency through the replacement of fossil fuels with renewable energy.[41]
- Haiti's 2023 NAP seeks to enhance infrastructure resilience through improved construction standards, zoning regulations, risk and disaster management, infrastructure maintenance and urban planning.[42]

In North America, Canada submitted a NAP in 2024 and the United States submitted one in early 2025 (in the final weeks of the Biden administration).[43] (See 3.5 North America Regional Overview.)

- Canada's NAP highlights regional adaptation challenges, noting that warmer winters have made ice roads less reliable, reducing access to remote mine sites and northern communities. The NAP does not provide specific actions in the context of transport.[44]
- The US NAP, submitted in January 2025, consolidates strategies including the National Climate Resilience Framework (2023) and the Department of Transportation's 2024-2027 Climate Adaptation Plan (2024).[45] It highlights that a transition to a carbon-free, sustainable and resilient transport system leads to better air quality, fewer traffic fatalities, lower travel costs, improved mental and physical health, and healthier ecosystems. Adaptation actions by the transport department focus on incorporating resilience into grant and loan programmes, enhancing resilience in the project planning and development process, ensuring resilience of department facilities and operational assets, and improving climate education and research on resilience.[46]

In Oceania, six countries (Fiji, Kiribati, Marshall Islands, New Zealand, Papua New Guinea and Tonga) had submitted NAPs to the UNFCCC as of 1 August 2025; however, only three of these – Marshall Islands, New Zealand and Papua New Guinea – were new submissions between 2023 and mid-2025.[47]

- Marshall Islands' 2023 NAP emphasises careful design, construction and maintenance of public facilities – including roads and runways – to improve overall infrastructure resilience. It highlights the need for infrastructure planning that avoids negative impacts such as coastal erosion and pollution.[48]
- New Zealand's 2023 NAP commits to incorporating adaptation into decision making for investments in land transport. Nature-based solutions will be embedded to reduce transport emissions and increase the sector's adaptation capacity. Infrastructure improvements are planned for the rail network, public transport and active transport. The NAP also references the New Zealand Freight and Supply Chain Strategy, which is key to system-wide adaptation and resilience actions.[49]
- Papua New Guinea's 2023 NAP reiterates the country's NDC commitment to transport adaptation through the construction or rehabilitation of transport assets worth USD 1.2 billion (PGK 4.2 billion), in accordance with climate-resilient codes and standards. The plan includes conducting comprehensive risk and vulnerability assessments of inland and coastal road networks, as well as updating road design standards to account for climate change.[50]

Way forward for NAPs

In contrast to NDCs, very few resources exist for NAPs that provide tailored guidance on incorporating transport content into adaptation plans. Although the UNFCCC maintains a library of supplementary materials to support NAP development, very few focus on specific sectors or thematic areas.[51] Existing technical guidance covers health, information and communication technologies, agriculture, forestry and fisheries, migration, finance, and urban and human settlements; the latter includes several references to transport and its linkages to the SDGs and other sectors.[52]

As of August 2025, no dedicated guidance was available on transport and infrastructure within NAPs. Several transport-related guidance documents for NDCs address adaptation and resilience and can be applied to NAPs, as many of the general principles are shared (see Spotlight on Transport Ambition in NDCs 3.0). Additionally, a growing number of publications on transport adaptation and resilience have recently become available to policy makers, planners, and other national and local stakeholders (Table 1).[53]

Making adaptation and resilience efforts more consistent and effective will require maximising existing synergies between the elaboration and implementation of national transport policies, NAPs, the Sendai Framework for Disaster Risk Reduction, and SDG targets related to resilience and transport.[54]

TABLE 1. Recent publications on transport adaptation and resilience

Resource	Description
Adapting Public Transport to Climate Change: The Key for Resilient Cities (International Association of Public Transport – UITP)	This policy brief features a seven-stage climate adaptation framework to help organisations from the public transport sector consider climate risks, impacts, and practical adaptation measures to climate change. It includes case studies from Ireland, Singapore, Barcelona, Montreal and New York City as well as key recommendations to kick-start an organisation's adaptation journey.
Adapting Urban Transport to Climate Change (second edition) – SUTP Module 5f (GIZ)	This module is intended to raise awareness of the expected impacts of climate change on urban passenger transport – as well as possible adaptation measures – as transport decision makers in developing countries are confronted with extreme weather events such as flooding, sea-level rise and storms. These impacts are expected to increase with climate change, and the inability of transport systems to recover could result in exponential damages.
Climate-resilient Transport: A Policy Guide (High-Volume Transport Applied Research, developed under the leadership of the University of Birmingham)	This policy guide provides background and practical steps for developing, preparing and implementing adaptation plans for transport resilience to climate change. It is based on findings in a recent State of Knowledge report on Adaptation for Transport Resilience in Low-Income Countries in Africa and South Asia, and is targeted at policy makers in these regions. However, the guidance should be useful for all those involved in transport resilience.
Green Roads Tool Kit (Asian Development Bank)	This toolkit of good practices on sustainable roads provides a comprehensive collection of measures to guide the planning, construction and operation of road infrastructure. It outlines interventions and good practices across several dimensions, including climate resilience.
Infrastructure and Nature-Based Solutions Program (Global Center on Adaptation)	The programme has released several reports on resilient infrastructure, aimed at helping countries assess, plan and finance climate-resilient infrastructure investments.
Strengthening Freight Transport Resilience: A Climate Imperative for a +2°C World (Kuehne Climate Center)	The report proposes a practical framework for strengthening climate resilience across freight transport systems, centred around three pillars: 1) conducting climate risk assessments, 2) investing in best-in-class operational resilience and 3) strengthening the physical resilience of critical infrastructure.
Strengthening the Investment Case for Climate Adaptation: A Triple Dividend Approach (World Resources Institute)	This paper discusses using the Triple Dividend of Resilience framework to evaluate the full benefits of 320 climate adaptation investments and reveal their full value. Covering investments in 12 countries, the study finds that every USD 1 invested in adaptation can yield over USD 10.50 in benefits. With average returns of 20-27%, the analysis provides compelling evidence for scaling adaptation finance, improving data collection and appraisal methods, and unlocking synergies with mitigation.
Transport Resilience Financing, Resources and Opportunities (World Bank)	This report presents information on global financing facilities, public funds, and tax measures, offering valuable insights into financing transport resilience in low- and middle-income countries. It is intended to provide a clearer understanding of financing resources and associated challenges. The report highlights the need for a combination of innovative approaches, strategic partnerships, and diverse funding sources, as well as potential solutions to help bridge the gap in transport resilience financing and implementation.
Transport System Resilience (International Transport Forum)	The report draws on the deliberations of the ITF Roundtable on transport resilience and highlights three key insights: transport networks are vulnerable, disruptions have spillover effects, and resilience must be systematic.

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SPOTLIGHT

Assessing Progress: The Transport Decarbonisation Index

This spotlight is an excerpt from the High-Volume Transport Applied Research Programme on the Transport Decarbonisation Index (TDI)*, funded by UKAID through the UK Foreign, Commonwealth & Development Office. The TDI was developed by the SLOCAT Partnership, the Urban Electric Mobility Initiative, and individual experts Lewis Fulton, Pierpaolo Cazzola and Jacob Teter.*

Context, challenges and opportunities

A systemic transformation in transport and mobility is urgently needed, particularly in low- and middle-income countries across Sub-Saharan Africa and South Asia. In many countries, rapid population growth and urbanisation, rising private motorisation, and limited access to integrated transport systems are driving a surge in greenhouse gas emissions from surface transport, which are projected to outpace the global average in the coming decades.[1] Efforts to decarbonise transport must be balanced with the need to increase access to integrated transport systems that support connectivity, regional integration, economic growth, poverty reduction and inclusive communities in these countries.

The magnitude of the challenge is immense. In many low- and middle-income countries, data related to transport remain limited. This has hindered the capacity of policy makers to make informed policy and investment decisions and to effectively trace transport decarbonisation, access and resilience pathways that are aligned with countries' broader development and sustainability goals. Additionally, the limited technical capacity to develop bankable projects remains a key obstacle in attracting international climate investments to spur transport sector transformation. The core challenge for low- and middle-income countries lies not just in setting ambitious transport targets, but in tracking tangible progress. Robust transport assessments and indices are essential tools for informing effective policy and financing decisions in the systemic transformation of transport infrastructure, systems and services.

Against this backdrop, the Transport Decarbonisation Index (TDI) project seeks to support policy makers in low- and middle-income countries across Sub-Saharan Africa and South Asia in their efforts to reduce emissions from surface transport, while advancing broader sustainable development objectives.[2] The TDI aims to enable evidence-based, time-sensitive and targeted decisions on surface transport decarbonisation, by delivering a data-driven overview of where countries stand in their journey to net zero greenhouse gas emissions and complementing it with tailored, yet non-prescriptive, policy advice. The TDI project falls under the High-Volume Transport Applied Research Programme (HVT), funded by the UK Foreign, Commonwealth & Development Office.

If you can't measure it, you can't improve it

Without reliable benchmarks and tracking mechanisms, decarbonisation and sustainability efforts risk being fragmented, inefficient, or misaligned with long-term global and national goals. By providing comprehensive, data-driven insights into climate and sustainability trends, policy effectiveness, and investment gaps in the transport sector, transport assessments enable policy makers to design targeted interventions that maximise emission reductions, minimise the sector's negative externalities and deliver socio-economic benefits for society. They also help financial institutions and investors identify high-impact projects, de-risk investments and allocate resources more efficiently.

The TDI project's diagnostic toolkit allows policy makers to evaluate the current state of their country's transport sector, identify their respective strengths and gaps, and undertake high-impact policy and financing actions towards a decarbonisation pathway. More than a diagnostic tool, the TDI can act as a catalyst for knowledge sharing, partnership building, and collaborative learning, supporting low- and middle-income countries in aligning national policies with national and global climate and sustainability agendas.

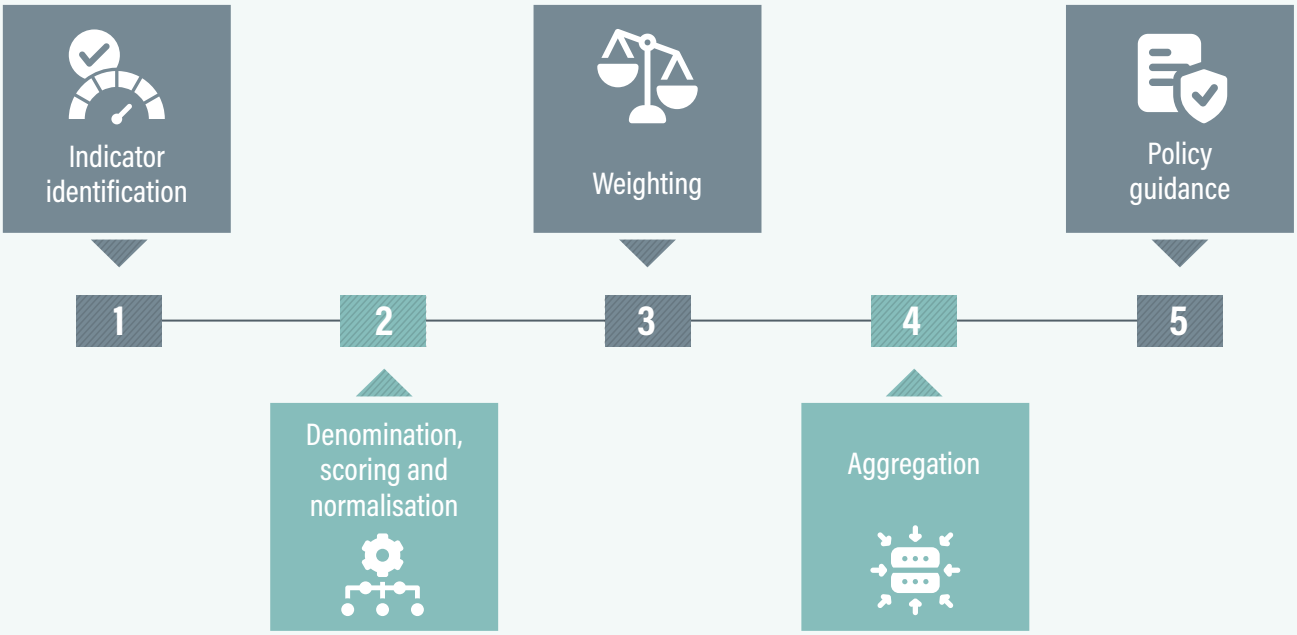
The TDI in a nutshell: methodology and toolkit

A clear methodology – including rigorous processes for indicator selection, normalisation, weighting and aggregation – is at the heart of any successful composite indicator system, with the TDI being no exception. The TDI methodology follows a comprehensive framework for assessing transport in low- and middle-income countries. It combines quantitative and qualitative aspects into relevant indicators to capture the complexity of transport systems, focusing on both current performance (e.g., emission levels) and future commitments (e.g., targets in Nationally Determined Contributions). The TDI's scope covers a range of surface transport modes – including road, rail and inland waterways – across both passenger and freight transport. The methodology is designed to balance robustness with flexibility, allowing application in countries that have varying data availability.

See the full TDI Methodology Report for a comprehensive overview of the methodology.[3]

The methodology of the TDI revolves around five main elements, which are common to any major composite indicator system (Figure 1).[4] **The index itself encompasses a broad range of indicators across eight dimensions, including passenger mobility, freight systems, finance and economics, governance, energy and context.** Based on the A-S-I-F (Activity-Structure-Intensity-Factor of emissions) framework, these dimensions reflect core elements of surface transport sustainability and decarbonisation.

FIGURE 1. The five elements of the TDI's methodological framework



Source: See endnote 4 for this section.

In selecting the indicators, a balance has been struck between the need for minimal coverage and pragmatism regarding data availability. Additionally, the selection has been guided by interpretability for user understanding and relevance for measuring progress towards net zero greenhouse gas emissions from surface transport, both within and across countries. Priority has been given to indicators from international databases, given their broad coverage and regular updates across the majority of low- and middle-income countries. However, restricting data collection, validation and scoring efforts to international databases carries the risk of excluding highly relevant indicators that are not systematically reported and collected globally.

Overcoming data gaps is crucial for the TDI. Proxies constitute one method for bridging gaps but should be used sparingly, with the underlying assumptions clearly stated. Importantly, the TDI can perform even if the data for some indicators are missing. (*For more on overcoming data limitations, see the TDI Benchmarking Report.*[5])

After the data are collected, the indicators are "normalised" to make them usable for aggregation. This begins with "denomination", which adjusts the indicators based on population to enable cross-country comparisons. Indicators that reflect extensive monetary values (e.g., fossil fuel subsidies) or physical quantities (e.g., paved road length) are denominated by the total population. In contrast, urban-specific metrics (e.g., rapid public transport) are denominated based on urban population size.

Once denominated, the indicators are "scored" either by using min-max scoring methods or "best-in-class" values or by grouping values into discrete bins. Scoring ensures comparability across different units of measurement, distributions, variances and scales. Following the scoring of the individual indicators, a second level of normalisation of the variables is added to ensure that they are on a common scale before aggregating them into composite values.

Weighting is a critical step in index development, often sparking debate over the optimal approach. The default weighting system of the TDI is equal weighting, attributing equal importance to each indicator within a dimension. This approach allows for automatic adjustment based on available indicators within dimensions and minimises bias towards certain aspects while enabling flexibility in cases where indicators are missing.

In the final step, the treated, denominated, normalised and weighted indicators are aggregated into final dimension scores. Specifically, the TDI shows the dimension scores derived from the sum of the normalised and weighted indicator scores for the indicators in each respective dimension. Thus, the aggregation indicates scores from 0 to 1 for the dimensions, with "1" constituting the best performance possible, whereas

"0" signals severe challenges in the context of transport sustainability and decarbonisation.

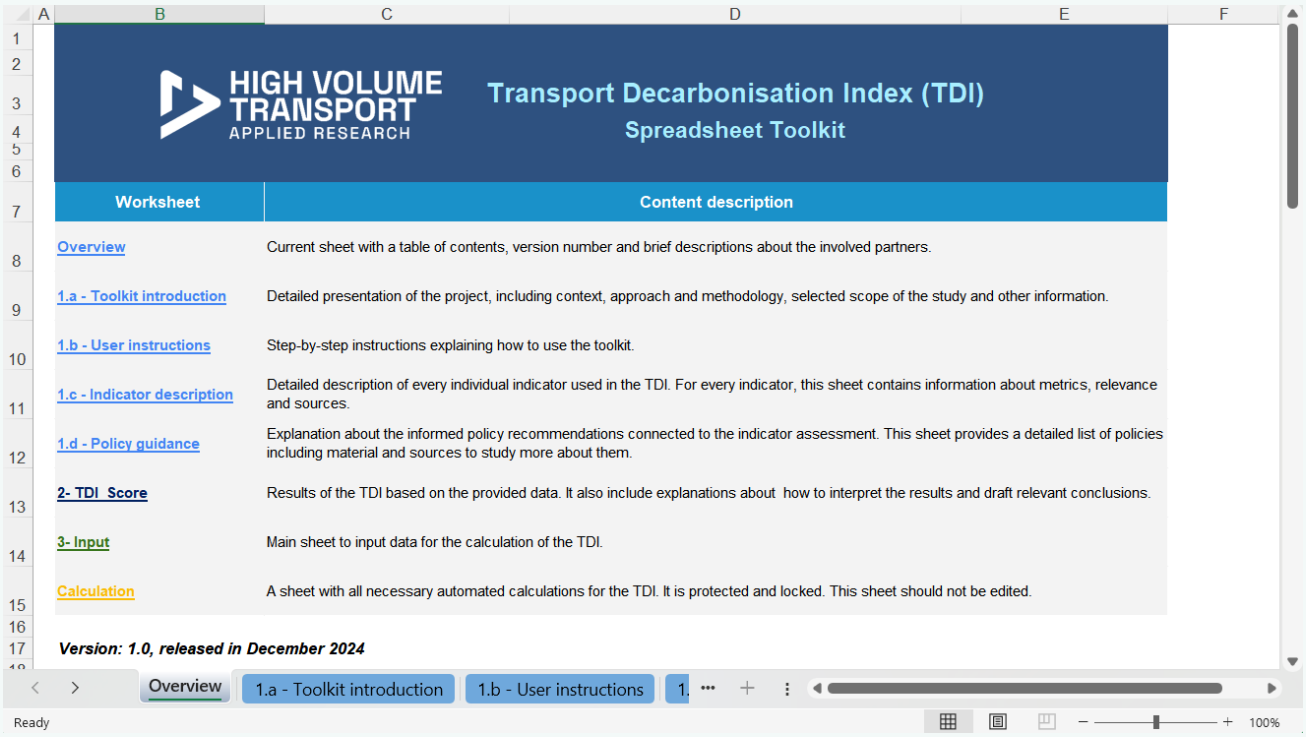
Each country is provided with illustrative and non-prescriptive advice in relation to its two lowest-scoring dimensions, with the intention of supporting evidence-based and informed policy making. These policy actions are to be regarded within the context of each country, accounting for characteristics linked to levels of development, the availability of natural resources, the presence of manufacturing capacity, and the existence of specific geographical characteristics, among others. To be impactful, policies require an enabling financial, political and institutional environment. The TDI is, therefore, not to be used in isolation but to be considered in parallel with a range of policy and financing instruments to effectively steer the sector on a low-carbon pathway.

To learn more about how to boost ambition for transport mitigation, adaptation and resilience in the third generation of Nationally Determined Contributions (NDCs 3.0), and how to facilitate the access of low- and middle-income countries to climate finance for transport, see the **Spotlight on Transport Ambition in NDCs 3.0 (Module 2)** and the **Spotlight on Improving Access to Climate Finance for Transport in LMICs (Module 6)**.

The TDI enables users to self-assess a country's transport system through the Spreadsheet Toolkit, which is provided in the form of an Excel file to enable broad accessibility for practitioners and policy makers in low- and middle-income countries. The toolkit and its dedicated user guide can be downloaded from the HVT website and used as a local file without an internet connection (see Figure 2 for a snapshot of the toolkit's webpage).[6] Upon inputting transport data on a specific sheet, users are provided with a score for the dimensions. The results are accompanied by explanations about the scores' meanings and corresponding policy guidance specifically for the two lowest-scoring dimensions.

A well-defined and user-friendly diagnostic toolkit is central to fostering the independent and widespread use of the TDI. Besides enabling transport assessments, the TDI is paramount in guiding users in interpreting the scoring results and their related policy recommendations. This is crucial to maximising the TDI's benefits for all user groups while safeguarding its effectiveness not only as a diagnostic tool, but also as a catalyst for knowledge sharing, partnership building and collaborative learning – supporting low- and middle-income countries in their efforts to transition to low-carbon, sustainable and resilient transport systems.

FIGURE 2. Snapshot of the Transport Decarbonisation Index (TDI) Spreadsheet Toolkit



Source: See endnote 6 for this section.

The TDI: a catalyst for knowledge sharing, partnership building and collaborative learning

Importantly, the TDI is designed not as a tool for casting blame or shaming countries that have lower scores; rather, it is a platform for mutual learning, collaboration and inspiration. By approaching a low score as an indicator of significant untapped decarbonisation potential, policy makers can make informed decisions regarding the policy and financing efforts that need prioritisation.

Countries can leverage the index to:

- address knowledge and capacity gaps
- build investor trust through transparency
- strengthen partnerships with financial and development institutions
- mobilise financial and technical support
- devise impactful policies for sustainable, low-carbon transport
- fast-track progress towards net zero emissions by 2050 by benchmarking against global pathways aligning to sustainability and decarbonisation goals, and
- improve public awareness and engagement.

These activities can help to implement global agendas at the national and sub-national levels, including the Paris Agreement and the 2030 Agenda for Sustainable Development. To realise the TDI's full potential, however, the dissemination of the index's scoring results would have to be tailored to the needs, knowledge and data literacy of its target audience. Here, the engagement of all relevant stakeholders – from policy makers to practitioners – at the outset will be key to ensure relevance and increase the sense of ownership among end users.

To learn more about the importance of and challenges to capacity building, see **6.2 Capacity Building for Transport Transformations** (**Module 6**).

Key findings from the TDI piloting and conceptualisation

The application and benchmarking of the TDI was carried out across 12 pilot countries, including 6 in Africa (Ethiopia, Ghana, Kenya, Nigeria, Rwanda, South Africa and Zimbabwe) and 6 in South Asia (Bangladesh, India, Nepal, Pakistan and Sri Lanka).

The piloting process demonstrated the importance of tailored transport assessments, underscoring both the potential and challenges in aligning national transport strategies with global decarbonisation and sustainability agendas. Although serving as a comparison tool is not the TDI's primary objective, the assessment of multiple countries offered a valuable opportunity to showcase the index's application. The results revealed substantial variability across countries in dimensions such as public transport investment, vehicle ownership, freight efficiency, emissions and clean energy. Despite this variability, some interesting observations can be drawn:

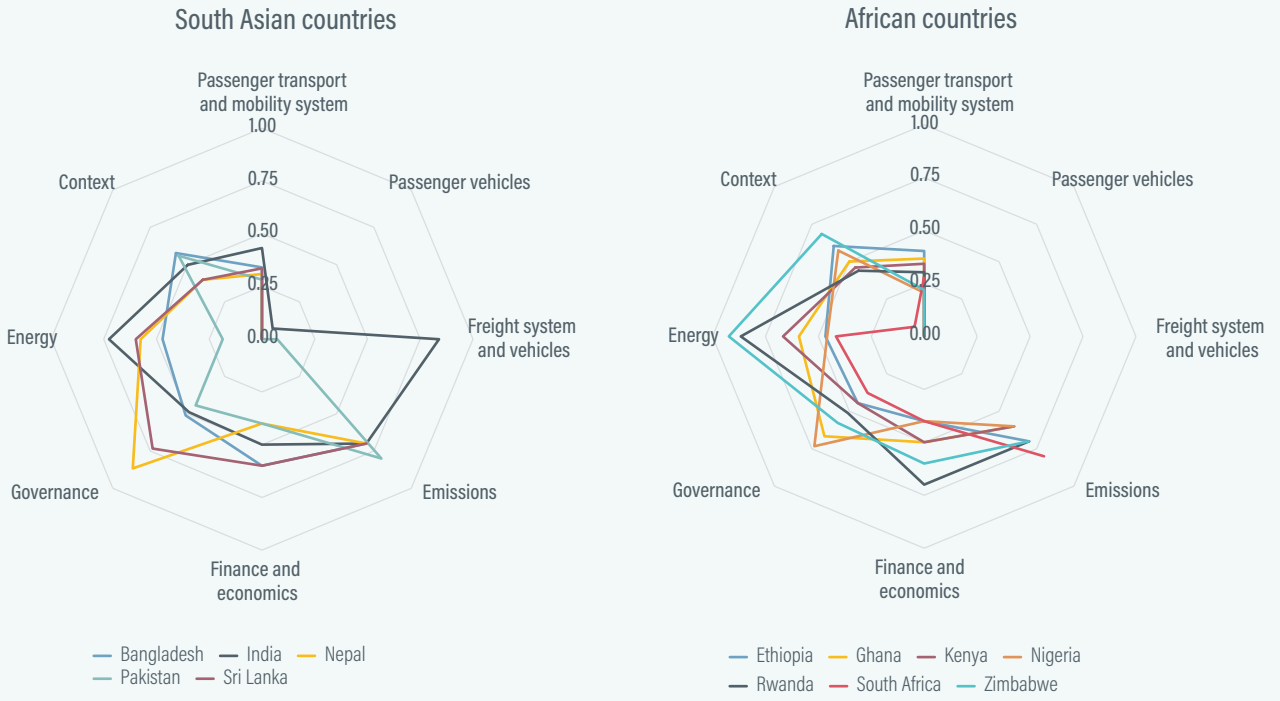
- The assessed countries provided **per capita fossil fuel subsidies** for petrol and diesel of between USD 17 and USD 180 in 2022; these levels were below global averages, resulting in higher TDI scores under the dimension "finance and economics".
- Lower TDI scores were observed in the pilot countries for the **availability of low-cost finance**, which refers to climate-related official development assistance (ODA). Although ODA data are not strictly limited to the transport sector, they offer a useful indication of potential financial support available for transport initiatives.
- Within the dimension "passenger transport and mobility system", data for the indicator of **walkability** (which relates to urban design and the proximity of residents to desired services and destinations) showed Nepal as the highest scoring country, with 77% of trips being walkable, whereas in Nigeria only 6% of trips are regarded as walkable.
- Sri Lanka demonstrated national best practice in **public transport investment** relative to other pilot countries, whereas India showed high scores on the indicator **policy strength of clean fuels** thanks to its high fuel quality standards.
- The majority of the 12 pilot countries examined through the TDI were marked by low baseline **transport carbon dioxide (CO_2) emissions**, with average per capita emissions of around 0.24 tonnes of CO_2 in 2022.
- Nearly all examined countries, except for South Africa, displayed extremely low levels of **private vehicle ownership**, reflecting room for further development of their transport systems.

- In Kenya, Nepal, and Nigeria, **renewables** accounted for more than 70% of total energy consumption in 2021; these were some of the highest values in the examined dataset, pointing to important opportunities to amplify the emission benefits of transport electrification.
- Overall, South Asian countries yielded homogeneous results across the dimensions of "passenger transport and mobility systems", "emissions" and "finance and economics" (Figure 3).[7] South Asian countries generally scored low in the "light-duty vehicles" dimension and in the "emissions" dimension, signalling comparable levels of growth and per capita emissions.
- In contrast, African countries displayed greater diversity in their results. South Africa stood out in the "context" dimension, with **road traffic fatalities** significantly higher than in other pilot countries.
- The policy guidance results for the two lowest-scoring dimensions revealed that African countries could prioritise policies and activities on **light-duty vehicles** and **passenger transport**. South Asian countries, on the other hand, could address context-related issues, including **air pollution** and **road safety**.

All in all, the results of the TDI application in the 12 pilot countries pointed to significant challenges linked to road traffic fatalities and air pollution-related mortality. Emission-related indicators scored relatively well across most countries, despite rapid growth in transport CO_2 emissions. Maintaining low emission baselines, however, will require co-ordinated efforts across all dimensions covered by the TDI.

For in-depth analysis of the results of the TDI application and benchmarking process across the 12 pilot countries, see the **TDI Benchmarking Report**.[8]

FIGURE 3. TDI dimension scores for pilot countries in South Asia and Africa



Higher score is better, which means:

The score ranges from 0 (lowest) to 1 (highest).
A higher score means that a country performs well for the dimension.

Source: See endnote 7 for this section.

Way forward and areas for improvement

The Transport Decarbonisation Index provides a critical framework for assessing and supporting low- and middle-income countries in their efforts to achieve sustainable and decarbonised transport systems, while supporting broader sustainable development objectives. Despite data challenges, the TDI has proven that it can be a valuable tool for benchmarking performance and informing policy decisions by offering a nuanced understanding of key transport dimensions such as emissions, governance, infrastructure and finance.

Notwithstanding, incorporating new elements into future iterations of the TDI could enhance the index's assessment results and its adoption among policy makers.

- First, **expanding the availability of TDI resources in multiple languages** beyond English would increase accessibility for a broader range of users. This would improve its usability among policy makers and practitioners in low- and middle-income countries, where language barriers may limit engagement. The success of the TDI will largely depend on its uptake by policy makers in the Global South.
- Second, **applying the TDI to a wider range of countries** across different regions would strengthen its indicator set and scoring methodology. The benchmarking of the TDI was focused on a small number of countries in two regions, making it difficult to establish robust thresholds for scoring country performance.
- Third, **a more sophisticated weighting approach** could be introduced if the TDI were tested across more countries, improving its practical application. Currently, the TDI employs an equal weighting system, treating all indicators within a dimension as equally important for the final dimension score.
- Fourth, the TDI would benefit from **greater efforts in data collection and sharing**. Despite prioritising indicators that have good data coverage across the pilot countries and relying on globally recognised databases with harmonised collection processes and annual updates, the application of the TDI faced significant data limitations. Such limitations make comprehensive transport assessments challenging.

The TDI's application in the pilot countries provided valuable insights into the type of data that need to be captured. It also underscored the **need for improvements in data collection and availability in low- and middle-income countries, with regional data analysis efforts holding great potential** to improve assessment and policy making in transport. The **Asian Transport Observatory (ATO)** was identified as a successful data resource for the Asia-Pacific region, serving as a potential model for replication in other data-limited regions such as Africa and Latin America. This effort could be supported by developing guidelines or toolkits to help countries improve transport data collection, reporting and management. Partnerships with international databases could help leverage existing data while encouraging countries to contribute more consistently.

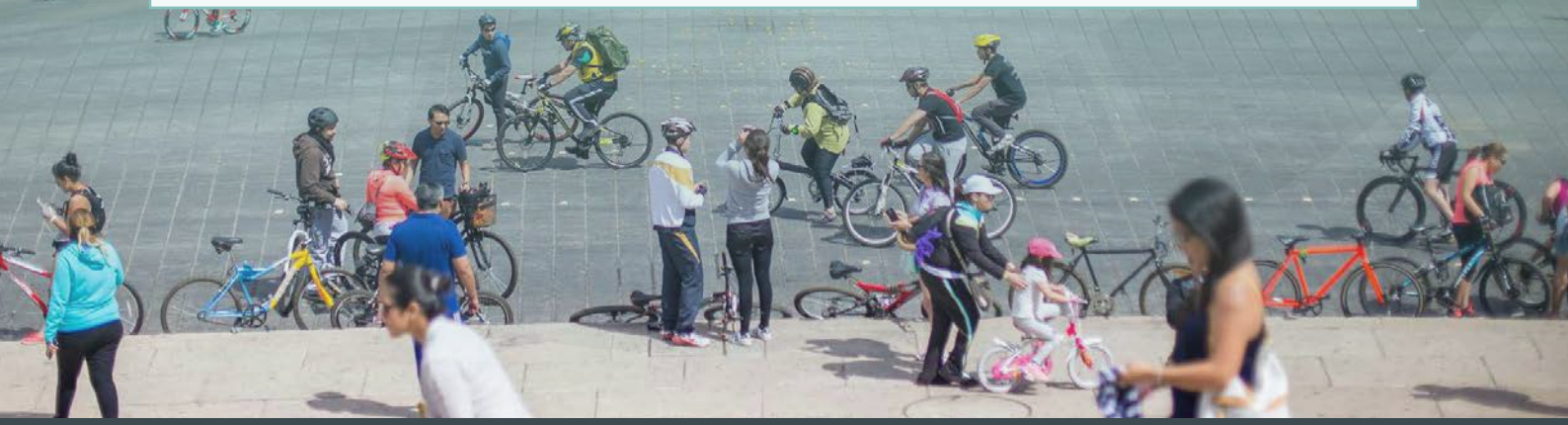
- Fifth, future iterations of the TDI could be enhanced by **incorporating additional indicators**. With improved data availability, the TDI could include themes not currently covered, such as equity and informal transport. While maintaining its overall structure, additional indicators could refine the assessment. A TDI comparison incorporating a significantly broader coverage of aspects with adequate data availability can provide more accurate insights into countries' performance. Moreover, this can incentivise countries to gauge their own efforts to collect the needed data and put in place ongoing tracking efforts.
- Finally, future development could include **enhanced interactive elements (toolkit, visualisations and dashboards)**. With additional resources, an interactive online dashboard using R, Python or other coding languages could be developed and implemented, improving the TDI's accessibility and usability.



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Sub-National Transport Pathways to Reach Climate and Sustainability Goals

This section focuses on transport action by sub-national governments (regions, states, provinces, cities, municipalities and local authorities). However, because many sub-national datasets focus only on urban areas, the section content does not provide a complete picture of the situation at other sub-national levels. The examples are synthesised mainly from the following sources: Voluntary Local Reviews (VLRs) on the implementation of the Sustainable Development Goals (conducted by sub-national governments from 2023 to 2025), the MobiliseYourCity Global Monitor (2023, 2024 and 2025 editions), publications from international organisations and journal articles.[1]



KEY FINDINGS

- Many sub-national governments and cities, especially in emerging economies, are experiencing rapid population growth and urbanisation as well as shrinking public budgets. This has led to growing pressures to ensure affordable services and transport that can improve quality of life and access to socio-economic opportunities for all residents in urban, peri-urban and rural environments.
- In many cases, transport systems have been an afterthought in urban and metropolitan development, struggling to catch up with rising demand for moving people and goods and unable to address systemic inequalities without major shifts in governance, infrastructure and investment.
- Sub-national governments and cities – including regions, states, provinces, municipal and local authorities – are on the front lines of dealing with the negative impacts of transport systems, including road crashes, unsafe walking and cycling conditions, inadequate public and collective transport, heavy reliance on private vehicles, congestion, emissions, air and noise pollution, and spatial segregation.
- The extent of these impacts – and the ability to provide adequate sustainable transport infrastructure – vary widely depending on a jurisdiction's regional and national contexts.
- Although the mandates and competences of sub-national governments and cities vary greatly across countries, these jurisdictions have played an increasingly effective role in advancing climate and sustainability action. Beyond their formal mandates, they deliver impactful action in critical areas at the intersection of transport, climate, sustainability and social justice.
- Developing and maintaining sustainable transport systems demands significant co-ordinated planning, investment, and technical action, which are often beyond the fiscal and technical capacities of sub-national governments and cities.
- Strengthening multi-level governance mechanisms is essential to align objectives, clarify roles and ensure coherence between national frameworks and local implementation. Institutionalised, cross-sectoral collaboration across government departments can improve planning, financing and monitoring of transport interventions.
- Despite these challenges, opportunities abound for sub-national governments to prioritise and advance sustainable transport systems and with it foster inclusive growth; enhance access to jobs, education and health care (including for marginalised groups); and enable thriving local economies and connected communities.



KEY FINDINGS

Demand, use and access

- The share of trips by different transport modes varies across regions and depends on factors such as city size, income level and access to transport options.
- A 2024 analysis of nearly 800 cities in 61 countries found that, on average, 51% of journeys were by car, 26% by public transport, and 22% by active travel (walking and cycling), with varying trends by region. Car use dominated in Europe, Oceania, and North America, whereas the combination of public transport, walking and cycling had the highest modal shares in Africa, Asia and Latin America.
- In some low-and middle-income countries, the dependence on public transport, walking and cycling represents "captive users" who have few other available transport options; meanwhile, rising prosperity is linked to an increase in private motorised transport.
- Walking and cycling continue to account for a large share of daily trips in many cities and regions, although they remain undercounted in statistics and thus neglected by policies. The undercounting of walking and cycling in statistics impedes efforts to provide people with important services and opportunities close to their homes and within walking and cycling distance.
- In 2022, only 52% of the urban population globally had convenient access to public transport, a share that has not changed measurably in recent years despite the implementation of new projects and services. Both public transport and informal transport face challenges of inefficiency, inadequacy, low quality, and poor maintenance, prompting many users to shift to private vehicles.
- As of February 2025, 191 cities globally had bus rapid transit (BRT) networks, carrying a combined 32 million passengers daily. BRT has been a common (although complex) mass transport solution in cities such as Ahmedabad (India), Dakar (Senegal), Medan (Indonesia) and Peshawar (Pakistan).
- Increasingly, sub-national governments and cities have recognised the role of informal transport (also known as popular transport or paratransit) in local development and economies. Efforts to improve informal transport systems include network redesign, fleet modernisation, professionalisation, digitalisation and integration into formal networks.
- Some sub-national governments face challenges of under-developed road networks. In 2020, a majority (85%) of the world's lower-income population lived in rural areas, yet only 38% of the rural population globally had access to all-weather primary and secondary roads, leading to isolation and spatial segregation across urban-rural areas and hindering regional connectivity.
- Research shows that the financial burden of transport is higher in areas that are more car dependent; however, many sub-national governments and cities have taken steps to ease the financial burden of mobility, particularly for low-income and vulnerable populations.



KEY FINDINGS



Sustainability and climate trends

- Urban transport (passenger and freight) was responsible for an estimated 5% of global greenhouse gas emissions and 31% of total transport emissions in 2023. Urban passenger transport represented an estimated 39% of all passenger transport activity and contributed 34% (1.4 gigatonnes) of the total CO_2 equivalent emissions from passenger transport in 2023.
- Urban freight transport contributed around 28% (1.1 gigatonnes) of freight transport emissions, even though it accounted for only an estimated 5% of global freight activity in 2023.
- Research from 2022 found that urban freight transport accounted for an estimated 15-25% of the vehicle-kilometres travelled, occupied 20-40% of the motorised road-space, and released around 30-50% of air pollutants globally.
- The integration of transport, land use and urban planning has gained momentum as a key mobility planning trend, linking transport development to liveability and climate goals. This includes the increasing uptake by national and sub-national governments and cities of Sustainable Urban Mobility Plans (SUMPs) and National Urban Policy and Investment Programmes (NUMPs).
- Another key trend in sub-national and city action has been the shift towards people-centred mobility planning that considers the diverse needs of all residents, which accelerated in 2020-21 through responses to the COVID-19 pandemic. This includes a strong emphasis on universal accessibility, improved transport access for persons with disabilities, and tariff subsidies for vulnerable populations.



Policy and investment developments

- Transport policy is structurally complex, as it involves multiple governance layers and diverse stakeholders, cutting horizontally across agencies and vertically across national, regional and local jurisdictions. This often creates a misalignment of policies, resources and responsibilities.
- SUMPs and NUMPs are strategic, action-oriented frameworks that take an integrated approach to planning, with the goal of supporting sustainable urban mobility and improving quality of life. These tools ensure co-ordination across different levels of government and stakeholder groups, promoting a holistic and systemic approach to urban and metropolitan mobility.
- Sub-national governments and cities have often been at the forefront of transport policy action on air quality, climate, and environmental protection, with increasing attention to noise pollution, energy consumption, ecosystem protection and broader sustainability matters. However, political shifts, geopolitical challenges and divergent stakeholder interests have countered these efforts in recent years, with push-back leading to policy reversals in some cases.
- A growing number of sub-national governments have committed to reducing transport emissions. Sub-national governments are the largest signatory group to the Zero Emission Vehicles Declaration, accounting for 37% of the 214 total signatories as of 2025.
- Sub-national governments and cities have been lead actors in the electrification of vehicle fleets. To meet the Paris Agreement goal of keeping global temperature rise within 1.5 degrees Celsius, electric buses will need to achieve 100% adoption by 2027 in leading markets, and by 2030 in other markets. However, recent roll-backs and delays are likely to slacken the pace of adoption at a time when substantial acceleration is needed.
- To meet the challenges of rising urban freight demand, sub-national governments and cities have explored approaches that include consolidation hubs, off-peak deliveries and delivery robots.

KEY FINDINGS

- Developing and maintaining sustainable transport systems requires significant co-ordinated planning, investment, and technical action, including across government levels, departments and sectors.
- Reviews of the implementation of the Sustainable Development Goals (SDGs) – including Voluntary Local Reviews (VLRs) by sub-national governments and cities, and to some extent Voluntary National Reviews (VNRs) by national governments – offer insights into how sustainable transport connects with day-to-day action and governance by sub-national governments and cities.
- Providing infrastructure for public transport, walking and cycling is key for enabling marginalised populations to access social and economic opportunities. VLR submissions from 2023 and 2024 featured the implementation of transport projects focused on equity, affordability and access.
- In 2023, a survey of transport-related targets set by sub-national governments and cities revealed a strong priority on modal share targets (42% of all committed targets), followed by electrification efforts (30%). To pursue modal share targets, sub-national governments worldwide have made substantial investments in sustainable transport infrastructure, as expressed in recent VLR submissions.
- Digital and smart technologies are being integrated into urban mobility systems to improve efficiency, safety and environmental outcomes.
- Recent VLR submissions since 2023 indicate that sub-national governments and cities have begun to invest in corridor-level planning and inter-municipal co-ordination, pushing for joint strategies that reflect real travel patterns, not just administrative maps.
- VLRs submitted in 2023 and 2024 highlight that sub-national governments and cities have been adopting innovative methods of sustainable transport through community participatory planning.
- As of 1 August 2025, 29 countries had submitted new Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement; however, actual NDC implementation often falls to sub-national governments and cities, particularly in sectors such as transport.
- Among the 29 third-generation NDCs submitted to the United Nations, at least 12 featured explicit actions to mitigate greenhouse gas emissions in urban transport; these were from Andorra, Belize, Brazil, Canada, Kenya, Lesotho, Maldives, Nepal, the Republic of Moldova, the United Arab Emirates, the United States and Uruguay.
- In 2022 and 2023, the global landscape of transport investments pointed towards a widening gap between investment needs and actual investment volumes. Among investments related to private participation in infrastructure, those earmarked for transport fell sharply in 2023, to below levels during the COVID-19 pandemic in 2020.
- Efforts to ensure and expand transport investments at the sub-national level have continued in recent years, with some countries establishing national urban mobility funds and securing project funding through innovative approaches.
- VLR submissions from 2023 and 2024 featured examples of how cities directly fund sustainable transport initiatives through municipal budgets and how they engage in public-private partnerships and external collaboration.





Context, challenges and opportunities

Many sub-national governments and cities, especially in emerging economies, are experiencing rapid population growth and urbanisation as well as shrinking public budgets. This has led to growing pressures to ensure affordable services and transport that can improve quality of life and access to socio-economic opportunities for all residents in urban, peri-urban and rural environments.[2] **In many cases, transport systems have been an afterthought in urban and metropolitan development, struggling to catch up with rising demand for moving people and goods and unable to address systemic inequalities without major shifts in governance, infrastructure and investment.**[3]

Sub-national governments and cities- including regions, states, provinces, municipal and local authorities - are on the front lines of dealing with the negative impacts of transport systems, including road crashes, unsafe walking and cycling conditions, inadequate public and collective transport, heavy reliance on private vehicles, congestion, emissions, air and noise pollution, and spatial segregation. The extent of these impacts - and the ability to provide adequate sustainable transport infrastructure - vary widely depending on a jurisdiction's regional and national contexts.[4]

In 2021, more than half (58%) of the global population lived in areas that lacked appropriate urban speed limits (i.e., 50 kilometres per hour or lower) for four-wheelers and motorised two- and three-wheelers.[5] Meanwhile, traffic noise from vehicles is a widespread problem across all regions. A 2023 report noted that harmful levels of traffic noise affected at least 20% of European Union (EU) citizens, the majority of cyclists in Ho Chi Minh city (Viet Nam), as well as public transport users in New York City (United States).[6]

Cities contribute significant shares of both passenger and freight transport greenhouse gas emissions and also release large quantities of air pollutants from vehicle emissions.[7] As of 2023, 7.3 billion people worldwide – 80% of them in low- and middle-income countries – were exposed to annual particulate matter ($PM_{2.5}$) levels above the World Health Organization's threshold.[8] Air pollution was the second largest cause of death in Africa in 2022 and caused 8.1 million deaths globally in 2021, with transport being responsible for around 6% (2019 estimates).[9]

Although the mandates and competences of sub-national governments and cities vary greatly across countries, these jurisdictions have played an increasingly effective role in advancing climate and sustainability action. Beyond their formal mandates, they deliver impactful action in critical areas at the intersection of transport, climate, sustainability and social justice.[10] Not all sub-national governments and cities advance sustainable transport from the same starting points, nor do they define progress in the same way as national governments. Common goals such as access, decarbonisation and equity are prioritised and operationalised differently across local contexts.

The extent to which sub-national governments and cities shape decision making can vary depending on how resources are distributed and on the degree of local discretion over policy directives. In 2022, sub-national governments and cities handled 40% of public spending and 58% of public investment across countries in the Organisation for Economic Co-operation and Development (OECD).[11] Sub-national governments and cities are also significant public employers, accounting for more than 61% of total public workforce spending in OECD countries in 2023.[12]

Developing and maintaining sustainable transport systems demands significant co-ordinated planning, investment, and technical action, which are often beyond the fiscal and technical capacities of sub-national governments and cities. Strengthening multi-level governance mechanisms is essential to align objectives, clarify roles and ensure coherence between national frameworks and local implementation. Institutionalised, cross-sectoral collaboration across government departments can improve planning, financing and monitoring of transport interventions. In many places, effective action by sub-national governments and cities in advancing sustainable transport is hindered by fragmented mandates and misaligned policies across local, regional and national levels; limited technical capacities; scarce public resources; and evolving urban and metropolitan landscapes.

Despite these challenges, opportunities abound for sub-national governments to prioritise and advance sustainable transport systems and with it foster inclusive growth; enhance access to jobs, education and health care (including for marginalised groups); and enable thriving local economies and connected communities. Investments in walking and cycling and modernised fleets (such as electric buses) reduce noise pollution and promote healthier lifestyles, while high-quality public transport such as bus rapid transit reduces congestion and improves the reliability of commutes.[13] The integration of mass public transport, walking and cycling requires around 50% less government spending than car-centric models and yields significant benefits from reduced emissions, improved air quality and enhanced public health.[14]

By integrating land use and transport planning, governments can support compact, mixed-use development, reducing social segregation and car dependence. (See 4.2 Integrated Transport Planning.) Sustainable transport can deliver trillions in savings by 2050 through reduced fuel use, lower operational costs and avoided congestion.[15] Leveraging innovations such as Mobility as a Service (MaaS) and Intelligent Transports Systems (ITS), alongside public-private partnerships, can optimise transport efficiency and stimulate economic growth through job creation.

Demand, use and access

The share of trips by different transport modes varies across regions and depends on factors such as city size, income level and access to transport options.[16] A 2024 analysis of nearly 800 cities in 61 countries found that, on average, 51% of journeys were by car, 26% by public transport, and 22% by active travel (walking and cycling), with varying trends by region.[17] Car use dominated in Europe, Oceania, and North America, whereas the combination of public transport, walking and cycling had the highest modal shares in Africa, Asia and Latin America.[18]

Understanding the modal share offers critical insight into the mobility patterns, infrastructure challenges and policy trajectories of cities worldwide; however, modal share methodologies often undercount walking and cycling. (See 4.2 Integrated Transport Planning.)

In some low-and middle-income countries, the dependence on public transport, walking and cycling represents "captive users" who have few other available transport options; meanwhile, rising prosperity is linked to an increase in private motorised transport.[19] Compounded with poor traffic management and insufficient road infrastructure to accommodate growing numbers of private vehicles, this results in rising traffic congestion, emissions, air and noise pollution, and road crashes.

- In Santo Domingo (Dominican Republic), the transport system is based heavily on individual motorised transport, with motorisation rates of 40-60% (depending on the municipality) in 2025 and high shares of transport greenhouse gas emissions from private cars (56%) and informal taxis (16%).[20]
- In Yaoundé (Cameroon), although only 10% of trips were made by private car as of 2025, car ownership has increased steadily in line with rising living standards.[21]
- Household survey data for Dakar (Senegal) indicated that the percentage of captive pedestrians fell with rising incomes.[22]
- In South Africa, the Department of Transport projected that captive public transport users constituted around 50% of the country's urban passenger transport market by 2020.[23]

Walking and cycling continue to account for a large share of daily trips in many cities and regions, although they remain undercounted in statistics and thus neglected by policies.[24] Despite high shares of walking and cycling in parts of Africa, infrastructure for active mobility is frequently inadequate or absent, making it unsafe or unattractive. Some sub-national governments have addressed this through dedicated infrastructure, public awareness efforts and urban integration.

- In Dire Dawa (Ethiopia), 46% of trips are made on foot, while in Maputo (Mozambique) walking and cycling represent 45.9% of the modal share.[25]
- A pilot project for bicycle parking in Puebla (Mexico) is linked to the use of bus rapid transit systems.[26]
- In Santo Domingo (Dominican Republic), the installation of 10 kilometres of cycling lanes led to the creation of national bicycle infrastructure guidelines.[27]
- Globally, the share of older adults walking in urban areas fell from 34% in 2012 to 28% in 2022, with much of this decline occurring in high-income and ageing countries.[28]

The undercounting of walking and cycling in statistics impedes efforts to provide people with important services and opportunities close to their homes and within walking and cycling distance.[29]

- In 2024, less than half (44%) of urban residents globally lived within 1 kilometre of both healthcare and education services; in Africa, only 35% of urban residents had such services nearby, compared to 83% in Europe.[30] (See 4.3 Walking.)
- As of 2024, only 6% of the global urban population had access to a protected bike lane within 300 metres; regional disparities were significant, with 27.6% of urban dwellers in Europe having such access, but only 0.7% in Africa.[31] (See 4.4 Cycling.)

In 2022, only 52% of the urban population globally had convenient access to public transport, a share that has not changed measurably in recent years despite the implementation of new projects and services.[32] **Both public transport and informal transport face challenges of inefficiency, inadequacy, low quality, and poor maintenance, prompting many users to shift to private vehicles.**

As of February 2025, 191 cities globally had bus rapid transit (BRT) networks, carrying a combined 32 million passengers daily.[33] Key challenges in BRT implementation include spatial disparities in peripheral areas, difficult topography, and the specific needs of vulnerable groups such as people with limited mobility, children, and women, who often encounter safety and infrastructure barriers. (See 4.5 Public Transport.)

- **BRT has been a common (although complex) mass transport solution in cities such as Ahmedabad (India), Dakar (Senegal), Medan (Indonesia) and Peshawar (Pakistan).**[34]
- In South African municipalities, several public transport initiatives are under way to improve access to informal settlements, focusing on both formal and informal transport systems. These include the Rea Vaya BRT in Johannesburg, the City of Tshwane BRT system, and the Gautrain rail project, among others.[35]

Increasingly, sub-national governments and cities have recognised the role of informal transport (also known as popular transport or paratransit) in local development and economies. Efforts to improve informal transport systems include network redesign, fleet modernisation, professionalisation, digitalisation and integration into formal networks.[36] Informal modes, such as motor-taxis, minibuses, and tuk-tuks, dominate travel in Africa, Asia and Latin America but are major contributors to greenhouse gas emissions and are often associated with safety and labour issues. Informal transport may offer lower fares, but in some cases the lack of regulation allows associations to set unreasonably high prices, undermining affordability. (See 4.6 Informal Transport.)

- Data for different cities in the Global South show that informal modes still represent a large share of passenger transport services, ranging from 11% to 95% of trips, with an average of 48% of trips (based on data from 15 countries).[37]
- In 2023, Mexico City's transport agency SEMOVI launched a modernisation programme with the commitment to replace 5,800 microbuses.[38] In 2025, Mexico opened its first interstate electric trolleybus line, serving up to 100,000 passengers per day. Of the 18.5 kilometres in total length, 6.7 kilometres are fully elevated and separated from other road traffic.[39]
- The BRT systems in many cities in low- and middle-income countries are operated/owned by former minibus operators formed into companies.[40]
- Mexico City's Ruta 2 union, with 200 concessionaires, was transformed into a modern public transport company (CISA) that now operates the Metrobús system.[41] The city has introduced training for minibus operators to become transport companies and to be able to access funding for new vehicle fleets.
- The City of Douala (Cameroon) began digital registration of moto-taxi drivers in July 2024, creating a database of verified drivers with the aim of improving safety and streamlining operations.[42]
- In 2023, the municipality of Flores (Guatemala) trained 39 drivers and operators of *tuk-tuk* services in Paxcamán, San Miguel and the central area of Santa Elena.[43]

Some sub-national governments face challenges of under-developed road networks. In 2020, a majority (85%) of the world's lower-income population lived in rural areas, yet only 38% of the rural population globally had access to all-weather primary and secondary roads, leading to isolation and spatial segregation across urban-rural areas and hindering regional connectivity.[44] In Brazil, the Urban Development Program of Pará state includes initiatives such

as the "Asphalt Throughout Pará Program" and "Paving, Recovery and Drainage of Urban Roads" to improve the road system and facilitate urban and trans-border integration. The state also conducts inspections and regulation of public inter-city passenger transport services by land and waterway across 83 municipalities.[45]

Research shows that the financial burden of transport is higher in areas that are more car dependent; however, many sub-national governments and cities have taken steps to ease the financial burden of mobility, particularly for low-income and vulnerable populations.[46] (See 4.2 Integrated Transport Planning.)

- In Yaoundé (Cameroon), transport accounts for over 11% of household spending, making it the third largest expenditure item.[47] This burden is often exacerbated by inefficient informal transport services, poorly maintained road infrastructure and a limited formal public transport system.
- In Khouribga (Morocco) and Maputo (Mozambique), inadequate public transport supply has led to increased reliance on private vehicles, disproportionately affecting low-income residents by restricting access to jobs, health care and other essential services due to higher costs and longer travel times.[48]
- Kuala Lumpur (Malaysia) has improved the affordability of public transport through the introduction of the MY50 pass, which provides unlimited monthly rides on RapidKL buses and trains for just USD 11.90 (MYR 50), making public transport both accessible and budget-friendly.[49]
- Rottenburg am Neckar (Germany) offers affordable and user-friendly digital mobility packages tailored to different age and user groups, complemented by reasonably priced, modernised public transport to reduce private car use.[50]

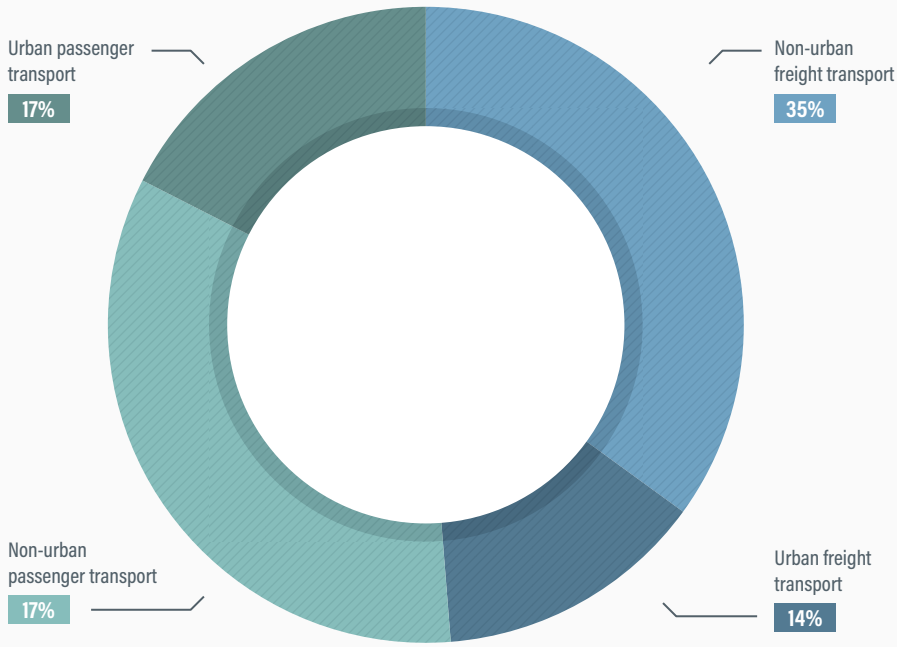
Sustainability and climate trends

Urban transport (passenger and freight) was responsible for an estimated 5% of global greenhouse gas emissions and 31% of total transport emissions in 2023 (Figure 1)**.**[51] **Urban passenger transport represented an estimated 39% of all passenger transport activity and contributed 34% (1.4 gigatonnes) of the total CO_2 equivalent emissions from passenger transport in 2023.**[52]

Urban freight transport contributed around 28% (1.1 gigatonnes) of freight transport emissions, even though it accounted for only an estimated 5% of global freight

FIGURE 1. Share of urban transport in total transport emissions, 2023

Share of urban transport (passenger and freight) in total transport emissions



Urban transport (passenger and freight) was responsible for an estimated 5% of global greenhouse gas emissions and 31% of total transport emissions in 2023.

Source: See endnote 51 for this section.



activity in 2023.[53] **Research from 2022 found that urban freight transport accounted for an estimated 15-25% of the vehicle-kilometres travelled, occupied 20-40% of the motorised road-space, and released around 30-50% of air pollutants globally.**[54]

The integration of transport, land use and urban planning has gained momentum as a key mobility planning trend, linking transport development to liveability and climate goals. This includes the increasing uptake by national and sub-national governments and cities of Sustainable Urban Mobility Plans (SUMPs) and National Urban Policy and Investment Programmes (NUMPs). (For more on SUMPs and NUMPs, see 4.2 Integrated Transport Planning.)

- Buenos Aires (Argentina) is reorganising traffic around pillars such as healthy mobility and intelligent transport systems.[55]
- SUMPs in Dakar (Senegal) and Dire Dawa (Ethiopia) propose and set guidelines for transit-oriented development projects, focus on multi-modal and integrated transport schemes across public transport and informal transport services, and outline efforts towards integrated ticketing systems and inter-modal infrastructure.[56]
- Freiburg (Germany), Lviv (Ukraine) and Münster (Germany) are developing SUMPs that not only connect modes of transport but also align with compact city planning and climate neutrality; these cities are investing in multi-modal hubs, shared mobility systems and digital integration to reduce reliance on private vehicles and support public and active transport.[57]
- The SUMP of Kisumu (Kenya) envisions a high-quality, cost-effective, and user-friendly public transport system, integrated with accessible pedestrian and cycling networks to enhance mobility and access for all residents; this is to be achieved through measures including safe active mobility infrastructure development, bike sharing systems, and public transport development, among others.[58]

Another key trend in sub-national and city action has been the shift towards people-centred mobility planning that considers the diverse needs of all residents, which

accelerated in 2020-21 through responses to the COVID-19 pandemic. This includes a strong emphasis on universal accessibility, improved transport access for persons with disabilities, and tariff subsidies for vulnerable populations.

- Cities developing mobility plans that cater to people with reduced mobility include Barcelona (Spain), Freiburg (Germany), London (United Kingdom), Lviv (Ukraine) and Rottenburg am Neckar (Germany); these cities offer digital packages tailored to diverse user groups and facilitate broad participation.[59]
- Córdoba Province (Spain), Sacramento (United States), São Paulo (Brazil) and Suva City (Fiji) explicitly embed principles of equity and environmental justice, ensuring that transport services respond to the needs of women, children, persons with disabilities, the elderly and marginalised communities.[60]
- In Bhopal (India) and Shanghai (China), the commitment to equity is reinforced by tracking access to transport services disaggregated by sex, age and disability.[61]
- Various cities globally – including Braga (Portugal), Buenos Aires (Argentina), Buffalo City (South Africa), Chandragiri (Nepal), Fürstenfeldbruck (Germany), Maringá and Pará (Brazil), Tshwane (South Africa) and Vantaa (Finland) – are aligning transport planning with broader social inclusion and equity goals and implementing projects such as pedestrian school routes and gender-sensitive urban design.[62]

Policy and investment developments

Transport policy is structurally complex, as it involves multiple governance layers and diverse stakeholders, cutting horizontally across agencies and vertically across national, regional and local jurisdictions.[63] This often creates a misalignment of policies, resources and responsibilities.[64] Effective transport policy making calls for a poly-centric and multi-level governance approach with comprehensive and holistic measures.[65] Each level of government may operate with different policy goals and priorities, with national governments setting strategic direction or budget envelopes, and sub-national actors managing implementation and service delivery.[66]

SUMPs and NUMPs are strategic, action-oriented frameworks that take an integrated approach to planning, with the goal of supporting sustainable urban mobility and improving quality of life. These tools ensure co-ordination across different levels of government and stakeholder groups, promoting a holistic and systemic approach to urban and metropolitan mobility. At the country level, NUMPs serve as strategic frameworks to enhance the capabilities of cities to meet their mobility needs in a sustainable way, while at the local level SUMPs can have a significant impact in reshaping how cities approach transport planning. (See 4.2 Integrated Transport Planning.)

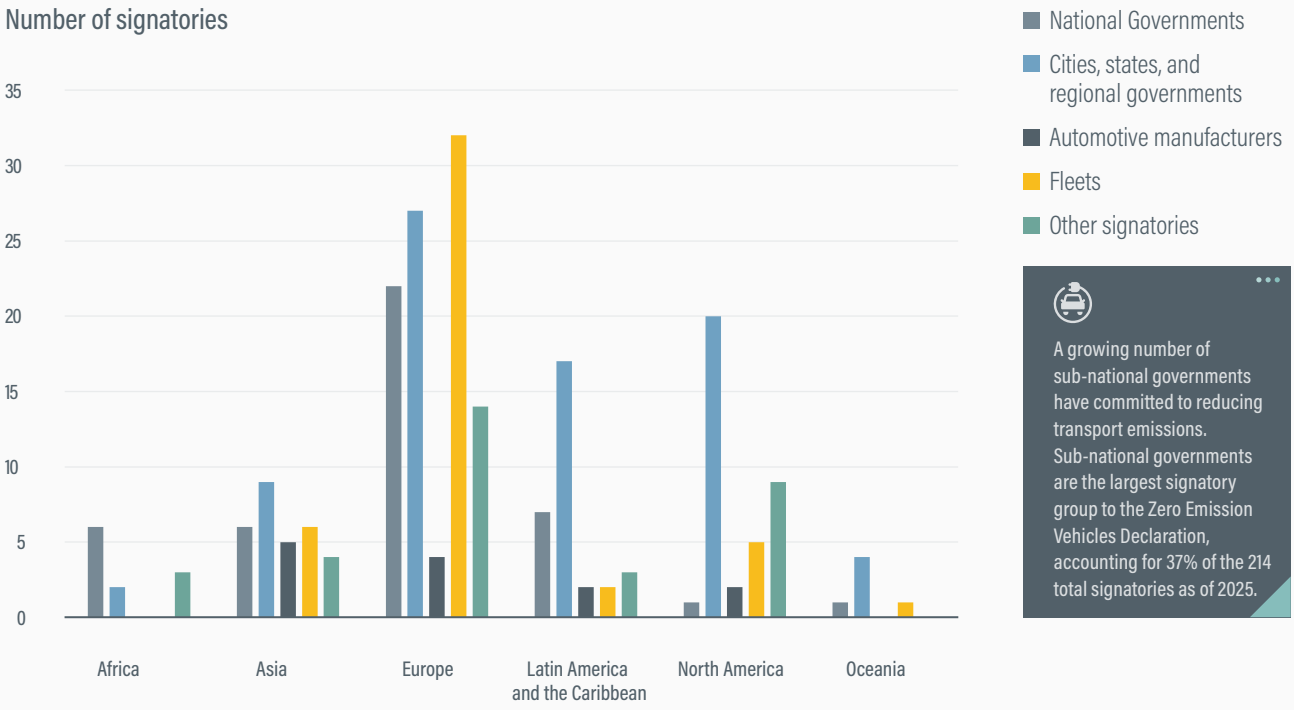
Sub-national governments and cities have often been at the forefront of transport policy action on air quality, climate, and environmental protection, with increasing attention to noise pollution, energy consumption, ecosystem protection and broader sustainability matters. However, political shifts, geopolitical challenges and divergent stakeholder interests have countered these efforts in recent years, with push-back leading to policy reversals in some cases.

- Agadir (Morocco) has addressed air pollution and traffic-related injuries in tandem with mobility reforms.[67]
- Braga (Portugal) and São Paulo (Brazil) adopted electric buses and fleet decarbonisation not only to cut greenhouse gas emissions, but also to improve air quality and reduce noise.[68]
- Fürstenfeldbruck (Germany) and Vantaa (Finland) align transport development with broader goals of resource efficiency and financial sustainability.[69]
- Jakarta (Indonesia) links sustainable mobility to ecosystem protection, such as preserving mangroves to combat air pollution.[70]
- In Münster (Germany), the transport master plan incorporates emission control and energy-efficient lighting to improve urban health and safety.[71]
- Pará (Brazil) links improved road systems with economic inclusion and reduced transport costs for both passengers and goods.[72]
- São Paulo (Brazil) highlights the medium- and long-term economic benefits of transitioning to electric buses, citing much lower energy and maintenance costs.[73]

A growing number of sub-national governments have committed to reducing transport emissions. Sub-national governments are the largest signatory group to the Zero Emission Vehicles Declaration, accounting for 37% of the 214 total signatories as of 2025 (Figure 2)**.**[74] In every region except Africa, more sub-national stakeholders than national governments have signed the Declaration, which aims for all new car and van sales to be zero emission globally by 2040 (and 2035 in leading markets).[75]

Sub-national governments and cities have been lead actors in the electrification of vehicle fleets. To meet the Paris Agreement goal of keeping global temperature rise within 1.5 degrees Celsius, electric buses will need to achieve 100% adoption by 2027 in leading markets, and by 2030 in other markets.[76] However, recent roll-backs and delays

FIGURE 2. Signatories of the Zero Emission Vehicles Declaration, by region, as of 2025



Source: See endnote 74 for this section.

are likely to slacken the pace of adoption at a time when substantial acceleration is needed. (See 5.2 Road Vehicle Electrification.)

- Cairo (Egypt) is piloting electric buses in its urban fleet, supported by local manufacturing of components.[77]
- In California (United States), the Advanced Clean Fleet requirements (and aspects of it that have been integrated into the Advanced Clean Trucks rule) require government fleets to comprise 50% zero-emission vehicles by 2026 and 100% by 2036, and large fleets to comprise 100% zero-emission vehicles by 2036.[78]
- EU standards establish minimum requirements for 90% zero-emission urban bus sales by 2030 and 100% by 2035.[79]
- In 2024, Viet Nam issued a requirement that all urban buses purchased from 2025 onward be battery electric.[80] Similar fleet requirements were enacted at the city and state/provincial levels.

To meet the challenges of rising urban freight demand, sub-national governments and cities have explored approaches that include consolidation hubs, off-peak deliveries and delivery robots.[81] The focus for sustainable urban freight has been mainly on technical and economic approaches, but there is a need to address pressing social issues such as health effects and social inequity.[82] Integrating freight transport and logistics into urban and land-use planning enhances transport strategies and connects logistics with development. Data on local freight activities remain scarce but are an important prerequisite for actions in this area.

- Cities in China, France, the Netherlands, Sweden and the United Kingdom have implemented zero-emission zones that ban all petrol and diesel vehicles from these areas.[83]
- Baixada Santista (Brazil) has received technical assistance to develop a regional mobility and logistics plan to improve traffic, reduce travel time and establish a monitoring system.[84]
- Santo Domingo (Dominican Republic) is creating a Regional Road Plan to define key road infrastructure.[85]

Developing and maintaining sustainable transport systems requires significant co-ordinated planning, investment, and technical action, including across government levels, departments and sectors. Reviews of the implementation of the Sustainable Development Goals (SDGs) – including Voluntary Local Reviews (VLRs) by sub-national governments and cities, and to some extent Voluntary National Reviews (VNRs) by national governments – offer insights into how sustainable transport connects with day-to-day action and governance by sub-national governments and cities.[86]

- Montevideo (Uruguay), in its 2024 VLR, commits to improving women's safety in public spaces and public transport (linked to SDG 16 – Peace, Justice and Strong Institutions); sustainable transport also plays a role in the city's climate-resilient planning and emission reductions (SDG 13 – Climate Action).[87]
- The 2024 VLR by Mombasa County (Kenya) features investments in walking and cycling in the central business district (connected to SDG 13 – Climate Action), school transport systems for children (SDG 16 – Peace, Justice and Strong Institutions) and the development of a master plan in collaboration with Japan International Cooperation Agency (SDG 17 – Partnerships).[88]

Providing infrastructure for public transport, walking and cycling is key for enabling marginalised populations to access social and economic opportunities. VLR submissions from 2023 and 2024 featured the implementation of transport projects focused on equity, affordability and access.

- Braga (Portugal) exemplifies inclusive mobility through human-centred initiatives such as the PediBus, which promotes equitable redistribution of urban space and upholds values of diversity and non-discrimination.[89]
- Fürstenfeldbruck (Germany) ensures that all mobility options are barrier-free and safe, underscoring the district's focus on inclusive design and accessibility across the transport system.[90]
- In Suva City (Fiji), affordability is central to ensuring equitable access to essential services, especially for vulnerable households; the city acknowledges that high upfront costs for electric vehicles are a barrier to transitioning towards sustainable e-mobility, underlining the need for financial incentives.[91]
- In Vantaa (Finland), equality and non-discrimination are integrated across all city operations, including the planning of new tramways aimed at reducing regional disparities. Vantaa recognises that formal equality does not automatically translate into real access or benefits, signalling a more sophisticated and reflexive understanding of equity.[92]
- Authorities in the Basque Country (Spain) have implemented inter-institutional discounts for public transport to make urban and inter-city mobility more affordable, aligning with broader efforts towards affordable rental housing.[93]
- Córdoba Province (Argentina) has introduced tariff compensation schemes across urban and inter-urban networks, supported by multiple levels of government, to reduce the cost burden on users and extend transport access to a broader population.[94]

In 2023, a survey of transport-related targets set by sub-national governments and cities revealed a strong priority on modal share targets (42% of all committed targets), followed by electrification efforts (30%).[95] To pursue modal share targets, sub-national governments worldwide have made substantial investments in sustainable transport infrastructure, as expressed in recent VLR submissions.



- Across Africa, Asia, and Latin America, municipalities such as Addis Ababa (Ethiopia), Dar es Salaam (Tanzania), Maringá and Pará (Brazil), Nairobi (Kenya), Puebla (Mexico), and West Java (Indonesia) are pursuing major infrastructure projects, including redesigning streets to prioritise walking, cycling and bus-only lanes.[96]
- Addis Ababa (Ethiopia), Chennai (India), Lagos (Nigeria), Nairobi (Kenya) and Seoul (Republic of Korea) have put in place sub-national walking and/or cycling strategies.[97]
- Bhopal (India), Brisbane (Australia), Buenos Aires (Argentina) and Sacramento (United States) are investing in active transport infrastructure and launching projects such as complete streets, e-bike programmes and incentive schemes for cyclists.[98]
- The Basque Country (Spain) and Suva City (Fiji) are investing in bus systems and rail infrastructure, often supported by national or regional budgets.[99]
- In Germany, the cities of Freiburg and Münster focus on creating safe, accessible environments supported by integrated mobility systems and electric vehicle fleets.[100]
- Kuala Lumpur (Malaysia) is upgrading its medium- and light-rail networks, integrating feeder bus routes and promoting electric buses.[101]
- São Paulo (Brazil) aims to shift 70% of motorised trips to collective transport modes by 2030.[102]
- In South Africa, the cities of Buffalo City and Tshwane are expanding rapid transit systems and renovating key transport hubs to improve commuter experiences.[103]

Digital and smart technologies are being integrated into urban mobility systems to improve efficiency, safety and environmental outcomes.

- Agadir (Morocco) and Bhopal (India) are incorporating information and communications technology (ICT) into transit systems through intelligent traffic management and smart street infrastructure.[104]
- The public transport fleet in Shanghai (China) uses real-time monitoring and data integration.[105]
- Tokyo (Japan) advances universal Mobility-as-a-Service (MaaS) and autonomous mobility solutions.[106]
- Innovation hubs such as the Urban Innovation Laboratory in Braga (Portugal) and the Ciudad 3D platform in Buenos Aires (Argentina) are promoting low-carbon and digital-first approaches to urban development.[107]
- Pará (Brazil) and Puebla (Mexico) are investing in electric mobility, smart chargers, and broader ICT access to ensure inclusive and future-ready mobility solutions.[108]

Recent VLR submissions since 2023 indicate that sub-national governments and cities have begun to invest in corridor-level planning and inter-municipal co-ordination, pushing for joint strategies that reflect real travel patterns, not just administrative maps. Governance fragmentation has become a significant barrier to sustainable mobility, especially as urban boundaries blur and as functional regions become more inter-connected. (See 4.2 Integrated Transport Planning.)

- In Agadir (Morocco), the Urban Mobility Plan includes the creation of an inter-municipal oversight unit and a mobility observatory, supported by land-use planning measures to influence traffic patterns.[109]
- Buffalo City (South Africa) is pioneering spatially integrated planning approaches through its District Development Model and "One Plan", which aim to unify strategic planning, investment and service delivery.[110]
- Córdoba Province (Argentina) stands out for its active engagement in cross-jurisdictional platforms such as ZICOSUR and the ATACALAR Region, co-ordinating municipal, provincial, and national efforts with academic and civil society actors to localise global goals.[111]
- The local master plan in Freiburg (Germany) promotes regional co-operation, with efforts to reduce inequalities by aligning land-use planning and integrated mobility systems across municipal borders.[112]
- In Maringá (Brazil), the Integrated Urban Development Plan (PDUI) frames metropolitan mobility as a shared public function, highlighting the importance of regional governance structures in addressing mobility challenges that exceed individual municipal capacities.[113]
- Puebla (Mexico) operates within inter-municipal metropolitan zones that facilitate synchronised governance across government levels.[114]
- Sacramento (United States) exemplifies cross-regional and cross-sectoral planning through its Transportation Climate Adaptation Plan, which strengthens resilience by linking local neighbourhoods with regional transport infrastructure.[115]
- Shanghai (China) is working on spatial integration and the digital interoperability of urban systems across towns and departments to enable real-time co-ordination and service optimisation.[116]

VLRs submitted in 2023 and 2024 highlight that sub-national governments and cities have been adopting innovative methods of sustainable transport through community participatory planning.

- Freiburg (Germany) aims to reduce its transport CO_2 emissions 40% by 2030 through its Climate Mobility Plan, shaped by ongoing citizen feedback via a "Mobility Unit".[117]
- In Maringá (Brazil), the Urban Mobility Plan (PlanMob) was developed through community engagement and includes a focus on cycling infrastructure, monitoring citizen involvement in planning and budgeting.[118]
- Münster (Germany) prioritises sustainable mobility in its municipal budget through the Masterplan Mobility Münster 2035+, developed with extensive citizen



engagement; the process included workshops and a project website, supported by a scientific advisory board and a steering committee, along with "pedestrian traffic checks" to enhance safety.[119]

- In Sacramento (United States), the Streets for People: Sacramento Active Transportation Plan focuses on community involvement to improve conditions for pedestrians and cyclists, incorporating stakeholder feedback into engineering and policy decisions.[120]
- São Paulo (Brazil) aims for safe, affordable, sustainable transport systems through its Municipal Agenda 2030, emphasising public transport and cycling.[121] The "Social Urbanism Program" promotes collaboration between authorities and residents, resulting in urban intervention plans that enhance road safety for children.[122]
- Suva City (Fiji) prepared its VLR through participatory methods, refining strategies based on stakeholder feedback and aiming to achieve a "smart city" that enhances public involvement in sustainable transport.[123]

As of 1 August 2025, 29 countries had submitted new Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement; however, actual NDC implementation often falls to sub-national governments and cities, particularly in sectors such as transport.[124] Yet there is frequently little clarity on how national targets cascade down to sub-national governments and cities, or on how sub-national efforts are counted or integrated into national inventories.[125]

Among the 29 third-generation NDCs submitted to the United Nations, at least 12 featured explicit actions to mitigate greenhouse gas emissions in urban transport; these were from Andorra, Belize, Brazil, Canada, Kenya, Lesotho, Maldives, Nepal, the Republic of Moldova, the United Arab Emirates, the United States and Uruguay.

- Brazil's third-generation NDC seeks to improve the urban mobility sector through sustainable urban development, active mobility and public transport improvements, while intending to reduce dependence on individual transport modes.
- Nepal's 2025 NDC commits to the development of a mobility policy by 2030, as well as implementing bicycle lanes in all metropolitan and sub-metropolitan cities, and bike-sharing systems in at least three cities by 2030.
- The third-generation NDC of the United Arab Emirates features climate action plans by major cities (such as Abu Dhabi, Dubai, Ras Al Khaimah and Sharjah) that envision electrification of public buses and taxis.

In 2022 and 2023, the global landscape of transport investments pointed towards a widening gap between investment needs and actual investment volumes. Among investments related to private participation in infrastructure, those earmarked for transport fell sharply in 2023, to below levels during the COVID-19 pandemic in 2020.[126] The withdrawal of sub-national investments, particularly in China and India, resulted in these steep declines. The retreat of state-level investments reflects a contraction in fiscal affordability



and in private operators willing to take sub-national credit risk as authorities that grant public-private partnerships.[127] (See 6.1 Financing Sustainable Transport in Times of Constrained Public Budgets.)

Efforts to ensure and expand transport investments at the sub-national level have continued in recent years, with some countries establishing national urban mobility funds and securing project funding through innovative approaches.

- In 2021, Agadir (Morocco) received a USD 34 million (MAD 345 million) loan from the French Development Agency to support its bus rapid transit project (BHNS); the total investment for the project is USD 88 million (MAD 900 million), also backed by the European Investment Bank's Urban Projects Finance Initiative.[128]
- In Braga (Portugal), the "Decarbonization of the Tub fleet" project presents a total eligible investment of over USD 14.8 million (EUR 14.4 million), with significant financial support from the EU and national and regional public sources.[129] The additional phase, "Tub 2023", received an investment of USD 8.96 million (EUR 8.7 million) for the purchase of new electric buses, financed by the EU Cohesion Fund.[130]
- Kuala Lumpur (Malaysia) has partnered with the World Bank and the Asian Development Bank to secure funding for green infrastructure projects, which are crucial for achieving sustainable transport goals.[131]
- Medan (Indonesia), which records losses of USD 5.6 billion annually due to congestion, has emphasised the economic benefits of sustainable transport in creating stable employment opportunities and formalising the informal transport sector.[132]
- In São Paulo (Brazil), the electrification of public transport has received support from the International Council on Clean Transportation (ICCT), C40 Cities, and the World Resources Institute Brazil, among others, with a focus on the mutual exchange of experiences, emphasising collaborative support even in the absence of direct financial funding.[133]
- Tunisia has proposed funding urban mobility through road and local taxes.

VLR submissions from 2023 and 2024 featured examples of how cities directly fund sustainable transport initiatives through municipal budgets and how they engage in public-private partnerships and external collaboration.

- Agadir (Morocco) and Braga (Portugal) have launched public-private cycling initiatives and are developing infrastructure to support bus rapid transit expansion and multi-modal travel.[134]
- Brisbane (Australia) has invested over USD 210 million (AUD 320 million) in its cycle network since 2008, and also funds the Green Bridges Program as a significant investment in active transport infrastructure.[135]
- Buffalo City (South Africa) emphasises that private sector financing through public-private partnerships, corporate social responsibility initiatives, and foreign direct investments is a significant modality for implementing public transport initiatives.[136]
- Chandragiri (Nepal) has undertaken the construction of a cable car in partnership with the private sector, aimed at easing public transport for residents.[137]
- In Córdoba Province (Argentina), fare compensation schemes and public-private partnerships are helping to widen transport access and improve regional integration.[138]
- Rottenburg am Neckar (Germany) finances its free cargo bike rental service with the help of Local Agenda 21 funds; it is also continuously converting its municipal vehicle fleet to electric vehicles and purchases e-bikes for employees.[139]
- In Sacramento (United States), the California Mobility Center serves as a public-private venture to accelerate innovation in clean mobility. It stands out as a hub for research and development in electric transport, encompassing electric vehicles, autonomous transport and shared mobility solutions.[140]

Through global and regional networks and initiatives, sub-national governments and cities come together to advance peer learning, capacity building and international collaboration for transformations towards sustainable transport. These efforts help inform and deliver on national priorities and global agendas.[141]

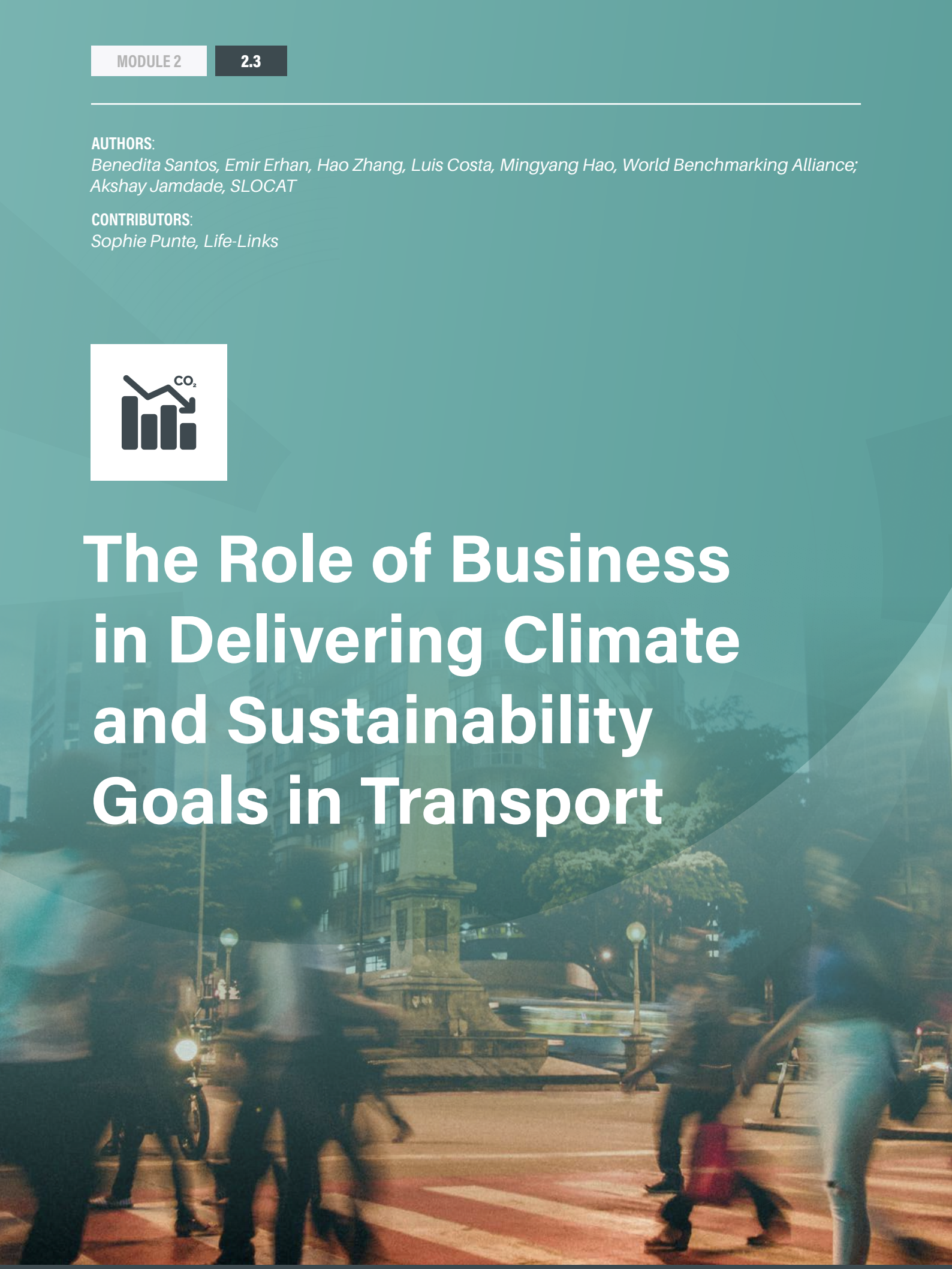
- In 2023, the **Climate Pledge and C40 Cities** launched **Laneshift**, a partnership aimed at reducing emissions, cleaning up the air, generating green jobs and working towards a just transition for workers. The partners committed USD 10 million to kick-start the development and deployment of zero-emission electric trucks and charging infrastructure across major cities in India (Bengaluru, Delhi, Mumbai and Pune) and Latin America (Bogotá and Medellin in Colombia; Curitiba and Rio de Janeiro in Brazil; Quito, Ecuador; and Mexico City, Mexico).[142]
- At the **12th World Urban Forum** in Cairo (Egypt) in 2025, several academic institutions, non-governmental organisations and multilateral development banks co-organised training events on topics such as "Accelerating Access to Low Carbon Urban Mobility Solutions through Digitalisation", "Empowering African Cities – Advancing Urban Mobility Solutions" and "Empowering Communities Participatory Approaches for Inclusive and Climate-Resilient Urban Transportation". Co-organisers included the UN Environment Programme (UNEP), the Institute for Transportation and Development Policy (ITDP), the Stockholm Environment Institute and the University of York. [143]
- **The Clean Air Accelerator Programme** of C40 Cities supports 50 cities globally with setting and achieving targets to reduce air pollution. Among the programme's actions, 55.3% lie in the transport sector; they include walking and cycling, zero-emission vehicles and buses, mass transit, low- and zero- emission areas, fuel and vehicle standards, freight and ports.[144] As of 2023, 77% of actions were on track or had been delivered.[145]
- In June 2025, ICLEI Africa, CDP and the Covenant of Mayors of Sub-Saharan Africa co-developed and published a report on **How African Cities Are Driving Global Climate Action Through Local Data**.[146]

MODULE 2 | 2.3

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The Role of Business in Delivering Climate and Sustainability Goals in Transport



KEY FINDINGS



- Decarbonising the transport sector and making it more sustainable requires active participation from private sector actors, including manufacturers, transport service providers and operators, and companies that use transport. These actors play a central role in delivering technology, services and investment; evolving production and consumption patterns; and influencing travel patterns and transport services.

Ambition

- OEMs include manufacturers of vehicles, aircraft and marine/inland vessels as well as their engines, components and other equipment. This section draws on sustainability disclosures from 44 of the most influential transport manufacturers: 30 major global automotive companies, which accounted for 80% of global vehicle sales in 2023, and 14 manufacturers of aircraft, ships, trains and trucks/buses.
- Combined, the sold products of these manufacturers contributed just over half (52%) of global transport sector emissions in 2023. These 44 companies collectively generated USD 3.2 trillion in revenue and directly employed 5.5 million workers that year.
- In 2023, 7 out of 11 Chinese manufacturers assessed lacked emission reduction targets, and none addressed emissions from both manufacturing (Scopes 1 and 2) and product use (Scope 3), despite being leaders in electric vehicle development.
- Between 2021 and 2023, the auto industry made only mild improvements in the adoption of climate targets covering emissions from manufacturing (upstream, or Scope 1 and 2 emissions).
- As of 2023, 63% of automotive companies had committed to reducing emissions from manufacturing (direct and indirect). However, only half of companies disclosed sufficient detail to allow for a thorough evaluation of their alignment with the industry-specific pathway for limiting global warming to 1.5 °C.
- Meanwhile, target setting to reduce emissions from the use of sold vehicles (downstream, or Scope 3 emissions) stagnated between 2021 and 2023, impeding alignment with 1.5°C pathways. Scope 3 emissions often account for 75-80% of an automaker's total carbon footprint.
- As of 2023, only half of the most impactful auto companies have set targets for downstream emissions, underscoring the significant work needed to align with a 1.5°C pathway. Of these companies, only seven (23%) disclosed enough information for their targets to be assessed for alignment with a 1.5°C pathway.
- Aviation's path to net zero emissions by 2050 hinges on radical decarbonisation, with major manufacturers prioritising fleet renewals, operational efficiency, sustainable aviation fuels (SAF), and hydrogen, despite significant challenges related to infrastructure and scalability. Given aggressive delivery targets and the long operational lifetimes of aircraft, the industry's pathway to achieving net zero by 2050 is focused on decoupling growth from emissions, rather than capping it.
- Both Airbus and Boeing, which together account for around 89% of global new commercial aircraft deliveries, have aligned with the industry's 2050 net zero goal.
- The global shipping industry faces significant pressure to accelerate the adoption of zero-emission fuels and to address the critical gap in emission reduction across the value chain. The sector is on a trajectory to exhaust its proportional 1.5°C carbon budget by 2030, its 1.7°C budget by 2037 and its 2°C budget by 2047.
- Although several major shipbuilders have set targets to reduce manufacturing emissions (direct and indirect), none have set targets for reducing product emissions, which account for the bulk of emissions in the shipping industry.
- Rail manufacturers have adopted strong targets towards achieving net zero emissions. This includes using renewable energy sources and advancing technologies such as hydrogen and battery electric trains.

KEY FINDINGS

- Although OEMs increasingly reference their climate commitments, evidence suggests that these companies are responding to, rather than shaping, the market transition. This limited progress reflects a set of structural barriers.
- Transport service providers have demonstrated growing decarbonisation ambition, with targets across the entire value chain increasingly becoming the norm. Progress has been made in addressing Scope 1 and 2 (upstream) emissions, while Scope 3 (downstream) emission reductions remain a challenge.
- A growing number of public transport and freight transport operators have set targets for net zero greenhouse gas emissions to achieve carbon neutrality; in a few cases, these include short-term net zero targets within the decade.
- Third-party logistics providers have begun to set measurable decarbonisation targets, although ambitions are uneven across companies and are often limited to incremental goals or pilot geographies. Some actors have outlined long-term aspirations such as net zero emissions or reductions in emission intensity, but concrete commitments are largely focused on vehicle counts or modest emission cuts, with limited clarity on broader systemic transformation.

Action

- So far, it has not been common practice for auto manufacturers to make public financial commitments in support of their low-carbon transition plans. As of 2025, only seven auto manufacturers (representing 28% of total vehicle production) had committed to increasing their capital expenditure on low-carbon activities.
- Automakers have been scaling up and reshaping their financial strategies to meet the IEA's goal of 65% electric vehicle sales in total car sales by 2030, in line with net zero emission trajectories. As of 2022, electric car sales were broadly in line with a 1.5°C roadmap; however, the auto industry risked falling behind, given that no major manufacturer had pledged to fully phase out fossil fuel vehicle production by 2035.
- Even if all auto manufacturers fully achieve their publicly disclosed targets for phasing out fossil fuel vehicle production, and Chinese companies meet the national goal of 40% new energy vehicle sales, only around 38% of vehicles globally are projected to be fully electric by 2035 under current company plans.
- Alongside governments, major auto manufacturers have been investing in public charging infrastructure, which is key to supporting mass adoption of electric vehicles. Global charging infrastructure expanded more than 30% in 2024, adding more than 1.3 million public charging points.
- Although new-generation aircraft from Airbus and Boeing are already compatible with up to 50% SAF blends, the pace of SAF adoption has been constrained by under-investment from the energy sector, which has not scaled production fast enough to meet aviation's climate targets. In 2024, SAF production doubled to 1 million tonnes, yet it accounted for just 0.3% of global jet fuel output.
- The use of hydrogen-powered aircraft is still not a feasible business model. Although Airbus initially targeted 2035 for the entry into commercial service of a hydrogen-powered aircraft, it has postponed this goal to the late 2030s due to slower-than-expected technological advancements and infrastructure development.
- The current and projected uptake of zero-emission fuels in shipping – including ammonia, hydrogen and methanol – remains well below what is needed to meet Paris-aligned targets, based on a 2050 vision on fuel standards for shipping.
- Leading rail manufacturers are deploying a diversified portfolio of alternative propulsion systems. These include hydrogen fuel cell trains, battery electric trains and advanced hybrid models.
- Production shortfalls by aircraft and engine manufacturers have caused persistent supply chain delays. Record-high backlogs in aircraft deliveries were expected to continue into 2025, impacting airline performance by raising costs and limiting growth.
- Railway companies have increasingly embedded sustainability into their supply chains, with 73% including green clauses in supplier contracts and 63% monitoring the sustainability performance of suppliers as of 2022.
- Of the 1,061 transport service companies that disclosed targets to CDP in 2023, only one reported having all 21 key indicators of a Climate Transition Plan. Of the remaining companies, 10% (104 companies) had many of these indicators, 19% (202 companies) had some indicators, and 71% (754 companies) had few indicators.
- Third-party logistics providers are pursuing operational decarbonisation through combined strategies including vehicle electrification, alternative fuels, fuel-saving driver practices and digital tools.

KEY FINDINGS

Advocacy

- The advocacy and policy positions of leading global auto manufacturers have posed a significant obstacle to operationalising climate-friendly policies in the industry. Many companies have supported policies favouring internal combustion engine (ICE) vehicles. The resistance to stricter vehicle emission standards and accelerated ICE phase-out policies have been compounded by factory closures and job losses. The EU has partially rolled back its vehicle emission and ICE phase-out targets following industry pushback and trade tariff tensions with the United States.
- As of 2023, 60% of auto industry players had not disclosed how they govern their relationships with trade alliances, associations, coalitions and think tanks – influential parties through which companies can indirectly influence climate-related policy.
- Overall, as of 2023, 63% of the automotive industry disclosed public support for significant climate policies, including a commitment to the Paris Agreement; however, only 37% of industry players had a monitoring and reviewing process to ensure that their policy positions aligned with the Paris goals.
- Beyond the auto industry, most other transport manufacturers have shown limited corporate policy engagement, with few signs of active participation in associations or coalitions.
- The International Civil Aviation Organization (ICAO) has issued recommendations on a methodology for monitoring and reporting emission reductions in the sector, including proposals for more stringent aircraft noise and CO_2 emissions standards. Both Airbus and Boeing have expressed alignment with low carbon goals and have publicly supported and committed to the principles of the Paris Agreement; however, neither company has specified a monitoring and review process to ensure that its policies are aligned.
- In 2025, the IMO adopted the first legally binding Net-Zero GHG framework for global shipping, aligning the sector with the Paris Agreement. While some shipping companies engage in climate actions, most have yet to address concerns about policy engagement with outside groups.
- All rail or rolling stock manufacturers have demonstrated some involvement with national and sub-national authorities to test or implement climate-related policies and partnerships; however, no manufacturers are entirely aligned with a low-carbon pathway.
- Global and regional advocacy coalitions have emerged in recent years. Cross-company coalitions such as EV100+, the First Movers Coalition (FMC), and the Zero Emission Leadership Coalition show promise, but they remain concentrated in major economies and sectors, with limited participation from emerging markets or smaller companies. These coalitions risk becoming echo chambers for large multi-national players unless they expand to include a broader diversity of actors, such as small carriers, logistics providers, and public transport authorities, particularly from low- and middle-income countries.

Accountability

- Climate disclosures have become mainstream in the transport sector, yet critical accountability gaps remain – particularly in the reporting of Scope 3 emissions and the adoption of robust interim targets. To drive progress, companies must enhance their disclosure of emissions (including Scope 3), set emission reduction targets, increase the transparency of R&D and develop comprehensive transition plans.
- The aviation industry has sought to adopt best practices for globally recognised accounting systems for SAF uptake (regardless of uplift location), with the goal of facilitating economies of scale in SAF production.
- The global finance portfolio for shipping has aligned increasingly with the ambitious decarbonisation goals of the IMO, according to a 2024 disclosure report under the Poseidon Principles.
- Since 2022, to enhance transparency, signatories of the Poseidon Principles have disclosed the share of their portfolio used to calculate climate alignment – known as the reporting percentage. The average reporting percentage rose from 91% in 2022 to 93.3% in 2024, with 80% of signatories disclosing reporting percentages of more than 90% and eight achieving full (100%) reporting.
- Although target setting has improved for transport service providers and operators – with more companies now publishing science-aligned or time-bound climate targets – verification has remained questionable. Between 2023 and 30 July 2025, 233 transport companies joined the Science Based Targets initiative (SBTi); of these, 51% (119 companies) had set net zero targets, and 49% (114) had committed to net zero targets.

KEY FINDINGS

- Companies increasingly mention Scope 3 emissions, yet few offer detailed disclosures or breakdowns. The risk of overstated environmental claims remains significant. In the aviation sector, companies often highlight biofuels and optimisation even as SAF use remains very low. Major blind spots in accountability include emissions from supply chains, infrastructure, vehicle manufacturing and embedded energy in fuels. Many transport companies claim future decarbonisation while continuing to expand routes, fleets and hubs.

The "4 A's" across companies that use transport

- Companies engage in transport both through their own fleets and by using public and freight services provided by third parties.
- These actors shape the transport space by leveraging their purchasing power to demand zero-emission transport services, sustainable fuels, and clean infrastructure, thereby influencing market dynamics and policy directions.
- Despite some progress and the setting of diversity targets, private sector players in transport have lagged in achieving meaningful gender representation.

Challenges and opportunities for decarbonising private transport

- Stable, forward-looking regulation presents a vital opportunity for the private sector to lead the transformation towards net zero emissions in the road transport sector. Regulatory clarity can stimulate investment in low-emission technologies, encourage innovation and create competitive advantages for first movers. However, recent significant opposition within the automotive, petrochemical and affiliated industries has diluted or delayed climate policies in key jurisdictions, undermining this potential.
- Rather than opposing reform, businesses stand to gain by actively engaging in the regulatory process and leading on solutions. Constructive partnerships between government and the private sector will be essential to ensure that policies are not only ambitious and credible but also practical and supportive of innovation. This is not merely a compliance challenge – it is a commercial opportunity to shape the future of mobility and to lead the low-carbon transition in a way that is profitable, inclusive and forward-looking.
- Digital payment platforms such as Mastercard and Visa present an opportunity to accelerate decarbonisation across transport systems, particularly in first- and last-mile connectivity.
- Newer OEMs that do not have legacy platforms based on ICE technologies are uniquely positioned because they are not constrained by fossil fuel phase-out targets and can instead focus on achieving full life-cycle sustainability from the outset. However, real progress towards decarbonisation will depend on whether the transition strategies of these manufacturers are time-bound, financially viable and focused on aligning core business functions (including capital expenditure and R&D) with low-carbon technologies, such as battery manufacturing and charging infrastructure.



Overview

Decarbonising the transport sector and making it more sustainable requires active participation from private sector actors, including manufactures, transport service providers and operators, and companies that use transport. These actors play a central role in delivering technology, services and investment; evolving production and consumption patterns; and influencing travel patterns and transport services. It is crucial to understand private sector involvement in the transport system and the ecosystem of transport stakeholders, as the relationships among them are complex and interdependent (Figure 1).

Business actors play an important role in advancing sustainable transport. They can be divided into three main categories:

- **Original Equipment Manufacturers (OEMs)** – entities that design, manufacture and assemble transport vehicles for both passenger and freight transport (disaggregated by the automotive industry, rail, aviation and shipping).
- **Transport Service Providers and Operators** – entities that deliver or manage passenger and freight transport services that use vehicles, aircrafts, or vessels, including freight carriers, public transport operators and logistics companies.
- **Companies That Use Transport** – companies that engage in transport both through their own fleets and by using public and freight services provided by third parties.

The contributions of these business actors are evaluated here using the "4 A's of Climate Leadership": Ambition, Action, Advocacy and Accountability (Figure 2).[1] This framework was developed by the We Mean Business Coalition, which works with thousands of companies and partners to drive action towards net zero greenhouse gas emissions, in line with a pathway to keep average global temperature rise below 1.5 degrees Celsius (°C).[2] Using the 4 A's of Climate Leadership, leading transport businesses respond to the climate crisis through:

FIGURE 1. Relationships among private sector actors in the transport system

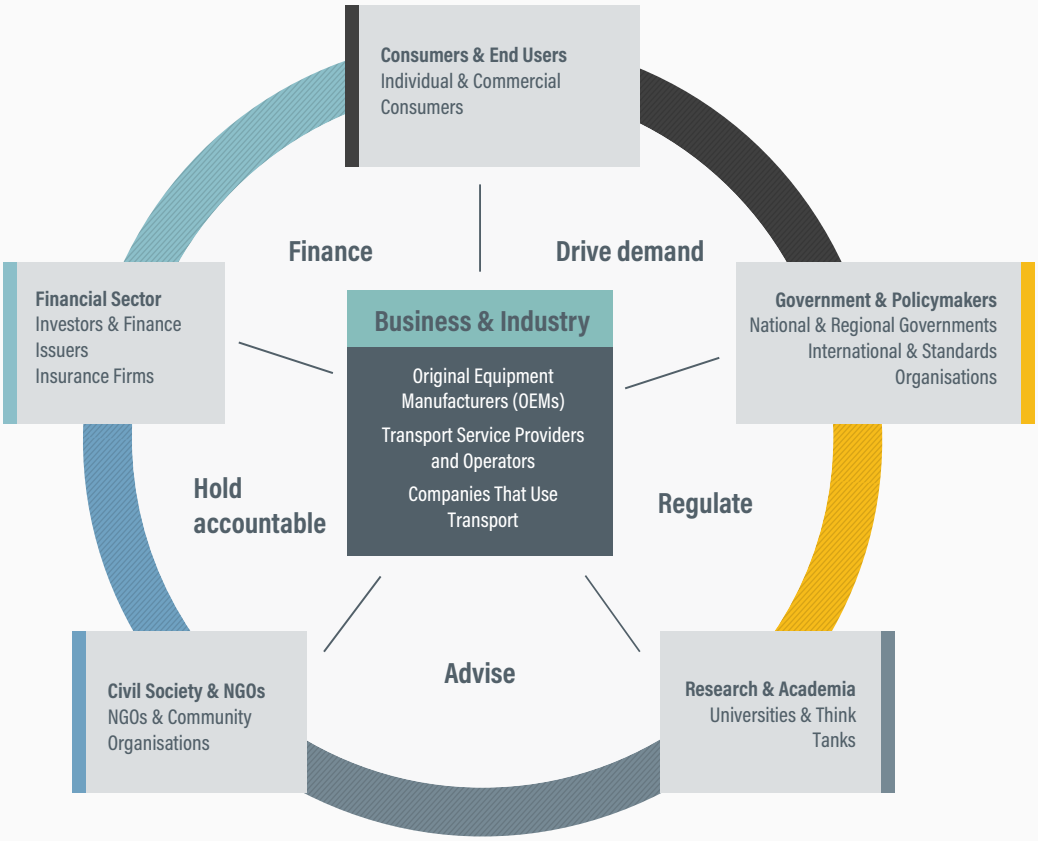
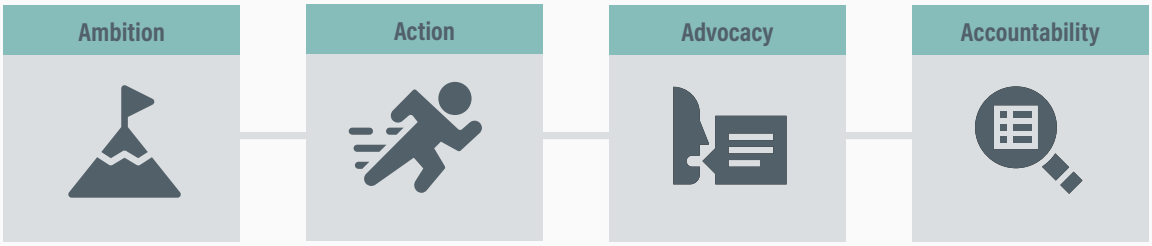


FIGURE 2. The 4 A's of Climate Leadership



- **Ambition**, by setting a clear, positive vision and plan for a net zero future.
- **Action**, by delivering on that vision with innovation and transformation.
- **Advocacy**, by using their influence to promote strong, science-based climate policy.
- **Accountability**, by transparently disclosing progress, risks and strategies to build trust and drive impact.

Understanding the challenges and opportunities businesses face in meeting global climate and sustainability goals enhances the potential to advance progress in these critical areas.

Box 1. Key concepts

Emission scopes

- **Scope 1** – direct emissions from sources owned or controlled by a company, including on-site fuel use, company vehicles and industrial processes (e.g., fuel burned by company vehicles or aircraft).
- **Scope 2** – indirect emissions from the generation of purchased energy consumed by the company (e.g., electricity, heating and cooling, steam for operating vehicles).
- **Scope 3** – all other indirect emissions across the value chain, such as fuel production, purchased goods, waste, business travel, and use of sold services or products.
  - For OEMs, Scope 3 emissions include upstream emissions (e.g., producing raw materials and manufacturing components) and downstream emissions (e.g., emissions from vehicles during the vehicle's entire lifespan).
  - For service providers and operators, and companies that use transport, Scope 3 can include outsourced transport or leased assets.

Upstream and downstream emissions (both part of Scope 3 emissions)

- **Upstream emissions** occur before the company's actual operations (e.g., supply chain activities, mining activities).
  - For OEMs, upstream emissions include emission from raw materials etc.
  - For transport service providers, upstream emissions include emissions from vehicle manufacturing, etc.
- **Downstream emissions** result from after company's operations
  - For OEMs, emissions are from during operation or use of vehicle (fuel burned, or electricity used, etc.).
  - For transport service providers, emissions from activities like operation of vehicles they lease out to other companies, emissions generated by any franchise partners, etc.

Key platforms

- **Carbon Disclosure Project (CDP)** – a global platform for companies to disclose environmental performance, including transport-related emissions.
- **Science Based Targets initiative (SBTi)** – assesses whether corporate climate targets align with science-based decarbonisation pathways, including transport sector benchmarks.

Source: See endnote 3 for this section.

Ambition

OEMs

Original equipment manufacturers (OEMs) include manufacturers of vehicles, aircraft and marine/inland vessels as well as their engines, components and other equipment.[4] This section draws on sustainability disclosures from 44 of the most influential transport manufacturers: 30 major global automotive companies, which accounted for 80% of global vehicle sales in 2023, and 14 manufacturers of aircraft, ships, trains and trucks/buses.[5]

Combined, the sold products of these manufacturers contributed just over half (52%) of global transport sector emissions in 2023.[6] These 44 companies collectively generated USD 3.2 trillion in revenue and directly employed 5.5 million workers that year.[7] The following sections provide a detailed analysis, based on their sustainability disclosures, of how these manufacturers are addressing the individual components of the 4 A's of Climate Leadership.[8]

Automotive

Road vehicles emit the highest share of greenhouse gases among all transport modes and were responsible for nearly three-quarters (74%) of the world's transport greenhouse gas emissions in 2023.[9]

The major traditional auto manufacturers have shown varying ambition in setting targets to reduce their emissions, with some influential companies not committing to any specific emission reductions. The industry has continued to fall short. This is especially concerning given that, in line with the International Energy Agency's (IEA) Net Zero scenario and the Accelerate Climate Transition (ACT) benchmarking methodology, companies were expected to adopt ambitious targets (to reduce their direct emissions) 10 years after the Paris Agreement.[10] Greater disclosure and accountability across all scopes of emissions (Scope 1, 2 and 3) – including those from supply chains – will be essential to ensure that manufacturers' targets translate into real emission reductions and meaningful climate actions.

- **In 2023, 7 out of 11 Chinese manufacturers assessed lacked emission reduction targets, and none addressed emissions from both manufacturing (Scopes 1 and 2) and product use (Scope 3), despite being leaders in electric vehicle development.[11]**
- Although 60% of auto manufacturers have set targets for net zero greenhouse gas emissions, only two – Mercedes-Benz and Tata Motors – aim for net zero across all emissions prior to 2040.[12]
- Notably, no company's net zero targets align with the IEA's recommended time frame for achieving net zero greenhouse gas emissions.[13]



Between 2021 and 2023, the auto industry made only mild improvements in the adoption of climate targets covering emissions from manufacturing (upstream, or Scope 1 and 2 emissions) (Figure 3)**.**[14]

- **As of 2023, 63% of automotive companies had committed to reducing emissions from manufacturing (direct and indirect).**[15]
- **However, only half of companies disclosed sufficient detail to allow for a thorough evaluation of their alignment with the industry-specific pathway for limiting global warming to 1.5 °C.**[16]
- Dutch automaker Stellantis was the only company with both near- and long-term targets for manufacturing emissions, aligned with its 1.5°C pathway.[17]

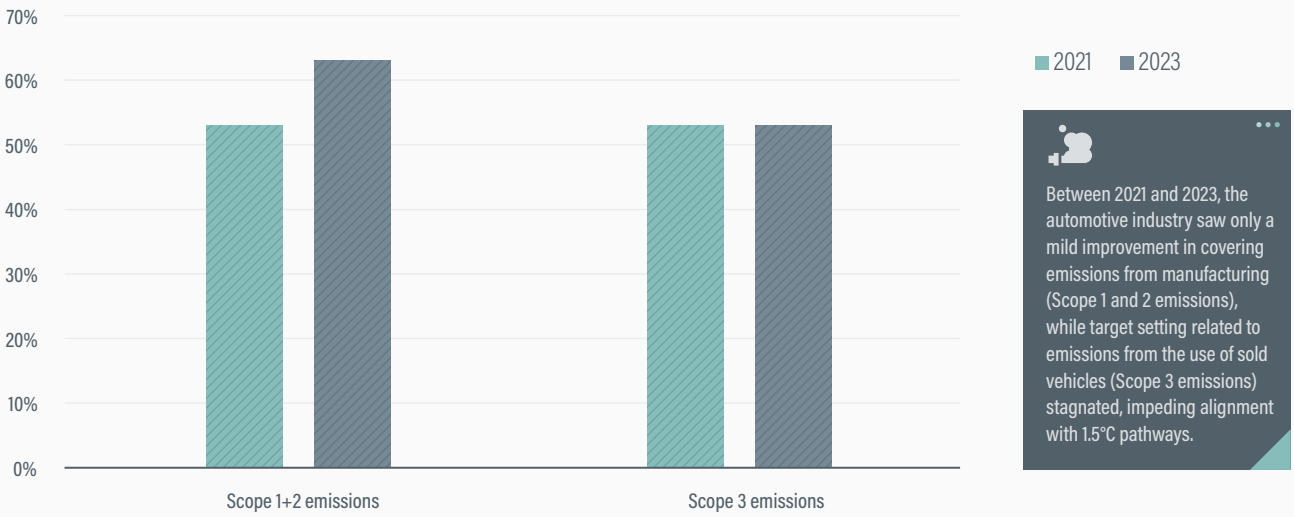
Meanwhile, target setting to reduce emissions from the use of sold vehicles (downstream, or Scope 3 emissions) stagnated between 2021 and 2023 (Figure 3)**, impeding alignment with 1.5°C pathways.**[18] **Scope 3 emissions often account for 75-80% of an automaker's total carbon footprint.**[19]

- **As of 2023, only half of the most impactful auto companies have set targets for downstream emissions** (Table 1)**, underscoring the significant work needed to align with a 1.5°C pathway.**[20]
- **Of these companies, only seven (23%) disclosed enough information for their targets to be assessed for alignment with a 1.5°C pathway.**[21]

Many manufacturers of heavy-duty vehicles have set long-term emission reduction goals; however, the lack of concrete near-term actions or foundational strategies by most highlights a critical challenge in pivoting to zero-emission vehicles.[22] **Target setting for reducing manufacturing emissions from heavy-duty vehicles is greatly influenced by stricter regulations.** With binding heavy-duty vehicle regulations on the horizon in the EU and new US tailpipe standards, stronger legislative pressure will be essential to match manufacturers' climate ambitions with Paris-aligned pathways.[23]

- Among the top 18 heavy-duty vehicle manufacturers globally[i], European manufacturers are generally committed to reducing manufacturing emissions, with

FIGURE 3. Share of automakers setting reduction targets for Scope 1, 2, and 3 emissions, 2021 and 2023



Source: See endnote 14 for this section.

i The 18 companies are: Volvo Group (Sweden), Daimler AG (Germany) PACCAR Inc. (United States) MAN SE (Germany), Tata Motors (India), Ashok Leyland (India), BharatBenz (India), Eicher Motors Limited (India), Ford Motor Company (United States), General Motors (United States), Scania AB (Sweden), Hyundai Motor (Republic of Korea), Dongfeng Motor Corporation (China), Shaanxi Automobile Group (China), CNHTC (China National Heavy Duty Truck Group) (China), FAW Group (China), Isuzu Motors (Japan) and Volkswagen Truck & Bus (Germany).

TABLE 1. Commitment to downstream emission targets by major auto manufacturers, as of 2023

Manufacturer	Commitment by 2030/2035 for downstream emissions
BMW	50% average emission reduction in the use phase of the vehicle (product use emissions) per kilometre driven, compared to 2019
Honda	27% reduction in the carbon dioxide (CO_2) emission intensity of product use, compared to 2020
Mercedes	15% reduction in product use emissions in absolute terms by 2030, compared to 2019
Renault	35% reduction in CO_2 equivalent emissions (well-to-wheel) per vehicle worldwide
Toyota Motor Company	50% reduction in greenhouse gas emissions from new vehicles, compared to 2019
Volkswagen AG	30% fewer CO_2 emissions on average per vehicle (passenger cars and light commercial vehicles) over the entire life cycle by 2030, compared to 2018. The targets are to be achieved through pure CO_2 reduction.

Source: See endnote 20 for this section.

Volvo targeting a 50% reduction by 2030 (2019 baseline), Scania 50% by 2025 (2015 baseline) and Daimler 43% by 2030 (2018 baseline).[24]

- Among the 18 top manufacturers of heavy-duty vehicles, only two firms from the EU (European Union) – Scania AB and Volkswagen Truck & Bus – set near-term manufacturing emission targets.[25]
- In the United States, Ford (2017 baseline) and General Motors (2018 baseline) announced manufacturing emissions cuts of 76% and 72%, respectively, by 2035.[26]

Aviation

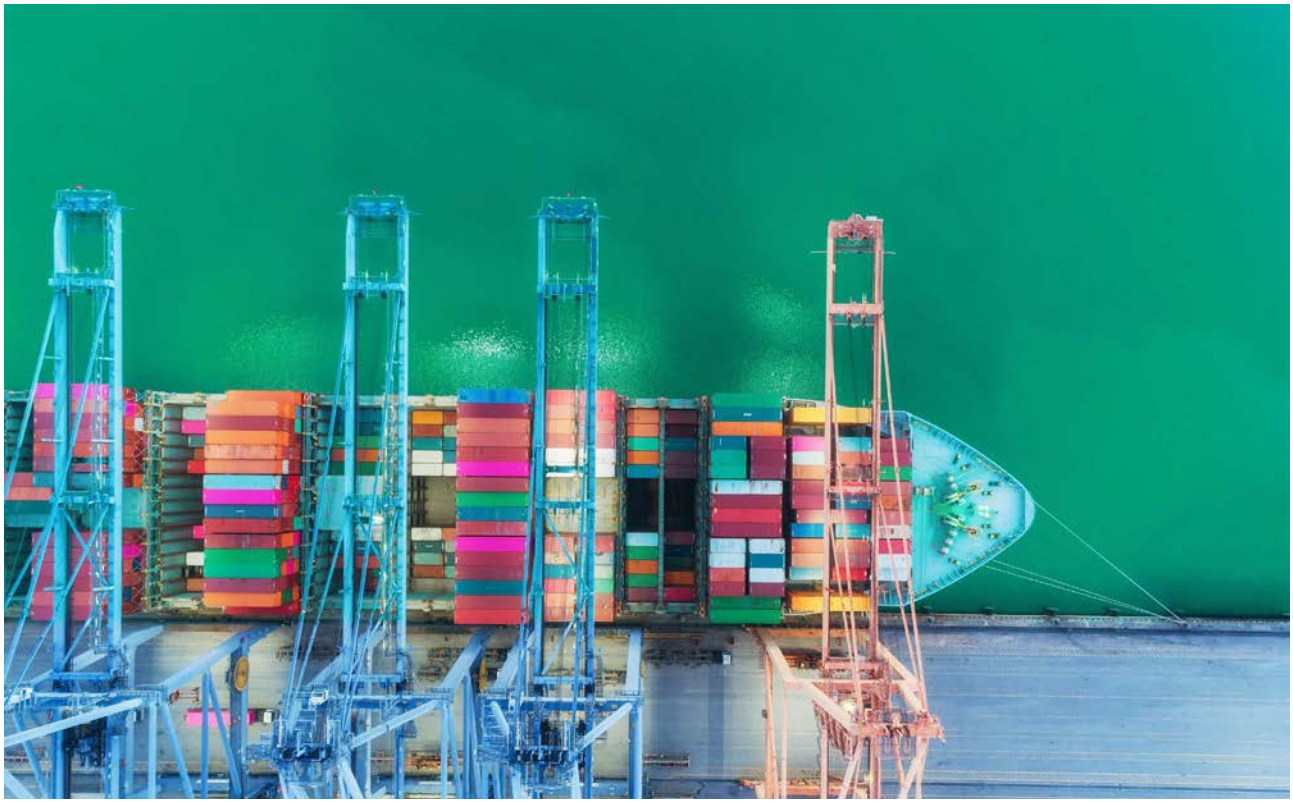
The aviation sector (domestic and international) was responsible for 11% of global transport greenhouse gas emissions in 2023.[27] More than 95% of the emissions from aircraft manufacturers originate from the use of their products (planes).[28]

Aviation's path to net zero emissions by 2050 hinges on radical decarbonisation, with major manufacturers prioritising fleet renewals, operational efficiency, sustainable aviation fuels (SAF), and hydrogen, despite significant challenges related to infrastructure and scalability.[29] Given aggressive delivery targets and the long operational lifetimes of aircraft, the industry's pathway to achieving net zero by 2050 is focused on decoupling growth from emissions, rather than capping it.[30]

Both Airbus and Boeing, which together account for around 89% of global new commercial aircraft deliveries, have aligned with the industry's 2050 net zero goal.[31] Airbus has set a target to reduce its manufacturing emissions 63% by 2030 (from 2015 levels), and cuts in these emissions are on track with the company's 1.5°C pathway.[32] Boeing has set a target to reduce its manufacturing emissions 55% by 2030 (below 2017 levels) and aims for 100% renewable electricity use by 2030.[33]

- Airbus aims to reduce its emissions from sold products per passenger-kilometre 46% by 2035 (below 2015 levels).[34]
- Airbus's efforts are underpinned by a comprehensive low-carbon transition plan and technological innovation (e.g., the ZEROe project and 100% SAF compatibility by the late 2020s).[35]
- Although Boeing's manufacturing emissions have decreased, the company lacks targets for its sold product emissions, which grew 84% between 2020 and 2023.[36]
- Before resorting to carbon offsets, Boeing plans to adopt an "avoid first, remove second" approach to prioritise the direct elimination of emissions through fleet renewal, operational efficiency and SAF.[37]

Sustainable aviation fuel is the most direct near-term option for decreasing the lifetime emissions from new aircraft fleets. SAF requires few changes to aircraft engines and fuelling infrastructure and can power flights with no distance limits. However, expanding the feedstock for SAF production can lead to deforestation or the conversion of carbon-rich ecosystems, undermining the climate benefits.[38] (See 4.9 Aviation.)



Shipping

Domestic and international shipping was responsible for 11% of global transport greenhouse gas emissions in 2023.[39] The International Maritime Organization's (IMO) 2023 GHG Strategy's aims to reduce the total annual greenhouse gas emissions from international shipping 20-30% by 2030 and 70-80% by 2040 (compared to 2008 levels), on a path to net zero emissions by or near 2050.[40]

The global shipping industry faces significant pressure to accelerate the adoption of zero-emission fuels and to address the critical gap in emission reduction across the value chain. The sector is on a trajectory to exhaust its proportional 1.5°C carbon budget by 2030, its 1.7°C budget by 2037 and its 2°C budget by 2047.[41] (See 4.10 Shipping.)

Although several major shipbuilders have set targets to reduce manufacturing emissions (direct and indirect), none have set targets for reducing product emissions, which account for the bulk of emissions in the shipping industry.[42] Manufacturers are under pressure to accelerate the production of ships that are compatible with zero-emission fuels (e.g., hydrogen, ammonia), as the sector is not on track to meet the target of 5-10% zero-emission fuel use by 2030.[43]

- China's state-owned conglomerate CSSC holds 21.5% of the global shipbuilding market but has yet to set any targets for direct or indirect product emissions.[44]
- Italy's Fincantieri has a scenario-tested transition plan targeting 20% emission reduction by 2030.[45]
- Hanwha in the Republic of Korea aims for carbon neutrality by 2050 by investing in onboard carbon capture and alternative fuels (e.g., liquefied natural gas, ammonia).[46]
- Korea Shipbuilding & Offshore Engineering (KSOE) plans to reduce its emissions 28% by 2030 and 60% by 2040, with the goal of carbon neutrality by 2050.[47]

Rail

Rail contributed only around 1% of global transport greenhouse gas emissions in 2023.[48] **Rail manufacturers have adopted strong targets towards achieving net zero emissions** (Table 2)**.**[49] **This includes using renewable energy sources and advancing technologies such as hydrogen and battery electric trains.**

- Alstom, Hitachi Rail, Siemens Mobility and Stadler Rail have all committed to net zero targets through the adoption of renewables and advancements in alternative propulsion technologies, particularly hydrogen and battery electric trains.[50] These four companies consistently provide highly specific, SBTi-validated targets across all emission scopes, along with detailed operational and product-level initiatives.
- In contrast, CRRC and CAF, while expressing commitment to sustainability, have sometimes offered less granular or externally validated short-term targets, especially for product emissions.[51]

TABLE 2. Net zero targets and SBTi status of global rail manufacturers

Company (location of headquarters)	**Net zero target year**	**SBTi validation status**	**Scope 1 and 2 emission reduction targets** (year, % reduction, baseline)	**Scope 3 emission reduction targets** (year, % reduction, baseline)	**Key strategic pillars**
Alstom SA (France)	2050	Validated (July 2023)	40% by FY2030/31 (2021/22 baseline)	Passenger rolling stock: 42% per passenger-kilometre by FY2030/31 (2021/22 baseline); freight: 35% per tonne-kilometre by FY2030/31 (2021/22 baseline); purchased goods/services and transport and distribution: 30% by 2030/31 (2022/23 baseline)	Moving towards net zero mobility, responsible value chain
Siemens Mobility (Germany)	2050	Validated (implied by 2030 targets)	90% by 2030 (2023 baseline)	20% supply chain by 2030; 30% absolute by 2030; 90% absolute by 2050	DEGREE framework (Decarbonisation, Ethics, Equity, Governance, Resource Efficiency, Employability)
Stadler Rail (Switzerland)	2050	In progress (SBTi joined, plan in development)	Halve by 2030 (2022 baseline)	Recording started in 2024, targets to be set	Innovation leader in sustainable vehicles, resource efficiency, social commitment
Hitachi Rail (United Kingdom)	2050	Validated (implied by 2030 targets)	100% by 2030 (absolute)	40% by 2030 (absolute)	Drive modal shift, accelerate rail decarbonisation, decarbonise own operations
CAF (Spain)	2045	In progress (SBTi technical validation)	Not explicitly detailed/ quantified	Significant portion from Scope 3 (11.3 million kilograms CO_2 equivalent in 2023)	Developing sustainable transport solutions, leading net zero mobility, Railsponsible Climate Pledge
CRRC (China)	Not explicitly stated	Not disclosed (No explicit SBTi validation mentioned)	Not explicitly detailed/ quantified	Not explicitly detailed/quantified	Focus on "green CRRC" and national plans, high-quality products/services, AI+ initiative, world-class Enterprise Incubation Program

Source: See endnote 49 for this section.

Box 2. The missing momentum and leadership of OEMs in decarbonisation

Although OEMs increasingly reference their climate commitments, evidence suggests that these companies are responding to, rather than shaping, the market transition. With the partial exception of electric vehicles, where cost parity and market readiness are driving uptake, OEMs remain reluctant to take the lead on other low-carbon technologies, such as SAF and zero-emission shipping. Most manufacturers indicate plans to scale up these solutions only once they become commercially viable relative to fossil fuel alternatives.

This limited progress reflects a set of structural barriers:

- Core business models remain dependent on internal combustion engine technologies, creating resistance to transition due to risks to existing revenue streams.
- In several jurisdictions, climate-related regulations and policies have been weakened, delayed or withdrawn – creating uncertainty – often under lobbying pressure from OEMs and the fossil fuel industry.
- Consumers and corporate clients remain largely unwilling to bear higher costs, limiting the demand signals that could incentivise early action.

These conditions risk undermining the efforts of other actors such as investors, start-ups and civil society organisations that are working actively to accelerate the transition.

Transport service providers and operators

Transport service providers and operators include companies that provide transport services – such as taxi services and bus, rail and ferry operators – as well as companies that operate transport systems for public and freight movement, including road, rail, water and air transport operators.[52]

Transport service providers have demonstrated growing decarbonisation ambition, with targets across the entire value chain increasingly becoming the norm. Progress has been made in addressing Scope 1 and 2 (upstream) emissions, while Scope 3 (downstream) emission reductions remain a challenge.

A growing number of public transport and freight transport operators have set targets for net zero greenhouse gas emissions to achieve carbon neutrality; in a few cases, these include short-term net zero targets within the decade.

- Bibby Marine has committed to becoming the United Kingdom's cleanest and most dedicated operator of Service Operation Vessels (SOVs), aiming to deploy a zero-emission SOV by 2030.[53]
- Among its goals for 2030, shipping company DHL is aiming for 66% electric vehicles in its last-mile fleet and a 30% SAF blend.[54]
- Hitachi Rail aims for net zero emissions by 2050, with an intermediate goal of carbon neutrality by 2030 in operations.[55]
- Global port developer Hutchinson Port has committed to a 54.6% reduction in Scope 1 and 2 emissions and a 32.5% reduction in Scope 3 emissions by 2033, aiming for a 90% reduction in all three by 2050.[56]
- Swiss Post has committed to net zero emissions by 2040 across its entire value chain.[57]

Third-party logistics providers have begun to set measurable decarbonisation targets, although ambitions are uneven across companies and are often limited to incremental goals or pilot geographies. Some actors have outlined long-term aspirations such as net zero emissions or reductions in emission intensity[ii], but concrete commitments are largely focused on vehicle counts or modest emission cuts, with limited clarity on broader systemic transformation.

- The freight logistics company 20Cube, based in Singapore, has an ambitious target of carbon neutrality for Scope 1 and 2 emissions by 2026, and for Scope 3 emissions by 2035.[58]
- Amazon has committed to net zero carbon emissions across its global operations by 2040.[59] It aims to have 100,000 electric delivery vans on the road by 2030, sourced from Rivian and other manufacturers.[60] Amazon set a regional target to deploy 10,000 electric vehicles in India by 2025 and achieved it a year early, in 2024.[61]
- GXO France, under the EVE Programme (a voluntary public-private environmental initiative in France), committed to reduce the carbon footprint of its fleet (both owned and subcontracted) 5% by end-2024, compared to 2021 levels.[62]
- J.B. Hunt aims to reduce its carbon emissions intensity 32% below 2019 levels by 2034.[63]

Action

OEMs

Automotive

So far, it has not been common practice for auto manufacturers to make public financial commitments in support of their low-carbon transition plans. As of 2025, only seven auto manufacturers (representing 28% of total vehicle production) had committed to increasing their capital expenditure on low-carbon activities.[64]

- For 15 (50%) of the companies assessed in 2023, no evidence was found of quantified financial content, making it unclear whether they are embedding carbon reduction efforts in key operational activities.[65]
- As of 2023, only BMW and Mercedes-Benz provided comprehensive and integrated descriptions of the major financial impacts of their transition plans (such as projections, cost estimates or other estimates of financial viability) across all time scales, fully aligned with the overall business strategy and profit-and-loss statement.[66]
- Among the seven manufacturers that had committed to low-carbon spending as of 2025, only Tesla and General Motors disclosed financial commitments at the level required for a low-carbon transition.[67]
- One-third of the assessed auto manufacturers disclosed their spending on low-carbon research and development (R&D) activities, comprising on average 34% of their total R&D expenditure; however, none of the companies disclosed the share of their R&D investments in non-mature technologies.[68]
- Auto manufacturers continue to rely mainly on sales of fossil fuel vehicles, with revenue from low-carbon vehicle sales averaging only 17% in 2023 for the nine companies that disclosed these data.[69]

ii Emission intensity refers to the amount of carbon emissions per unit of transport service delivered, a metric that accounts for both emissions and operational output.

Automakers have been scaling up and reshaping their financial strategies to meet the IEA's goal of 65% electric vehicle sales in total car sales by 2030, in line with net zero emission trajectories.[70] As of 2022, electric car sales were broadly in line with a 1.5°C roadmap; however, the auto industry risked falling behind, given that no major manufacturer had pledged to fully phase out fossil fuel vehicle production by 2035 (Figure 4).[71]

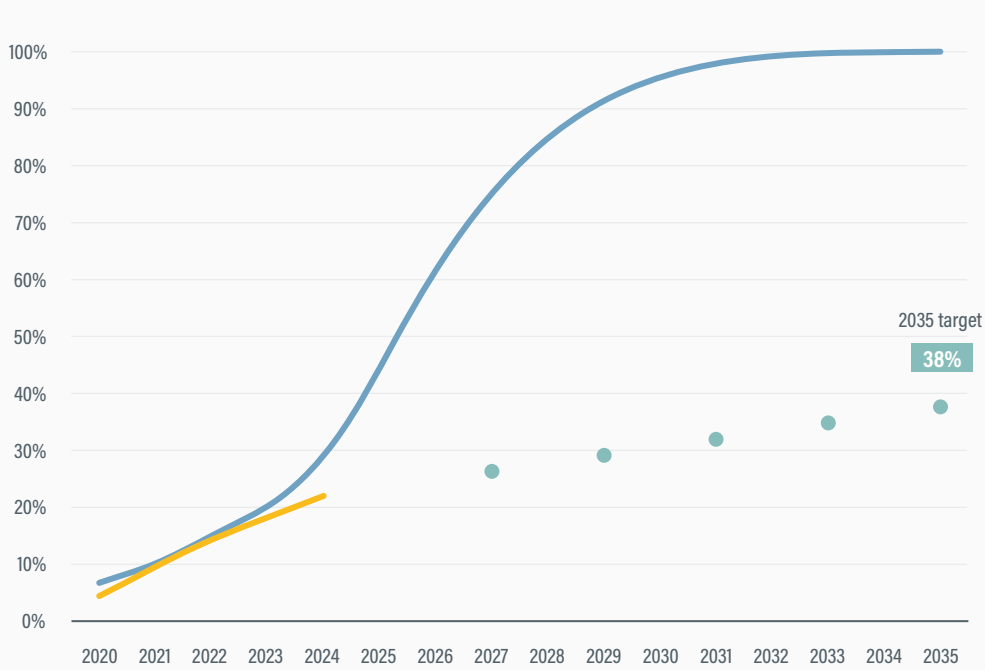
- In 2024, battery electric and fuel cell electric vehicles (excluding hybrid vehicles with combustion engines) represented 22% of global vehicle sales, up from 18% in 2023.[72]
- Global sales of battery-electric passenger cars surpassed 9.5 million units in 2023 and reached 11 million units in 2024.[73]
- China led global electric vehicle manufacturing in 2024 with over half of total output, followed by the United States with around 2.5 million units.[74]
- Only six auto manufacturers (Ford, General Motors, Hyundai, Kia, Renault and Stellantis) have committed to 100% electric car sales in specific markets, with five targeting Europe and one the United States.[75]

Even if all auto manufacturers fully achieve their publicly disclosed targets for phasing out fossil fuel vehicle production, and Chinese companies meet the national goal of 40% new energy vehicle sales, only around 38% of vehicles globally are projected to be fully electric by 2035 under current company plans.[76]

Electrification of heavy-duty vehicles has continued to lag that of light-duty vehicles. Buses remained the most mature category of electrified heavy-duty vehicles, with nearly 50,000 electric buses sold globally in 2023, or around 3% of total bus sales.[77] China led in the production of electric heavy-duty vehicles, driven by strong government support and substantial investment, although the European market gained ground.[78] Uptake of electric trucks has been much slower globally, but momentum is beginning to build. (See 5.2 Vehicle Electrification.)

- Electric truck sales increased 35% in 2023 to around 54,000 units globally, surpassing electric bus sales for the first time.[79]
- Among the major legacy truck manufacturers, only Daimler Truck disclosed its sales of low-carbon vehicles, which remained negligible.[80]

FIGURE 4. Projected gap in global electric vehicle sales, 2020-2035



Even if all auto manufacturers fully achieve their publicly disclosed targets for phasing out fossil fuel vehicle production, and Chinese companies meet the national goal of 40% new energy vehicle sales, only around 38% of vehicles globally are projected to be fully electric by 2035 under current company plans

Source: See endnote 71 for this section.

Alongside governments, major auto manufacturers have been investing in public charging infrastructure, which is key to supporting mass adoption of electric vehicles. Global charging infrastructure expanded more than 30% in 2024, adding more than 1.3 million public charging points.[81]

- Tesla opened more than 11,500 new Supercharger stalls in 2024, representing 19% growth.[82] As of 2024, more than 60,000 Superchargers were available worldwide.[83]
- In 2025, BYD unveiled a new fast-charging platform and announced that it would build a charging network across China.[84]

Aviation

The aviation industry has encountered significant obstacles towards decarbonisation, particularly in the adoption of sustainable aviation fuel and in the development of hydrogen-powered engines and aircraft.

Although new-generation aircraft from Airbus and Boeing are already compatible with up to 50% SAF blends, the pace of SAF adoption has been constrained by under-investment from the energy sector, which has not scaled production fast enough to meet aviation's climate targets.[85] **In 2024, SAF production doubled to 1 million tonnes, yet it accounted for just 0.3% of global jet fuel output.**[86]

The use of hydrogen-powered aircraft is still not a feasible business model. Although Airbus initially targeted 2035 for the entry into commercial service of a hydrogen-powered aircraft, it has postponed this goal to the late 2030s due to slower-than-expected technological advancements and infrastructure development.[87] Airbus aims to advance hydrogen-powered aviation through its ZEROe project.[88] In 2023, the company powered a 1.2 megawatt hydrogen fuel cell, and by 2024 it completed testing of an integrated fuel cell stack, electric motors, gearboxes, inverters and heat exchangers.[89]

Shipping

The current and projected uptake of zero-emission fuels in shipping – including ammonia, hydrogen and methanol – remains well below what is needed to meet Paris-aligned targets, based on a 2050 vision on fuel standards for shipping. According to the IMO's revised 2023 GHG Strategy, these targets would require at least a 20-30% cut in greenhouse gas emissions by 2030 and a 70-80% cut by 2040 (from 2008 levels) to reach net zero "by or around" 2050.[90] However, current adoption trajectories for zero-emission fuels fall well short of this 2050 fuel-standards vision.[91]

Rail

Leading rail manufacturers are deploying a diversified portfolio of alternative propulsion systems. These include hydrogen fuel cell trains (Alstom's Coradia iLint, Stadler's FLIRT H2)**, battery electric trains** (Stadler's FLIRT AKKU) **and advanced hybrid models** (Hitachi's Masaccio)**.** In 2023, Alstom allocated 80% of its total capital expenditure to low-carbon technologies, with related manufacturing activities accounting for 41% of the company's overall budget for capital expenditures.[92]

Rail manufacturers are cleaning up their operational emissions through renewable and clean energy investments. This includes offering tailored solutions for different rail networks, whether bridging electrification gaps with batteries or enabling long-distance, zero-emission travel with hydrogen.[93]

- Alstom has secured renewable electricity for its European sites through a long-term virtual power purchase agreement.[94]
- Stadler rely on widespread installation of on-site solar photovoltaic systems to power their production facilities.[95]



Box 3. Supply chain development among transport manufacturers

Electric vehicles and batteries

In 2023, demand for batteries and critical minerals continued to grow, with 95% of this growth from sales of electric cars. China continued to dominate global battery production, manufacturing more than three-quarters of batteries sold worldwide in 2023 (Figure 5).

- Although the current planned battery production capacity for 2030 (7,300 gigawatt-hours (GWh) per year) exceeds the anticipated demand for electric vehicle batteries (4,300 GWh per year), efforts are still needed to secure the necessary raw materials for these batteries.
- In 2024, responses from more than half of executives in major battery, automotive, and energy and utilities organisations indicated that securing a stable supply chain for battery components and materials was a key impediment to scaling up production.

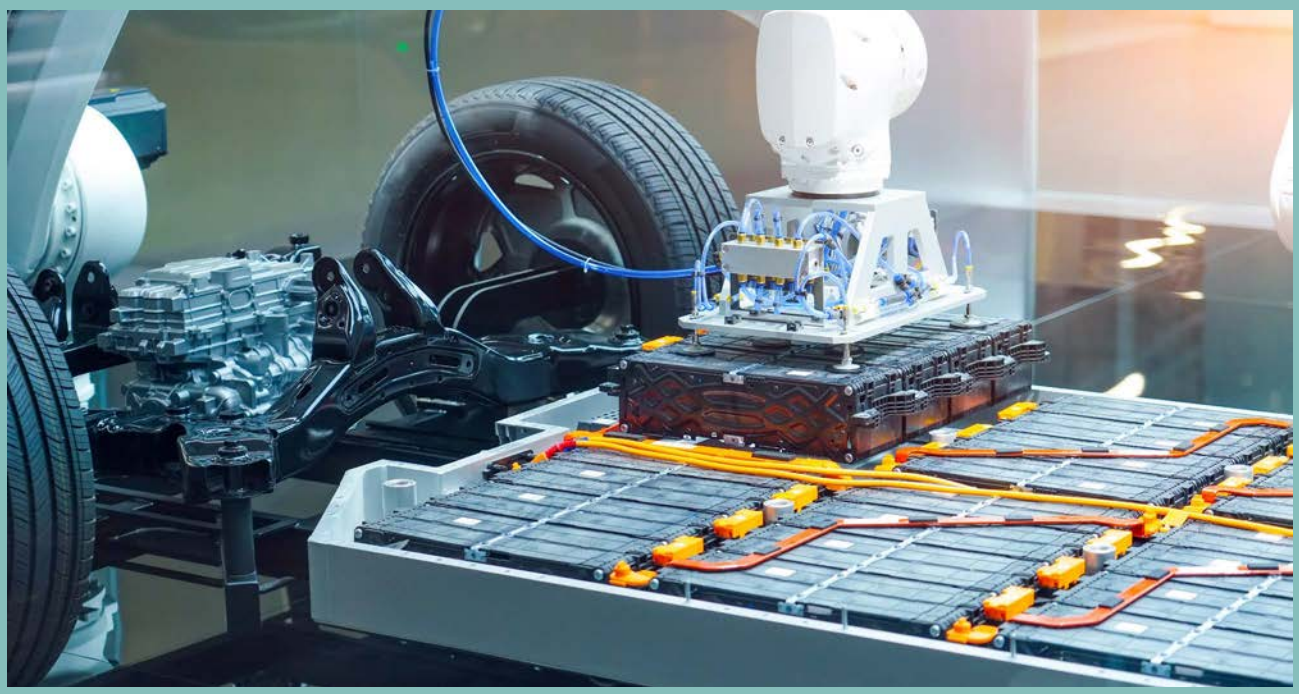
Batteries play a pivotal role in decarbonisation, contributing up to 60% of the required CO_2 emission reductions in the energy sector by 2030 in one scenario. However, geopolitical and trade tariff tensions may disrupt material supplies and slow production of electric vehicles and related batteries. Battery production also releases high upstream emissions during raw material extraction and processing.

In 2024, Western economies contributed minimally to upstream battery production processes, such as mining and refining. Europe accounted for more than 25% of global electric vehicle production yet held limited upstream capacity apart from 20% of global cobalt processing; the US played an even smaller role, with just 10% of electric vehicle production and 7% of battery manufacturing capacity. In contrast, China dominated with 57% of global lithium-ion battery production and the highest concentration of refined materials.

This geographic imbalance limits the ability of Western countries to manage or reduce the environmental impacts of resource extraction, despite strong regulatory ambitions at home. Fully decarbonising the electric vehicle sector requires streamlined in-house operations and external production with binding emission targets.

- As of 2023, only two major auto manufacturers – representing 6% of the electric vehicle market – required their suppliers to meet 1.5°C-aligned emission goals, and none had specific targets for battery suppliers.
- A total of 11 manufacturers – representing 60% of the global electric vehicle market – were shifting to in-house battery production as of 2023, enhancing their control of low-carbon activities. The companies were BAIC, BMW, BYD, Changan Automobile, Ford, GM, Guangzhou Automobile Company, Mercedes-Benz, Suzuki, Tesla and Volkswagen.

New US and EU tariffs announced in 2024 on electric vehicles and battery imports from China, as well as the US Trump administration's ongoing protectionist stance in industrial policy, will have implications for the competitive landscape of the automotive sector. Other regional policies, such as Indonesia's Export Ban on Nickel and China's New Graphite Restrictions in 2023, may further pose uncertainties in the supply of minerals globally.



Aviation

Production shortfalls by aircraft and engine manufacturers have caused persistent supply chain delays. Record-high backlogs in aircraft deliveries were expected to continue into 2025, impacting airline performance by raising costs and limiting growth.

- Aircraft deliveries in 2024 were 30% below forecasts – with 1,254 units delivered versus 1,813 expected – and projections for 2025 were also downgraded.
- At current rates (as of 2024), clearing the record backlog of 17,000 aircraft orders (cumulative number of unfulfilled orders) would take 14 years, double the pre-pandemic average.

Shipping

Although some shipping companies have set goals for procuring "green steel", little progress has been made in terms of policy supports, commitments from the steel industry and agreed-upon decarbonisation pathways. Because shipbuilding relies heavily on steel, the transition to low-carbon or green steel is essential for reducing emissions in the sector.

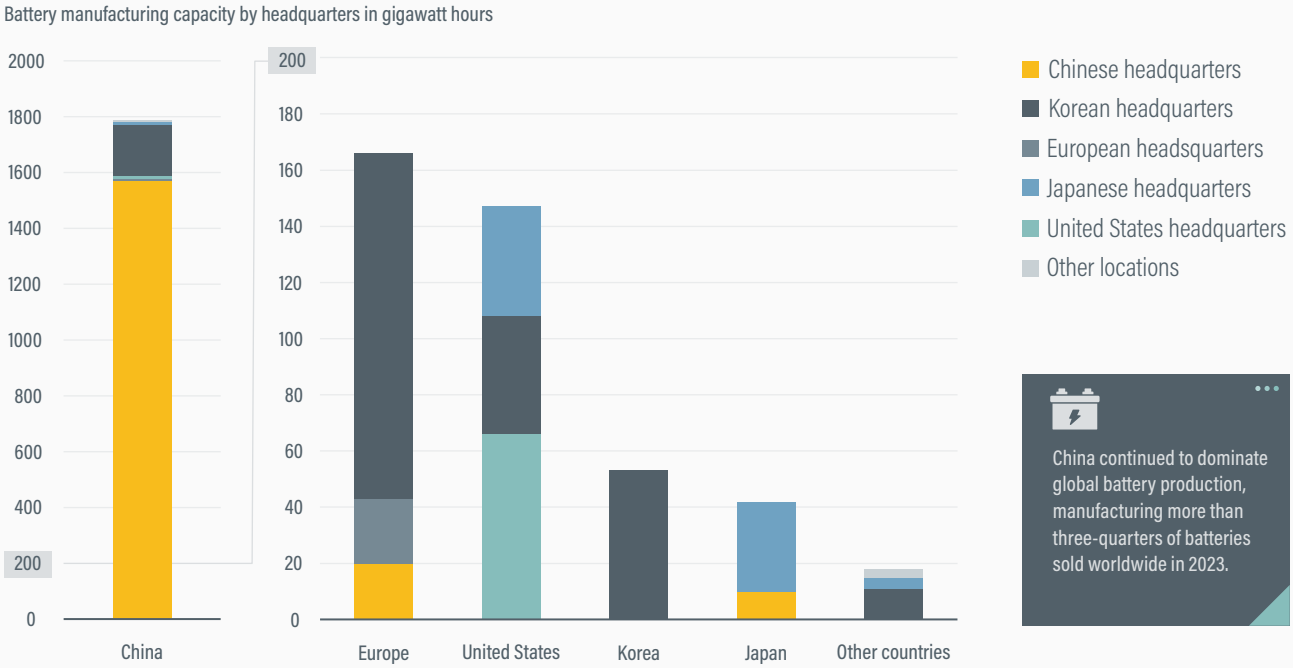
- Some shipping companies have joined the SteelZero initiative, which requires members to commit to using 50% "low-carbon steel" by 2030 and 100% by 2050.
- Maersk, the world's second largest shipping company, aims to procure, specify or stock 50% "low-emission steel" by 2030 and to set a clear pathway to using 100% net zero emission steel by 2040.
- The Ship Recycling Transparency Initiative was established in 2018 to advance responsible ship recycling by encouraging shipowners to publicly disclose their policies and practices.

Rail

Railway companies have increasingly embedded sustainability into their supply chains, with 73% including green clauses in supplier contracts and 63% monitoring the sustainability performance of suppliers as of 2022. Initiatives to cut waste and emissions include the use of recycled materials (such as in SNCF's eco-friendly sleepers) and circular economy programmes (such as KORAIL's e-waste recycling). China's CRRC, a leading rail transit manufacturer, has strengthened its global position through innovative supply chain strategies: by leveraging smart technologies and regional industrial clusters, the company sourced more than 80% of its components locally in 2023.

Source: See endnote 96 for this section.

FIGURE 5. Lithium-ion battery manufacturing capacity by region of manufacturer headquarters, 2023



Transport service providers and operators

Of the 1,061 transport service companies that disclosed targets to CDP in 2023, only one reported having all 21 key indicators of a Climate Transition Plan.[97] Of the remaining companies, 10% (104 companies) had many of these indicators, 19% (202 companies) had some indicators, and 71% (754 companies) had few indicators (Figure 6).[98]

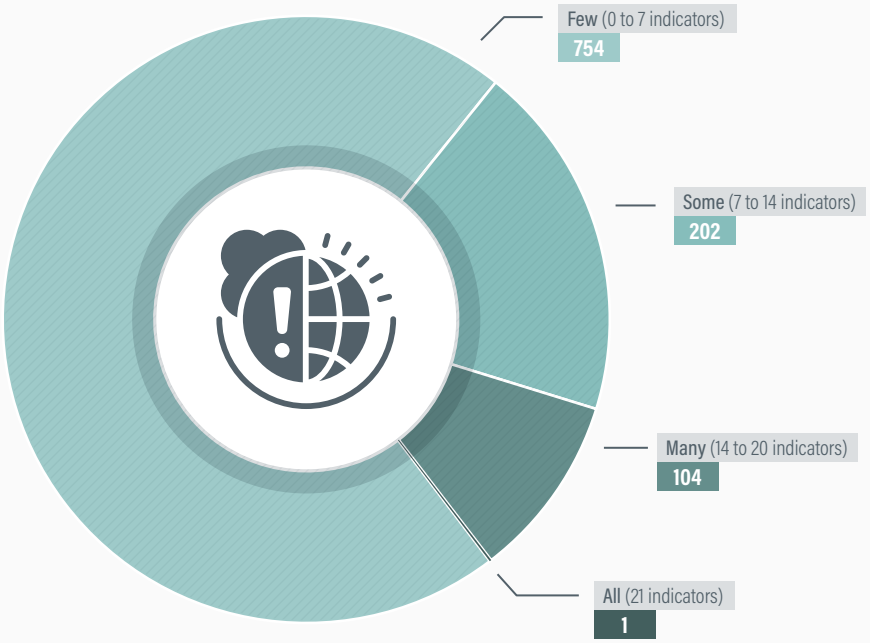
Action by transport service providers and operators has focused mainly on electric and zero-emission vehicles.

- Hitachi Rail launched the Masaccio Battery Train in Italy, as well as digital traffic management systems and smart mobility platforms in various cities.[99]
- As of 2023, Mobico Group had deployed 683 zero-emission vehicles (including 140 electric buses in Coventry), saved 2,351 tonnes of CO_2 annually by converting 21 buses to hydrogenated vegetable oil (HVO) biofuel in Ireland, and secured USD 72 million for electric school buses in North America.[100]
- New Zealand Post transitioned 67% of its nearly 1,000-vehicle fleet to electric by June 2024 (including 99% of cars and 68% of vans), supported by 176 charging points and a USD 20 million financing agreement with NZ Green Investment Finance.[101]

Third-party logistics providers are pursuing operational decarbonisation through combined strategies including vehicle electrification, alternative fuels, fuel-saving driver practices and digital tools.

- Amazon had more than 31,400 electric delivery vans on the road in 2024, moving towards its 2030 goal for electric vehicle deployment.[102] The company offset 100% of its electricity use for operations with renewable energy as of 2023, five years ahead of its 2025 target.[103]
- GXO Logistics has introduced multiple diesel-reduction strategies including anti-idling enforcement, driver training for fuel-efficient driving, and aerodynamic fleet vehicles.[104] In collaboration with Datasparq, GXO has implemented artificial intelligence-based route optimisation for its operations in Iceland and the United Kingdom; the initiative spans four distribution centres and more than 50 million kilometres annually, leading to enhanced route efficiency, productivity gains and driver satisfaction.[105]
- J.B. Hunt reported that 65% of its total diesel purchases in 2023 were renewable diesel blends or blends derived from biological sources such as plant oils or animal fats, with 24% of total fuel sourced from renewables.[106] The company operated eight eCascadias (electric trucks) and 182 natural gas-powered trucks.[107] As of 2023, it had 27 zero-emission vehicles, with plans to expand this fleet.[108]

FIGURE 6. Number of key indicators included in Climate Transition Plans of transport service companies



Of the 1,061 transport service companies that disclosed targets to CDP in 2023, only one reported having all 21 key Climate Transition Plan indicators. 71% had few indicators, 19% had some, and just 10% had many.

Source: See endnote 98 for this section.

Advocacy

OEMs

Automotive

The advocacy and policy positions of leading global auto manufacturers have posed a significant obstacle to operationalising climate-friendly policies in the industry. Many companies have supported policies favouring internal combustion engine (ICE) vehicles.[109] **The resistance to stricter vehicle emission standards and accelerated ICE phase-out policies have been compounded by factory closures and job losses. The EU has partially rolled back its vehicle emission and ICE phase-out targets following industry pushback and trade tariff tensions with the United States.**

- The European Commission announced that it would lower its 2025 emission targets for sales of new light-duty vehicles and allow auto manufacturers to continue to sell ICE vehicles beyond 2035.[110]
- For heavy-duty vehicles, the European Automobile Manufacturers' Association (ACEA) pushed back on the European Council's 2024 proposed stricter regulation on CO_2 emissions and higher associated fines. The ACEA argued that automakers that fall short on targets starting in 2025 would undermine the sector's progress, and that the fines could instead be redirected to the transition to zero-emission vehicles, avoiding job losses and strengthening the EU supply chain (which already faces high competition from Asian markets).[111] In 2025, the EU Council approved the penalty relief and the call for flexible measures for the auto manufacturing sector.[112]

As of 2023, 60% of auto industry players had not disclosed how they govern their relationships with trade alliances, associations, coalitions and think tanks – influential parties through which companies can indirectly influence climate-related policy.[113] The majority of industry players did not have a process for monitoring and reviewing the climate policy positions of the alliances, associations, coalitions and think tanks of which they were members, and virtually all failed to disclose an action plan for addressing instances when such associations were found to oppose climate policies. However, some manufacturers have stronger processes in place to govern their relationships.

- Ford, GM, Honda and Volkswagen all mentioned plans to withdraw funding from, or suspend or end memberships with, alliances, associations, coalitions and think tanks if these organisations opposed climate policies or engaged in climate-negative activities.[114]
- Analysis found that only 40% of auto manufacturers were not members of, and did not provide funding to, alliances and associations that had climate-negative activities or positions; the remaining 60% did engage with influential parties linked to negative climate actions.[115]

Overall, as of 2023, 63% of the automotive industry disclosed public support for significant climate policies, including a commitment to the Paris Agreement; however, only 37% of industry players had a monitoring and reviewing process to ensure that their policy positions aligned with the Paris goals.[116] Most of the auto industry collaborates with national and sub-national authorities on emission reduction projects.

- Ford has embedded many of the fundamentals of policy engagement supportive of strong climate action. It has a comprehensive policy covering all subsidiaries and jurisdictions, and discloses all affiliations and reviews memberships annually, with board oversight and actions including withdrawal from misaligned groups.[117] The company's climate advocacy aligns with the Paris Agreement, is backed by the SBTi and supports initiatives such as the United Nations' 1.5°C pledge.[118]
- Among truck manufacturers, Volvo has shown only average policy engagement, while Scania has demonstrated a minimum standard by avoiding support for climate-negative actions.[119]
- Daimler encourages regular stakeholder engagement and continuously exchanges with employees, customers, and suppliers, contributing to societal dialogue.[120]
- Volvo AB has publicly committed to international low-carbon pledges and participates in initiatives against climate change. [121]

Beyond the auto industry, most other transport manufacturers have shown limited corporate policy engagement, with few signs of active participation in associations or coalitions (Figure 7).[122]

Aviation

The International Civil Aviation Organization (ICAO) has issued recommendations on a methodology for monitoring and reporting emission reductions in the sector, including proposals for more stringent aircraft noise and CO_2 emissions standards.[123] **Both Airbus and Boeing have expressed alignment with low carbon goals and have publicly supported and committed to the principles of the Paris Agreement; however, neither company has specified a monitoring and review process to ensure that its policies are aligned.**[124]

- Boeing has a company-wide engagement policy that spans from manufacturing and supply chain players to customers and the communities that the company works in; although Boeing engages in dialogue with local authorities on climate policies, there is no evidence of significant partnerships or measurable emission reduction

FIGURE 7. World Benchmarking Alliance scores for policy engagement of transport manufacturers

			WBA Indicators score			
Type Transport Manufacturer	**Country HQ**	**Company**	Company policy on **engagement** with Associations, Alliances, Coalitions or Thinktanks	Associations, Alliances, Coalitions and Thinktanks supported do not have **climate-negative activities or positions**	Position on significant **climate policies**	**Collaboration** with **local public authorities**
Aviation	France	Airbus	50	100	70	50
	USA	Boeing	75	50	70	25
	China	Comac	0	0	0	0
Rail	France	Alstom	40	100	60	75
	China	CRRC Corporation	0	0	0	50
	Switzerland	Stadler Rail	0	50	45	25
Ships	China	China State Shipbuilding	0	0	0	0
	Italy	Fincantieri	0	50	90	50
	South Korea	Hanwha Ocean	0	0	45	0
	South Korea	South Korea Korea Shipbuilding	0	100	30	0
Trucks	Germany	Daimler Truck	40	50	45	50
	USA	PACCAR	50	50	45	25
	Sweden	Scania AB	0	100	70	50
	Sweden	Volvo AB	60	50	90	25

Note: Scores greater than 70-100 = indicators met favourably; scores 40-69 = indicators met averagely; scores 0-40 = indicators met poorly (or unmet if 0).

Source: See endnote 122 for this section.

from these engagements.[125]

- Airbus appears not to support climate-negative actions and participates in small-scale pilot/short-term/one-off programmes.[126]
- China's state-owned plane manufacturer Comac does not meet any indicator related to policy engagement or climate-friendly policy.[127]

Shipping

In 2025, the IMO adopted the first legally binding Net-Zero GHG framework for global shipping, aligning the sector with the Paris Agreement.[128] While some shipping companies engage in climate actions, most have yet to address concerns about policy engagement with outside groups. The IMO framework, which will include emission limits and greenhouse gas pricing by 2027, marks a critical shift towards cleaner operations. However, a delayed timeline, announced in April 2025, raises concerns about its impact on meeting 2030 and 2050 targets.[129] (See 4.10 Shipping.)

- Korea Shipbuilding is the only major shipbuilder not fully engaged in supporting climate-negative action. Shipbuilders in the Republic of Korea support international climate goals, but without clear oversight processes.[130]
- Fincantieri has shown evidence of partnering with governments and universities to enhance shipbuilding innovation and reduce operational costs – including by improving the capabilities of commercial vessels; providing a co-operative framework for managing, focusing, developing and sharing R&D; and leveraging best practices in shipbuilding and repair.[131]
- Chinese manufacturers such as China State Shipbuilding have not shown evidence of favourable involvement in climate-friendly policies.[132]

Rail

All rail or rolling stock manufacturers have demonstrated some involvement with national and sub-national authorities to test or implement climate-related policies and partnerships; however, no manufacturers are entirely aligned with a low-carbon pathway.

- Alstom is not involved in climate-negative actions and supports international climate goals, but without clear oversight processes.[133]
- CRRC Corporation actively opposes climate policies.[134]

The European Rail Supply Industry Association (UNIFE) has been engaging and supporting European climate policies and ambitions to reduce rail sector emissions, in line with the 2030 greenhouse gas reduction targets. UNIFE has also advocated for a modal shift in transport towards rail.[135]

Knorr-Bremse is a founding member of the Europe's Rail Joint Undertaking which aims to deliver, via an integrated system approach, a high-capacity, flexible, multi-modal, sustainable, reliable and integrated EU railway network for European passengers and cargo and collaborates with more than 15 research institutions.[136]

Transport service providers and operators

Companies have increasingly collaborated with public authorities to elaborate policies, regulations, and standards, including related to a modal shift. However, these efforts range widely and are often localised.

- 20Cube encourages a modal shift from air to sea as well as truck-on-train logistics.[137]
- DHL engages in policy debates through logistics councils, supports mandates for SAF and advocates for standardised greenhouse gas accounting.[138]
- Hitachi Rail promotes public-private partnerships and stronger policy support for rail electrification.[139] The company advocates for a modal shift and focuses on digital solutions to support it.[140]

Global and regional advocacy coalitions have emerged in recent years. Cross-company coalitions such as EV100+, the First Movers Coalition (FMC), and the Zero Emission Leadership Coalition show promise, but they remain concentrated in major economies and sectors, with limited participation from emerging markets or smaller companies. These coalitions risk becoming echo chambers for large multi-national players unless they expand to include a broader diversity of actors, such as small carriers, logistics providers, and public transport authorities, particularly from low- and middle-income countries.

- Mobico Group – which operates in Canada, Germany, Morocco, North America, Spain, the United Kingdom and Ireland, and the United States – is a member of EV100 and leads the Zero Emission Leadership Coalition.[141]
- DHL is part of FMC, which pushes for SAF adoption and freight decarbonisation; as of 2024, the coalition had 28 members from aviation, 18 members from shipping and 16 members from trucking.[142]
- The International Union of Railways (UIC) plays a pivotal role in uniting railway operators worldwide to decarbonise the sector, align with net zero pathways and promote modal shift to rail.[143] Through joint commitments, technical standards, and knowledge-sharing platforms, UIC enables its transport service provider members to adopt concrete, measurable actions that cut emissions and improve efficiency.
- The United Kingdom's Network Rail – a signatory to the UIC Climate Declaration (2021) – aims for carbon neutrality by 2050 and is advancing low-emission operations, climate resilience, and diesel replacement with electric, battery and hydrogen traction.[144]

Accountability

OEMs

Automotive

Climate disclosures have become mainstream in the transport sector, yet critical accountability gaps remain – particularly in the reporting of Scope 3 emissions and the adoption of robust interim targets. To drive progress, companies must enhance their disclosure of emissions (including Scope 3), set emission reduction targets, increase the transparency of R&D and develop comprehensive transition plans.[145] Weak disclosure practices, particularly among East Asian manufacturers, continue to hinder climate and social performance.[146]

- More than 90% of top automotive and transport manufacturers have board-level climate oversight, yet only 17% possess strong expertise in climate change and low-carbon transition strategies – including BMW, Ford, Mercedes-Benz and Stellantis.[147]

Aviation

The aviation industry has sought to adopt best practices for globally recognised accounting systems for SAF uptake (regardless of uplift location), with the goal of facilitating economies of scale in SAF production.[148]

In 2024, global SAF output hit 1 Mt (about 1.25 billion liters), twice the 2023 volume, accounting for 0.3% of total jet fuel consumption, with 11 certified production pathways.[149]

In 2025, the IATA introduced the SAF Registry to standardise and transparently log SAF transactions, enabling stakeholders to track environmental benefits along the supply chain and claim them for both regulatory compliance and voluntary commitments[150]

Shipping

The global finance portfolio for shipping has aligned increasingly with the ambitious decarbonisation goals of the IMO, according to a 2024 disclosure report under the Poseidon Principles.[151] The Poseidon Principles is a framework designed to help financial institutions evaluate and disclose the climate alignment of their shipping portfolios.[152]

Since 2022, to enhance transparency, signatories of the Poseidon Principles have disclosed the share of their portfolio used to calculate climate alignment – known as the reporting percentage. The average reporting percentage rose from 91% in 2022 to 93.3% in 2024, with 80% of signatories disclosing reporting percentages of more than 90% and eight achieving full (100%) reporting.[153]

Transport service providers and operators

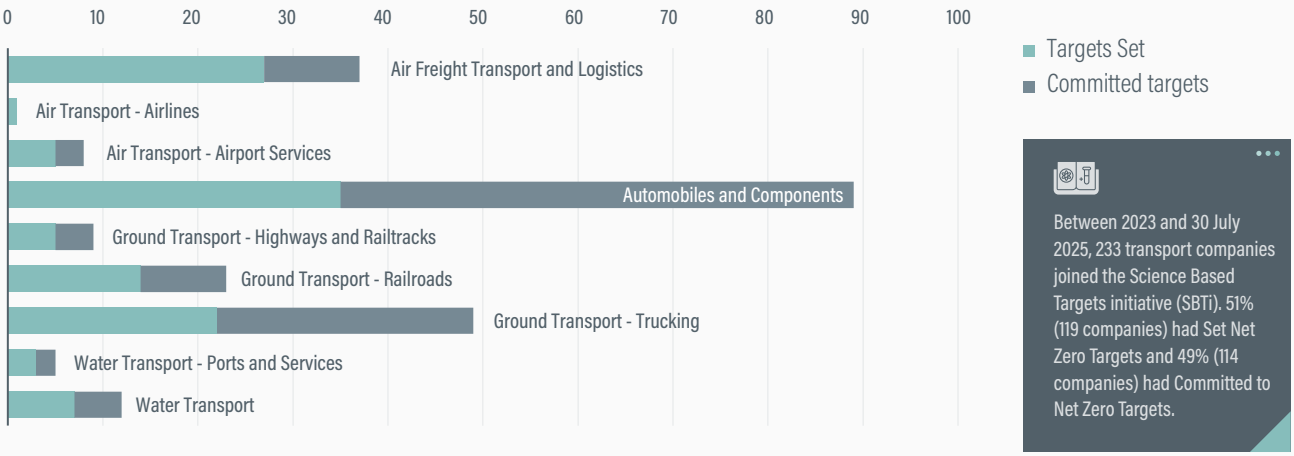
Although target setting has improved for transport service providers and operators – with more companies now publishing science-aligned or time-bound climate targets – verification has remained questionable. Between 2023 and 30 July 2025, 233 transport companies joined the Science Based Targets initiative (SBTi); of these, 51% (119 companies) had set net zero targets, and 49% (114) had committed to net zero targets (Figure 8).[154] (In the SBTi framework, companies with targets "set" have validated science-based decarbonisation targets, while those marked "committed" have pledged to set such targets.)

- Knorr-Bremse has validated Scope 1-3 reduction targets, and reports annually using SBTi-aligned pathways.[155]
- New Zealand Post offers transparent updates, backed by fleet electrification data, financing details and public emission disclosures.[156]

Companies increasingly mention Scope 3 emissions, yet few offer detailed disclosures or breakdowns. The risk of overstated environmental claims remains significant. In the aviation sector, companies often highlight biofuels and optimisation even as SAF use remains very low. Major blind spots in accountability include emissions from supply chains, infrastructure, vehicle manufacturing and embedded energy in fuels. Many transport companies claim future decarbonisation while continuing to expand routes, fleets and hubs.

- DHL and other FMC members target 30% SAF use by 2030; however, as of 2024 the share of SAF use globally was just 3.5%.[157]
- In India, actors such as Indian Oil, IndiGo, Vistara and the Indian Air Force are piloting SAF use, but none have yet met the FMC's SAF 85 standard, which requires a minimum 85% reduction in life-cycle greenhouse gas emissions.[158] Key barriers to scaling near-zero emission aviation in India include the high cost of SAF 85 production (2-3 times the cost of jet fuel), uncertain access to green hydrogen and a lack of demand.[159]

FIGURE 8. SBTi net zero commitments across transport industry sub-sectors, 2023-2025



Between 2023 and 30 July 2025, 233 transport companies joined the Science Based Targets initiative (SBTi). 51% (119 companies) had Set Net Zero Targets and 49% (114 companies) had Committed to Net Zero Targets.

Source: See endnote 154 for this section.

The "4 A's" across companies that use transport

Companies engage in transport both through their own fleets and by using public and freight services provided by third parties. A shipper is any entity that sends, receives, or manages the transport of goods, typically by contracting carriers or logistics providers, even if they do not operate transport vehicles themselves. Freight buyers and large corporate players also play a pivotal role in determining how goods are transported across global and regional supply chains.

These actors shape the transport space by leveraging their purchasing power to demand zero-emission transport services, sustainable fuels, and clean infrastructure, thereby influencing market dynamics and policy directions. Key players include companies such as IKEA and Unilever, as well as coalitions and alliances such as EV100/EV100+, FMC, the Zero Emission Maritime Buyers Alliance (ZEMBA) and the Getting to Zero Coalition. Table 3 summarises the engagements of these groups in the transport space since 2023.[160]

- IKEA is targeting 100% zero-emission deliveries by 2025 and net zero emissions across its value chain by 2039; it aims to support this through electric vehicle pilots globally, modal shifts, and strong advocacy for infrastructure and supply-side policies, while transparently disclosing progress and defining zero-emission vehicles by tank-to-wheel emissions.[161]
- Unilever targets net zero emissions by 2039 across its value chain and is advancing this through renewable logistics pilots, efficiency improvements, and active participation in global alliances such as FMC, with transparent reporting via science-based and third-party verified platforms.[162]

TABLE 3. Summary of the "4 A's" of selected coalitions and alliances in the transport sector

Coalition/ Actor	Ambition	Action	Advocacy	Accountability
EV100 and EV100+	Electrification of vehicle fleets (public and freight); 100% electric vehicles by 2030.	More than 700,000 electric vehicles across 76 markets; 138,749 battery electric vehicles added in 2023; 400 e-trucks deployed in medium- to heavy-duty vehicle segment.	Promotion of corporate fleet transition; policy influence through demonstrating large-scale demand.	70% of members on track for 2030 goals; transparent reporting of fleet electrification.
First Movers Coalition (FMC)	Using purchasing power to scale decarbonisation of aviation, trucking and shipping.	28 companies committed to replacing 5% jet fuel with SAF (85% fewer life-cycle emissions).	Public-private partnership; advocates for clean fuel development and deployment.	Member performance documented in climate action platforms such as Climate Transition Action Plans.
Getting to Zero Coalition (via Global Maritime Forum)	Zero greenhouse gas emissions in shipping by 2050 (aligned with the IMO).	Cross-sector collaboration for scalable zero-emission shipping fuels and technology.	Influence on maritime regulation (e.g., IMO) through coalition strength.	Tracks adoption progress; includes Poseidon Principles for finance/ insurance accountability.
Zero Emission Maritime Buyers Alliance (ZEMBA)	100% zero-emission shipping for freight operations by 2040; net zero by 2050.	Support for scalable, verified zero-emission maritime shipping solutions; buyers form a demand coalition.	Shippers drive zero-emission shipping by aggregating demand and pushing maritime carriers.	Third-party verification of zero-emission shipping; alliance fosters buyer-side accountability.

Source: See endnote 160 for this section.

Box 4. Gender equity in the private transport sector

Despite some progress and the setting of diversity targets, private sector players in transport have lagged in achieving meaningful gender representation. A few companies have demonstrated leadership through gender pay equity and diversity initiatives, yet overall efforts remain insufficient. Targets exist for increasing the number of women in senior roles, but tangible outcomes and broader industry-wide change are still limited.

- Maersk has committed to increasing the share of women in management and leadership positions from 35% in 2023 to more than 40% by 2025, and to boosting the share of executives of diverse nationalities from 20% in 2023 to more than 30% by 2025.[163]
- In 2022, New Zealand Post's gender pay gap was only 0.8%, down from 1% in 2021, compared to a national gender pay gap of 9.2%.[164] The company's progress is supported by actions including: unconscious bias training for employees and management; use of diverse hiring panels to promote fair recruitment; annual gender pay analysis as part of routine performance and compensation reviews; and public disclosure of pay gap data, with new efforts planned to address ethnic and cultural gaps.[165]
- At Swiss Post, 25.4% of senior managerial positions were held by women as of 2023, and 44.4% of board directors were female.[166]
- As of 2022, the public transport company Transdev had 26% women in the workforce; the company's diversity and inclusion roadmaps set a target for 34% women in top executive positions.[167]

Challenges and opportunities for decarbonising private transport

Stable, forward-looking regulation presents a vital opportunity for the private sector to lead the transformation towards net zero emissions in the road transport sector. Regulatory clarity can stimulate investment in low-emission technologies, encourage innovation and create competitive advantages for first movers. However, recent significant opposition within the automotive, petrochemical and affiliated industries has diluted or delayed climate policies in key jurisdictions, undermining this potential.[168] Industry players can help shape cost-effective, technology-agnostic pathways to reduce emissions in freight and logistics.

- The US Chamber of Commerce has called for a weakening of proposed greenhouse gas emission standards for light- and medium-duty vehicles beyond 2027, citing concerns about supply chain constraints, charging infrastructure and grid reliability.[169]
- The US National Federation of Independent Business has opposed the Environmental Protection Agency's proposed Phase 3 greenhouse gas standards for heavy-duty vehicles, citing economic costs and insufficient supporting infrastructure.[170] The federation's assertion that the standards would lead to trucks that are three times as expensive, with half the range and double the servicing costs, underscores the need for collaborative policy making.[171]
- BusinessEurope has opposed the EU's proposal to mandate 100% CO_2 emission reductions from new cars and vans by 2035, advocating instead for a 90% target.[172] Their argument rests on preserving technological neutrality and allowing room for low-carbon fuels. This reveals a broader tension between the urgency of climate targets and the desire to preserve incumbent technologies. However, businesses embracing full decarbonisation targets can benefit from clarity in future market trajectories, investor confidence and a growing consumer demand for cleaner mobility.
- The Australian Chamber of Commerce and Industry (ACCI) has challenged the proposed New Vehicle Efficiency Standard, arguing that it imposes disproportionate costs on manufacturers and ultimately consumers.[173] ACCI has proposed exemptions for large sport utility vehicles (SUVs) used by tradespeople and emergency services, and recommended aligning with the US approach, which exempts vehicles above 3.6 tonnes.[174]

Collectively, these positions reflect a reluctance among some actors to embrace regulatory ambition. Yet these very regulations – if designed in collaboration with industry – can unlock significant business opportunities: driving new product development, opening export markets for clean technologies, and lowering long-term operating costs through improved efficiency.

Rather than opposing reform, businesses stand to gain by actively engaging in the regulatory process and leading on solutions. Constructive partnerships between government and the private sector will be essential to ensure that policies are not only ambitious and credible but also practical and supportive of innovation. This is not merely a compliance challenge – it is a commercial opportunity to shape the future of mobility and to lead the low-carbon transition in a way that is profitable, inclusive and forward-looking.

Digital payment platforms such as Mastercard and Visa present an opportunity to accelerate decarbonisation across transport systems, particularly in first- and last-mile connectivity. By enabling open-loop, contactless fare systems and app-based ticketing, these players reduce reliance on cash-based infrastructure and improve operational efficiency – key prerequisites for scaling low-emission mobility. For

private operators such as bike-shares or e-scooter companies, integrating with such digital payment backbones allows them to plug into a broader mobility ecosystem, making their services more discoverable, usable and efficient.[175]

- Mastercard's partnership with Metro de Panamá illustrates how open-loop payment systems can simplify access for more than 200,000 daily users, including tourists and occasional riders.[176] By facilitating fare payments through contactless cards, phones, or wearables, Mastercard supports more seamless multi-modal travel.
- Visa's Mobility & Transport Transaction (MTT) model, active in more than 250 cities, enables private mobility providers to integrate with public fare systems through contactless EMV-based infrastructure.[177]
- Through programmes such as "Visa Ready for Transit", private companies can deploy certified, inter-operable solutions that connect with public transport schedules and payment systems.[178] This fosters a unified user experience and improves the case for shifting from car ownership to shared, lower-emission travel modes.

Newer OEMs that do not have legacy platforms based on ICE technologies are uniquely positioned because they are not constrained by fossil fuel phase-out targets and can instead focus on achieving full life-cycle sustainability from the outset. However, real progress towards decarbonisation will depend on whether the transition strategies of these manufacturers are time-bound, financially viable and focused on aligning core business functions (including capital expenditure and R&D) with low-carbon technologies, such as battery manufacturing and charging infrastructure.

Unlocking future market potential will also require a strategic pivot away from high-cost premium electric vehicles towards more affordable models. However, this is complicated by protectionist trade measures that have constrained global supply chains and could delay cost parity with ICE vehicles. Unless industrial policies support cost-effective local manufacturing, and manufacturers realign their offerings, the sector may miss a crucial window to scale electrification equitably.



Regional Overviews: Trends and Policy Development

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION



MODULE 3

3.1  Africa Regional Overview 256

3.2  Asia Regional Overview 276

3.3  Europe Regional Overview 298

3.4  Latin America and the Caribbean Regional Overview 319

3.5  North America Regional Overview 340

3.6  Oceania Regional Overview 361

  Small Island Developing States Overview 380

LIST OF FIGURES

Africa Regional Overview

Figure 1. Access to all-weather roads in Africa, 2019 . . . . . **264**
Figure 2. Motorisation rates per 1,000 people in Africa, various years **267**
Figure 3. Transport greenhouse gas emissions in Africa, 2023 . . . . . **268**
Figure 4. Per capita transport greenhouse gas emissions in Africa, 2023 . . . . . **269**
Figure 5. Road casualties per 100,000 people in Africa, 2021 . . . . . **270**

Asia Regional Overview

Figure 1. Motorisation rates per 1,000 people in Asia, various years **285**
Figure 2. Transport greenhouse gas emissions in Asia, 2023 . . . . . **288**
Figure 3. Per capita transport greenhouse gas emissions in Asia, 2023 . . . . . **289**
Figure 4. Road casualties per 100,000 people in Asia, 2021 . . . . . **291**

Europe Regional Overview

Figure 1. Motorisation rates per 1,000 people in Europe, various years **307**
Figure 2. Per capita transport greenhouse gas emissions in Europe, 2023 . . . . . **308**
Figure 3. Hours of annual average traffic delays in major European cities, 2024 . . . . . **309**
Figure 4. Road casualties per 100,000 people in Europe, 2021 . . . . . **311**

Latin America and the Caribbean Regional Overview

Figure 1. Share of urban population with convenient access to public transport in Latin America and the Caribbean, various years (2020 to 2022) **326**
Figure 2. Motorisation rates per 1,000 people in Latin America and the Caribbean, 2016-2022 . . . . . **328**
Figure 3. Total electric buses in Latin America and the Caribbean, 2017-2025 . . . . . **330**
Figure 4. Per capita transport greenhouse gas emissions in Latin America and the Caribbean, 2023 . . . . . **331**
Figure 5. Road casualties per 100,000 people in Latin America and the Caribbean, 2021 . . . . . **333**

North America Regional Overview

Figure 1. Motorisation rates per 1,000 people in North America, 2022 . . . . . **349**
Figure 2. Shares of battery electric vehicles sold in Canada and the United States, 2024 . . . . . **350**
Figure 3. Per capita transport greenhouse gas emissions in North America, 2023 . . . . . **351**
Figure 4. Hours of annual average traffic delays in major North American cities, 2024 . . . . . **352**
Figure 5. Road casualties per 100,000 people in selected high-income countries, 2021 . . . . . **353**

Oceania Regional Overview

Figure 1. Share of urban population with convenient access to public transport in Oceania, 2020 . . . . . **368**
Figure 2. Motorisation rates per 1,000 people in Oceania, various years **370**
Figure 3. Per capita transport greenhouse gas emissions in Oceania, 2023 . . . . . **371**
Figure 4. Average annual hours of traffic delay in major Oceanic cities, 2024 . . . . . **372**
Figure 5. Road casualties per 100,000 people in Oceania, 2021 . . . . . **373**

Small Island Developing States Overview

Figure 1. Average access to public transport for urban population in SIDS, 2020 . . . . . **386**
Figure 2. Average motorisation rate (four-wheeled vehicles per 1,000 people) in SIDS, 2016-2022 . . . . . **387**
Figure 3. Liner Shipping Connectivity Index for selected SIDS, Q2 2020 to Q2 2025 . . . . . **387**
Figure 4. Per capita transport greenhouse gas emissions in SIDS, 2023 . . . . . **388**
Figure 5. Road casualties per 100,000 people in SIDS, 2021 . . . . . **389**
Figure 6. Physical infrastructure risk in SIDS, 2025 . . . . . **390**

MODULE 3 | 3.1

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Africa Regional Overview



THIS CHAPTER IS SUPPORTED BY
VREF

DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	Africa	Global
Population size (2023)	1,461 million	8,000 million
Population growth (2015-2023)	21.5%	8.5%
Urban population share (2023)	44.5%	57%
Urban population growth (2015-2023)	32.7%	16%
GDP per capita (2023)	USD 1,994 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	22%	22.8%
Share of women employed in transport and storage (2023)	6.5%	15.6%
Motorisation rate (2022)	51.2 vehicles per 1,000 people	218.7 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	31.5%	52%
Share of rural population with access to all-weather primary and secondary roads (2020)	31.3%	38%
Transport total GHG emissions (2023)	375 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	0.26 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 199 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport (2023)	0.15% (2021)	4.6%
Carbon intensity of electricity generation (2023)	430 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	3.2%	6%
Premature deaths attributable to air pollution by transport (2019)	1.0 per 100,000 people	2.3 per 100,000 people
Road casualties (2021)	18.8 per 100,000 people	15.0 per 100,000 people

Source: See endnote 1 for this section.



Cover Photo: Carlos Felipe Pardo
Photo: Carlos Felipe Pardo

KEY FINDINGS

Demand, use and access

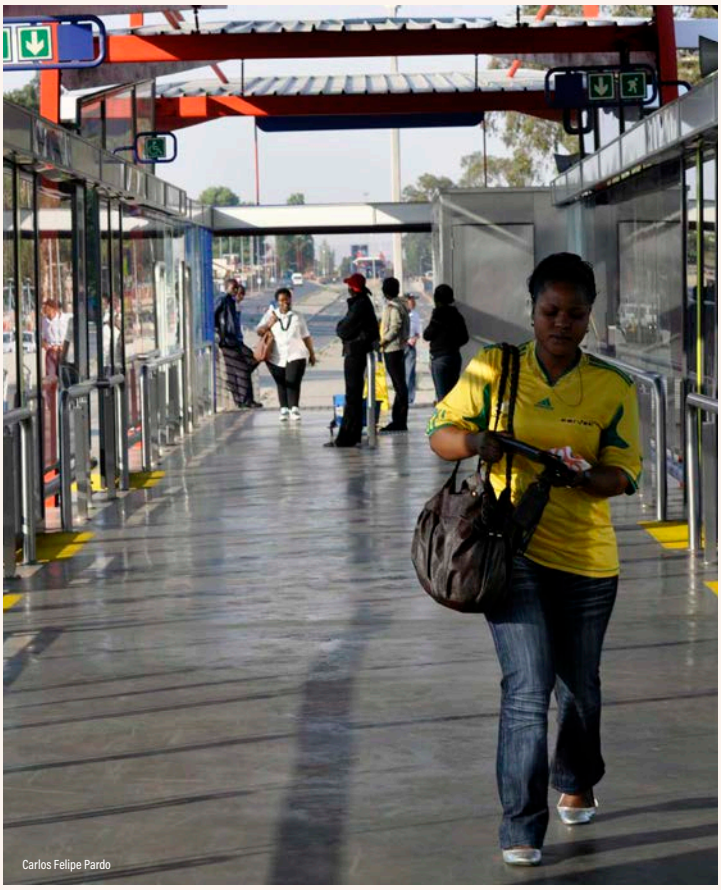
- Across Africa, demographic shifts such as rising populations and rapid urbanisation – as well as modest economic growth – have markedly expanded mobility needs and reshaped travel patterns, increasing the need for more efficient, inclusive, safer and sustainable transport.
- The transport sector is pivotal to the region's economic growth, development and regional integration, and its contribution to GDP remains significant, although it varies across countries.
- The transport sector employed an estimated 23 million people (around 5% of Africa's workforce) in 2023, with the bulk of these jobs concentrated in informal transport. While informal transport in the combination with walking and public transport moves 80 to 90% of commuters in many African cities, the sector faces safety issues, instability and personal security (especially for women).
- Although road transport remains the dominant mode of motorised transport in Africa, only around half of the region's roads were paved as of 2014.
- On average, only a third (31%) of Africa's rural population had access to all-weather roads in 2019, limiting people's access to basic services (such as education and health care) and constraining connectivity to economic opportunities.
- Progress in expanding and modernising road infrastructure has been uneven. Between 2004 and 2022, nearly 18,000 kilometres of climate-resilient regional highways were added along 25 road corridors, as well as 27 one-stop border stations. However, poor road maintenance due to underfunding and inefficient execution undermines the benefits of infrastructure investments and contributes to rapid deterioration.
- Investing in road infrastructure improvements is critical to reduce transport costs (which make up an estimated 40% of the final price of goods in Africa), speed the movement of goods and people, and improve overall transport efficiency. Yet Sub-Saharan Africa has been spending only around half of the estimated 7.1% of its GDP required annually to close its infrastructure gap by 2030.
- Freight transport has continued to expand in the region, with the volume of goods carried in Africa's freight forwarding market projected to reach 1.66 trillion tonne-kilometres in 2025. Container port traffic in the region grew 6.9% between 2015 and 2023, to 30.2 million twenty-foot equivalent units (TEU).
- Road freight transport carried up to 80% of total goods in Africa in 2014, placing significant pressure on the road network and reflecting the limited reach and capacity of the region's rail systems, as well as the high costs of air transport.



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KEY FINDINGS

- Even so, recent progress has been made in railway development across East and West Africa and in southern Africa.
- Road transport remains the main mode of transport for people in Africa, accounting for 90% of the region's passenger travel activity in 2014.
- Walking is by far the most common travel mode – either in itself or in combination with public transport – accounting for 50-90% of daily trips in many African cities as of 2021. Yet most African cities are not walkable.
- Despite the high modal share of collective transport in Africa, these systems have remained severely underdeveloped in many countries, often characterised by deep fragmentation, informal operations and weak regulatory oversight.
- Several African countries have made strides towards modernising and decarbonising public transport by introducing bus rapid transit (Senegal and Tanzania) and undertaking institutional reforms to strengthen governance (Kenya and Nigeria).
- In the absence of efficient, well-integrated public transport systems in many African cities, the region's rapidly expanding middle class has turned increasingly to private car ownership.


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- Africa's motorisation rate (covering four-wheeled motorised vehicles), at 51 vehicles per 1,000 people in 2022, remained well below the world average of 218 vehicles per 1,000 people. However, it is increasing rapidly, rising 34% between 2017 and 2022 due to rapid urbanisation and rising household incomes. More than three-quarters of the region's 72 million vehicles in use are concentrated in just 10 countries.
- More than 85% of vehicles in Africa in 2020 were used vehicles imported from Europe, the United States, and Japan, which typically fail safety and emission standards in their home countries.
- As of 2019, over 80% of the region's road vehicles fell below the Euro 4 vehicle emission standards while also lacking valid roadworthiness.
- Domestic motor vehicle production in Africa rebounded 16% (well above the global rate of 3%) in 2021, after slumping in the early years of the COVID-19 pandemic; however, the region represented only 1.2% of total global vehicle production in 2023.
- Vehicle production in Africa is concentrated in Algeria, Egypt, Morocco, and South Africa, while a handful of other countries – such as Angola, Ethiopia and Ghana – have vehicle assembly plants.
- The rise in motorcycle use across Africa underscores growing mobility needs for both personal and commercial use, as well as the continued challenges posed by inadequate and unreliable public transport.
- Electric vehicles had a very minor presence in Africa in 2024, with the region's 15,000 electric cars comprising only 0.05% of the total car fleet, and its 25,000 electric motorised two- and three-wheelers having only a 0.13% fleet share.
- The market for electric vehicles in Africa could reach USD 21.4 billion by 2027, driven by projected growth in the market for electric two- and three-wheelers from USD 3.65 billion in 2021 to USD 5.07 billion in 2027. Electric two- and three-wheelers could account for 50-70% of the region's total electric vehicle sales by 2040.
- Africa holds vast reserves of critical minerals essential for electric vehicle manufacturing and supporting the global energy transition.

KEY FINDINGS

Sustainability and climate trends

- In 2023, Africa was home to nearly one-fifth (18%) of the world's population, yet it contributed only 6.2% of global greenhouse gas emissions and 5.3% of global transport greenhouse gas emissions (excluding international aviation and shipping).
- The region's transport emissions grew 0.1% in 2023 to reach 375 million tonnes of CO_2 equivalent.
- Although Africa had the second lowest transport emissions among global regions in 2023 (after Oceania), they increased 10.3% between 2015 and 2023, the second highest growth rate after Asia (19%).
- The distribution of emissions across Africa is highly uneven, with the top four emitting countries – Nigeria, Egypt, South Africa and Algeria – responsible for more than half (56%) of the region's transport greenhouse gas emissions in 2023.
- Africa's per capita transport greenhouse gas emissions remained the lowest globally in 2023, at only 0.26 tonnes of CO_2 equivalent per person, well below the global average of 0.89 tonnes of CO_2 equivalent per person.
- In 2021, surface transport (road, rail and inland waterways) accounted for 98% of the region's transport greenhouse gas emissions.
- Africa's transport emissions relative to economic output fell 2.3% in 2023 to reach 1.29 tonnes of CO_2 equivalent per USD 10,000, but this was still the highest level among global regions.
- Reliance on private road transport has led to high levels of traffic congestion in many African cities.
- The average carbon intensity of electricity generation in Africa in 2023 was 430 grams of CO_2 equivalent per kilowatt-hour (kWh), close to the global average of 417 grams of CO_2 equivalent per kWh. Many of the African countries with high transport greenhouse gas emissions have very low shares of renewable energy in their total transport energy consumption, constraining a key benefit of transport electrification.
- Transport contributed 3.2% of the region's total air pollution in 2019, leading to 1.01 premature deaths per 100,000 people in 2019; this was well below the global average of 6% and 2.3 deaths per 100,000 people.
- Despite low motorisation, Africa experiences relatively high road fatality rates due to the gap in safe infrastructure – with an average of 18.8 casualties per 100,000 people in 2021 – making it home to the world's most dangerous roads. More than half of road traffic deaths in the region involve vulnerable road users such as pedestrians, cyclists and motorcyclists.
- Despite contributing the second least to global greenhouse gas emissions, Africa is among the most vulnerable regions to the impacts of climate change. The region loses an estimated USD 7-15 billion annually due to the devastating effects of climate change, a figure that could rise to USD 50 billion by 2030, representing up to 7% of Africa's GDP on average.



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KEY FINDINGS

Policy and investment developments



- Although Africa's shift to electric mobility has lagged, more governments have become aware of the detrimental impacts of fossil fuel-powered vehicles and have implemented policies and fiscal incentives to promote the uptake of electric vehicles.
- More African countries also joined global initiatives to phase out fossil fuel-powered vehicles.
- As of 25 May 2025, five African countries – Botswana, Lesotho, Kenya, Zambia and Zimbabwe – had submitted to the United Nations their third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement.
- Among Africa's second-generation NDCs (2019-2024), 11 countries (or 34% of the total submissions) included specific targets for reducing transport-related greenhouse gas emissions.
- As of 25 May 2025, 10 African countries (out of 76 total submissions) had submitted to the United Nations their LT-LEDS (Long-Term Low Emissions Development Strategies), indicating stronger national commitment to reducing transport greenhouse gas emissions, facilitating the shift to more sustainable modes and increasing alignment with the Paris Agreement.
- During the 2023-2024 period, five African countries – Burundi, Morocco, Mozambique, Zambia and Zimbabwe – submitted National Adaptation Plans (NAPs) to enhance their transport adaptation and resilience efforts.
- In 2023, fossil fuel subsidies in Africa totalled USD 199 per capita, the lowest level among regions and less than a fourth of the global average of USD 813 per capita. However, the region's fossil fuel subsidies are projected to increase around 45% between 2023 and 2030, further undermining climate and sustainability efforts.
- Renewables represented only 0.15% of Africa's total final energy consumption in transport in 2021. However, countries have made strides to harness the region's great potential for renewable energy.
- Developments in freight transport policy have advanced in the context of improving intra-Africa trade and operationalising the African Continental Free Trade Area (AfCFTA).
- More African countries have recognised the importance of enhancing walking, cycling and public transport for improved urban mobility.
- Several African countries have taken significant steps to address road safety challenges through a combination of policy and innovative, context-specific initiatives.
- The region faces a major gap in infrastructure investment, with average annual investment in 2022 totalling around USD 80 billion, well below the required USD 130 to 170 billion per year. Transport infrastructure alone requires USD 35 to 47 billion per year.

Context, challenges and opportunities

Africa's transport sector is central to achieving economic growth, social inclusion, and regional integration, yet it continues to face significant challenges due to limited infrastructure, weak governance and climate vulnerability. However, growing and promising advancements have been made in transport infrastructure development, institutional set-up, policy, and investment, as well as a continuing acknowledgement of the role of sustainable transport in regional development. Transport is a critical pillar of Africa's economy, supporting the mobility needs of 1.4 billion people and facilitating trade across a rapidly urbanising continent.[2]

In 2023, Africa contributed only 5.3% of global transport greenhouse gas emissions (excluding international aviation and shipping), mainly from fossil fuel-powered road transport.[3] Despite this modest contribution to global emissions, the region remains highly vulnerable to the adverse effects of climate change.[4]

Passenger transport in many parts of Africa is characterised by high levels of public and collective transport use, and walking. Studies indicate that walking is the primary mode of passenger transport, either in combination with public transport or as a main mode of transport.[5] In many African cities – such as Dakar (Senegal), Casablanca (Morocco), Dire Dawa (Ethiopia), Maputo (Mozambique) and Douala (Cameroon) – the combination of walking, public transport and informal transport (in some cases termed as paratransit or popular transport) moves up to more than 80% of commuters (in some cases up to 90%).[6] Although most public transport users are captive users in the region, this trend presents an opportunity to diverge from unsustainable car-centric transport development, by prioritising investment in clean and equitable transport systems.

This reality is not yet being leveraged. In 2020, only 31.5% of Africa's urban population on average had convenient access to public transport, compared to 52% globally.[7] To some extent, this highlights limited service provision across the region; however, the data also may not fully cover informal public transport services (along non-fixed routes and stops) due to nascent mapping efforts. Investment in high-quality walking and cycling infrastructure has lagged, and pedestrians constitute a large share of road fatalities. Less than 10% of roads in Sub-Saharan Africa have pedestrian facilities (such as sidewalks and footbridges).[8]

The region's demand for freight transport is expected to surge, with the forthcoming African Continental Free Trade Agreement (AfCFTA) projected to increase intra-Africa trade up to 28%, and demand for maritime freight 62%, by 2030.[9] Maritime transport is the region's main facilitator of international trade, whereas road transport dominates freight transport within Africa, due to limited railway infrastructure.[10] Port infrastructure was seen as "below average" quality from 2007 to 2017.[11]

Although data on Africa's freight transport activity are limited, maritime transport data indicate a 6.9% increase in container port traffic between 2015 and 2023.[12] This trend, alongside broader increases in intra-African trade flows, suggests a rising need to scale up sustainable freight transport solutions. Doing so will be critical not only for supporting economic growth, but also for mitigating the negative environmental and social impacts of rising transport activity. However, sustainable freight transport solutions/interventions are stifled by challenges such as diverse geographical landscapes, varying levels of economic development, and a mix of formal and informal activity within the sector.[13]

The increasing number and intensity of extreme weather events and related fatalities in Africa since 2023 points to the need to improve resilience and adaptation to climate change. Transforming transport infrastructure – across road, rail, maritime and air – to minimise damages and losses is critical. Severe flooding in Mozambique has destroyed roads and bridges; storms in Nigeria threaten to erode port infrastructure; and rail networks in Zambia and Tanzania have suffered disruptions from washouts and landslides.[14] Such events highlight the urgent need for climate-resilient infrastructure across all modes, although a lack of access to climate finance hampers these developments.

Critically, Africa faces governance and institutional capacity challenges, including staffing shortages, technical expertise gaps and lack of political will. The governance structure for providing urban mobility services in many African countries, especially in highly informal environments, is characterised by overlapping mandates and poor interagency co-ordination, which lead to duplicated efforts that hinder effective transport planning.[15]

Demand, use and access

Across Africa, demographic shifts such as rising populations and rapid urbanisation – as well as modest economic growth – have markedly expanded mobility needs and reshaped travel patterns, increasing the need for more efficient, inclusive, safer and sustainable transport. Between 2015 and 2023, the region's population grew 21.5%, to 1.46 billion people.[16] This rapid growth was accompanied by a surge in urbanisation, with the share of people living in the region's cities growing 32.7% over this period.[17] Africa's urban population share was around 44.5% in 2023 and could reach 65% by 2050.[18] Meanwhile, the region's gross domestic product (GDP) grew 3.1% on average between 2011 and 2020,



outpacing the global average of 2.4%.[19] In 2023, it grew 3.2%, above the global average of 2.8%.[20]

The transport sector is pivotal to the region's economic growth, development and regional integration, and its contribution to GDP remains significant, although it varies across countries. In South Africa, the transport sector contributed 6.5% of GDP in 2022, in Kenya it contributed 8.1% of GDP in the first quarter of 2022, and in Côte d'Ivoire it accounted for 9.3% of GDP in 2019.[21]

The transport sector employed an estimated 23 million people (around 5% of Africa's workforce) in 2023, with the bulk of these jobs concentrated in informal transport. While informal transport in the combination with walking and public transport moves 80 to 90% of commuters in many African cities, the sector faces safety issues, instability and personal security (especially for women). [22] Women accounted for only 6.5% of employment in the region's transport and storage sector in 2023, down from 8.2% in 2015.[23] Labour impact assessments across African countries indicate that while informal transport workers support the provision of opportunities for work, the sector faces many challenges including insecure and precarious work with little to no social protection, extreme working hours, high levels of crime, poor working environments, and widespread discrimination and sexual harassment against women.[24]

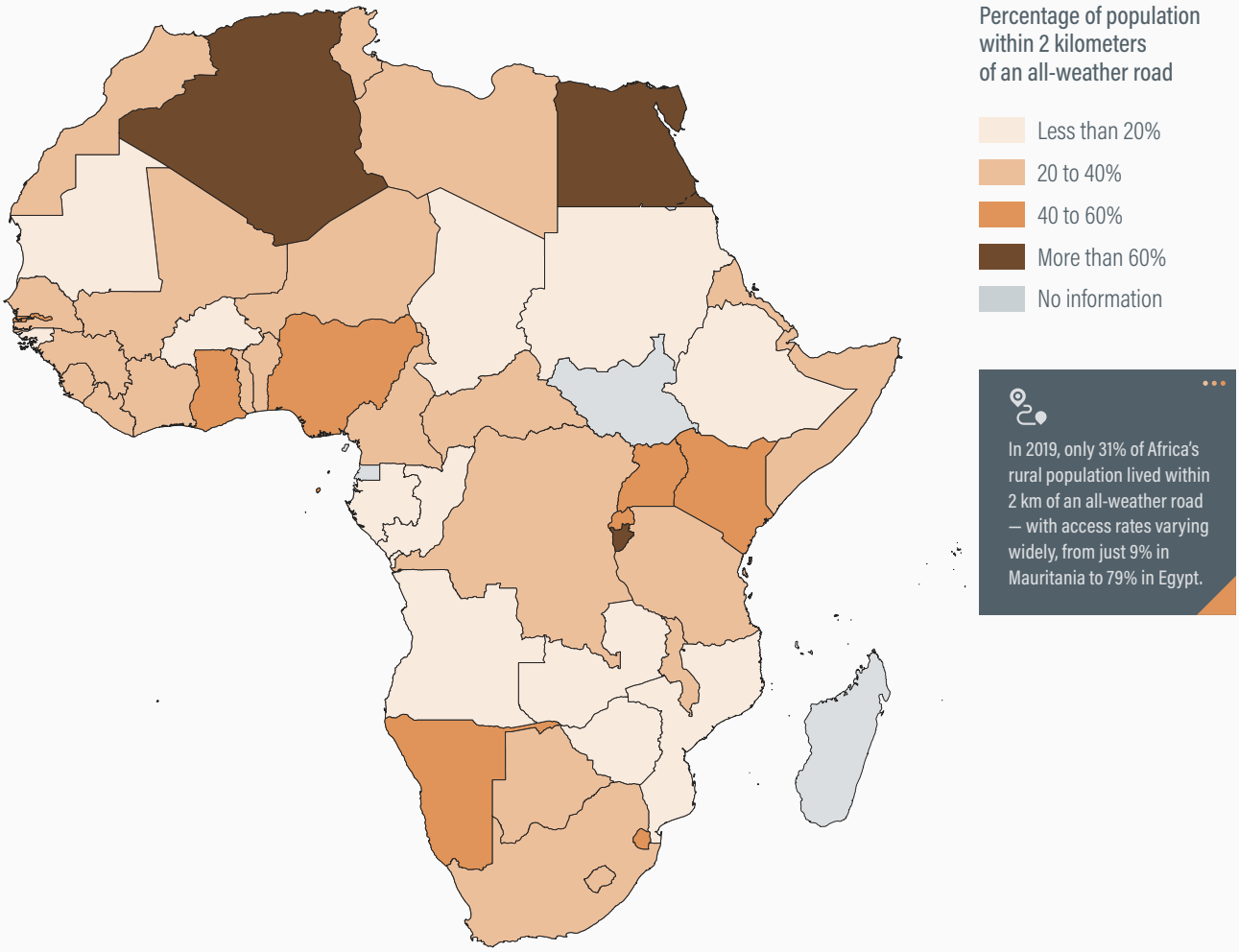
- In Zambia, the transport sector contributed 5.3% of total employment in 2022; the vast majority (95%) of transport workers were male, and nearly three-quarters worked in the informal economy.[25]
- In Kampala (Uganda), paratransit services employed an estimated 100,000 people in 2021, and in Lagos (Nigeria) the figure was as high as 500,000 in 2021.[26] Paratransit services, in the context of Sub-Saharan Africa, are characterised by different levels of business formality, competition regulation, and service planning. Whereas business formality ranges from informal to formal registered businesses, their level of competition regulation typically ranges from unregulated open markets to some level of regulation, and service planning ranges between flexible routes and service frequencies and fixed routes and schedules/headways.[27]

To address the gender imbalance in transport employment, the World Bank recommends adopting targets for women's participation in technical and managerial roles in the sector and monitoring progress; addressing legislative barriers and gaps that hinder women's employment and progression in the sector; and strengthening recruitment processes to eliminate gender bias.[28]

Overall, challenges limiting the efficiency and competitiveness of Africa's transport sector include poor inland road quality, inefficient port and border operations, inadequate rail capacity, limited multi-modal infrastructure, political and security instability, and slow technology innovation and adoption.[29]

Although road transport remains the dominant mode of motorised transport in Africa, only around half of the region's roads were paved as of 2014.[30] On average, only a third (31%) of Africa's rural population had access to

FIGURE 1. Access to all-weather roads in Africa, 2019



Source: See endnote 32 for this section.

all-weather roads in 2019, limiting people's access to basic services (such as education and health care) and constraining connectivity to economic opportunities.[31] Access to regional road networks is uneven, with the share of the rural population having access to an all-weather road in 2019 ranging from as low as 9% in Mauritania and 11% in Sudan, to 65% in Burundi, 73% in Algeria and 79% in Egypt (Figure 1).[32]

Progress in expanding and modernising road infrastructure has been uneven. Between 2004 and 2022, nearly 18,000 kilometres of climate-resilient regional highways were added along 25 road corridors, as well as 27 one-stop border stations, with support from the African Development Bank.[33] **However, poor road maintenance due to underfunding and inefficient execution undermines the benefits of infrastructure investments and contributes to rapid deterioration.** In many countries, the road network suffers from vehicle overloading, causing surfaces to prematurely degrade and resulting in reduced construction life span and high maintenance cost.[34]

Investing in road infrastructure improvements is critical to reduce transport costs (which make up an estimated 40% of the final price of goods in Africa), speed the movement of goods and people, and improve overall transport efficiency.[35] **Yet Sub-Saharan Africa has been spending only around half of the estimated 7.1% of its GDP required annually to close its infrastructure gap by 2030.**[36]

Freight transport has continued to expand in the region, with the volume of goods carried in Africa's freight

forwarding market projected to reach 1.66 trillion tonne-kilometres in 2025.[37] **Container port traffic in the region grew 6.9% between 2015 and 2023, to 30.2 million twenty-foot equivalent units (TEU).**[38] However, it fell by 3.6 million TEU in 2023, possibly due to global supply chain disruptions and to the effects of attacks on commercial vessels in the Red Sea, which resulted in longer travel times from rerouting, port inefficiencies, higher transport and insurance costs, and delayed deliveries.[39] Overall, freight transport is a critical driver of African trade, regional integration and economic growth.

Road freight transport carried up to 80% of total goods in Africa in 2014, placing significant pressure on the road network and reflecting the limited reach and capacity of the region's rail systems, as well as the high costs of air transport.[40] Road transport continued to dominate in Africa even though transporting freight by rail tends to be cheaper, faster and safer.[41]

- As of 2020, 85% of all freight (except phosphate) in Morocco was transported by road.[42]
- Road freight accounted for around 80% of freight transport in Nigeria in 2011.[43]
- In 2022, South Africa's road freight sector moved 8.4 million tonnes of goods, more than five times the amount transported by rail (1.55 million tonnes).[44]

Even so, recent progress has been made in railway development across East and West Africa and in southern Africa.

- Tanzania's electric Standard Gauge Railway, spanning over 2,500 kilometres, is expected to be operational in 2025 and provides a rail freight transport option for several East African countries, connecting key Tanzanian ports (from Dar es Salaam on the Indian Ocean to Mwanza on Lake Victoria) as well as Burundi, the Democratic Republic of the Congo (DRC) and Rwanda.[45]
- In West Africa, the 393-kilometre Kano-Maradi single-track rail line between Kano (Nigeria) and Maradi (Niger) is planned to be completed in 2025, with a capacity to transport 9,300 passengers and 3,000 tonnes of freight per day.[46]
- In southern Africa, construction has begun on the Trans-Kalahari Railway connecting Walvis Bay (Namibia) to Gaborone (Botswana), with the aim of improving trade and providing better access to global markets for the landlocked countries of Botswana, Malawi, Zambia and Zimbabwe.[47]
- In 2024, feasibility studies confirmed the viability of the Ethiopia-Sudan Rail project, providing a level of bankability for the construction of 1,522 kilometres of rail connecting Addis Ababa to Port Sudan on the Red Sea.[48]

Road transport remains the main mode of transport for people in Africa, accounting for 90% of the region's passenger travel activity in 2014.[49] **Walking is by far the most common travel mode – either in itself or in combination with public transport – accounting for 50-90% of daily trips in many African cities as of 2021.**[50] **Yet most African cities are not walkable.** Most of the region's walkers are low-income residents, especially women, who cannot afford bus fares and struggle to access services. Although many governments have invested in infrastructure for vehicles, they often have not adhered to basic design standards for pedestrian infrastructure, with walkers having to navigate crude or non-existent footpaths, steep routes, potholes, open electrical wires and abandoned construction material.[51]

- In Tshwane (South Africa), nearly 65% of commuters walked or used public transport in 2015, compared to private car use of 33.1%.[52]
- A 2021 study in Kampala (Uganda) found that 50% of workers walk to and from the city, while nearly 90% of commuters either use public transport or walk for their daily commute.[53]

Despite the high modal share of collective transport in Africa, these systems have remained severely underdeveloped in many countries, often characterised by deep fragmentation, informal operations and weak regulatory oversight.[54] Collective transport in the region includes buses, shared minibus taxis (typically 13-25-seater vans), two- and three-wheeler motorcycle taxis, and rail. These services often operate without formal schedules or fixed routes, resulting in a highly fragmented network that varies in quality and reliability. In most cities, minibuses run by numerous private players dominate the landscape, operating in a largely un-co-ordinated manner that undermines efficiency and reliability. Many of the vehicles are second-hand imports, which are often poorly maintained and fuel-inefficient, contributing to both congestion and air pollution.

Several African countries have made strides towards modernising and decarbonising public transport by introducing bus rapid transit (Senegal and Tanzania) and undertaking institutional reforms to strengthen governance (Kenya and Nigeria).[55] Although informal systems dominate, some large metropolitan areas have set up more formal public transport systems (such as the Nairobi Metropolitan Area Transport Authority (NAMATA) and the Lagos Metropolitan Area Transport Authority (LAMATA)), in a shift towards more modern, inclusive systems.

- In January 2025, Morocco announced a USD 10.7 billion investment in high-speed rail and public transport, including USD 9.6 billion to expand the national rail network and USD 1.1 billion to improve urban transport by

adding 3,746 new buses across 37 cities.[56]

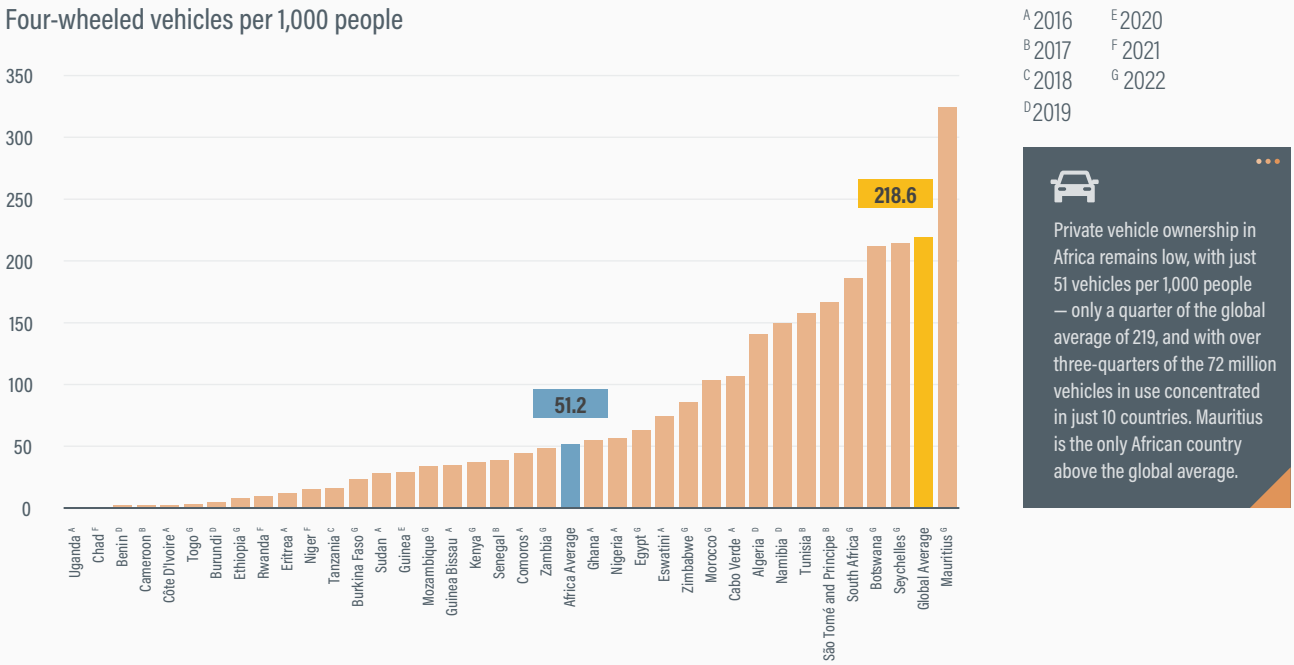
- Nigeria launched Sub-Saharan Africa's first metro system in 2023.[57] Implemented through the Lagos Area Metropolitan Area Transport Authority, the Lagos Rail Mass Transit (LRMT) is improving urban transport through its operational blue and red lines and a 37-kilometre green line, which is starting construction in 2025 at a cost of USD 3 billion.[58]
- A bus rapid transit project in Dar es Salaam (Tanzania), launched in 2016 and being implemented incrementally, has improved the city's quality of life by reducing travel time, private car use, and urban congestion, while providing affordable, inclusive and safe travel for more than 8 million residents.[59] The project will avoid the release of an estimated 70,000 tonnes of CO_2 equivalent transport emissions annually on average over 30 years.[60]
- In 2023, Dakar (Senegal) launched West Africa's first fully electric bus rapid transit system, which operates 121 articulated electric buses, each with a range of 250 kilometres, along an 18.3-kilometre dedicated corridor with 23 stations across 14 city districts.[61] The system is co-financed by the World Bank, the European Investment Bank, and the Green Climate Fund, and is designed to carry up to 300,000 passengers daily, cut commuting times by half and reduce emissions.[62]
- Additional African cities that are piloting electric buses to reduce operating costs and environmental impact include Cape Town (South Africa), Kigali (Rwanda), Lagos (Nigeria), and Nairobi (Kenya), under operators like BasiGo and Roam.[63]
- The government of Rwanda has provided incentives for electric bus operators and for local assembly of electric vehicles.[64]

In the absence of efficient, well-integrated public transport systems in many African cities, the region's rapidly expanding middle class has turned increasingly to private car ownership. Urban sprawl has left many communities underserved by public transport, leading those who can afford it to rely on private vehicles as a more accessible means of travel.[65] Although vehicle ownership in Africa remains below the global average, its growth rate is among the world's fastest, and the vehicle market is rife with polluting second-hand imports.[66] This trend is reinforcing car-centric transport planning, worsening inequalities for the majority share of the population that depends on walking, cycling and public transport. There is a critical need to decouple the region's rising motorisation rate and car-centric planning and to favour plans for more sustainable transport.

Africa's motorisation rate (covering four-wheeled motorised vehicles), at 51 vehicles per 1,000 people in 2022, remained well below the world average of 218 vehicles per 1,000 people (Figure 2).[67] **However, it is increasing rapidly, rising 34% between 2017 and 2022 due to rapid urbanisation and rising household incomes.**[68] **More than three-quarters of the region's 72 million vehicles in use are concentrated in just 10 countries.**[69] African countries with the highest motorisation rates include Mauritius (324 vehicles per 1,000 people), Seychelles (214), Botswana (212) and South Africa (186).[70]



FIGURE 2. Motorisation rates per 1,000 people in Africa, various years



Private vehicle ownership in Africa remains low, with just 51 vehicles per 1,000 people — only a quarter of the global average of 219, and with over three-quarters of the 72 million vehicles in use concentrated in just 10 countries. Mauritius is the only African country above the global average.

Source: See endnote 67 for this section.

More than 85% of vehicles in Africa in 2020 were used vehicles imported from Europe, the United States, and Japan, which typically fail safety and emission standards in their home countries.[71] **As of 2019, over 80% of the region's road vehicles fell below the Euro 4 vehicle emission standards while also lacking valid roadworthiness.**[72] In 2022, more than 750,000 used light-duty vehicles were imported to Africa, many of them old, unsafe and polluting vehicles.[73]

Domestic motor vehicle production in Africa rebounded 16% (well above the global rate of 3%) in 2021, after slumping in the early years of the COVID-19 pandemic; however, the region represented only 1.2% of total global vehicle production in 2023.[74] **Vehicle production in Africa is concentrated in Algeria, Egypt, Morocco, and South Africa, while a handful of other countries – such as Angola, Ethiopia and Ghana – have vehicle assembly plants.**[75] The reliance on used vehicle imports has hampered the development of a robust African automotive industry, particularly for the production and assembly of light-duty, four-wheeled motorised vehicles.

The rise in motorcycle use across Africa underscores growing mobility needs for both personal and commercial use, as well as the continued challenges posed by inadequate and unreliable public transport.

- As of mid-2022, an estimated 27 million motorcycles were in use across Sub-Saharan Africa, up from only 5 million in 2010, with projections for 9.5% annual growth through 2030.[76]
- Household survey data from 2010 to 2022 found that West Africa led in motorcycle ownership, with the highest rates in Mali (64%), Burkina Faso (63%), and Benin (56%), followed distantly by East Africa with its highest rates in Kenya (14%), Tanzania (12%) and Mozambique (10%).[77]

Electric vehicles had a very minor presence in Africa in 2024, with the region's 15,000 electric cars comprising only 0.05% of the total car fleet, and its 25,000 electric motorised two- and three-wheelers having only a 0.13% fleet share.[78] As of 2024, Tanzania had the largest electric vehicle fleet in East Africa, with more than 10,000 units in use; more than 90% of these were two- and three-wheelers, reflecting their dominance in the country's electrification landscape.[79]

The market for electric vehicles in Africa could reach USD 21.4 billion by 2027, driven by projected growth in the market for electric two- and three-wheelers from USD 3.65 billion in 2021 to USD 5.07 billion in 2027.[80] **Electric two- and three-wheelers could account for 50-70% of the region's total electric vehicle sales by 2040.**[81] Most electric vehicle businesses in Africa have focused on two- and three-

wheelers, although there is growing interest in electrifying buses for public transport in countries like Egypt, Kenya, Senegal and South Africa.[82]

Africa holds vast reserves of critical minerals essential for electric vehicle manufacturing and supporting the global energy transition. For example in 2019, the DRC was responsible for 70% of global production of cobalt.[83] These sources, if harnessed with sustainable practices and industrial policy, could create regional value chains in battery production and electric vehicle assembly.

Overall, Africa's transport sector can benefit from addressing the significant challenges of limited infrastructure, weak governance and climate vulnerability.

Sustainability and climate trends

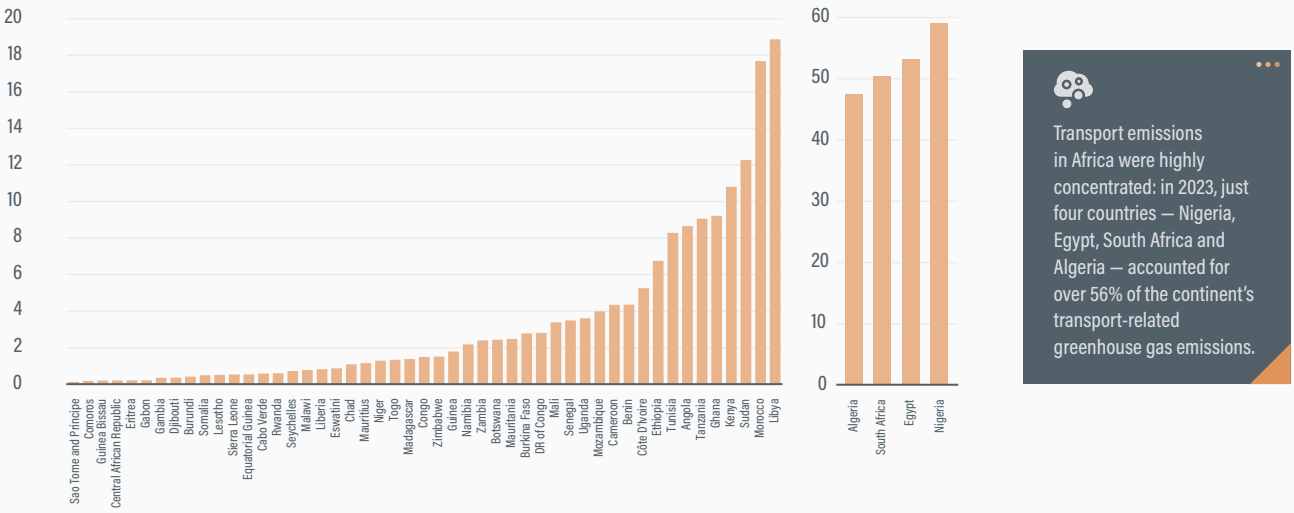
In 2023, Africa was home to nearly one-fifth (18%) of the world's population, yet it contributed only 6.2% of global greenhouse gas emissions and 5.3% of global transport greenhouse gas emissions (excluding international aviation and shipping).[84] The region's transport emissions grew 0.1% in 2023 to reach 375 million tonnes of CO_2 equivalent.[85] Although Africa had the second lowest transport emissions among global regions in 2023 (after Oceania), they increased 10.3% between 2015 and 2023, the second highest growth rate after Asia (19%).[86] In East Africa and South Africa, rising emissions were driven mainly by population growth and economic growth.[87]

The distribution of emissions across Africa is highly uneven, with the top four emitting countries - Nigeria, Egypt, South Africa and Algeria - responsible for more than half (56%) of the region's transport greenhouse gas emissions in 2023 (Figure 3).[88] Transport was the second largest greenhouse gas emitting sector in Algeria in 2023, and the largest sector in countries like Cabo Verde, Comoros, São Tomé and Príncipe, and Seychelles.[89]

Africa's per capita transport greenhouse gas emissions remained the lowest globally in 2023, at only 0.26 tonnes of CO_2 equivalent per person, well below the global average of 0.89 tonnes of CO_2 equivalent per person (Figure 4).[90] The distribution of per capita transport emissions ranged from only 0.027 tonnes in Djibouti to 5.69 tonnes in Seychelles, a country with high transport demand driven by tourism, particularly from long-haul flights arriving from Europe and beyond.[91]

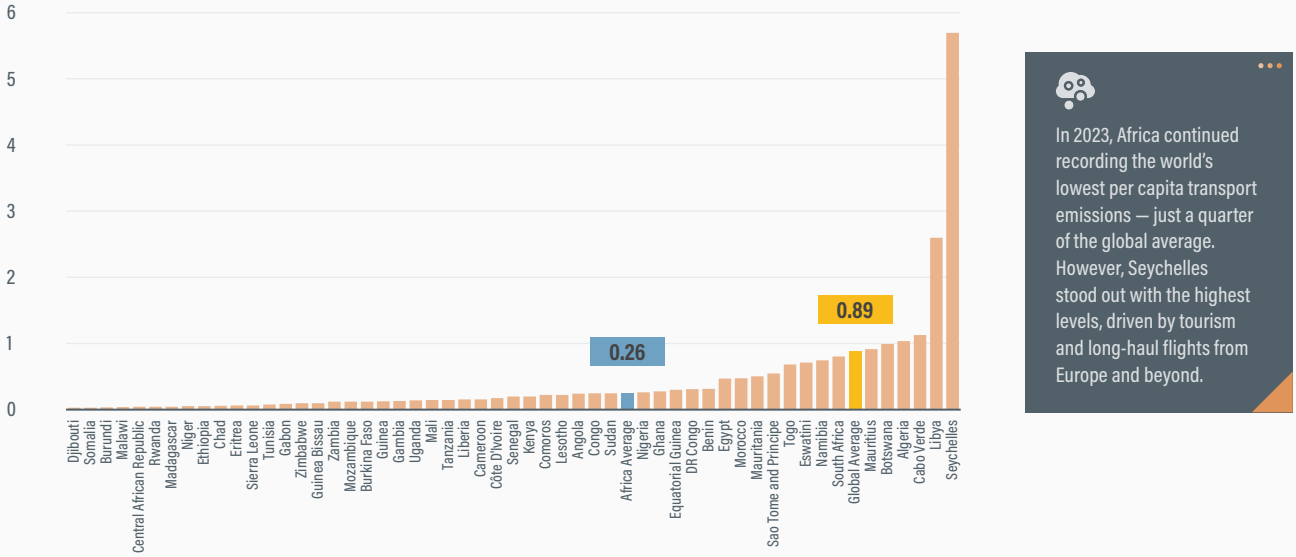
In 2021, surface transport (road, rail and inland waterways) accounted for 97% of transport greenhouse gas emissions in Sub-Saharan Africa.[92] Increases in road transport emissions were driven by dependence on fossil fuels; reliance on used

FIGURE 3. Transport greenhouse gas emissions in Africa, 2023



Source: See endnote 88 for this section.

FIGURE 4. Per capita transport greenhouse gas emissions in Africa, 2023



In 2023, Africa continued recording the world's lowest per capita transport emissions — just a quarter of the global average. However, Seychelles stood out with the highest levels, driven by tourism and long-haul flights from Europe and beyond.

Source: See endnote 90 for this section.

vehicle imports that are older, less fuel-efficient and unsafe; and a lack of efficient public transport systems.[93]

Africa's transport emissions relative to economic output fell 2.3% in 2023 to reach 1.29 tonnes of CO_2 equivalent per USD 10,000, but this was still the highest level among global regions.[94] The most likely reason for the decline was that economic growth outpaced the growth in transport emissions.

Reliance on private road transport has led to high levels of traffic congestion in many African cities.

- In the Greater Kampala Metropolitan Area (Uganda), the estimated daily cost of congestion was USD 1.5 million in 2020, or 4.2% of the area's GDP.[95]
- A 2023 study found that workers in Lagos (Nigeria) spent on average 2.2 hours on their daily commute, costing the city USD 2,500 million (NGN 4 trillion) per year.[96]
- Cape Town (South Africa) ranked among the world's top 10 most congested cities in 2024, with more than 94 hours of traffic delay annually, based on a dataset that includes only cities in South Africa.[97]

The average carbon intensity of electricity generation in Africa in 2023 was 430 grams of CO_2 equivalent per kilowatt-hour (kWh), close to the global average of 417 grams of CO_2 equivalent per kWh.[98] **Many of the African countries with high transport greenhouse gas emissions have very low shares of renewable energy in their total transport energy consumption, constraining a key benefit of transport electrification.**[99] In Algeria, renewable energy accounted for 1.1% of total transport energy consumption in 2022.[100] The region's high transport emitters had low shares of renewable energy consumption in the transport sector

Transport contributed 3.2% of the region's total air pollution in 2019, leading to 1.01 premature deaths per 100,000 people in 2019; this was well below the global average of 6% and 2.3 deaths per 100,000 people.[101] However, these values vary greatly by country.[102]

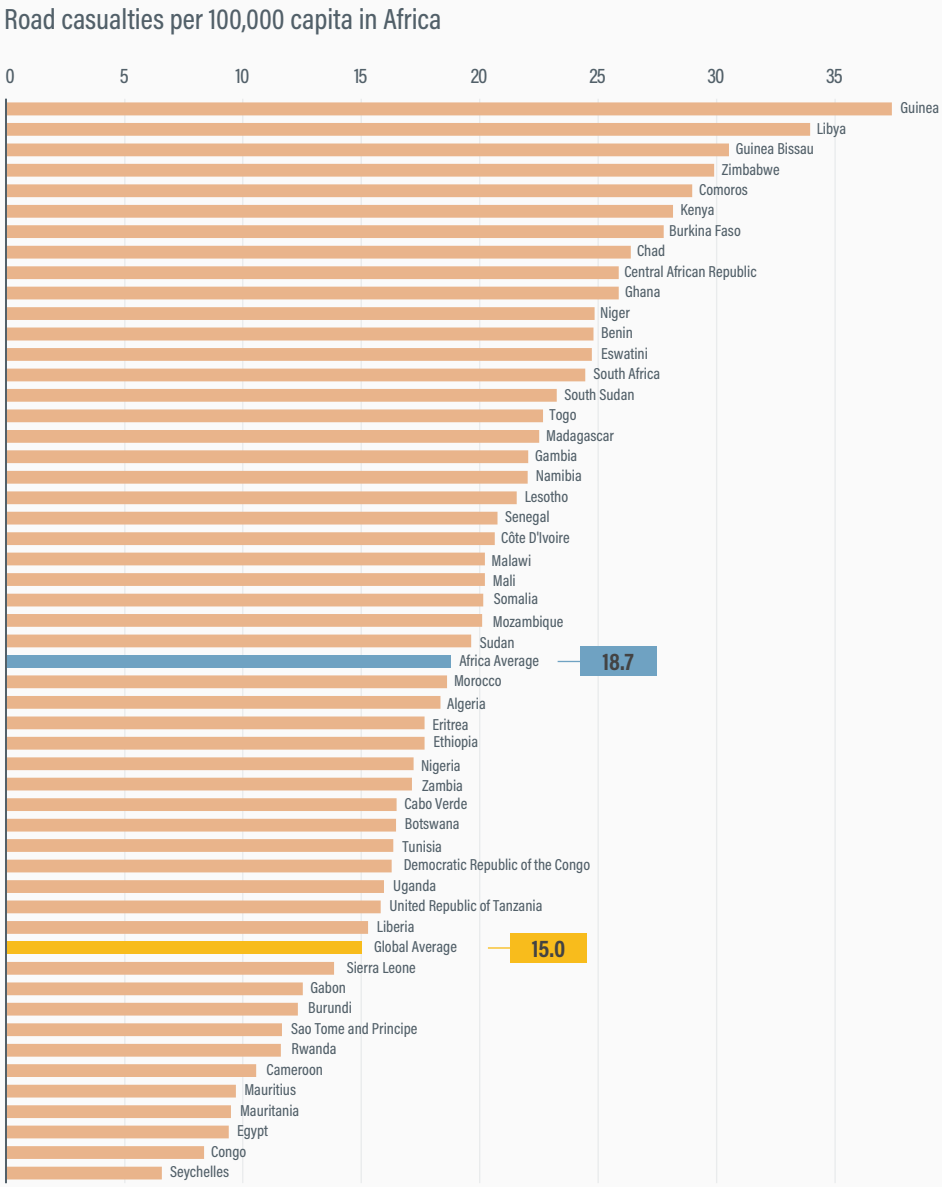
- Transport's contribution to air pollution ranged from 0.4% in Cabo Verde to 18% in Algeria, where air pollution led to an estimated 8.84 premature deaths per 100,000 people in 2019.[103] This was almost four times the global average and is attributed to the exponential rise in motorisation rates and an ageing vehicle fleet, among other factors.[104]
- In 2024, Benin, Egypt, Mali, the Republic of Congo and Somalia reported very high sulphur levels in their fuels (exceeding 5,000 parts per million), which contributes to air pollution.[105]

Despite low motorisation, Africa experiences relatively high

road fatality rates due to the gap in safe infrastructure – with an average of 18.8 casualties per 100,000 people in 2021 (Figure 5) – **making it home to the world's most dangerous roads.**[106] **More than half of road traffic deaths in the region involve vulnerable road users such as pedestrians, cyclists and motorcyclists.**[107] Across Africa, sub-standard reporting on road traffic fatalities has undermined efforts to effectively monitor road safety and to implement evidence-backed interventions.[108] In 2021, less than 20% of assessed roads in Africa met recommended three-star or better safety standards for pedestrians and cyclists, while the rate was below 30% for motorcyclists and below 40% for vehicle occupants.[109] Stronger regulation and investments in cleaner, safer two-wheelers are needed to address the significant public health concerns associated with motorcycles, particularly air pollution and the high risk of road crashes.

Despite contributing the second least to global greenhouse gas emissions, Africa is among the most vulnerable regions to the impacts of climate change.[110] **The region loses an**

FIGURE 5. Road casualties per 100,000 people in Africa, 2021



Most African countries have road fatality rates above the global average, making Africa home to the world's most dangerous roads.

Source: See endnote 106 for this section.

estimated USD 7-15 billion annually due to the devastating effects of climate change, a figure that could rise to USD 50 billion by 2030, representing up to 7% of Africa's GDP on average.[111] The region has experienced increasing numbers and intensities of extreme weather events, with record fatalities due to rising temperatures, persistent drought, catastrophic flooding and destructive cyclones. In addition to the toll on livelihoods, these impacts are reversing economic gains and increasing the risk of more people slipping into extreme poverty.[112]

- Most African countries lose between 2% and 5% of their GDP every year due to climate change and must adjust up to 9% of their national budgets to respond to extreme weather events.[113]
- In February 2025, heavy summer rainfall and storms in South Africa's KwazaNatal Province claimed 22 lives and caused an estimated USD 166 million (SAR 3.1 billion) in damages, including to transport infrastructure and assets.[114]
- Mozambique's National Adaptation Plan from 2023 highlights that since 2019, weather-related events had destroyed 7,627 bridges and 32,9334 school infrastructures, and compromised around 47,774 kilometres of road.[115]

Policy and investment developments

The need for greener, more equitable, healthier and safer mobility systems in Africa has become increasingly urgent. The combined impacts of climate change, public health crises and heightened geopolitical tensions have underscored the importance of transforming transport in the region. Many African governments have recognised the need to transform transport systems to support envisioned economic growth. This is reinforced by global and regional frameworks, including the United Nations' 2030 Agenda for Sustainable Development, which notes the importance of sustainable transport in achieving the Sustainable Development Goals (SDGs), and the African Union's Agenda 2063, which points to the role of efficient transport in Africa's transformation to a global powerhouse.[116]

Although Africa's shift to electric mobility has lagged, more governments have become aware of the detrimental impacts of fossil fuel-powered vehicles and have implemented policies and fiscal incentives to promote the uptake of electric vehicles.[117]

- In Zambia, the government removed customs duties on electric vehicles, electric buses, and trucks, as well as on charging systems and accessories for electric vehicles or cycles, with the aim of encouraging clean energy use and reducing fossil fuels.[118]
- To address the high costs of imported petrol and diesel, Ethiopia announced a ban in 2024 on imports of internal combustion engine vehicles, becoming the first country in the world to prohibit imports of fossil fuel vehicles; only electric-powered vehicles were to be allowed into the country as of January 2024.[119]
- Ghana removed import duties on electric vehicles and their components in 2024 and launched a National Electric Vehicle Policy in 2023.[120]
- Rwanda has one of Africa's most extensive strategies to support electric vehicle adoption, providing exemptions on value-added tax (VAT) and import duties for electric vehicles, spare parts, and charging equipment; a preferential corporate income tax rate for investors in the electric vehicle market; and reduced electricity tariffs for electric vehicles and charging stations.[121]

More African countries also joined global initiatives to phase out fossil fuel-powered vehicles.

- In 2024, Nigeria joined the Accelerating to Zero Coalition, a global initiative aiming for all sales of new cars and vans to be zero-emission by 2040; Ghana, Kenya, Morocco and Rwanda have been signatories since 2021.[122]
- Ghana and Cabo Verde joined the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles in 2023, followed by Ethiopia, Mozambique and Seychelles in 2024.[123] The initiative commits signatories to achieving 100% zero-emission new truck and bus sales by 2040, with an interim target of 30% by 2030.[124]

As of 25 May 2025, five African countries – Botswana, Lesotho, Kenya, Zambia and Zimbabwe – had submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their third generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement.[125] Botswana's was the only submission from Africa with a target for reducing transport greenhouse gas emissions.

- Botswana's NDC of 2024 aims to reduce transport emissions by 0.429 million tonnes of CO_2 equivalent by 2030 (of which 0.147 million tonnes of CO_2 equivalent are conditional).[126]
- Lesotho's NDC of 2024 sets out to increase the share of public passenger transport from 10% to 30%, develop new cycling lanes and reduce the number of poor-performing vehicle imports through regulations on used car imports. It features strong content on adaptation and resilience, including detailed targets, measures, and their respective



Carlos Felipe Pardo

mitigation benefits and alignment with the Sustainable Development Goals (SDGs).[127]

- Zambia's new NDC does not include any transport mitigation or adaptation actions or targets, whereas Zimbabwe's halts all of the transport actions that were included in the country's previous NDC, including biofuel support measures and improvements to vehicles and public transport.[128]
- As of 25 May 2025, the third-generation NDC submissions from Africa (with the exception of Lesotho's) failed to identify actions for walking and cycling, despite high use of these modes by African populations, particularly vulnerable groups.[129]
- Africa's third-generation NDCs as of May 2025 missed an opportunity to acknowledge the potential for informal transport to contribute to climate change mitigation and adaptation – an approach that can be leveraged to attract more funding to improve and modernise this sub-sector.[130]

Among Africa's second-generation NDCs (2019-2024), 11 countries (or 34% of those with transport-related greenhouse gas mitigation targets in their second-generation NDCs) included explicit targets for reducing transport-related greenhouse gas emissions.[131] The 11 countries were Burkina Faso, Egypt, Gambia, Guinea, Liberia, Mauritania, Mauritius, Seychelles, South Sudan, Sudan and Uganda.

For the latest analysis of transport commitments in NDCs, including those expected ahead of COP30, see the NDC Transport Tracker by GIZ and SLOCAT*, a database on ambition, targets and policies in NDCs and Long-Term Strategies.*[132]

As of 25 May 2025, 10 African countries (out of 76 total submissions) had submitted to the United Nations their LT-LEDS (Long-Term Low Emissions Development Strategies), indicating stronger national commitment to reducing transport greenhouse gas emissions, facilitating the shift to more sustainable modes and increasing alignment with the Paris Agreement.[133] LT-LEDS complement NDCs and reflect countries' strategies to 2050 and beyond. More African countries have integrated low-emission growth strategies into their national development plans, recognising the need to foster economic development alongside efforts to address climate change.

- Burkina Faso's LT-LEDS of 2025 aims to reduce transport emissions 41.1% compared to business as usual by 2050 through investments in rail infrastructure (with an aim to transport 40-80% of traded goods by rail), public transport use and transit-oriented development in cities.[134]
- Ethiopia's LT-LEDS of 2023 promotes the electrification of the vehicle fleet (including by introducing electric buses and scaling up charging infrastructure), the expansion of mass transit and non-motorised transport, and

improvements in fuel efficiency, including a ban on used vehicle imports by 2030 – underscoring the benefits for climate resilience and sustainable urban development.[135]

- Equatorial Guinea's LT-LEDS of 2024 envisions improving the efficiency of road, air and sea transport; substituting zero-emission vehicles; strengthening public transport; and promoting walking and cycling by 2050.[136] In line with its NDC, the country's Long-Term Vision suggests transport measures including a carbon pricing market, a robust urban and intra-urban public transport network (mostly zero-emission buses) by 2050 and a 50% drop in private vehicle use.[137]
- Nigeria's LT-LEDS of 2024 outlines a clear strategy for decarbonising the transport sector, including through wide adoption of electric and ethanol vehicles (alongside massive deployment of clean natural gas and liquefied petroleum gas vehicles) by 2060, a shift to low-carbon modes, adoption of Euro 4 efficiency standards for all road vehicles by 2030 and the use of smart transport management technologies.[138] The strategy does not outline specific transport adaptation strategies but highlights the adaptation co-benefits of mitigation measures.[139]

During the 2023-2024 period, five African countries – Burundi, Morocco, Mozambique, Zambia and Zimbabwe – submitted National Adaptation Plans (NAPs) to enhance their transport adaptation and resilience efforts.[140]

- Burundi's NAP of 2023 presents adaptation actions set out in the country's Third National Communication on Climate Change (2019), including actions related to inland water transport (dredging, river training, and protection of access channels and port basins) and rehabilitation and maintenance of the existing road network to adapt it to the effects of climate change.[141]
- Morocco's NAP of 2024 prioritises developing a vulnerability assessment methodology to serve as a baseline for a city adaptation strategy and measures; the assessment would be supported by urban sustainability indicators relating to infrastructure and mobility, among others.[142] The NAP also supports addressing climate change locally in all policies, as well as developing knowledge and research to strengthen adaptation approaches and actions, including strengthening knowledge of the impacts of climate change on the transport sector.[143]
- In its 2023 NAP, Mozambique, one of the most-exposed African countries to extreme weather events, identifies floods and tropical cyclones as the highest risks to transport infrastructure, whereas rising sea levels and changes in temperature are seen as medium risks.[144] Proposed activities to enhance resilience include mapping and vulnerability/risk assessment of disaster-prone infrastructure and improving climate insurance.[145] Mozambique also adapted the 2017-2030 Disaster Risk Reduction Master Plan (2017-2030) and the SADC Infrastructure Master Plan.[146]
- Zambia's 2023 NAP provides a detailed assessment of vulnerability elements, exposures by hazard, adaptive capacity, level of sensitivity, and climate risk level, among others.[147] Adaptation actions for transport infrastructure include enforcing construction codes, improving access to weather and climate information, strengthening early warning systems, and applying climate-resilient infrastructure codes and standards to transport infrastructure (i.e., airports and railways).[148]
- Zimbabwe's NAP of 2024 aims to integrate climate change adaptation strategies into development policies, strategies, plans, programmes and activities. Transport-related adaptation actions include developing and promoting climate-resilient infrastructure standards, updating existing standards to consider climate change, strengthening early warning systems, and sustaining cross-cutting enablers such as capacity building, knowledge management and financing to build resilience.[149]

In 2023, fossil fuel subsidies in Africa totalled USD 199 per capita, the lowest level among regions and less than a fourth of the global average of USD 813 per capita.[150] **However, the region's fossil fuel subsidies are projected to increase around 45% between 2023 and 2030, further undermining climate and sustainability efforts.**[151] Fossil fuel subsidies have incentivised ongoing fossil fuel use in Africa, contributing to rising greenhouse gas emission levels.

Renewables represented only 0.15% of Africa's total final energy consumption in transport in 2021.[152] **However, countries have made strides to harness the region's great potential for renewable energy.** South Africa's Renewable Energy Masterplan, launched in 2023, aims for a minimum roll-out of 3 gigawatts (GW) of renewables annually, ramping up to 5 GW by 2030.[153] Although this target is not sector-specific, the increased renewable energy supply could support transport-related activities.

Developments in freight transport policy have advanced in the context of improving intra-Africa trade and operationalising the African Continental Free Trade Area (AfCFTA).

- The Northern Corridor, an important transport route in East and Central Africa, aspires to become a net zero emission corridor by 2050.[154] A key objective of the Northern Corridor Green Freight Strategy, released in 2024, is to ensure that the freight system along the corridor remains robust, adaptable and resilient in the face of climate change.[155]

- In 2024, the Tanzania-Zambia Railway Authority (TAZARA) signed an agreement with China Civil Engineering Construction Corporation to invest up to USD 1.4 billion to rehabilitate and upgrade the TAZARA railway line in southern and eastern Africa.[156] This critical route linking Zambia to the port of Dar Es Salaam (Tanzania) is expected to enhance connectivity and offer an alternative to road transport for cargo movements.[157] Revitalising TAZARA provides an opportunity to shift a large share of regional freight traffic from road transport towards a lower-emitting rail network.
- The Lobito Corridor Memorandum of Understanding – signed in 2023 by development partners including Angola, the DRC, Zambia, the European Union and the United States – includes plans to rehabilitate and expand the rail line connecting mineral-rich regions of the DRC and Zambia to the port of Lobito (Angola), including by renovating the existing BenguWela railway and building new rail lines (including a 350-mile extension into Zambia).[158] The rail corridor is expected to provide an alternative route that could greatly reduce transport costs for mineral exports.[159]
- In 2024, the African Development Bank allocated around USD 279 million (EUR 246 million) for construction of the 104.5 kilometre Guercif-Nador Highway Project in Morocco, which aims to better connect the country's inland production zones with the future Nador West Med Port on the Mediterranean Sea, helping to boost the number of products coming through the region.[160]

More African countries have recognised the importance of enhancing walking, cycling and public transport for improved urban mobility.

- The Pan-Africa Action Plan for Active Mobility (PAAPAM), launched at the World Urban Forum in Cairo in 2024, seeks to elevate walking and cycling in African mobility systems.[161] Its vision is anchored on three strategic pillars – safety, advocacy and policy integration – with strategies to eliminate road fatalities for pedestrians and cyclists, enhance accessibility and create infrastructure that fosters clean access for all.[162] A milestone has been the prioritisation of non-motorised transport in urban policy discussions, although challenges include difficulties changing mindsets around walking and cycling, inadequate financing and the lack of political commitment.[163]
- In Kumasi (Ghana), the Sustainable Urban Mobility Plan (SUMP) for 2024-2040 aims to promote walking and cycling as safe, viable transport modes, including by improving non-motorised transport, traffic conditions and safety; developing the road network; installing more than 100 kilometres of quality sidewalks and piloting a shared bicycle system.[164] The plan proposes a three-tier public transport system with bus rapid transit on key corridors, quality bus services on secondary routes, and enhanced regulation of the *tro-tro* minibus network. The aim is to improve accessibility, safety and service while shifting to more sustainable, inclusive urban mobility.[165]

Several African countries have taken significant steps to address road safety challenges through a combination of policy and innovative, context-specific initiatives.

- The Marrakech Declaration, emanating from the Fourth Global Ministerial Conference on Road Safety in Morocco in February 2025, adheres to "the fundamental premise that the transport system should result in zero deaths or serious injuries and that safety should not be compromised for other factors such as cost or the desire for faster transport times".[166] The event invited Member States and relevant stakeholders to leverage the UN Decade of Sustainable Transport, set to begin in 2026, as "an opportunity to embed road safety as an integral part of the agenda for sustainable transport" and called on members to implement policies for multi-modal mobility.[167]
- In 2024, Morocco's National Road Safety Agency introduced the Collision Matrix, a diagnostic tool designed to provide greater insight into the dynamics of road traffic crashes by analysing high-risk interactions among different user types.[168] Encompassing data collection, matrix development, stakeholder engagement, and localised action planning, the initiative has informed interventions such as stronger enforcement of helmet laws and the development of dedicated cycling lanes, and has shown early success in reducing injury severity and improving road user safety.[169]
- In Cameroon, the Ministry of Transport's Ym@ne Driver System aims to address key risk factors in inter-city transport and uses a combination of real-time data collection, driver behaviour analysis and fleet management to address three main concerns: human error, vehicle defects and poor road conditions.[170] The initiative has helped reduce speeding, phone use and seatbelt non-compliance; fatalities from hazardous goods transport; and crash incidences for transporters.[171]
- In 2024, Kenya launched its National Road Safety Action Plan (2024-2028), aimed at reducing road traffic fatalities 50 percent by 2030.[172] The strategy is managed through a multi-sectoral governance structure, and initial impact assessments show a decline in speeding violations and improved adherence to traffic rules; however, efforts to improve safety have been slowed by inadequate infrastructure, particularly in rural areas, as well as user resistance to change.[173]

The region faces a major gap in infrastructure investment, with average annual investment in 2022 totalling around

USD 80 billion, well below the required USD 130 to 170 billion per year.[174] Transport infrastructure alone requires USD 35 to 47 billion per year. In addition to infrastructure deficits, there are shortages in vehicles: research on the implementation of the African Continental Free Trade Area estimated that 2 million heavy-duty trucks, 150,000 rail wagons, 150 ships, and 250 aircraft would be needed, amounting to a financial requirement of USD 400 billion.[175]

- In 2023, multilateral development banks provided USD 2.2 billion for mitigation activities in the transport sector, and USD 1.9 billion for adaptation measures (covering energy, transport and other built environment and infrastructure sectors), in low- and middle-income countries of Africa and the Middle East.[176] This represented 26% of the banks' overall mitigation finance in 2023 and 30% of their overall adaptation finance.[177]
- In 2023, private investment in transport infrastructure projects in Africa was less than a third of the level in Asia and 2.5 less than in Latin America and the Caribbean.[178]

Partnerships in action

SLOCAT partners engaged in dozens of actions during 2023-2024, including:

- **Bridges to Prosperity**, a non-profit organisation based in the United States and Africa, is working to end rural isolation by building bridge infrastructure to link underserved communities to markets, schools and health care.[179] Operating in more than 21 countries and using local labour and government support, the organisation has built more than 480 bridges, benefiting around 1.7 million people.[180] Most bridges are completed within 12 weeks and typically repay their investment within two years.[181] The initiative exemplifies how low-cost, community-based infrastructure can generate outsized social and economic returns.
- The **EBee Kenya – Sustainable Transport Africa** project, supported by the World Resources Institute, is advancing the adoption of electric bicycles in Mombasa and Nairobi.[182] The partnership goes beyond product deployment, aiming to build an enabling environment for e-bike adoption through policy engagement, awareness campaigns and job creation.[183]
- The **Emergent + Empowered forum**, held in September 2024, was focused on mobilising global informal transport systems, especially in the Global South, for greater equity, sustainability and resilience. The forum identified four strategic pathways – Climate Action and Just Transition, Finance and Investment, Policy and Advocacy, and Data and Research – as critical levers for transforming informal transport networks.[184] The event was convened by the Shared-Use Mobility Center, the Center for Sustainable Urban Development at Columbia Climate School, the Partnership for Research in Informal and Shared Mobility (PRISM) and Volvo Research and Educational Foundations (VREF).
- The **Green Freight Support Program**, launched in 2024 by the Kuehne Climate Center and Smart Freight Centre, promotes efficient, low-emission and inclusive freight systems across eastern Africa.[185] The programme supports implementation of the green freight strategies of the Northern Corridor Transit and Transport Coordination Authority and the Central Corridor Transit Transport Facilitation Agency, and also fosters training and knowledge sharing among freight operators to accelerate a just and sustainable logistics transition (through partnerships with the Shippers Council of Eastern Africa, the Federation of East African Freight Forwarders and others).[186]
- The African Transport Policy Program (SSATP), in partnership with the World Bank Group, implements the **Leaders in Urban Transport Planning (LUTP)** programme across Anglophone and Francophone African countries.[187] Through a combination of case studies and practical sessions, LUTP equips transport officials with the tools to make informed decisions in urban mobility planning, helping to strengthen leadership capacity and promote integrated, sustainable transport strategies tailored to local needs.[188]
- The **Pan-African Action Plan for Active Mobility (PAAPAM)** is a continent-wide policy framework that aims to help African cities and countries improve conditions for walking and cycling, protect vulnerable road users and enhance access to public transport.[189] By prioritising non-motorised transport, the framework supports equitable and low-carbon urban mobility across the continent. PAAPAM is coordinated by the UN Environment Programme, UN-Habitat and the World Health Organisation. It was developed with several partners including the Institute for Transportation and Development Policy, WRI and GIZ. The plan was developed with global strategic insights from Walk21.

MODULE 3 | 3.2

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Asia Regional Overview



THIS CHAPTER IS SUPPORTED BY

DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	Asia	Global
Population size (2023)	4,732 million	8,000 million
Population growth (2015-2023)	6.8%	8.5%
Urban population share (2023)	52.3%	57%
Urban population growth (2015-2023)	18.1%	16%
GDP per capita (2023)	USD 7,496 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	36.5%	22.8%
Share of women employed in transport and storage (2023)	13.3%	15.6%
Motorisation rate (2022)	140.4 vehicles per 1,000 people	218.66 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	49.1%	52%
Share of rural population with access to all-weather primary and secondary roads (2020)	40.8%	38%
Transport total GHG emissions (2023)	2,871 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	0.61 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 865 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport	3% (2021)	4.6% (2023)
Carbon intensity of electricity generation (2023)	559.5 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	8%	6%
Premature deaths attributable to air pollution by transport (2019)	3.2 per 100,000 people	2.29 per 100,000 people
Road casualties (2021)	15.5 per 100,000 people	15 per 100,000 people

Source: See endnote 1 for this section.



KEY FINDINGS

Demand, use and access

- In 2023, Asia was home to more than half (58%) of the world's population and accounted for 47% of global GDP. However, the region housed only 38% of the world's transport infrastructure that year.
- Around 60% of Asia's rural population lacked access to all-weather roads network as of 2019, impeding connectivity and limiting access to economic opportunities. Access levels varied widely across countries.
- Although more than half (52%) of Asia's population resided in cities in 2023, slightly less than half (49.1%) of the region's urban population on average had convenient access to public transport (compared with a global average of 52%). Levels ranged from 99.9% in Singapore to only 7.3% in Jordan. A 2024 assessment found that a third of Asian countries (31%) had set targets to enhance public transport, introducing bus rapid transit systems or urban rail.
- As of 2023, only 24% of cities in Asia were providing at least half of their population with access to essential services (such as health care and education) within a 1-kilometre walking distance, compared to 39% of around 1,000 cities globally. Walking and cycling are on the decline in Asian cities, as data from 2018 to 2023 showed a shift to motorcycles and cars.
- Despite considerable expansion of bus rapid transit systems across the region – from around 9,400 kilometres in 118 cities in 2015 to 15,800 kilometres in 154 cities in 2021 – their availability has lagged compared to high-income countries, and the bus sector has continued to face challenges.
- In 2023, less than 20% of the population across most of Asia lived within 300 metres of a physically protected bikeway.
- Progress in enhancing freight transport and logistics performance has been uneven across Asia, with China, India, Indonesia, Thailand, and Viet Nam making strides, while other countries lagged.
- Freight transport in Asian cities grew an estimated 20% in 2020, driven by a surge in e-commerce and online deliveries, particularly by couriers, forwarders and parcel-delivery services.
- Passenger transport demand in Asia fell temporarily in 2020 due to the effects of the COVID-19 pandemic, but by 2023 the sector had recovered to surpass 2018 levels in most sub-regions, except the Pacific.
- Passenger and freight transport demand in Asia is projected to double or even triple between 2020 and 2050.
- Asia has experienced tremendous development in transport infrastructure in recent years, driven by economic growth, transport demand, trade flows, regional connectivity needs and urbanisation.
- Roads accounted for the vast majority (98%) of the region's surface transport infrastructure during 2021-2023, whereas railways made up 2% and urban rapid transit systems a mere 0.1%. Funding for road infrastructure has outweighed that for rail infrastructure in Asia, despite substantial (yet uneven) growth in rail across countries.
- In 2023, the transport infrastructure density in Asia was 433 kilometres per 1,000 square kilometres, well below the density for countries in the Organisation for Economic Co-operation and Development (OECD), at 690 kilometres per 1,000 square kilometres. Asia's road transport infrastructure, at 10 kilometres of road per 1,000 people, was below the global average of 11 kilometres of road per 1,000 people in 2022.
- Asia has experienced steady growth in rail infrastructure since 2015, accounting for 75% of the global growth in railways between 2015 and 2021. The region's railway infrastructure expanded by around 116,000 kilometres between 2010 and 2021.



KEY FINDINGS

- Growth in the region's road transport infrastructure has been greatly outpaced by the surge in private vehicle ownership, which grew 7.3% annually between 2010 and 2022.
- In 2022, the average motorisation rate in Asia (covering four-wheeled motor vehicles) was 140.4 vehicles per 1,000 people, although disparities persist across the region. This was below the global average of 219 vehicles per 1,000 people in 2022, but above Asia's rate of 123 vehicles per 1,000 people in the 2016-2020 period.
- The bus sector in Asia has been in crisis, with bus manufacturing dropping 44% between 2015 and 2022, while manufacturing of other vehicle types rose 3%. The region experienced a 34% decline in bus ridership during this period.
- Motorised two- and three-wheelers comprise a significant share of vehicle fleets in Asia, particularly as shared modes become accessible through ride-hailing apps and offline.
- Regional production of bicycles (both regular and electric) has grown minimally since 2015. Revenue in Asia's bicycle market is projected to increase 2.55% annually between 2025 and 2029, from USD 21.3 billion to USD 23.6 billion.
- Maritime transport has played an important role in meeting the region's socio-economic and connectivity needs. The Asia-Pacific region vastly outperformed other world regions in the Liner Shipping Connectivity Index (LSCI) in 2023, with a score of 177, above the global average of 103. A total of 59 Asian ports ranked among the top 100 globally in the Container Port Performance Index.
- Air transport (domestic, regional and international) plays an important role in the Asian economy, employing 42 million people in 2023 and contributing USD 890 billion to the region's GDP. Air transport in Asia has undergone rapid expansion driven by rising middle-class demand, low-cost carrier networks and international tourism.
- Asia has firmly positioned itself as the global leader in electric vehicles and was home to 85% of the world's battery electric road vehicles in 2024. The region's imports of electric vehicles increased nine-fold between 2017 and 2023 – rising from USD 3 billion to USD 27 billion – while its share of the global electric vehicle export market grew from 27% to 34%. However, this leadership has not been shared equally shared among sub-regions and countries.
- While China dominated the electric vehicle uptake, India and Thailand have made significant strides in electric vehicle deployment through subsidies, domestic manufacturing and investment in charging networks. Across Asia, informal transport services carried out by two- and three-wheelers, jeepneys and other types of collective transport have been gradually electrifying.



Sustainability and climate trends

- In 2023, Asia's transport sector was responsible for around 6% of global greenhouse gas emissions and for around 40% of the world's transport greenhouse gas emissions (excluding international aviation and shipping). Since 2015, the region's transport greenhouse gas emissions have increased around 2% annually.
- Transport has become Asia's second fastest growing source of greenhouse gas emissions, surpassed only by the power sector. However, emission growth rates vary greatly across economies.
- Asian transport emissions increased 6.8% in 2023, adding 182 million tonnes of CO_2 equivalent to reach a record high of 2.87 gigatonnes of CO_2 equivalent, nearly the same level as in Europe and North America combined.
- Asia's per capita transport greenhouse gas emissions totalled 0.61 tonnes of CO_2 equivalent in 2023, below the levels in Europe (1.66 tonnes) and Latin America and the Caribbean (0.94 tonnes) but higher than in Africa (0.26 tonnes).
- Trends show signs of a decoupling between economic growth and transport emissions. Asia's transport emissions relative to economic output increased 3% in 2023 to reach 0.81 tonnes of CO_2 equivalent per USD 10,000, the third highest level among global regions but much lower than in Africa (1.29 tonnes) and Latin America and the Caribbean (1.12 tonnes). By 2022, high-income Asian economies had achieved "absolute" decoupling (where transport emissions fell even as GDP rose), and middle- and low-income countries

KEY FINDINGS

showed "relative" decoupling (with transport emissions rising, but more slowly than economic output).

- Freight transport is expected to contribute around 60% of the region's domestic transport emissions during the 2020-2030 period. Across Asia, urban freight accounted for only 15% of total freight activity, but it produced 43% of freight-related CO_2 emissions in 2022, due to frequent, small-batch deliveries in congested traffic.

- Road transport has fuelled the growth in Asia's transport emissions, responsible for 88% of the total in 2022. Other transport sub-sectors contributed much lower shares of transport emissions, including domestic aviation (5%), inland waterways (5%) and railways (1%).


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- Asia's transport sector accounted for 21% of the region's total primary energy use in 2022, and road transport consumed 83% of the transport sector's energy in 2020. Energy consumption in transport fell 0.2% annually from 2015 to 2021, spurred by energy efficiency improvements in railways linked to greater electrification.

- CO_2 emissions from Asia's rail sector grew 2% annually on average between 2000 and 2010, then fell 0.2% annually between 2010 and 2022. This decline in rail's emissions is attributed to increased rail electrification. As of 2024, 56% of rail tracks in Asia were electrified, up from 34% in 2000, and 60% of railway energy came from electricity.

- The transition to renewable energy in Asia's transport sector has been slower than in other sectors, with the share of renewables used in transport rising from 1.6% in 2015 to 3.0% in 2021. Fossil fuel use dominates, particularly in road transport. Most Asian countries still rely on a carbon-intensive power grid, resulting in the highest carbon intensity of electricity generation among global regions in 2023.

- Biofuels were the leading renewable energy source in transport in South-East Asia in 2023, supplying nearly 10% of road transport energy, well above the global average of 4%.

- Among cities across Asia, car commuters in Istanbul experienced the highest annual hours of traffic delay due to congestion (105 hours) in 2024, followed by Jakarta (89 hours) and Bangkok (74 hours).

- Transport-induced air pollution contributed roughly 8% of total air pollutant emissions in Asia, resulting in 3.2 premature deaths per 100,000 people in 2019, compared to global averages of 6% and 2.3 premature deaths. As of 2024, virtually the entire population in East Asia and in South-East Asia was living in areas where air pollution levels exceeded the World Health Organization's safe air standards.

- The enactment of vehicle emission standards and fuel quality standards has led to a 2% annual decrease in certain pollutants in Asia between 2000 and 2022. The share of vehicle registrations in Asian countries that have emission standards at the Euro 4 level or above increased from 9% in 2010 to 89% in 2023.

- Road safety remains a persistent public health challenge in Asia, where road deaths averaged 15.5 casualties per 100,000 people in 2021, above the global average of 15.0 casualties. In 2021, the region accounted for more than half the world's 1.19 million annual road traffic deaths, with 35% representing motorised two-wheeler users, followed by pedestrians at 22%.

- With rising motorisation, there is an urgent need to improve the region's infrastructure for walking and cycling.

- In the Asia-Pacific region, weather hazards related to climate change caused an estimated USD 12 billion in median yearly damage to transport assets (such as roads, railways and ports) – or 60% of the total global damage of USD 20 billion – according to research of 2019 and 2023. Railways shoulder around 25% of these losses.

- Despite bear the bulk of the world's damage to transport infrastructure from climate change, most Asian countries lack robust policies or financing for adaptation. Climate finance for transport heavily favours mitigation, with only 0.13% of transport-related climate finance in Asia in 2022 allocated to adaptation and only 0.06% to a combination of mitigation and adaptation.

KEY FINDINGS

Policy and investment developments

- As of 25 May 2025, only five countries in Asia – Japan, Maldives, Nepal, Singapore and the United Arab Emirates (UAE) – had submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. Among these, Nepal and the UAE were the only countries to include transport greenhouse gas mitigation targets in their NDCs.
- Some of the Asian NDCs include transport adaptation and resilience-related targets and measures that are reflective of existing climate finance flows. In 2022, only an estimated 0.13% of the committed funds for transport-related climate finance in the region were earmarked to support adaptation.
- As of 25 May 2025, 18 Asian countries had submitted to the United Nations their LT-LEDS (Long-Term Low Emission Development Strategies).
- Eleven Asian countries had submitted National Adaptation Plans (NAPs) to the UN as of 25 May 2025, with the majority identifying transport-specific adaptation strategies.
- In addition to national strategies, several Asian countries have strengthened their commitments through international decarbonisation frameworks.
- A growing number of Asian countries have developed strategies to enhance their climate adaptation and preparedness for natural disasters.
- Countries have increasingly recognised that developing efficient public transport networks is central to promoting access for Asia's growing urban populations.
- Since 2021, several countries in the region have advanced road safety through multi-year action plans.
- According to 2025 studies, national government spending on transport in Asia over a five-year period was only 1.5% of GDP on average, and countries with higher per capita GDPs allocated more resources to infrastructure maintenance. The Asian transport sector received 55% of global Official Development Assistance (ODA) from 2016 to 2023, up from 43% between 2011 and 2015.
- In 2023, fossil fuel subsidies in Asia totalled USD 865 per capita, just above the global average of USD 813 per capita, although some countries have taken steps to phase out, reduce or reform these policies. Asian fossil fuel subsidies are projected to increase 32% between 2023 and 2030, further undermining climate and sustainability efforts.



- The momentum around electric vehicle adoption in the region has been coupled with a growing body of policy initiatives, financing mechanisms, and infrastructure programmes at the national and sub-national levels.
- Several countries in Asia are advancing vehicle efficiency and fuel economy regulations to curb emissions, improve air quality and reduce fuel consumption. In parallel, a growing number of countries in the region have sought to increase the use of renewable energy as well as low-carbon fuels in transport.
- Although the aviation industry is an important driver of economic development and employment in Asia, its sustainability hinges on decarbonisation measures.
- For maritime transport, a growing number of Asian countries have embraced green shipping corridors and engaged in other emission reduction measures.
- Inland waterway transport had gained attention in countries with extensive river networks and coastlines.
- Although freight transport remains less prominent than passenger transport in many Asian NDCs, its profile has grown within national transport strategies.

Context, challenges and opportunities

Asia is a highly diverse region, hosting two of the world's largest economies (China and India) as well as low- and middle-income and extremely climate-vulnerable countries such as Afghanistan, Myanmar, Nepal and Timor-Leste. The region reflects varying levels of development, infrastructure, policy capacity and mobility patterns.

In 2022, low- and middle-income countries in Asia represented roughly half the world's population and global gross domestic product (GDP), yet they housed only around one-third of the world's surface infrastructure.[2] Although transport infrastructure development has increased greatly in recent years, it has been dominated by road transport and by a strong increase in private vehicle ownership. Expansion of transport infrastructure has been unevenly distributed, leaving many countries with inadequate access.

A large share of Asia's population – including the elderly, low-income groups and women – depends on walking, cycling and public transport for daily mobility.[3] Despite this, on average less than half (49.1%) of Asia's urban residents had convenient access to public transport in 2020, and only 40.8% of the rural population had access to primary and secondary roads.[4]

The share of women employed in Asia's transport and storage industries was 13.3% in 2023, well below the levels in North America (28.1%) and Europe (24.9%), and the second lowest share after Africa.[5] Limited access and safety of transport services are the greatest obstacles to labor participation in low- and middle-income countries of the region. Women rely more on walking and informal transport than men do.[6]

Since 2015, the implementation of national policies and actions has greatly improved Asia's transport emissions outlook. Even so, the region's transport greenhouse gas emissions increased 6.8% in 2023, reaching a record high of 2.8 gigatonnes of carbon dioxide (CO_2) equivalent, nearly the same as in Europe and North America combined.[7] Asia contributed around 40% of global transport emissions in 2023, underscoring the region's crucial role in transport decarbonisation and sustainability.[8] Passenger and freight transport demand in Asia are projected to double or even triple between 2020 and 2050.[9] Under current policies, the region's transport emissions could reach 4 gigatonnes of CO_2 by 2050, well short of the 0.3 to 1 gigatonnes required to meet the emission reduction goals of the Paris Agreement.[10]

Further compounding Asia's transport sector challenges are strong dependence on imported fossil fuels, slow uptake of renewables in transport and limited progress in reducing fossil fuel subsidies. In many countries, a large share of foreign exchange is spent on importing vehicles and fossil fuels, straining national budgets and underscoring the urgent need for multi-modal transport planning and fuel efficiency.[11] Renewable energy use in the region's transport sector ranged from 12.9% in Indonesia to 0% in Saudi Arabia in 2022.[12] Asia remained the region with the highest carbon intensity of electricity generation, despite some improvement since 2015.[13] Overall, regional progress on sustainable, low-carbon transport has been impeded by inadequate national policy frameworks and insufficient financing.

Asia has established itself as an epicentre of electric mobility globally, accounting for 60% of the global increase in electric vehicles and 90% of growth in electric buses from 2015 to 2023, driven largely by China's market leadership.[14] In 2024, 85% of the world's battery-electric road vehicles were in Asia.[15] In recent years, India, Indonesia and Viet Nam all have introduced ambitious policies to scale up the use of electric vehicles (especially two- and three-wheelers) and public transport.

Given the region's vulnerability to the impacts of climate change, Asia has already felt the significant financial burden of multi-hazard damage to surface transport infrastructure. As of 2019 research, the Asia-Pacific region suffered an estimated USD 12 billion in median yearly damage to transport assets (such as roads, railways and ports), or 60% of the global total.[16] The COVID-19 pandemic had lasting effects on Asia's economies and transport, which are reflected in trade disruptions, reduction in public-private partnership investments and decreased public transport use, putting additional pressure on investments for sustainable transport.[17]

Asia has made important advances towards reducing transport-related air pollution and road fatalities.[18] Even so, transport-induced air pollution remains a leading health hazard in the region, responsible for roughly 8% of total air pollutant emissions and causing 3.2 premature deaths per 100,000 people in 2019.[19] Road safety remains a concern in Asia, which recorded 15.5 road casualties per 100,000 people in 2021, above the world average.[20]

Efforts to decarbonise and enhance the sustainability of Asia's transport sector must be pursued alongside infrastructure expansion and a rise in passenger and freight activity to accommodate economic growth. This calls for tailored approaches to transforming transport that cater to local contexts and needs – economic, social and infrastructural – while integrating broader sustainable development objectives.

Demand, use and access

In 2023, Asia was home to more than half (58%) of the world's population and accounted for 47% of global GDP.[21] **However, the region housed only 38% of the world's transport infrastructure that year.**[22] The transport sector employed 148 million people, or 7% of the region's total workforce, in 2023.[23] Yet the share of women employed in the transport and storage industries in Asia was only 13.3%, well below the levels in North America (28.5%), Oceania (23.3%) and Europe (22.3%) in 2023.[24]

Around 60% of Asia's rural population lacked access to all-weather roads network as of 2019, impeding connectivity and limiting access to economic opportunities.[25] **Access levels varied widely across countries:** whereas 78% of Lebanon's rural population lived within 2 kilometres of an all-season primary and secondary road, only 5.1% of Turkmenistan's did.[26]

Although more than half (52%) of Asia's population resided in cities in 2023, slightly less than half (49.1%) of the region's urban population on average had convenient access to public transport (compared with a global average of 52%).[27] **Levels ranged from 99.9% in Singapore to only 7.3% in Jordan.**[28] **A 2024 assessment found that a third of Asian countries (31%) had set targets to enhance public transport, introducing bus rapid transit systems or urban rail.**[29]

As of 2023, only 24% of cities in Asia were providing at least half of their population with access to essential services (such as health care and education) within a 1-kilometre walking distance, compared to 39% of around 1,000 cities globally.[30] **Walking and cycling are on the decline in Asian cities, as data from 2018 to 2023 showed a shift to motorcycles and cars.**[31] Walking is a critical enabler of public transport access, and its integration with public transport is a key strategy for reducing private car use.[32]

Despite considerable expansion of bus rapid transit systems across the region – from around 9,400 kilometres in 118 cities in 2015 to 15,800 kilometres in 154 cities in 2021 – their availability has lagged compared to high-income countries, and the bus sector has continued to face challenges.[33] Overall, Asia's urban public transport infrastructure tripled between 2000 and 2022.[34]

In 2023, less than 20% of the population across most of Asia lived within 300 metres of a physically protected bikeway.[35] This was above the world average of 5% but well below the shares of top-performing cities in 2023, all of which were in Europe.[36]

- China led the region in the share of people living near protected bikeways in 2023, with several cities exceeding the Asian average, including Sucheng District area at 40% and Ma On Shan area at 38%.[37]
- In Tel Aviv (Israel), 30% of residents lived close to protected bikeways in 2023, whereas the share in Jeonju (Republic of Korea) was 25%.[38]

Progress in enhancing freight transport and logistics performance has been uneven across Asia, with China, India, Indonesia, Thailand, and Viet Nam making strides, while other countries lagged.[39] Freight demand by road increased 21% and by rail increased 15% between 2015 and 2020, due to the expansion of infrastructure networks and economic development.[40] Inland waterways and domestic shipping are important modes of freight transport in most Asian countries (aside from the landlocked central Asian countries), and their share is projected to increase from 45% in 2020 to 50% in 2030 thanks to modal shift policies and infrastructure investments.[41]

Freight transport in Asian cities grew an estimated 20% in 2020, driven by a surge in e-commerce and online deliveries, particularly by couriers, forwarders and parcel-delivery services.[42] Although this growth has given rise to innovative solutions such as cargo bikes and scooters for last-mile deliveries, trucks and vans still dominate urban freight operations in the region.[43] Under current policies, urban freight demand in Asia could grow 3.7% annually between 2020 and 2050, overtaking the growth in urban passenger transport demand (2.1%).[44]

Passenger transport demand in Asia fell temporarily in 2020 due to the effects of the COVID-19 pandemic, but by 2023 the sector had recovered to surpass 2018 levels in most sub-regions, except the Pacific.[45] Lockdowns and other pandemic-related measures to contain the spread of coronavirus severely restricted transport and mobility. As in other global regions, passenger transport demand was more heavily impacted than freight demand across Asia.

- Metro ridership across Asia fell 32% on average in 2021, compared to a 63% drop in North America and a 40% decline globally.[46]
- Air travel was the transport mode most severely affected by COVID-19 travel restrictions in Asia, falling nearly 50% between 2015 and 2020; however, it has since recovered to pre-pandemic levels.[47]
- Asia ranked second among global regions in public transport ridership growth in 2024, after the Middle East and North Africa.[48]

Passenger and freight transport demand in Asia is projected to double or even triple between 2020 and 2050.[49] This very high growth trajectory implies that Asia alone could be


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responsible for roughly half of the global increase in transport demand during this period.[50] Trends point towards substantial growth in Asian transport activity, potentially outpacing population and infrastructure growth.

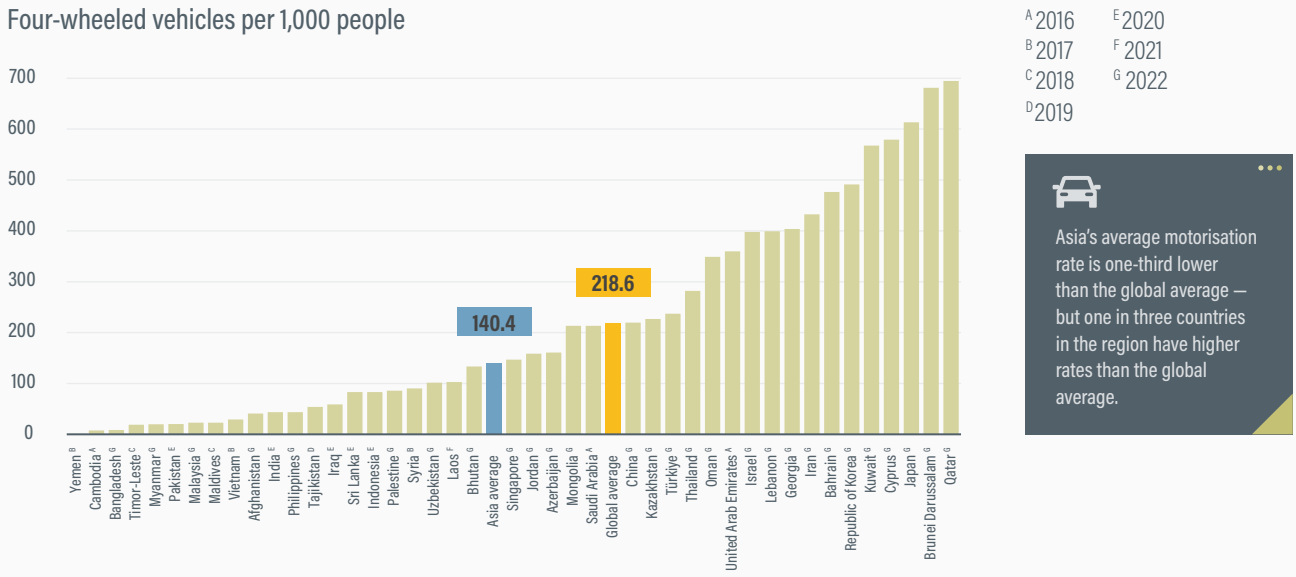
Asia has experienced tremendous development in transport infrastructure in recent years, driven by economic growth, transport demand, trade flows, regional connectivity needs and urbanisation. Roads accounted for the vast majority (98%) of the region's surface transport infrastructure during 2021-2023, whereas railways made up 2% and urban rapid transit systems a mere 0.1%.[51] **Funding for road infrastructure has outweighed that for rail infrastructure in Asia, despite substantial (yet uneven) growth in rail across countries.** Between 2010 and 2022, the region's road infrastructure length expanded 2.5% annually, greatly outperforming the growth of rail.[52]

In 2023, the transport infrastructure density in Asia was 433 kilometres per 1,000 square kilometres, well below the density for countries in the Organisation for Economic Co-operation and Development (OECD), at 690 kilometres per 1,000 square kilometres.[53] **Asia's road transport infrastructure, at 10 kilometres of road per 1,000 people, was below the global average of 11 kilometres of road per 1,000 people in 2022.**[54] By country, road infrastructure in the region ranged from well above the global average in Mongolia (32.9 kilometres per 1,000 people) and Bhutan (23.4 kilometres), to well below the Asian average in Bangladesh (0.9 kilometres) and Pakistan (1.1 kilometres).[55]

Asia has experienced steady growth in rail infrastructure since 2015, accounting for 75% of the global growth in railways between 2015 and 2021.[56] **The region's railway infrastructure expanded by around 116,000 kilometres between 2010 and 2021.**[57] China has continued to expand the rail network by improving regional connectivity, reducing travel times, and enabling cross-continental rail freight activities.[58]

- Sri Lanka added 344 kilometres of heavy railway routes between 2008 and 2021, reflecting annual growth of 1.9%.[59] It was among the region's top performers in the density of its railway network, with 26 kilometres of rail per 1,000 square kilometres in 2021.[60]
- As of early 2025, China's railway network exceeded 162,000 kilometres, including 48,000 kilometres of high-speed rail (the largest such network in the world).[61]
- Operating since 2011, the total number of freight trains traveling between China and Europe surpassed 100,000 in 2024.[62]

FIGURE 1. Motorisation rates per 1,000 people in Asia, various years



Asia's average motorisation rate is one-third lower than the global average — but one in three countries in the region have higher rates than the global average.

Source: See endnote 65 for this section.

Growth in the region's road transport infrastructure has been greatly outpaced by the surge in private vehicle ownership, which grew 7.3% annually between 2010 and 2022.[63] A staggering 1 billion vehicles were added to Asia's roads between 2000 and 2023, mirroring the region's rising motorisation rates.[64]

In 2022, the average motorisation rate in Asia (covering four-wheeled motor vehicles) was 140.4 vehicles per 1,000 people, although disparities persist across the region (Figure 1)**.**[65] **This was below the global average of 219 vehicles per 1,000 people in 2022, but above Asia's rate of 123 vehicles per 1,000 people in the 2016-2020 period.**[66] Motorisation growth has been driven by rising incomes, the explosion in private car ownership, and continued low levels of accessibility to public transport services in both urban and rural areas. These trends have put immense pressure on the region's road infrastructure to sustain a rapidly growing vehicle fleet.[67]

- The highest motorisation rates in Asia in 2022 were in Qatar (694.9 vehicles per 1,000 people) and Brunei Darussalam (681.2 vehicles), both of which were well above the global average.[68]
- The region's lowest motorisation rates were in Yemen (0.9 vehicles per 1,000 people in 2017) and Cambodia (7.6 vehicles per 1,000 people in 2016); more recent data are lacking due to challenges with data availability and collection across the region.[69]

The bus sector in Asia has been in crisis, with bus manufacturing dropping 44% between 2015 and 2022, while manufacturing of other vehicle types rose 3%.[70] **The region experienced a 34% decline in bus ridership during this period.**[71] These trends suggest a shifting preference away from buses, despite policy measures to improve public transit since 2015.[72]

- Annual production of buses and motor coaches in China declined from 140,686 units in 2019 to 89,008 units in 2022, and in Japan it fell from 123,097 units in 2017 to 84,611 units in 2022.[73]
- Imports of buses in Asia grew 7% between 2015 and 2023, compared to a 53% increase in imports of other vehicles.[74]
- Bus registrations in Asia increased 16% between 2015 and 2022, while registrations of other vehicles grew 56%.[75]

Motorised two- and three-wheelers comprise a significant share of vehicle fleets in Asia, particularly as shared modes become accessible through ride-hailing apps and offline. These vehicles often operate within the informal economy. Given the prevalence, high annual mileage, and operating patterns of motorised two- and three-wheelers, many governments across the region are looking to transition them to cleaner vehicles to reduce emissions and pollution in urban areas.

Regional production of bicycles (both regular and electric) has grown minimally since 2015.[76] **Revenue in Asia's**



bicycle market is projected to increase 2.55% annually between 2025 and 2029, from USD 21.3 billion to USD 23.6 billion.[77] This growth is driven mainly by China, where bicycle revenues were expected to total USD 12 billion in 2025.[78]

Maritime transport has played an important role in meeting the region's socio-economic and connectivity needs. The Asia-Pacific region vastly outperformed other world regions in the Liner Shipping Connectivity Index[i] **(LSCI) in 2023, with a score of 177, above the global average of 103.**[79] **A total of 59 Asian ports ranked among the top 100 globally in the Container Port Performance Index.**[80]

- China had the region's highest LSCI score in the second quarter of 2023, followed by the Republic of Korea, Singapore and Malaysia.[81]
- Between 2015 and 2023, Viet Nam improved its LSCI score by more than 50%.[82]
- In East Asia alone, 36 ports ranked among the global top 100 in port performance, underscoring the sub-region's significance in global trade and the maritime sector.[83]

Air transport (domestic, regional and international) plays an important role in the Asian economy, employing 42 million people in 2023 and contributing USD 890 billion to the region's GDP.[84] **Air transport in Asia has undergone rapid expansion driven by rising middle-class demand, low-cost carrier networks and international tourism.** The number of flights per 1,000 people in the region increased from 1.0 in 2001 to 2.9 in 2019, then falling to 1.8 in 2020 during the COVID-19 pandemic.[85] The Asia-Pacific region recorded its strongest annual increase in passenger traffic in 2024, at 16.9% (above the global average of 10.4%), driven mainly by strong domestic markets in China and India, although international travel in the region remained below 2019 levels.[86]

Asia has firmly positioned itself as the global leader in electric vehicles and was home to 85% of the world's battery electric road vehicles in 2024.87 The region's imports of electric vehicles increased nine-fold between 2017 and 2023 – rising from USD 3 billion to USD 27 billion – while its share of the global electric vehicle export market grew from 27% to 34%.88 However, this leadership has not been shared equally shared among sub-regions and countries.[89]

- In the Asia-Pacific region, electric vehicles accounted for 16% of motorised two- and three-wheelers (a total of 77 million), 11% of buses (726,200), 6.7% of cars (35 million), 2.2% of vans (1.3 million) and 0.8% of trucks (377,200) in 2024.[90]
- China continued to dominate electric bus exports, with 15,000 units exported in 2024, a 25% increase from 2023.[91]

i A comprehensive tool for quantifying a nation's integration into the global maritime network, which provides a standardised metric to assess a country's access to and efficiency within international liner shipping.



Carlos Felipe Pardo

Chinese manufacturers provided 80% of electric buses operating in Latin America and the Caribbean in 2024, and China's Yutong was the best-selling electric bus company in Europe between 2022 and 2024.[92]

While China dominated the electric vehicle uptake, India, Indonesia, Thailand and Viet Nam have made significant strides in electric vehicle deployment through subsidies, domestic manufacturing and investment in charging networks.[93] **Across Asia, informal transport services carried out by two- and three-wheelers, jeepneys and other types of collective transport have been gradually electrifying.**[94] Wider adoption of electric vehicles in many Asian low- and middle-income countries has been hampered by high upfront costs, limited awareness of alternative transport modes, inadequate charging infrastructure and limited technical capacity.[95]

- India has made important advances in the uptake of electric vehicles, notably through its ambitious electric bus programme, high fuel quality standards and policies under the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme.[96] India is the second largest market for electric two-wheelers globally, with annual sales expected to increase from 1 million units in 2023 to 7-9 million units in 2030.[97]
- Electric two-wheeler sales in South-East Asia are projected to reach 3-4 million units in 2030.[98]
- Spurred by a strong policy framework, Thailand has led the electric vehicle transition in South-East Asia, with a 10.8% adoption rate for battery electric vehicles in 2023.[99] In 2025, Bangkok announced that it would retire 60% of its 2,300 combustion engine buses and replace them with electric buses by 2029.[100]
- Viet Nam doubled its sales of battery electric cars in 2024, with sales of 69,000 units (17% of total car sales), while sales of electric two-wheelers reached 250,000 (a near 10% sales share).[101] Viet Nam laid important groundwork in 2024 by developing a strategic framework to transition to electric vehicles.[102]

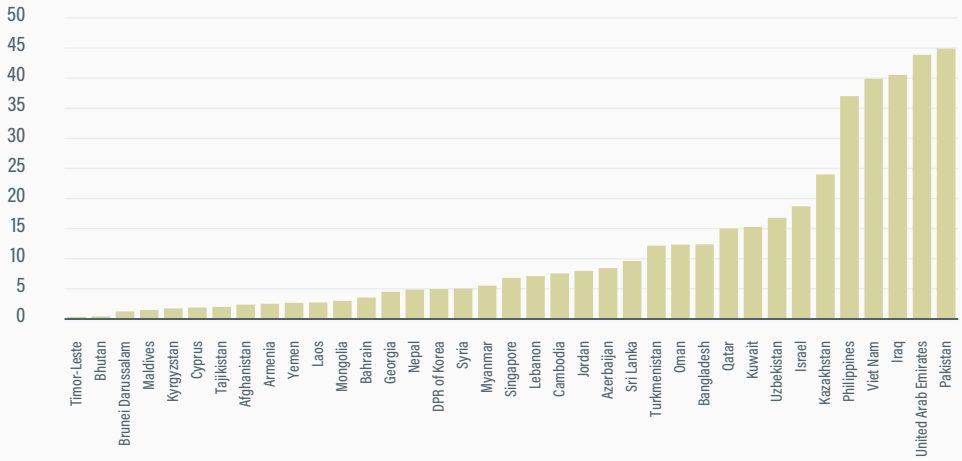
Sustainability and climate trends

In 2023, Asia's transport sector was responsible for around 6% of global greenhouse gas emissions and for around 40% of the world's transport greenhouse gas emissions (excluding international aviation and shipping).[103] **Since 2015, the region's transport greenhouse gas emissions have increased around 2% annually.**[104] This contrasts with the near-stagnant growth in transport emissions in Europe and North America (0.3%) and the slow annual increases in Latin America and the Caribbean (0.5%) and Africa (1.3%).[105]

Transport has become Asia's second fastest growing source of greenhouse gas emissions, surpassed only by the power sector.[106] **However, emission growth rates vary greatly across economies.** In Malaysia (an upper-middle-income country), transport emissions grew only 1% annually since 2015, whereas in Cambodia they grew 8% annually.[107] The share of high-income economies in total transport emissions fell from 36% in 2000 to 16% in 2022, confirming that their emission growth intensity has been much lower than in low- and middle-income economies.[108]

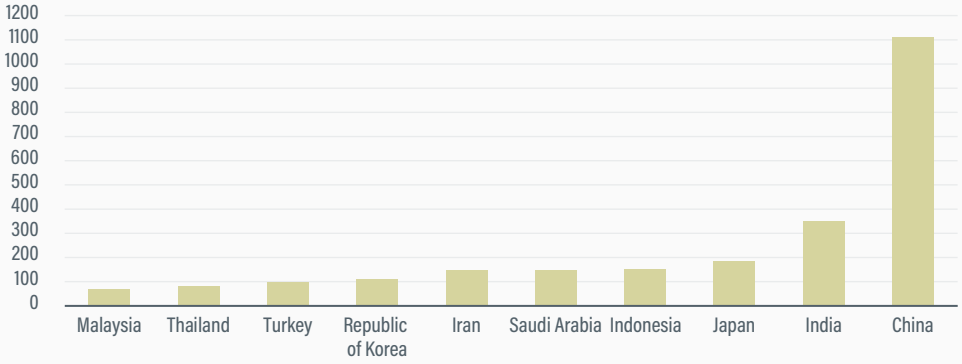
FIGURE 2. Transport greenhouse gas emissions in Asia, 2023

Asian countries with transport greenhouse gas emissions with less than 50 million tonnes, 2023



Transport greenhouse gas emissions in Asia vary widely. China alone emits more than 43 of the region's 46 countries combined (except India, Indonesia and Japan).

Asian countries with transport greenhouse gas emissions with more than 50 million tonnes, 2023



Transport greenhouse gas emissions in Asia vary widely. China alone emits more than 43 of the region's 46 countries combined (except India, Indonesia and Japan).

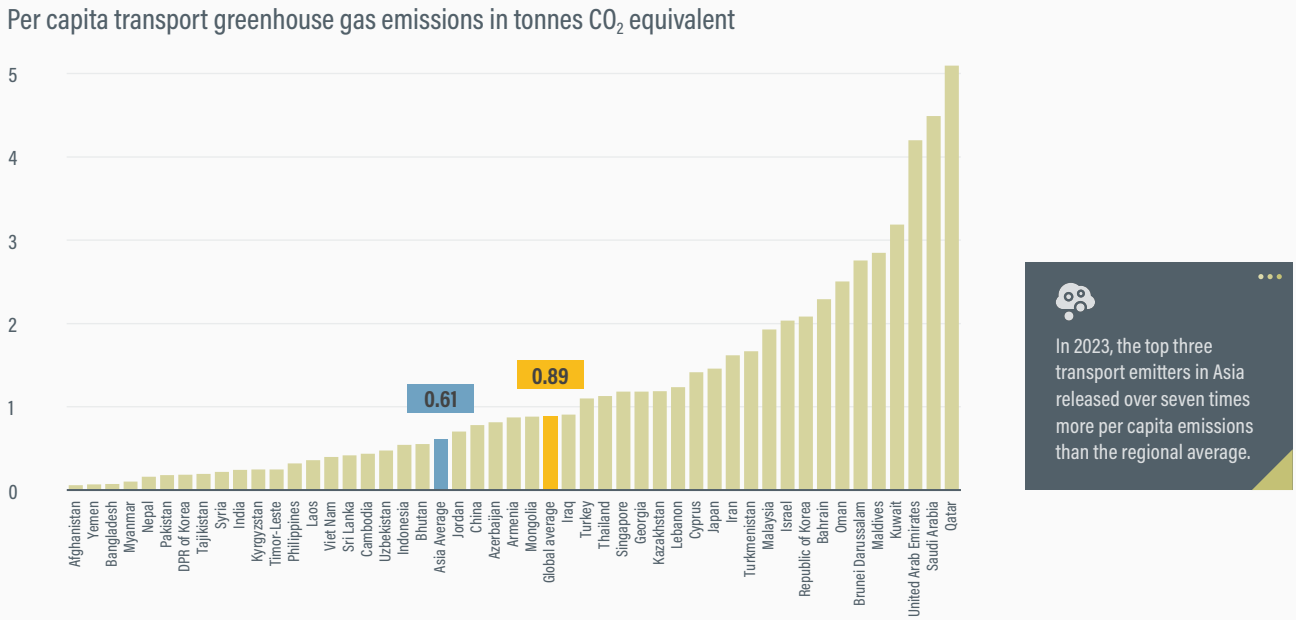
Source: See endnote 110 for this section.

Asian transport emissions increased 6.8% in 2023, adding 182 million tonnes of CO_2 equivalent to reach a record high of 2.87 gigatonnes of CO_2 equivalent, nearly the same level as in Europe and North America combined.[109] China was responsible for most of these emissions (1,110.2 million tonnes of CO_2 equivalent), followed distantly by India (349.3 million tonnes) and Japan (182 million tonnes) (Figure 2).[110] The region's lowest transport emissions were in Timor-Leste (0.3 million tonnes) and Bhutan (0.4 million tonnes).[111]

Asia's per capita transport greenhouse gas emissions totalled 0.61 tonnes of CO_2 equivalent in 2023 (Figure 3)**, below the levels in Europe (1.66 tonnes) and Latin America and the Caribbean (0.94 tonnes) but higher than in Africa (0.26 tonnes).**[112] With its high motorisation rate, Qatar was the region's highest per capita transport emitter at 5.1 tonnes in 2023, followed by Saudi Arabia (4.5 tonnes) and the United Arab Emirates (UAE) (4.2 tonnes).[113] The region's lowest per capita transport emissions were in Afghanistan (0.06 tonnes) and Yemen (0.07 tonnes), reflecting low motorisation rates and underdeveloped road and public transport networks.[114]

Trends show signs of a decoupling between economic growth and transport emissions. Asia's transport emissions relative to economic output increased 3% in 2023 to reach 0.81 tonnes of CO_2 equivalent per USD 10,000, the third highest level among global regions but much lower than in Africa (1.29 tonnes) and Latin America and the Caribbean (1.12 tonnes).[115] **By 2022, high-income Asian economies had achieved "absolute" decoupling (where transport**

FIGURE 3. Per capita transport greenhouse gas emissions in Asia, 2023



In 2023, the top three transport emitters in Asia released over seven times more per capita emissions than the regional average.

Source: See endnote 112 for this section.

emissions fell even as GDP rose), and middle- and low-income countries showed "relative" decoupling (with transport emissions rising, but more slowly than economic output).[116] These trends are driven by factors such as slower growth in emissions than economic growth, increased vehicle efficiency and greater electric vehicle adoption.[117]

Freight transport is expected to contribute around 60% of the region's domestic transport emissions during the 2020-2030 period.[118] **Across Asia, urban freight accounted for only 15% of total freight activity, but it produced 43% of freight-related CO_2 emissions in 2022, due to frequent, small-batch deliveries in congested traffic.**[119] Freight also contributes to traffic delays and pollution, with high economic costs and health impacts. The freight sector, particularly urban freight, has been under-emphasised in many national climate and sustainable development strategies.

Road transport has fuelled the growth in Asia's transport emissions, responsible for 88% of the total in 2022.[120] **Other transport sub-sectors contributed much lower shares of transport emissions, including domestic aviation (5%), inland waterways (5%) and railways (1%).**[121] Between 2000 and 2022, emissions from road transport increased 3.2% annually, compared with 2.9% for domestic aviation, 2.5% for domestic navigation and 0.7% for rail transport.[122] Road transport accounted for up to 73% of Myanmar's transport emissions and 100% of Kazakhstan's in 2022.[123] This dependence on carbon-intensive road transport modes can be attributed to heavy reliance on oil products, rapid growth in private vehicles and inadequate access to public transport.[124]

Asia's transport sector accounted for 21% of the region's total primary energy use in 2022, and road transport consumed 83% of the transport sector's energy in 2020.[125] **Energy consumption in transport fell 0.2% annually from 2015 to 2021, spurred by energy efficiency improvements in railways linked to greater electrification.**[126]

CO_2 emissions from Asia's rail sector grew 2% annually on average between 2000 and 2010, then fell 0.2% annually between 2010 and 2022.[127] **This decline in rail's emissions is attributed to increased rail electrification.**[128] **As of 2024, 56% of rail tracks in Asia were electrified, up from 34% in 2000, and 60% of railway energy came from electricity.**[129] China and India together account for the majority of Asia's rail network and have led aggressive electrification programmes.

- Between 2000 and 2023, the length of electrified rail routes increased substantially in China (up 800% to reach 119,400 kilometres) and achieving around 75% railway electrification in 2023.[130]
- As of March 2025, 98% of India's rail network was electrified, expanding by more than 4,500 kilometres annually between 2014 and early 2025.[131]

The transition to renewable energy in Asia's transport sector has been slower than in other sectors, with the share of renewables used in transport rising from 1.6% in 2015 to 3.0% in 2021.[132] **Fossil fuel use dominates, particularly in road transport.**[133] **Most Asian countries still rely on a carbon-intensive power grid, resulting in the highest carbon intensity of electricity generation among global regions in 2023** – at 559.5 grams of CO_2 equivalent per kilowatt-hour – despite falling 1.6% on average since 2015.[134] As of mid-2025, China derived 18% of its electricity from solar and wind, while India reached 10%, limiting the full emission-reduction potential of transport electrification.[135]



Carlos Felipe Pardo

Biofuels were the leading renewable energy source in transport in South-East Asia in 2023, supplying nearly 10% of road transport energy, well above the global average of 4%.[136] This trend is supported by long-standing blending mandates and a maturing palm oil biodiesel industry, especially in Indonesia and Thailand.[137]

Among cities across Asia, car commuters in Istanbul experienced the highest annual hours of traffic delay due to congestion (105 hours) in 2024, followed by Jakarta (89 hours) and Bangkok (74 hours).[138] Congestion, delays and excessive fuel consumption related to rising road traffic all contribute to higher vehicle emissions and lower quality of life.

Transport-induced air pollution contributed roughly 8% of total air pollutant emissions in Asia, resulting in 3.2 premature deaths per 100,000 people in 2019, compared to global averages of 6% and 2.3 premature deaths.[139] **As of 2024, virtually the entire population in East Asia and in South-East Asia was living in areas where air pollution levels exceeded the World Health Organization's safe air standards.**[140] Asia's transport sector generates further societal costs in the form of noise pollution, road fatalities, ecosystem degradation and loss of agricultural land, among others.

- In 2024, cities across South and Central Asia dominated the global rankings for air pollution from particulate matter (PM) 2.5.[141] The most polluted cities included Byrnihat, Delhi and Mullanpur in India; Lahore and Dera Ismail Khan in Pakistan; and Karaganda (Kazakhstan).[142]
- Among the cleanest urban air in the region was in Kashiwazaki, Sumoto, and Kushiro in Japan, and in Tra Vinh (Viet Nam).[143]

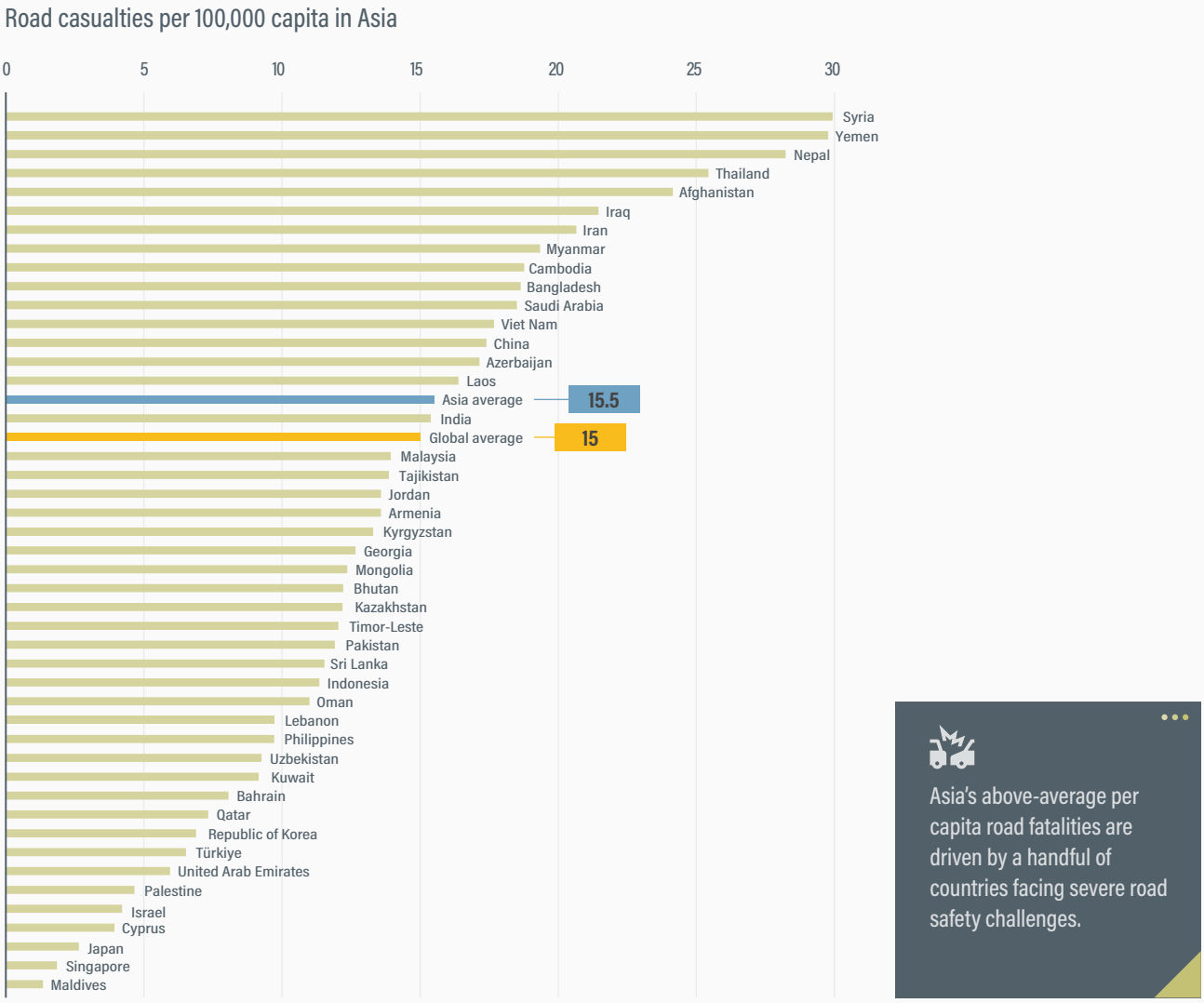
The enactment of vehicle emission standards and fuel quality standards has led to a 2% annual decrease in certain pollutants in Asia between 2000 and 2022.[144] **The share of vehicle registrations in Asian countries that have emission standards at the Euro 4 level or above increased from 9% in 2010 to 89% in 2023.**[145] However, rising emissions from other transport modes, such as domestic waterways and shipping, has undermined progress.[146]

Road safety remains a persistent public health challenge in Asia, where road deaths averaged 15.5 casualties per 100,000 people in 2021, above the global average of 15.0 casualties (Figure 4).[147] **In 2021, the region accounted for more than half the world's 1.19 million annual road traffic deaths, with 35% representing motorised two-wheeler users, followed by pedestrians at 22%.**[148]

- Syria had the region's highest level of road casualties, at 29.93 deaths per 100,000 people in 2021, whereas Maldives had the lowest at 1.34 per 100,000 people.[149]

With rising motorisation, there is an urgent need to improve the region's infrastructure for walking and cycling.[150] In 2021, less than 20% of roads assessed in Asia met the recommended three-star or better safety standard for pedestrians and cyclists; the share was less than 25% for motorcyclists and less than 40% for vehicle occupants, underscoring a widespread lack of safe road design.[151] South Asia and South-East Asia have especially high-risk road networks.[152]

FIGURE 4. Road casualties per 100,000 people in Asia, 2021



Asia's above-average per capita road fatalities are driven by a handful of countries facing severe road safety challenges.

Source: See endnote 147 for this section.

In the Asia-Pacific region, weather hazards related to climate change caused an estimated USD 12 billion in median yearly damage to transport assets (such as roads, railways and ports) – or 60% of the total global damage of USD 20 billion – according to research of 2019 and 2023.[153] **Railways shoulder around 25% of these losses,** despite accounting for only around 2% of Asia's total transport infrastructure.[154]

- Pakistan ranked 26th out of 208 countries in national road vulnerability in 2023 and faces significant climate risks, with average annual losses to transport infrastructure estimated at USD 218.7 million in 2023.[155]
- Bangladesh, where 9% of the population lived in low-elevation coastal zones as of 2023, the average annual loss to transport infrastructure due to climate-related hazards in 2023 was USD 178.95 million, equivalent to 0.01% of the GDP; this loss is concentrated in roads (79%), followed by rail (14%), airports (5%) and ports (2%).[156]

Despite bear the bulk of the world's damage to transport infrastructure from climate change, most Asian countries lack robust policies or financing for adaptation. Climate finance for transport heavily favours mitigation, with only 0.13% of transport-related climate finance in Asia in 2022 allocated to adaptation and only 0.06% to a combination of mitigation and adaptation.[157] The gap between rising climate risks and limited transport adaptation measures leaves critical infrastructure exposed, particularly in coastal and flood-prone areas.[158]

Policy and investment developments

As of 25 May 2025, only five countries in Asia – Japan, Maldives, Nepal, Singapore and the United Arab Emirates (UAE) – had submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement.[159] **Among these, Nepal and the UAE were the only countries to include transport greenhouse gas mitigation targets in their NDCs.**

- Nepal's 2025 NDC extends the country's previous targets for electric vehicle share from 2030 to 2035, and commits to reduce transport greenhouse gas emissions by 1,426.22 gigagrams of CO_2 equivalent by 2030 and 2,731.57 gigagrams by 2035.[160]
- The NDC of the UAE sets a target to reduce transport greenhouse gas emissions at least 20% below 2019 levels by 2035, to reach 24.2 million tonnes of CO_2 equivalent; it touches on all three pillars of the "Avoid-Shift-Improve" (A-S-I) Framework, with plans to enhance walking and public transport use and to improve vehicle energy efficiency while promoting wider adoption of electric vehicles.[161]
- Japan's NDC of 2025 sets targets to reduce economy-wide emissions 60% below 2013 levels by 2035, 75% by 2040 and net zero by 2050.[162] However, analysis suggests that Japan would need to reduce its emissions 81% below 2013 levels (from all sectors, including land use and forestry) to align with Paris Agreement goals.[163] Japan's NDC does not include sector-specific commitments, which are to be elaborated in an upcoming national "Plan for Global Warming Countermeasures".[164]

The NDCs of the UAE (2024) and Singapore (2025) establish direct links between the outcomes of the First Global Stocktake (GST) on the implementation of the Paris Agreement, and take a comprehensive approach to sustainable transport activities, including through developing walking, cycling and public transport infrastructure and rapid deploying zero- and low-emission vehicles.[165]

Some of the Asian NDCs include transport adaptation and resilience-related targets and measures that are reflective of existing climate finance flows. In 2022, only an estimated 0.13% of the committed funds for transport-related climate finance in the region were earmarked to support adaptation, and only 0.06% of funds were earmarked for actions with multiple objectives, including mitigation and adaptation.[166]

- The UAE's NDC of 2024 acknowledges the importance of climate-proofing infrastructure, including through its design, location, construction, operation and maintenance. The UAE is preparing a roadmap covering all aspects of the urban environment (including sustainability guidelines for roads and other infrastructure), investing in research and development of climate-resilient construction materials and developing infrastructure proofed against sea-level rise.[167]
- The Maldives aims to ensure climate-proof infrastructure and facilities, particularly critical infrastructure such as airports, maritime ports, powerhouses and utilities.[168]

For the latest analysis of transport commitments in NDCs, including those expected ahead of COP 30, see the NDC Transport Tracker by GIZ and SLOCAT*, a database on ambition, targets and policies in NDCs and Long-Term Strategies.*169

As of 25 May 2025, 18 Asian countries had submitted to the United Nations their LT-LEDS (Long-Term Low Emission Development Strategies).[170] LT-LEDS complement NDCs and reflect countries' strategies to 2050 and beyond.[171] Between 2023 and March 2025, a total of nine Asian countries (Armenia, Bhutan, Cyrus, Georgia, Kazakhstan, Oman, Sri Lanka, Türkiye and United Arab Emirates) submitted LT-LEDS.

- Kazakhstan's LT-LEDS of 2024 outlines actions across all components of the A-S-I Framework; the country aims to pursue the efficient management of passenger and freight traffic, enhance public transport systems, promote efficient urban planning to reduce the need for vehicle trips, and encourage the widespread use of alternative fuels and large-scale electrification of transport.[172]
- Bhutan's LT-LEDS of 2023 aims to reduce greenhouse emissions from surface transport through both demand and supply side management; sets a target to transition 100% of light vehicle and bus sales to electric vehicles by 2045 and 25% of heavy vehicle (freight) imports to electric vehicles by 2050, and encourages the use of shared mobility, public transport and non-motorised transport.[173]

Eleven Asian countries had submitted National Adaptation Plans (NAPs) to the UN as of 25 May 2025, with the majority identifying transport-specific adaptation strategies.[174] NAPs support countries, especially developing and least-developed countries, in planning and implementing medium- and long-term adaptation to climate change.

- Bangladesh's NAP of 2023 sets out to improve urban environments and drainage systems through interventions linked to the expansion and conservation of green and blue infrastructure as well as the promotion of environmentally friendly vehicles and mass transit.[175]
- The Philippines' NAP of 2024 highlights comprehensive planning and response mechanisms and sufficient capacity as key adaptation priorities to ensure resilient,



Carlos Felipe Pardo

sufficient and sustainable transport infrastructure and related services; concrete measures include factoring in climate risk when planning roadways and transport hubs, and climate-proofing critical transport infrastructure (e.g., through landslide protection measures).[176]

- Thailand's NAP of 2024 underlines mixed-use developments to discourage reliance on long-distance transport.[177]

In addition to national strategies, several Asian countries have strengthened their commitments through international decarbonisation frameworks.

- At the 2023 UN Climate Change Conference (COP 28), Israel joined the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles, committing to 100% zero-emission new truck and bus sales by 2040.[178]
- Multiple Asian governments (Armenia, Azerbaijan, Israel and Türkiye) as well as sub-national governments in India, Japan and the Republic of Korea participate in the Accelerating to Zero (A2Z) Coalition, which supports the global transition to 100% zero-emission vehicle sales by 2040 at the latest.[179]

A growing number of Asian countries have developed strategies to enhance their climate adaptation and preparedness for natural disasters.

- Bangladesh's Mujib Climate Prosperity Plan seeks to ensure that at least 50% of the country's railway infrastructure is climate-resilient and energy efficient by 2030.[180]
- Sri Lanka's National Road Master Plan 2021-30 proposes developing a Disaster Planning System to document information on natural disasters such as flooding, landslides and river/sea erosion.[181]
- Türkiye's Climate Change Adaptation Strategy and Action Plan (CCASAP) for 2024-2030 identifies 11 priority sectors that are highly vulnerable to climate change, including transport.[182]

Countries have increasingly recognised that developing efficient public transport networks is central to promoting access for Asia's growing urban populations. Between 2015 and 2023, references to public transit measures tripled in the region's NDCs, and they increased more than 17 times in national transport policy documents.[183]



- To cut emissions, Azerbaijan's NDC of 2023 underscores the promotion of environmentally friendly modes of transport, improvements in intelligent transport management systems and the enhanced use of public transport; it also announces measures aimed at improving walking and cycling infrastructure to promote their wider use.[184]
- Oman's updated NDC of 2023 sets out to develop urban transport plans to reduce emissions and promote public transport; these plans are explicitly linked to efforts to reduce traffic congestion and improve air quality in urban areas.[185]
- Singapore's 2025 NDC reaffirms the country's commitment to "Walk-Cycle-Ride" (WCR) by encouraging wider uptake of walking, cycling, and public and shared transport; by 2040, the aim is for all journeys to the nearest neighbourhood centre using 15 WCR modes to take no more than 20 minutes, and for 90% of all peak-period WCR journeys to be completed in less than 45 minutes.[186] Singapore seeks to expand its rail network from 270 kilometres in 2025 to 360 kilometres by the early 2030s – putting 80% of households within a 10-minute walk from a train station – and to extend the cycling path network from more than 600 kilometres in 2025 to around 1,300 kilometres by 2030.[187]
- Uzbekistan's Voluntary National Review (VNR) of 2023 seeks to increase the share of public transport use in large, medium and small cities and envisages adapting public transport infrastructure for sedentary populations, including people with disabilities.[188]

Since 2021, several countries in the region have advanced road safety through multi-year action plans.

- Laos has committed to reduce road traffic fatalities and serious injuries by 70% by 2035, supported by helmet enforcement, speed regulations, improved infrastructure and seat belt laws.[189]
- Nepal, which had the third-highest rate of road traffic fatalities in the region in 2021, enacted its Road Safety Action Plan (2021–2030) that same year. The plan commits to reducing road traffic fatalities and injuries by 50% by 2030 and achieving Vision Zero by 2050, in alignment with SDG 3.6 on road traffic injuries.[190]
- The Philippines released the Philippine Road Safety Action Plan 2023–2028, targeting a 35% reduction in road traffic deaths by 2028.[191]

According to 2025 studies, national government spending on transport in Asia over a five-year period was only 1.5% of GDP on average, and countries with higher per capita GDPs allocated more resources to infrastructure maintenance.[192] **The Asian transport sector received 55% of global Official Development Assistance (ODA) from 2016 to 2023, up**

from 43% between 2011 and 2015.[193] However, public-private partnership (PPP) investments in Asia fell from 77% to 64% of the global total during 2016-2023, due largely to the COVID-19 pandemic.[194]

- ODA for rail transport grew substantially, from USD 2 billion (26% of total transport ODA) during 2002-2005, to USD 24 billion (51%) during 2016-2022.[195]
- ODA for roads grew in absolute terms from USD 5 billion to USD 17 billion during the same period, while its share of total transport ODA fell from 52% to 35%.[196]
- Road projects remained dominant in PPP investments, reflecting USD 121 billion (63% of total transport PPPs) between 2016 and 2022.[197]

In 2023, fossil fuel subsidies in Asia totalled USD 865 per capita, just above the global average of USD 813 per capita, although some countries have taken steps to phase out, reduce or reform these policies.[198] **Asian fossil fuel subsidies are projected to increase 32% between 2023 and 2030, further undermining climate and sustainability efforts.**[199] Although the transport sector's share of total fossil fuel subsidies in Asia fell from 22% in 2014 to 14% in 2022, the absolute value of transport-related subsidies rose sharply in 2022, in line with the spike in fossil fuel subsidies.[200] The region allocated a total of USD 97 billion to transport fuels in 2022, the highest annual level in a decade.[201]

- Indonesia enacted several policy measures in 2022 to address growing energy subsidies while reallocating resources more efficiently.[202]
- In 2024, Malaysia announced reforms to revamp its petrol subsidies by introducing targeted assistance; the measures, to be implemented from mid-2025 onwards, would mainly affect foreigners and high-income individuals and save around USD 1.9 billion annually.[203]

The momentum around electric vehicle adoption in the region has been coupled with a growing body of policy initiatives, financing mechanisms, and infrastructure programmes at the national and sub-national levels.[204]

- Azerbaijan's NDC of 2023 outlines a plan to equip all passenger buses operating in the administrative area of Baku city with compressed natural gas or electric motors starting in January 2025, and to exempt electric vehicle imports and sales, as well as their chargers, from value-added tax (VAT).[205]
- India introduced the FAME II scheme (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) in 2019, and since then it has incentivised 1.6 million electric vehicles, including two-, three- and four-wheelers. Since 2021, India has launched several additional schemes, such as a production-linked incentive programme to support domestic electric vehicle and battery manufacturing, along with programmes to scale up electric buses, trucks and charging infrastructure.[206]
- Indonesia aims to deploy 2.1 million electric vehicles and 13 million electric motorcycles by 2030, supported by Presidential Regulation No. 55/2019, which promotes domestic electric vehicle production, battery supply chains and nationwide charging infrastructure.[207] The government also offers tax incentives and has introduced a roadmap for electrification of public and private fleets.[208]
- Oman's NDC and LT-LEDS of 2023 reaffirm a vision to transition to electric light-duty vehicles and hydrogen fuel cells for long-distance trucks and buses, while supporting behavioural changes to reduce (individual) car use.[209]
- Oman's Sustainable Transport Master Plan aims to reduce the carbon intensity of the transport sector 20% and to electrify 34% of cars by 2030; as part of a goal to reduce 0.85 tonnes of CO_2 equivalent per capita per year, the plan includes initiatives to develop public transport systems, promote electric vehicles and create a dedicated bus lane on Sultan Qaboos Street.[210]
- Singapore's latest NDC reaffirms its commitment to phasing out pure internal combustion engine vehicles by 2040 and enabling the adoption of electric and other clean energy vehicles; since 2020, all new public bus purchases in the country have been cleaner energy models, including electric and diesel-hybrid buses.[211]
- Thailand's Thirteenth National Economic and Social Development Plan (2023-2027) sets out various goals for 2027, including converting at least 40,000 vehicles to modified electric vehicles; increasing the number of public charging stations (including fast chargers) by 5,000 while supporting grid reinforcement; and ensuring that an additional 5,000 automotive workers are upskilled for employment in the electric vehicle industry.[212] These goals support Thailand's "30@30" goal from 2022 of having 30% of the country's vehicle production be electric by 2030.[213]
- In 2024, the UAE set goals to increase the electric vehicle share to 50% of total car sales by 2050 and to reduce transport energy consumption 40% by 2050.[214]
- Dubai (UAE), through its Dubai Green Mobility Strategy 2030, aims to increase the number of electric and hybrid vehicles while making all public transport carbon-free by 2050.[215] Ras Al Khaimah launched solar-powered bus shelters using locally sourced materials as part of the RAKTA plan 2023-2030, and Ras Al Khaimah Insurance offers reduced rates for battery electric vehicles.[216] Sharjah has integrated an 83% share of hybrid and eco-friendly vehicles into its taxi fleet and aims for 100% by 2027.[217]
- Uzbekistan's VNR of 2023 sets a target to convert 80% (around 6,500 units) of public transport to gas-fuelled or electrically powered units by 2030; it exempts electric vehicle imports from excise taxes, customs duties, and

automobile fees, and aims to increase the electrification of railway infrastructure to 60% by 2026.[218]
- In 2024, Viet Nam announced a target for 30% of cars and 22% of motorbikes to be electric by 2030.[219] The government developed a National Programme for Transition to Electric Transport Vehicles outlining a strategic framework and mandating that all road vehicles use electricity or clean energy sources by 2050.[220]

Several countries in Asia are advancing vehicle efficiency and fuel economy regulations to curb emissions, improve air quality and reduce fuel consumption.

- Thailand has developed and implemented fuel economy policies through its Eco Sticker programme, requiring every new car to display information on fuel consumption and CO_2 emissions.[221]
- Thailand's Thirteenth National Economic and Social Development Plan (2023-2027) aims to reduce transport-induced air pollution ($PM_{2.5}$) and greenhouse gas emissions 4% annually by 2027.[222] In 2024, Thailand's House of Representatives approved several drafts of the Clean Air Act, which introduces comprehensive air quality controls (including on pollution from transport) and was expected to be enacted in April 2025.[223]
- Viet Nam has established a fuel economy baseline for passenger cars with under nine seats and is exploring regulatory pathways for setting efficiency standards.[224]

In parallel, a growing number of countries in the region have sought to increase the use of renewable energy as well as low-carbon fuels in transport.

- India has stood out in the promotion of alternative fuels to cut vehicle emissions: the Ministry of Road Transport and Highways has set emission standards for fuels, to ensure safety and support the use of cleaner fuels while exploring how combining different transport modes could help lower fuel costs.[225]
- To further India's integration of renewables in transport, the government advanced its target of 20% ethanol blending in petrol from 2030 to 2025.[226]
- Indonesia has strong biofuel blending mandates in place, with a 35% blend in 2023 and plans to increase the share to 40% in 2025 and 50% in 2029.[227]
- Thailand's Thirteenth National Economic and Social Development Plan (2023-2027) aims to increase the share of renewables in final energy consumption at least 24% by 2027.[228]

Although the aviation industry is an important driver of economic development and employment in Asia, its sustainability hinges on decarbonisation measures.[229] Several countries in the region have launched sustainable aviation fuel initiatives, including mandates, incentives and blending targets. Thailand plans to replace 1% of conventional jet fuel with sustainable aviation fuel in 2026, while China, Japan and Singapore are scaling up sustainable aviation fuel production and supply chain investment.[230]

For maritime transport, a growing number of Asian countries have embraced green shipping corridors and engaged in other emission reduction measures. In 2024, Singapore and Australia signed a Memorandum of Understanding (MoU) formalising their co-operation on a Green and Digital Shipping Corridor, which would pilot solutions to enhance the resilience, efficiency and sustainability of global supply chains and logistics between the countries.[231]

Inland waterway transport had gained attention in countries with extensive river networks and coastlines. In China, inland shipping is being modernised and decarbonised through shore power and vessel electrification policies, and Viet Nam has included waterway transport improvements in its national climate and transport strategies.[232]

Although freight transport remains less prominent than passenger transport in many Asian NDCs, its profile has grown within national transport strategies. Several countries have introduced new measures to support a modal shift to rail and to electrify freight fleets.

- In 2024, China released the Action Plan for Reducing Costs and Improving Quality and Efficiency in Transportation and Logistics. Key targets for 2027 include reducing the cost of social logistics to around 13.5% of GDP, increasing rail freight tonne-kilometres by around 10%, growing rail-waterway intermodal container transport at ports by an average of 15% annually, and ensuring that over 80% of port cargo is transported via rail, waterways, enclosed belt conveyors and new energy vehicles.[233]
- To expand its rail freight sector, the Philippines' Development Plan 2023-2028 aims to connect cargo and freight rail infrastructure to strategic infrastructure such as ports.[234]
- In its Action Plan Logistics Development 2023-2027, Thailand sets a target for rail to carry 7% of the country's total freight volume on average during the period 2023-2025.[235]
- In 2024, Viet Nam laid out new national plans to electrify its transport sector, including targets for freight vehicles: electric trucks are expected to account for 15% of sales by 2030, 20% by 2040 and 25% by 2050. This represents the slowest growth among all road vehicle segments.[236]

Partnerships in action

SLOCAT partners engaged in dozens of actions during 2023-2024, including:

- The **Asian Transport Observatory (ATO),** developed with the support by the Asian Development Bank and the Asian Infrastructure Investment Bank, provides a platform to strengthen the knowledge base on transport in the Asia-Pacific region. The ATO supports comprehensive yet focused data towards enabling better informed investments, and policy decisions in the transport sector.[237]
- As of 2024, several Asian actors – including India, Thailand and non-governmental stakeholders in Azerbaijan – have endorsed the **Global MoU committing to 100% zero-emission truck and bus sales by 2040**.[238] Facilitated by the Drive to Zero initiative, the MoU promotes collaboration on policy harmonisation, technology deployment, and freight sector decarbonisation, offering a platform for both governments and cities to accelerate zero-emission freight adoption.[239]
- The **Leadership Group for Clean Transport in Asia** supports knowledge exchange and peer learning on sustainable urban mobility, and since 2022 has addressed themes including infrastructure for walking and cycling, electrification of public transport and climate-smart urban freight. The Group is convened by the Asia LEDS Partnership / ICLEI South Asia in collaboration with national and local governments, including Bangladesh, Bhutan, India, Indonesia, Lao PDR, Mongolia, Nepal, the Philippines, Sri Lanka and Thailand. In 2023, at the 16th Regional Environmentally Sustainable Transport (EST) Forum in Asia, the Group launched a communiqué underscoring six priority areas: intermodal, low-carbon freight transport systems; increasing the share of electric two-and three-wheelers, cars, trucks and buses; electric vehicle charging infrastructure and safe and resilient grid integration; robust fuel efficiency and emission standards; renewable energy; and zero emission energy sources for all transport modes.[240]
- **MobiliseYourCity** has supported the development of Sustainable Urban Mobility Plans (SUMPs) in Asian countries including India, Cambodia and Nepal.[241] Through technical co-operation, capacity building, and financing facilitation, the initiative helps cities mainstream climate, accessibility and inclusion in mobility planning.[242] Since 2022, projects in Kochi (India) and Battambang (Cambodia) have helped align local transport strategies with national climate targets.[243]
- The **NDC Transport Initiative for Asia**, launched in 2020 and active across China, India, Viet Nam, and regional platforms, supports the integration of transport decarbonisation into NDC implementation and long-term strategies.[244] The initiative engages national ministries, research institutions, and city governments in developing climate-aligned roadmaps; monitoring, reporting, and verification (MRV) systems; and finance strategies.[245]
- The Regional Action Programme for Sustainable Transport, implemented by the **United Nations Economic and Social Commission for Asia and the Pacific,** is focused on decarbonisation, digitalisation and resilience.[246] Through policy dialogues, capacity building, and support to member states, the initiative aims to align transport systems with the Sustainable Development Goals and the Paris Agreement. Recent work includes regional forums on freight efficiency, low-carbon fuels and the integration of transport in climate adaptation plans.[247]

MODULE 3 | 3.3

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Europe Regional Overview



DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	Europe	Global
Population size (2023)	745 million	8,000 million
Population growth (2015-2023)	0.3%	8.5%
Urban population share (2023)	75.3%	57%
Urban population growth (2015-2023)	2.7%	16%
GDP per capita (2023)	USD 28,945 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	12.5%	22.8%
Share of women employed in transport and storage (2023)	24.9%	15.6%
Motorisation rate (2022)	588.5 vehicles per 1,000 people	218.7 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	88%	52%
Share of rural population with access to all-weather primary and secondary roads (2020)	No data*	38%
Transport total GHG emissions (2023)	1,238 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	1.66 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 1,265 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport (2023)	10.1%	4.6%
Carbon intensity of electricity generation (2023)	283.9 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	9%	6%
Premature deaths attributable to air pollution by transport (2019)	4.1 per 100,000 people	2.3 per 100,000 people
Road casualties (2021)	5.8 per 100,000 people	15 per 100,000 people

Source: See endnote 1 for this section.

* The underlying data for rural access is based on the Rural Access Index, which does not cover high-income countries. As a result, no region-wide value is available for Europe.



KEY FINDINGS

Demand, use and access

- Transport is a key pillar of the European economy, employing roughly 30 million people (in transport and storage) in 2023 while providing essential goods and services and fostering socio-economic development. Overall, transport contributed around 5% to the European Union's (EU) GDP in 2022.
- Women continue to be underrepresented in most transport-related industries in Europe. The share of women employed in the European transport and storage sector has fallen from 25.7% in 2015 to 24.9% in 2023, placing the region second after North America.
- Europe had the world's highest share of convenient access to public transport for its urban populations, at 88% in 2020, reflecting generally well-developed public transport networks. Public transport ridership in Europe tends to be high compared to other world regions.
- In 2023, Europe was home to the top six countries worldwide with the highest shares of people living within 300 metres of a physically protected bike lane.
- Across Europe, most rural populations had near-universal access to all-season road infrastructure as of 2019 (including 98.5% of Albania's rural population and 99.9% of Romania's).
- Transport consistently ranked as the third largest category of household expenditure across European countries (after housing and food and non-alcoholic beverages) in 2023, accounting for between 11.5% and 13.5% of spending since 2000.
- Freight transport activity in Europe has continued to surge since 1995. Road freight transport dominates in the EU-27, representing 53.8% of total freight transport activity in 2022, followed by intra-EU maritime transport at 28%. The share of rail in EU freight transport activity has decreased relative to 1995 but is expected to grow in the coming decade.
- Passenger transport activity in Europe grew consistently between 2012 and 2019, with the EU recording more than 6,000 billion passenger-kilometres in 2019; it then fell sharply in 2020 and 2021 due to the COVID-19 pandemic.
- In the EU-27, total passenger transport activity by motorised transport (all types) reached an estimated 5,617 billion passenger-kilometres in 2022, or an average of 12,545 kilometres per person.
- Passenger transport activity and the shares of various modes in Europe stayed relatively constant from 2015 to 2022, with passenger cars continuing to accounting for the bulk (73%) of activity (measured in passenger-kilometres) in 2022. Buses and coaches represented 7.2%, railways 7.2%, tram and metro 1.2%, and motorised two-wheelers 2%.
- The appetite for long-distance rail travel in Europe, including night trains, has grown in the aftermath of COVID-19. Companies have responded with new service offerings.
- Cycling has received growing attention at the regional, national and local levels since 2019, a trend that was further amplified during COVID-19.
- While walking is a cornerstone of sustainable transport, its prevalence in Europe varies depending on the urban design, cultural norms and policy support. A 2024 study found that Europe had the second highest share of people walking (21.8%) among regions globally, after Africa (35.8%).
- In 2024, the motorisation rate (covering four-wheeled motor vehicles) in Europe was 588.5 vehicles per 1,000 people, well above the world average of 218.6 vehicles per 1,000 people. This was up from a European average of 554 vehicles per 1,000 people during 2016-2020.



KEY FINDINGS

- Government investment in transport infrastructure as a share of GDP in the EU was an estimated 3.2% in 2022, in line with the average over the period 2003-2022.
- Due to a decline in investments, the European railway network shrunk 1.3% between 2013 and 2023; however, rail networks grew 8.9% in Lithuania and 5.2% in Spain. Overall, the European high-speed rail network grew 47.2% during the decade.
- European sales of battery electric vehicles increased by double digits annually from 2017 to 2023, then stalled in 2024 at 2.2 million units (the same as in 2023). The region's total fleet of battery electric cars exceeded 8.7 million units in 2024, making up 4.7% of the overall car fleet. Electric vehicles accounted for 22% of new vehicle sales in both 2023 and 2024.
- Zero-emission buses and trucks have gained traction in Europe, with more than 21,600 zero-emission heavy-duty vehicles sold in 2024, up from 19,300 in 2023. Electric buses represented 2.2% of the region's bus fleet in 2024, while electric trucks made up only 0.42% of all trucks. In the fourth quarter of 2024, zero-emission city buses exceeded 50% of the new sales share in Europe, marking the first time their sales share surpassed that of internal combustion engine buses.
- Critical to the discourse on vehicle electrification, the carbon intensity of electricity generation in Europe was an estimated 287.5 grams of CO_2 equivalent per kilowatt-hour in 2024, showing a progressive 26% reduction since 2015.



Sustainability and climate trends

- Transport is one of the largest sources of greenhouse gas emissions in Europe, contributing 1,238 million tonnes of CO_2 equivalent in 2023 and accounting for 18% of the region's total emissions.
- The European transport sector (excluding international aviation and shipping) was responsible for 17.4% of global transport greenhouse gas emissions in 2023.
- Per capita transport greenhouse gas emissions in Europe, at 1.66 tonnes of CO_2 equivalent, were well above the global average in 2023, consistent with the region's high motorisation rates.
- European transport remains highly dependent on oil, although the average share of renewable energy used for road and rail transport in the EU increased from below 2% in 2005 to 10.1% in 2023.
- Oil-derived fuels accounted for 92.7% of the region's energy consumption in transport in 2022 (including international navigation and aviation).
- Despite intensified decarbonisation efforts, European transport emissions have not fallen significantly since 2005.
- Given their dominance in the region, passenger cars contributed nearly three-quarters (73.2%) of Europe's transport greenhouse gas emissions in 2022 (including domestic transport and international bunkers).
- Congestion in and around European cities cost an estimated USD 113.4 billion (EUR 110 billion) per year, or 1% of EU GDP (2012 research).
- Railways, which have the lowest emissions per kilometre and unit transported, contributed 0.3% of EU transport greenhouse gas emissions in 2022.
- Rail is the only EU transport sector in which greenhouse gas emissions have consistently fallen since 1990 (reduced by 70%), a trend largely attributable to the electrification of rail lines and to the declining carbon intensity of the EU electricity mix.
- In 2022, aviation contributed around 3.8% to 4% of the EU's total greenhouse gas emissions and 13.9% of the region's transport emissions (the second largest source after road transport); it has experienced the fastest emission growth among transport modes in recent decades.
- Maritime transport accounts for 3-4% of the EU's total CO_2 equivalent emissions. The maritime sector contributed more than a quarter (26%) of all methane emissions from the EU transport sector in 2022.
- Overall, the share of European greenhouse gas transport emissions from aviation and international maritime transport is projected to increase from around 26% in 2022 to more than 47% in 2050.

KEY FINDINGS

- In addition to being a leading contributor to climate change, Europe's transport sector is particularly vulnerable to its consequences. Transport costs associated with climate change-induced hazards are projected to increase sharply by the 2080s, potentially exceeding USD 10.35 billion (EUR 10 billion) annually, up 20-fold from 2024.
- Transport has been a major contributor to health-damaging air pollution, accounting for 9% of Europe's air pollutant emissions in 2019 and an estimated 569,000 deaths annually in the region.
- In 2022, more than 100 million Europeans were exposed to noise pollution from transport, primarily from road traffic, despite policies and regulations targeting motor vehicle sound levels and aircraft noise management.
- As of 2024, more than 20% of the region's population lived in areas where road traffic noise levels exceed EU regulations and can cause significant harm to health and well-being; this share rises above 30% if the stricter thresholds of the World Health Organization (WHO) are applied.
- Although Europe experienced the fewest road traffic fatalities globally in 2021, road crashes are the leading cause of death for individuals aged 5-29 years, resulting in one person dying every seven minutes and more than 62,000 people being killed on the region's roads every year. Despite a 3% decrease in road fatalities in 2024, most EU countries are not on track to meet the region's goal of halving road deaths by 2030.



Policy and investment developments

- Tackling transport emissions has been a key focus in Europe, and the European Green Deal, launched in 2021, is a key driver of EU efforts to become climate-neutral by 2050.
- The EU Clean Industrial Deal of 2025 outlines actions to turn decarbonisation into a driver for growth in key European industries, such as transport through a Sustainable Transport Investment Plan, a Hydrogen Mechanism and the implementation of the EU Critical Raw Materials Act. Contrary to expectations, the Deal does not include a 90% emission reduction target for 2040, which some argue risks creating regulatory and investment uncertainty in the transport sector.
- As of 25 May 2025, only five European countries – Andorra, Moldova, Montenegro, Switzerland and the United Kingdom – had submitted their third-generation Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change.
- The EU's second-generation NDC of 2023 reflects essential elements under the "Fit for 55" Package and aims to cut the region's greenhouse gas emissions 55% below 1990 levels by 2030.
- As of 25 May 2025, 29 European countries as well as the EU had submitted LT-LEDS (Long-Term Low Emission Development Strategies) to the UNFCCC.
- Four countries from Eastern Europe – Albania, Bosnia and Herzegovina, Moldova and Serbia – had submitted National Adaptation Plans (NAPs) to the UNFCCC as of 25 May 2025.
- The shift from fossil fuels to low-carbon fuels and electrification has been a major focus of EU legislative efforts. As part of its "Fit for 55" Package", in 2023 the EU adopted the revised Regulation 2019/631, which in practical terms would translate into the phase-out of new sales of ICE vehicles from 2035.
- Across Europe, fossil fuel subsidies have contributed to growing fossil fuel use and related greenhouse gas emissions. In 2023, fossil fuel subsidies in the region totalled USD 1,265 per capita, the second highest level after North America (USD 2,172 per capita) and well above the global average (USD 813 per capita).
- In 2024, the revised EU Regulation 2019/1242 set CO_2 emission standards for heavy-duty vehicles, calling for a near-complete phase-out of diesel-powered models by 2040.
- The EU's vehicle efficiency standards (expressed as CO_2 emission standards) for cars, vans and heavy-duty vehicles have narrowed the emissions gap needed to align road transport with the goals of the Paris Agreement, by 66% for heavy-duty vehicles and 75% for light-duty vehicles.

KEY FINDINGS



- In March 2025, the European Commission launched an Action Plan to respond to the rapid technological advancements and fierce global competition in the region's automotive sector; critics worry that the plan will derail EU transport emission efforts, as it proposes extending the timeline for automakers to comply with the 2025 emission reduction targets for cars and vans, up until 2027.
- Ongoing challenges related to international trade tariffs have triggered similar policy reactions at the national level.
- As of 2022, the EU had an average of 10 electric vehicles per charging station, and just three countries (Germany, France and the Netherlands) accounted for more than two-thirds of all EU charging points. Meanwhile, 10 countries did not have a single charger per 100 kilometres of road, presenting a challenge for electric cross-border travel in Europe.
- The EU's Sustainable and Smart Mobility Strategy prioritises infrastructure development for zero- and low-emission vehicles and sets a regional target for 1 million public charging points by 2025.
- The EU has achieved its target for 10% of all energy used in road and rail transport to originate from renewable sources by 2020, as set in Renewable Energy Directive 2009/28/EC.
- The revised Renewable Energy Directive EU/2023/2413 of 2023, part of the "Fit for 55" Package, set a new binding EU target for at least 42.5% renewable energy by 2030 (but aiming for 45%), through the use of renewable fuels, including hydrogen, in sectors where electrification is not yet a feasible option (such as shipping and aviation).
- In aviation and maritime transport, Europe has embraced measures including demand reduction and a shift to more sustainable modes. The ReFuelEU Aviation and FuelEU Maritime regulations, adopted in 2023, aim to support the uptake of renewable and low-carbon fuels in these sectors.
- The latest revisions of the EU Emission Trading System (ETS) will impact the aviation and maritime sectors, while a new, separate ETS2 aims to reduce emissions from road transport.
- Beyond decarbonisation, the EU has pursued policy efforts to tackle air pollution from the transport sector.
- As of 2024, the EU's revised Trans-European Transport Network (TEN-T) policy mandates urban nodes to adopt a Sustainable Urban Mobility Plan (SUMP) and to collect and regularly submit data on urban mobility indicators.
- Many European countries have adopted SUMPs and Urban Vehicle Access Regulations (UVARs) to advance a balance of transport modes while encouraging a shift towards higher-quality and sustainable transport. In Europe, 73% of UVARs were low- and zero-emission zones as of 2022.
- Closer integration between urban mobility and land use planning has gained traction in the region.
- As of 2025, 13 European countries had national cycling strategies in place. The EU's European Declaration on Cycling in 2024 marked an important turning point, elevating cycling to a strategic policy priority and recognising it as "the most sustainable, accessible and inclusive, low-cost and healthy form of transport and recreation".
- In 2023, 69% of European countries had national walking policies or similar measures, although only 6 countries had specific national walking policies. The first-ever Pan-European Master Plan on Walking, launched in 2024, has spurred efforts to work with national governments to develop and implement walking policies.

Context, challenges and opportunities

Transport is a key pillar of the European economy and contributes significantly to the region's gross domestic product. Europe's have the greatest access to public transport globally as well as near-universal access to all-weather road infrastructure for rural residents.

Yet transport remains the only major sector of the European economy where greenhouse gas emissions have stayed well above 1990 levels and have only recently started to dip.[2] Europe's transport sector accounted for 17.4% of global transport greenhouse gas emissions (excluding international aviation and shipping) in 2023.[3] Consistent with its high motorisation rates, Europe has relatively high per capita transport greenhouse gas emissions, at 1.66 tonnes of carbon dioxide (CO_2) equivalent in 2023.[4]

Despite extensive legislation to reduce the climate and environmental footprint of European transport, the sector could account for nearly half of total EU emissions by 2030, based on current policies under the European Green Deal aimed at making the EU climate-neutral by 2050.[5] Getting on track to climate neutrality will require the EU to reduce its transport emissions 90% by 2050 relative to 1990 levels.[6]

In addition to being a prime contributor to climate change, Europe's transport sector is particularly vulnerable to its consequences. The costs related to transport infrastructure losses from climate change-induced hazards are projected to reach up to USD 10.3 billion (EUR 10 billion) by the 2080s, up 20-fold from the 2024 level.[7]

Beyond its climate impacts, transport contributed around 9% of Europe's air pollution emissions, resulting in around 4.1 premature deaths per 100,000 people in 2019.[8] Advances in road transport have enabled large declines in air pollutant emissions, but this progress has not been spread evenly across pollutants and transport modes, with air pollutants from aviation and shipping still increasing.[9] Progress in reducing transport noise has lagged despite policies and regulations targeting motor vehicle sound levels and aircraft noise management.[10] Although Europe is considered the safest region globally for road transport, road crashes remained a leading cause of death for children and young adults, claiming more than 62,000 lives in 2021; most EU countries are not on track to meet the goal of halving road deaths by 2030.[11]

The share of women employed in transport and storage was only around 24.9% in 2023 and has remained relatively constant over the past 10 years.[12] Addressing transport affordability is also a concern, with transport consistently ranking as the third largest category of household expenditure in Europe (accounting for between 11.5% and 13.5% of spending since 2000).[13] This reflects structural characteristics of European transport systems, including a high reliance on private car ownership, as well as rising fuel prices and inflation.

Transport is broadly recognised as a critical enabler of the European Green Deal, the Paris Agreement on climate change and the 2030 Agenda for Sustainable Development. Achieving the ambitions set by these policy frameworks will require co-ordinated policy efforts at the EU, national and local levels to accelerate the uptake of sustainable transport solutions, contain inefficient transport demand and shift activity to more sustainable modes.

However, the implementation of such measures is facing mounting challenges. Tight public budgets, high debt levels and shifting political priorities have constrained action across Europe. Recent trade tensions, particularly among the EU, China, and the United States, alongside concerns from European automakers about job losses and competitiveness, have prompted a rethinking of electric vehicle policies and a weakening of legislation to phase out internal combustion engine (ICE) vehicles, with a view to prioritise local production and protect domestic industries. This operating context has inspired initiatives such as the EU's Clean Industrial Deal and the Industrial Action Plan for the European Automotive Sector, which aim to align decarbonisation objectives with industrial growth while securing critical battery supply chains for a homegrown electric vehicle industry.[14]

Ongoing geopolitical conflicts, notably in Ukraine and the Middle East, as well as the lingering impacts of the COVID-19 pandemic have underscored the urgency of strengthening Europe's energy independence. Transport remains one of the region's most fossil fuel-dependent sectors, with much of the energy imported. This has spurred European efforts to expand renewable energy use, electrify transport and reduce overall demand. As of 2023, renewables accounted for 10.1% of the energy used in EU road and rail transport (up from less than 2% in 2005), and battery electric vehicles represented 22% of new vehicle registrations in 2024, with large variations across European countries.[15]

Europe remains heavily reliant on imports for critical electric vehicle battery materials, such as lithium (where the region has 100% dependence), nickel (75%) and aluminium (58%).[16] The need to ensure a secure and sustainable supply of critical raw materials has inspired EU initiatives such as the Critical Raw Materials Act of 2023, aimed at lowering industry dependence on single-country suppliers.[17]

Meanwhile, tensions persist between boosting aviation connectivity and curbing emissions, as illustrated by debates over airport expansions and domestic flight bans. At the



national and local levels, discussions have gained traction around free public transport and urban vehicle access regulations (UVARs), reflecting a growing momentum to make mobility more accessible, inclusive and sustainable.[18]

Not least, weakened global climate and sustainability multilateralism, as exemplified by the US withdrawal from the Paris Agreement, has intensified pressure on the EU to double down on its role as a global climate leader. This, however, has been challenged by a wave of political changes across the continent and by broader global economic instability.[19] The significant delay in the EU's submission of its third-generation Nationally Determined Contribution (NDC) towards reducing emissions under the Paris Agreement has been attributed to European elections and to EU plans to first approve a new climate target for 2040.[20]

Demand, use and access

Transport is a key pillar of the European economy, employing roughly 30 million people (in transport and storage) in 2023 while providing essential goods and services and fostering socio-economic development.[21] Overall, transport contributed around 5% to the EU's GDP in 2022.[22]

Women continue to be underrepresented in most transport-related industries in Europe. The share of women employed in the European transport and storage sector has fallen from 25.7% in 2015 to 24.9% in 2023, placing the region second after North America.[23]

Europe had the world's highest share of convenient access to public transport for its urban populations, at 88% in 2020, reflecting generally well-developed public transport networks.[24] Public transport ridership in Europe tends to be high compared to other world regions.

- Estonia, with its nationwide free public transport policy, ranked first in Europe with 98.3% of its urban population enjoying convenient access to public transport, followed by Liechtenstein (96.8%), Spain (95.8%) and Austria (95.7%).[25]
- In 2022, Budapest (Hungary) was by far the city with the highest public transport ridership per capita worldwide, at around 727 trips; Prague (Czech Republic) took second place globally at 687 trips, followed by Warsaw (Poland) at 452 trips.[26]

In 2023, Europe was home to the top six countries worldwide with the highest shares of people living within 300 metres of a physically protected bike lane.[27] Proximity

to safe cycling infrastructure is a key factor in encouraging people to use cycling as their preferred mode of transport. The top six countries globally were Finland (83% of the population near a bike lane), Denmark (82%), Sweden (74%), the Netherlands (69%), Germany (53%) and Norway (53%).[28] By comparison, only 5% of the world's population on average lived near protected bikeways in 2023.[29]

Across Europe, most rural populations had near-universal access to all-season road infrastructure as of 2019 (including 98.5% of Albania's rural population and 99.9% of Romania's).[30] This reflects in part EU and national funding to boost regional development and close connectivity gaps. (Note that Rural Access Index data for high-income countries are less comprehensive than for lower-income countries.)

Transport consistently ranked as the third largest category of household expenditure across European countries (after housing and food and non-alcoholic beverages) in 2023, accounting for between 11.5% and 13.5% of spending since 2000.[31] Since 2015, consumer prices for personal transport as well as transport services have continued to outpace overall inflation.[32] This reflects the essential role of transport in daily lives as well as structural characteristics of the European transport sector, such as the dominant role of private car ownership and rising fuel prices.

Freight transport activity in Europe has continued to surge since 1995.[33] **Road freight transport dominates in the EU-27, representing 53.8% of total freight transport activity in 2022, followed by intra-EU maritime transport at 28%.**[34] Overall, European freight transport suffered much less than passenger traffic during the COVID-19 pandemic and recovered fully by 2021.[35]

The share of rail in EU freight transport activity has decreased relative to 1995 but is expected to grow in the coming decade.[36] EU legislation is aimed at promoting a modal shift from roads to railways and inland waterways to boost energy efficiency and reduce emissions of greenhouse gases and air pollutants.[37]

- Railways accounted for 11.9% of EU freight transport, inland waterways for 3.5% and intra-EU air transport for only 0.1% in 2022.[38]
- The EU's Sustainable and Smart Mobility Strategy aims to raise rail freight's share to 30% by 2030.[39]

Passenger transport activity in Europe grew consistently between 2012 and 2019, with the EU recording more than 6,000 billion passenger-kilometres in 2019; it then fell sharply in 2020 and 2021 due to the COVID-19 pandemic.[40] **In the EU-27, total passenger transport activity by motorised transport (all types) reached an estimated 5,617 billion passenger-kilometres in 2022, or an average of 12,545 kilometres per person.**[41] The European Commission projects that passenger transport activity across all modes will increase 15.5% between 2015 and 2030, to reach 6,487 billion passenger-kilometres.[42]

Passenger transport activity and the shares of various modes in Europe stayed relatively constant from 2015 to 2022, with passenger cars continuing to accounting for the bulk (73%) of activity (measured in passenger-kilometres) in 2022.[43] **Buses and coaches represented 7.2%, railways 7.2%, tram and metro 1.2%, and motorised two-wheelers 2%.**[44] Intra-EU air transport constituted 9.1% (up 1.2% from 2015 to 2022), and intra-EU maritime transport represented 0.3% (down 8%).[45]

The appetite for long-distance rail travel in Europe, including night trains, has grown in the aftermath of COVID-19. Companies have responded with new service offerings.

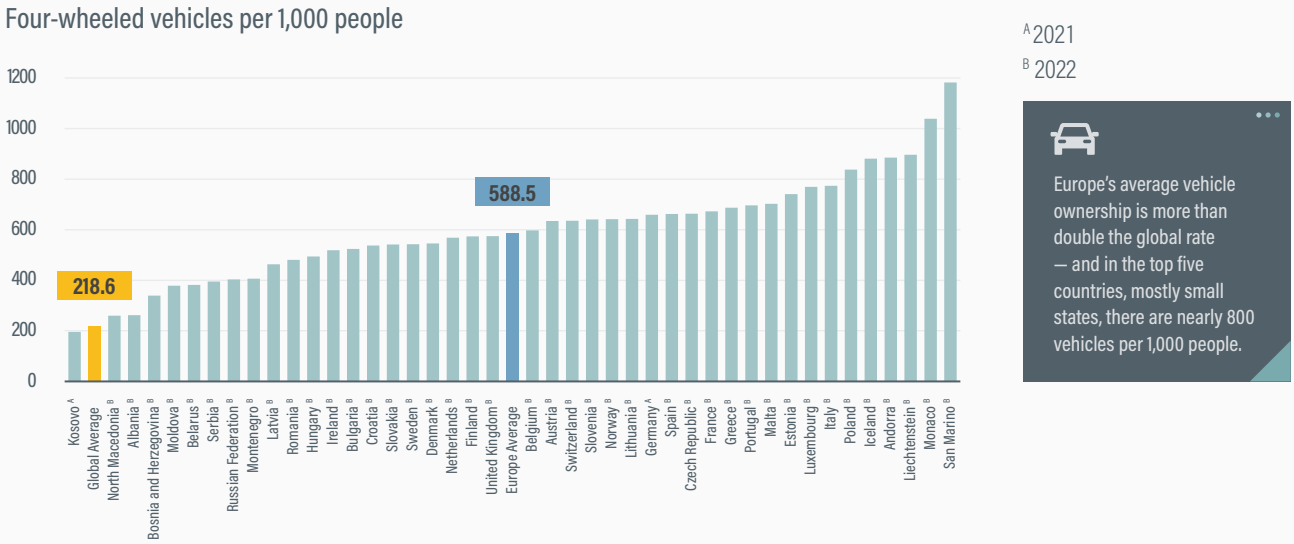
- Since September 2024, Austria's national railway company ÖBB has operated "NightJet" night train services between Munich and Bologna, Salzburg and Florence, and Vienna and Rome.[46]
- A daytime high-speed train has linked Paris and Berlin since December 2024.[47]
- Germany's Deutsche Bahn and French railway company SNCF plan to launch a direct, high-speed rail route from Munich to Paris at the end of 2026 with five daily direct connections.[48]

Cycling has received growing attention at the regional, national and local levels since 2019, a trend that was further amplified during COVID-19. However, the data show different realities across zones.

- In Paris (France), 84 kilometres of cycling lanes have been added since 2020, and bike use grew 71% between the end of the pandemic lockdowns and 2023.[49] As of 2024, more people were cycling in inner Paris than using cars, with only 4.3% of trips made by driving, 11.2% by bicycle, 30% by public transport and 53% by walking.[50]
- According to EuroVelo, a network of 17 long-distance cycle routes that cross and connect Europe, cycle traffic increased 1.4% in rural areas and 1.3% in urban areas in 2024, but fell 0.7% in peri-urban areas.[51]
- Cycle traffic on three EuroVelo routes – #14 "Waters of Central Europe", #11 "East Europe Route" and #1 "Atlantic Coast Route" – increased in 2024, with the latter recording 6% growth that year.[52]

While walking is a cornerstone of sustainable transport, its prevalence in Europe varies depending on the urban

FIGURE 1. Motorisation rates per 1,000 people in Europe, various years



Source: See endnote 57 for this section.

design, cultural norms and policy support.[53] **A 2024 study found that Europe had the second highest share of people walking (21.8%) among regions globally, after Africa (35.8%).**[54]

- A study of 10 European countries found that the share of daily trips made by walking ranged from 9% in Ireland to 26% in the United Kingdom.[55]
- A 2024 study showed significant variation in modal shares across European cities, with the share of walking and cycling ranging from 12% in Málaga (Spain) to 75% in Utrecht (Netherlands).[56]

In 2024, the motorisation rate (covering four-wheeled motor vehicles) in Europe was 588.5 vehicles per 1,000 people, well above the world average of 218.6 vehicles per 1,000 people (Figure 1)**.**[57] **This was up from a European average of 554 vehicles per 1,000 people during 2016-2020.**[58] Motorisation rates vary widely across the continent, from a high of 1,182.9 vehicles per 1,000 people in the microstate of San Marino in 2022, to a low of 195.3 vehicles per 1,000 people in Kosovo in 2021 (below the global average).[59]

Government investment in transport infrastructure as a share of GDP in the EU was an estimated 3.2% in 2022, in line with the average over the period 2003-2022.[60] Investment in transport infrastructure is a critical element to assess connectivity and the sustainable functioning of economies. In 2022, the region's highest total expenditures in road transport construction were in Poland (USD 8,250 million, down from USD 8,970 in 2020) and the Netherlands (USD 7,854 million, down from USD 8,130 million in 2020).[61]

Due to a decline in investments, the European railway network shrunk 1.3% between 2013 and 2023; however, rail networks grew 8.9% in Lithuania and 5.2% in Spain.[62] **Overall, the European high-speed rail network grew 47.2% during the decade.**[63] In Spain, the network of high-speed lines increased 66% from 1,919 kilometres in 2013 to 3,190 kilometres in 2023, the highest such growth in Europe.[64] France, the continent's pioneer of high-speed rail, ranked second with 35% growth in its high-speed network (to 2,748 kilometres in 2023), followed by Germany with a 32% increase (to 1,163 kilometres).[65]

European sales of battery electric vehicles increased by double digits annually from 2017 to 2023, then stalled in 2024 at 2.2 million units (the same as in 2023).[66] **The region's total fleet of battery electric cars exceeded 8.7 million units in 2024, making up 4.7% of the overall car fleet.**[67] **Electric vehicles accounted for 22% of new vehicle sales in both 2023 and 2024.**[68] In addition, 110,000 battery electric vans were sold in 2024, representing 5.3% of all new vans registered in the region (down slightly from 130,000 units sold and a 6.3% share in 2023).[69] The European countries with the highest market shares of battery electric and plug-in hybrid passenger cars in 2024 were Norway (92%), Sweden (58%) and Denmark (55%).[70]

Zero-emission buses and trucks have gained traction in Europe, with more than 21,600 zero-emission heavy-duty vehicles sold in 2024, up from 19,300 in 2023.[71] **Electric buses represented 2.2% of the region's bus fleet in 2024, while electric trucks made up only 0.42% of all trucks.**[72] **In the fourth quarter of 2024, zero-emission city buses exceeded 50% of the new sales share in Europe, marking the first time their sales share surpassed that of ICE buses.**[73]

- In seven European countries – Bulgaria, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands and Romania – only zero-emission city bus models were sold in 2024.[74]
- Germany has fuelled growth in zero-emission trucks, with 1,200 heavy-duty trucks (1.7% sales share) and 2,692 light- and medium trucks (16% sales share) sold in 2024.[75]

Critical to the discourse on vehicle electrification, the carbon intensity of electricity generation in Europe was an estimated 287.5 grams of CO_2 equivalent per kilowatt-hour (kWh) in 2024, showing a progressive 26% reduction since 2015.[76] Europe's carbon intensity of electricity was well below that in Asia (514.3 grams of CO_2 equivalent per kilowatt-hour), Africa (501.2 grams) and Oceania (335.9 grams) but above that in North America (279.2 grams) and Latin America and the Caribbean (272.3 grams).[77]

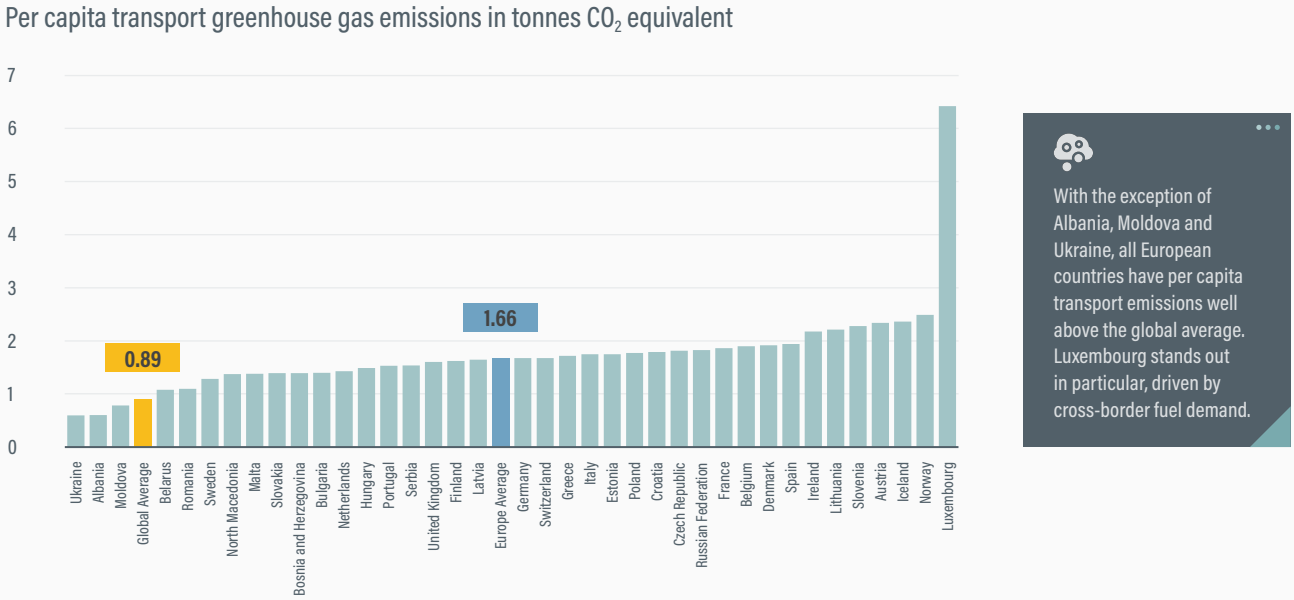
Sustainability and climate trends

Transport is one of the largest sources of greenhouse gas emissions in Europe, contributing 1,238 million tonnes of CO_2 equivalent in 2023 and accounting for 18% of the region's total emissions.[78] **The European transport sector (excluding international aviation and shipping) was responsible for 17.4% of global transport greenhouse gas emissions in 2023.**[79] Transport emissions in Europe have plateaued at around 1.2 gigatonnes since 2009, although they fell slightly by 0.7% in 2023.[80]

Per capita transport greenhouse gas emissions in Europe, at 1.66 tonnes of CO_2 equivalent, were well above the global average in 2023 (Figure 2)**, consistent with the region's high motorisation rates.**[81] European per capita transport emissions were the third highest globally after North America (4.99 tonnes) and Oceania (2.68 tonnes).[82] By country, the region's highest per capita transport emissions were in Luxembourg (6.4 tonnes) and Norway (2.5 tonnes), and the lowest were in Ukraine and Albania (both roughly 0.6 tonnes).[83] Per capita emissions in Luxembourg are influenced by strong cross-border fuel demand, with foreign vehicles representing 71% of energy consumption in the transport sector in 2022.[84]

European transport remains highly dependent on oil,

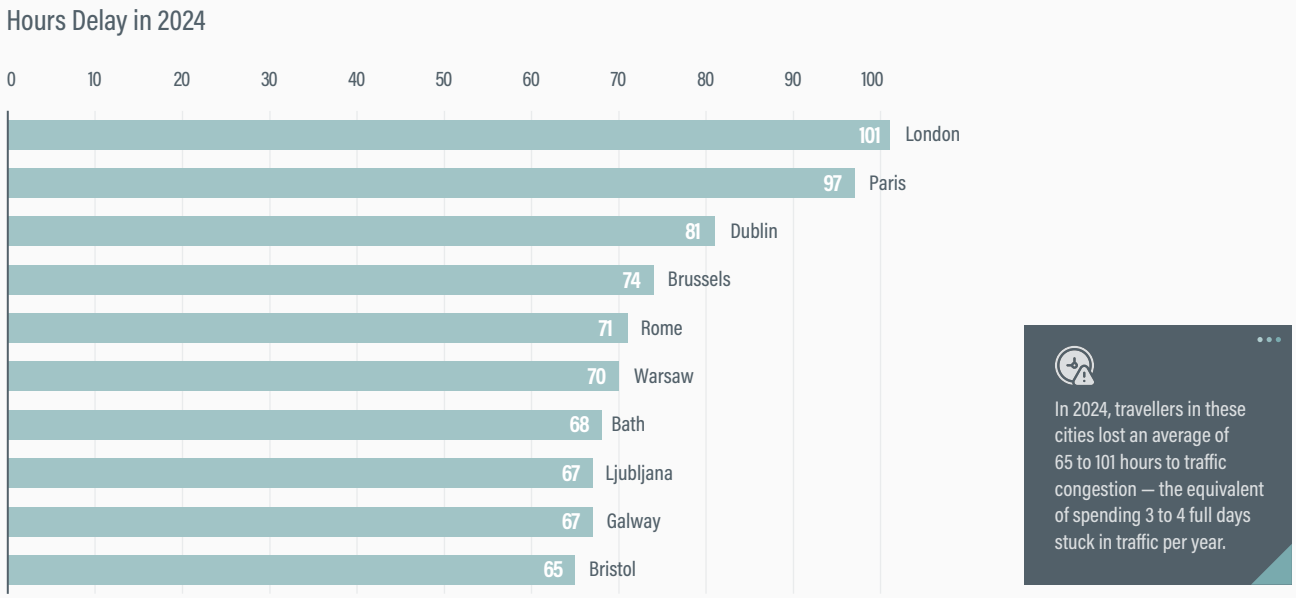
FIGURE 2. Per capita transport greenhouse gas emissions in Europe, 2023



With the exception of Albania, Moldova and Ukraine, all European countries have per capita transport emissions well above the global average. Luxembourg stands out in particular, driven by cross-border fuel demand.

Source: See endnote 81 for this section.

FIGURE 3. Hours of annual average traffic delays in major European cities, 2024



Source: See endnote 95 for this section.

although the average share of renewable energy[i] used for road and rail transport in the EU increased from below 2% in 2005 to 10.1% in 2023.[85] **Oil-derived fuels accounted for 92.7% of the region's energy consumption in transport in 2022 (including international navigation and aviation).**[86] Most of this oil use was for road transport, representing 73.6% of the EU total in 2022.[87] However, the picture varied by country (see Policy developments section).[88]

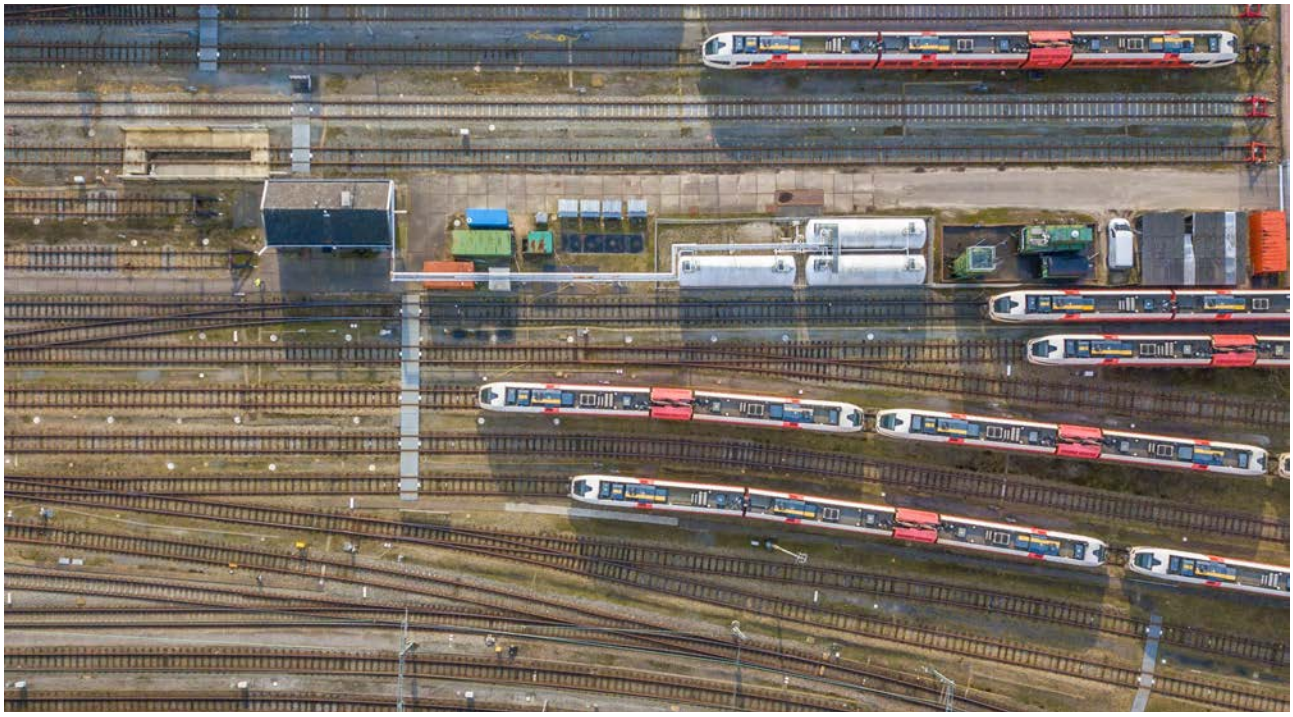
Despite intensified decarbonisation efforts, European transport emissions have not fallen significantly since 2005.[89] The region's transport greenhouse gas emissions decreased only 0.8% in 2023, and national-level transport emissions are projected to dip below 1990 levels only by 2032.[90] Under current policies and measures, European transport emissions are projected to remain 4% above 1990 levels by 2030; however, with additional policies focused on low-carbon fuels, zero-emission technologies, and a modal shift from private cars to public transport, emissions could fall 8% below 1990 levels by 2030.[91]

Given their dominance in the region, passenger cars contributed nearly three-quarters (73.2%) of Europe's transport greenhouse gas emissions in 2022 (including domestic transport and international bunkers).[92] Despite improvements in vehicle and fuel efficiency, and growth in the European electric vehicle market in 2023, tailpipe emissions from passenger cars have remained high (at nearly 500 million tonnes of CO_2 annually), driven by rising vehicle numbers and sizes, and longer distances travelled.[93]

Congestion in and around Europe's urban centres cost the region an estimated USD 113.4 billion (EUR 110 billion) per year, or 1% of the EU's GDP, based on research from 2012.[94] The European city with the highest average traffic delays in 2024 was London (101 hours of delay), followed by Paris with 97 hours of delay and Dublin with 81 hours of delay (Figure 3).[95]

Railways, which have the lowest emissions per kilometre and unit transported, contributed 0.3% of EU transport greenhouse gas emissions in 2022.[96] **Rail is the only EU transport sector in which greenhouse gas emissions have consistently fallen since 1990 (down more than 70%), a trend largely attributable to the electrification of rail lines and to the declining carbon intensity of the EU electricity mix.**[97] Railways in the EU produced 3.5 million tonnes of CO_2 equivalent in 2022, down 8% from 2021.[98]

i Including biofuels, renewable electricity, or hydrogen and synthetic fuels of renewable origin.



- Of the 202,000 kilometres of rail lines operating in the EU in 2022, nearly 57% had been electrified, a 31% increase compared with 1990.[99]
- Luxembourg had the region's highest share of electrified railway lines in 2023, at 96.7%.[100]

In 2022, aviation contributed around 3.8% to 4% of the EU's total greenhouse gas emissions and 13.9% of the region's transport emissions (the second largest source after road transport); it has experienced the fastest emission growth among transport modes in recent decades.[101] Emissions from international aviation in the EU fell 58% in 2020 as a result of the COVID-19 pandemic, but then rose 25% in 2021 and 57% in 2022.[102] Europe's demand for aviation is expected to return to 2019 levels by 2025, and aviation greenhouse gas emissions are projected to show the strongest increase among transport modes by 2030.[103] Research by the European Aviation Safety Agency found that two-thirds of the sector's global warming impact in 2018 was from non-CO_2 effects (including persistent contrails, nitrogen oxides and soot particles), leading the EU to initiate work in 2025 to measure these effects and include these emissions in the EU Emission Trading System as of 2027.[104]

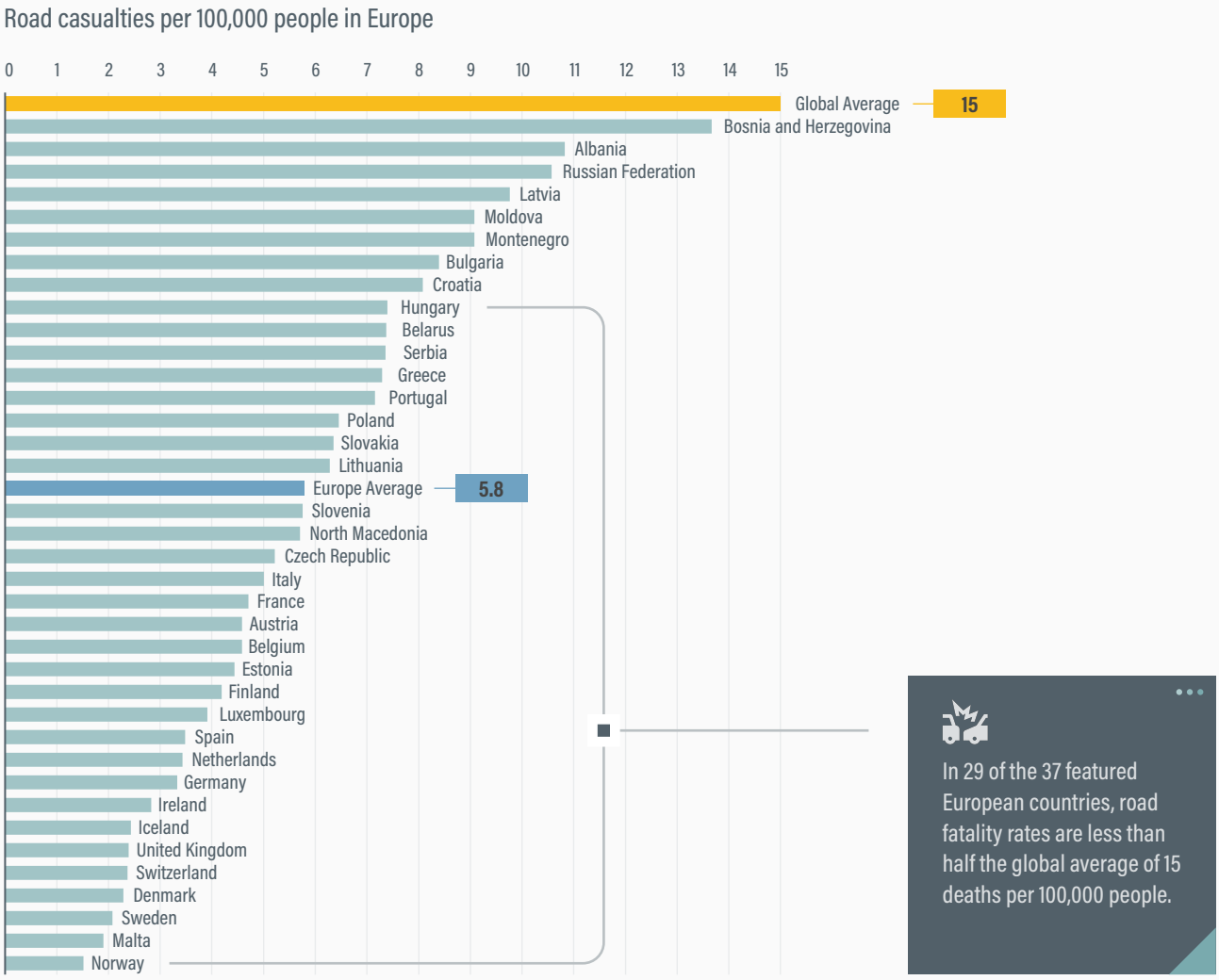
Maritime transport accounts for 3-4% of the EU's total CO_2 equivalent emissions.[105] **The maritime sector contributed more than a quarter (26%) of all methane emissions from the EU transport sector in 2022.**[106] EU emissions of methane – a greenhouse gas roughly 80 times more potent than CO_2 at warming the Earth on a 20-year time scale – have at least doubled between 2018 and 2023.[107] **Overall, the share of European greenhouse gas transport emissions from aviation and international maritime transport is projected to increase from around 26% in 2022 to more than 47% in 2050.**[108]

In addition to being a leading contributor to climate change, Europe's transport sector is particularly vulnerable to its consequences. Transport costs associated with climate change-induced hazards are projected to increase sharply by the 2080s, potentially exceeding USD 10.35 billion (EUR 10 billion) annually, up 20-fold from 2024.[109] Heatwaves in the region have led to road melting, failures of railway assets, and speed restrictions to prevent track buckling, causing major disruptions and impeding connectivity.[110] Ports, especially in northern and western Europe, are particularly vulnerable to sea-level rise, storm surges and changes in wave agitation.[111]

- Across Europe, the annual damage to transport infrastructure in the 2000s was around USD 828 million (EUR 800 million), of which an estimated 51% was from river flows and 27% from heatwaves.[112]
- Heatwaves are expected to account for 92% of the total damage to the region's transport infrastructure by the 2080s, particularly affecting roads and railways.[113]

Transport has been a major contributor to health-damaging air pollution, accounting for 9% of Europe's air pollutant emissions in 2019 and an estimated 569,000 deaths annually in the region.[114] Although progress has been made in reducing air pollution from road transport, emissions of certain air pollutants from aviation and shipping have continued to increase.[115]

FIGURE 4. Road casualties per 100,000 people in Europe, 2021



Source: See endnote 122 for this section.

- Transport contributes more than half of all nitrogen oxide (NO_x) emissions in the region, which not only harm human health but also contribute to acid rain formation and the acidification of oceans.[116]
- Thanks to advances in road transport, the EU has observed significant decreases in particulate matter, with emissions of PM_{10} and $PM_{2.5}$ dropping 46% and 58%, respectively, between 2000 and 2022.[117]

In 2022, more than 100 million Europeans were exposed to noise pollution from transport, primarily from road traffic, despite policies and regulations targeting motor vehicle sound levels and aircraft noise management.[118] As of 2024, more than 20% of the region's population lived in areas where road traffic noise levels exceed EU regulations and can cause significant harm to health and well-being; this share rises above 30% if the stricter thresholds of the World Health Organization (WHO) are applied.[119]

Although Europe experienced the fewest road traffic fatalities globally in 2021, road crashes are the leading cause of death for individuals aged 5-29 years, resulting in one person dying every seven minutes and more than 62,000 people being killed on the region's roads every year.[120] Despite a 3% decrease in road fatalities in 2024, most EU countries are not on track to meet the region's goal of halving road deaths by 2030.[121] In 2021, Bosnia and Herzegovina recorded the highest number of road casualties per 100,000 people, at 13.67, while Norway had the lowest number (1.52) (Figure 4).[122]

Policy and investment developments

Tackling transport emissions has been a key focus in Europe, and the European Green Deal, launched in 2021, is a key driver of EU efforts to become climate-neutral by 2050.[123] This EU climate law set an intermediate target of reducing net greenhouse gas emissions at least 55% below 1990 levels by 2030.[124] Since the launch of the European Green Deal, the EU and individual countries in the region have prepared Nationally Determined Contributions (NDCs), Long-Term Low Emission Development Strategies (LT-LEDS) and National Adaptation Plans (NAPs) in the framework of the United Nations Framework Convention on Climate Change (UNFCCC). The region has also pursued other legislative and policy reforms and initiatives.

- The EU Sustainable and Smart Mobility Strategy of 2020 is centred on supporting the transport sector's transformation by: 1) making all modes more sustainable, 2) shifting passenger and goods transport towards more sustainable alternatives in a multi-modal transport system, and 3) setting the right incentives to drive the transition, in particular by internalising the external costs of transport through carbon pricing and infrastructure charging mechanisms.[125]
- The "Fit for 55" Package of 2021 puts forward regulatory reforms on transport, energy, climate, and taxation, with a view to ensuring that the EU is on track to reduce emissions at least 55% by 2030.[126]
- The EU is seeking to revise its Emission Trading System (ETS) to include the aviation and maritime sectors, and to develop a new, separate ETS2 to reduce emissions from road transport.[127]
- The EU Zero Pollution Action Plan sets ambitions for 2030 to reduce the health impacts of air pollution by 55% and the share of people chronically disturbed by transport noise by 30%, compared to 2005.[128]

The EU Clean Industrial Deal of 2025 outlines actions to turn decarbonisation into a driver for growth in key European industries, such as transport through a Sustainable Transport Investment Plan, a Hydrogen Mechanism and the implementation of the EU Critical Raw Materials Act.[129] **Contrary to expectations, the Deal does not include a 90% emission reduction target for 2040, which some argue risks creating regulatory and investment uncertainty in the transport sector.**[130] The Deal is designed to lower energy prices, create quality jobs, and foster an enabling environment for companies to thrive, and includes components relevant for the decarbonisation of the aviation and shipping industries.

- The Deal commits to boosting annual EU investments in transport, energy, and industrial innovation and to scale up by around USD 496.8 billion (EUR 480 billion) compared to the previous decade.[131]
- A dedicated Sustainable Transport Investment Plan, expected in 2025, will outline short- and medium-term measures to prioritise support for specific renewable and low-carbon fuels for aviation and waterborne transport. To allow these greener alternatives to compete on a level playing field, it will be paramount to include measures that bridge their current price gap with fossil fuels.[132]
- A Hydrogen Mechanism will seek to connect suppliers with potential buyers (e.g., airlines and shipping companies) while leveraging financing and de-risking instruments.[133]
- The Deal seeks to speed implementation of the Critical Raw Materials Act of 2023, which aims to ensure a secure and sustainable supply of critical raw materials for European industries, such as transport, while lowering EU dependence on imports from single-country suppliers.[134] Lithium, cobalt and nickel are indispensable for the region's shift to zero-emission electric transport.

As of 25 May 2025, only five European countries – Andorra, Moldova, Montenegro, Switzerland and the United Kingdom had submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their third generation Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change.[135] Of these five NDCs, two (Moldova and Switzerland) include targets for reducing transport greenhouse gas emissions.[136]

- Moldova's 2025 NDC sets out a target to reduce transport greenhouse gas emissions 52% below 1990 levels by 2030, as part of efforts to cut economy-wide emissions 75% below 1990 levels by 2035 and to achieve carbon neutrality by 2050.[137] The NDC outlines several mitigation and adaptation measures in the transport sector, while emphasising the importance of a just transition.[138]
- Switzerland's 2025 NDC aims to cut national transport emissions 41% below 1990 levels by 2035, 57% by 2040 and 100% by 2050.[139] It introduces targets and actions specific to transport emissions reduction and adaptation, and refers directly to the outcomes of the First Global Stocktake adopted at the 2023 UN Climate Change Conference (COP 28), which calls on countries to accelerate emission reductions from road transport by developing infrastructure and deploying zero- and low-emission vehicles, while transitioning away from fossil fuels in a just, orderly and equitable manner to achieve net zero emissions by 2050.[140]

For the latest analysis of transport commitments in NDCs, including those expected ahead of COP 30, see the NDC Transport Tracker by GIZ and SLOCAT*, a database on ambition, targets and policies in NDCs and Long-Term Strategies.*[141]



The EU's second-generation NDC of 2023 reflects essential elements under the "Fit for 55" Package and aims to cut the region's greenhouse gas emissions 55% below 1990 levels by 2030.[142] This is more ambitious than the 40% target set in the EU's first NDC.[143] The EU is expected to release its third-generation NDC at the 2025 UN Climate Change Conference (COP 30); the delay in submission has been attributed to European elections and to plans to first approve a new EU climate target for 2040.[144]

As of 25 May 2025, 29 European countries as well as the EU had submitted LT-LEDS (Long-Term Low Emission Development Strategies) to the UNFCCC.[145] LT-LEDS complement NDCs and reflect countries' strategies to 2050 and beyond. Ireland, Serbia and Switzerland were the only three European countries to submit updated LT-LEDS during the 2023-2024 period.

- Ireland's LT-LEDS of 2024 aims to reduce the country's transport emissions 50% below 2018 levels by 2030 and to achieve a carbon-neutral transport sector by 2050.[146] To reach this goal, Ireland's Climate Action Plan 2024 calls for reducing road transport demand, shifting to sustainable modes of transport and electrifying vehicle fleets. The Action Plan sets concrete targets including a 50% increase in daily active travel journeys and a 130% increase in daily public transport journeys by 2030.[147]
- Switzerland's LT-LEDS of 2024 targets a 57% reduction in transport emissions by 2040 and a completely emission-free transport sector by 2050.[148] Following the latest revision of the country's CO_2 Act in 2024, proceeds from emission rights for aircraft will be used to fund international night train connections and to develop sustainable aviation fuels.[149]

Four countries from Eastern Europe – Albania, Bosnia and Herzegovina, Moldova and Serbia – had submitted National Adaptation Plans (NAPs) to the UNFCCC as of 25 May 2025.[150] NAPs support countries, especially developing and least-developed countries, in planning and implementing medium- and long-term adaptation to climate change.

- Moldova's NAP of 2024 calls for better integrating climate change considerations into sectoral planning and budgeting, in recognition of the severe damage to transport infrastructure caused by extreme weather events, as well as the related social and economic costs.[151] The NAP recommends applying climate-resilient standards throughout the entire life cycle of transport infrastructure – from design to construction and maintenance – as well as modernising road drainage systems, improving rainwater collection, and afforesting areas affected by floods and landslides adjacent to roads.[152]
- Serbia's NAP of 2024 focuses mainly on enhancing the



resilience of road transport infrastructure to the impacts of climate change, and also recognises the need to revise construction standards and practices and to adapt the transport sector regulatory framework.[153] The NAP calls for improvements in the early warning system for road infrastructure.[154]

The shift from fossil fuels to low-carbon fuels and electrification has been a major focus of EU legislative efforts. As part of its "Fit for 55" Package", in 2023 the EU adopted the revised Regulation 2019/631, which in practical terms would translate into the phase-out of new sales of ICE vehicles from 2035.[155] The regulation requires reductions in CO_2 emissions of 55% for new cars and 50% for new vans from 2030 to 2034, and 100% from 2035 (all compared to 2021 levels).[156] This transition to zero-emission vehicles would put CO_2 emissions from EU road transport on a path to peak at nearly 800 million tonnes as early as 2025, and then fall by around one-quarter by 2035.[157]

Across Europe, fossil fuel subsidies have contributed to growing fossil fuel use and related greenhouse gas emissions. In 2023, fossil fuel subsidies in the region totalled USD 1,265 per capita, the second highest level after North America (USD 2,172 per capita) and well above the global average (USD 813 per capita).[158] Most EU Member States lack concrete plans for phasing out fossil fuel subsidies, which are projected to remain constant between 2023 and 2030.[159] Although the EU's 8th Environment Action Programme calls for a phase-out without delay – and many countries have ambitions to move away from fossil fuel use – only Denmark has translated this ambition into law.[160]

- EU fossil fuel subsidies were relatively stable from 2015 to 2021, then more than doubled in 2022 in response to high energy prices in the wake of the COVID-19 pandemic and the Russian Federation's invasion of Ukraine; in 2023, subsidies fell to USD 114.9 billion (EUR 111 billion).[161]
- More than 60% of EU fossil fuel subsidies granted in 2023 were spent in three countries: Germany (USD 42.4 billion or EUR 41 billion), Poland (USD 16.6 billion or EUR 16 billion) and France (USD 15.5 billion or EUR 15 billion).[162]
- As of 2023, 43% (USD 49.4 billion or EUR 47.7 billion) of EU fossil fuel subsidies had a planned end-date before 2025, while a further 9% (USD 10.5 billion or EUR 10.1 billion) had an end-date by 2030; however, 48% (USD 55 billion or EUR 53.1 billion) of fossil fuel subsidies had no planned end-date.[163]

In 2024, the revised EU Regulation 2019/1242 set CO_2 emission standards for heavy-duty vehicles[ii], calling for a near-complete phase-out of diesel-powered models by 2040.[164] The regulation signals a turning point for the European heavy-duty vehicle segment, and its implementation will likely support the shift of goods and passenger transport towards more environmentally efficient modes such as railways and inland waterways.[165]

- The revisions call for reductions in the average CO_2 emissions of heavy-duty vehicles of 45% by 2030, 65% by 2035 and 90% by 2040 (all compared to 2019 levels).[166]
- They also mandate that 90% of new city buses be zero-emission by 2030, and 100% by 2035.[167] In 2024, half (49%) of all new public transport buses in EU cities were zero-emission vehicles.[168]

The EU's vehicle efficiency standards (expressed as CO_2 emission standards) for cars, vans and heavy-duty vehicles have narrowed the emissions gap needed to align road transport with the goals of the Paris Agreement, by 66% for heavy-duty vehicles and 75% for light-duty vehicles.[169]

In March 2025, the European Commission launched an Action Plan to respond to the rapid technological advancements and fierce global competition in the region's automotive sector; critics worry that the plan will derail EU transport emission efforts, as it proposes extending the timeline for automakers to comply with the 2025 emission reduction targets for cars and vans, up until 2027.[170] The Action Plan aims to stimulate demand for European-made electric vehicles – such as by encouraging national incentives – and is accompanied by a strategy to decarbonise corporate fleets, which account for around 60% of new car registrations in Europe.[171] Yet critics have warned that the delay in compliance could lead European car makers to sell up to 880,000 fewer electric vehicles during the extension period.[172] Amid growing tensions around factory closures and job losses, European automakers have called for further concessions, including a moratorium on the complete phase-out of ICE vehicles.[173]

Ongoing challenges related to international trade tariffs have triggered similar policy reactions at the national level. In the United Kingdom, new hybrid and plug-in hybrid cars will be allowed on the market for an additional five years (until 2035), and low-volume, luxury car manufacturers will be exempted from the 2030 ban on ICE vehicles.[174] France, meanwhile, revised its electric vehicle subsidy programme in 2023 to favour vehicles with lower carbon footprints, ultimately disadvantaging Chinese models.[175]

As of 2022, the EU had an average of 10 electric vehicles per charging station, and just three countries (Germany, France and the Netherlands) accounted for more than two-thirds of all EU charging points.[176] **Meanwhile, 10 countries did not have a single charger per 100 kilometres of road, presenting a challenge for electric cross-border travel in Europe.**[177] **The EU's Sustainable and Smart Mobility Strategy prioritises infrastructure development for zero- and low-emission vehicles and sets a regional target for 1 million public charging points by 2025.**[178] Efforts are also needed at the national and sub-national levels to deploy a comprehensive and interoperable refuelling and recharging infrastructure network, while reinforcing grids to cope with growing electricity loads.

- As part of the EU's "Fit for 55" Package, the Regulation 2023/1804 on the deployment of alternative fuels infrastructure ("AFIR"), in force since 2024, sets minimum national targets for 2025 and 2030 for the deployment of infrastructure to support the use of alternative fuels (electricity, hydrogen, liquefied methane) in road vehicles, vessels and stationary aircraft.[179] The AFIR puts in place requirements for price transparency, common minimum payment options and coherent customer information for electric vehicles across the EU.[180]
- In March 2025, Poland launched two major funding programmes to support the development of charging infrastructure (including high-power charging stations) for heavy transport; the initiatives aim to accelerate compliance with the AFIR and are valued at USD 500 million (PLN 2 billion), funded by the EU's Modernisation Fund.[181]
- Amsterdam (Netherlands) launched a six-month electric vehicle smart charging pilot in March 2025 aimed at making charging more responsive to real-time electricity availability and prices, with the goal of optimising the use of the grid while also reducing grid load and cutting costs for consumers.[182]
- An estimated 90% of the EU's electric vehicle charging needs are satisfied in buildings (i.e., overnight at home or daily at the workplace).[183] In 2024, the EU adopted its revised Energy Performance of Buildings Directive, which complements the AFIR by introducing requirements for installing recharging infrastructure in residential and commercial buildings while removing administrative barriers.[184]

The EU has achieved its target for 10% of all energy used in road and rail transport to originate from renewable sources[iii] by 2020, as set in Renewable Energy Directive 2009/28/EC.[185] To support decarbonisation, the transition to

ii Heavy-duty vehicles include trucks (over 3.5 tonnes), buses and coaches.
iii Including biofuels, renewable electricity, or hydrogen and synthetic fuels of renewable origin.

electric mobility must go hand in hand with a shift towards clean electricity sourced from renewables.

- Preliminary estimates from 2023 revealed that eight EU countries had exceeded the 10% target: Austria, Belgium, Denmark, Germany, Italy, Malta, the Netherlands and Spain.[186]
- Sweden had the EU's highest share of renewables in transport in 2023, at 33.6%.[187] This was enabled by the country's ambitious biofuels policy, which requires fuel suppliers to reduce greenhouse gas emissions from petrol, diesel and aviation fuel by a certain percentage each year by blending them with biofuels.[188]
- Croatia had the EU's lowest share of energy from renewable sources in transport in 2023, at 1%.[189]

The revised Renewable Energy Directive EU/2023/2413 of 2023, part of the "Fit for 55" Package, set a new binding EU target for at least 42.5% renewable energy by 2030 (but aiming for 45%), through the use of renewable fuels, including hydrogen, in sectors where electrification is not yet a feasible option (such as shipping and aviation).[190] For these hard-to-electrify sectors, the directive sets new binding targets for renewable fuels of non-biological origin, with renewable hydrogen expected to account for at least 1% of total energy supplied to the EU's transport sector by 2030.[191]

In aviation and maritime transport, Europe has embraced measures including demand reduction and a shift to more sustainable modes. The ReFuelEU Aviation and FuelEU Maritime regulations, adopted in 2023, aim to support the uptake of renewable and low-carbon fuels in these sectors.[192]

- In 2023, following approval by the European Commission, France enacted new legislation banning short-haul domestic flights that can be completed by train in less than 2.5 hours.[193] As of March 2025, the ban applied only to three routes: from Paris' Orly airport to Bordeaux, Lyon and Nantes.[194]
- Thanks to Austria's biggest solar farm, the Vienna airport has been carbon neutral since 2023, meeting 40% of the site's total power demand with solar and aiming to shift to 100% zero-emission fleets for handling passenger and ground operations.[195]
- Meanwhile, some European countries have continued with airport expansions. The UK government has granted approval for a new terminal at Luton Airport – London's fourth largest – enabling it to accommodate an additional 32 million passengers per year.[196]

For more on the latest policy developments in the aviation and shipping sectors, see Section 4.9 Aviation and Section 4.10 Shipping (both in Module 4).

The latest revisions of the EU Emission Trading System (ETS) will impact the aviation and maritime sectors, while a new, separate ETS2 aims to reduce emissions from road transport. The 2023 revision of the ETS Directive (2003/87/EC) extended the system's scope to cover maritime transport and reduced the share of no-fee emission allowances granted to airlines.[197] Co-legislators also mandated the European Commission to implement a monitoring, reporting and verification system for non-CO_2 impacts of aviation starting in January 2025.[198]

A new, separate ETS2, to become operational in 2027, will cover CO_2 emissions from fuel combustion in road transport, among other sectors.[199] In practical terms, the ETS2 will require fuel suppliers to monitor and report their emissions, as well as surrender a corresponding number of allowances to cover these emissions. Implementation of the ETS2 is expected to reduce emissions 42% below 2005 levels by 2030.[200] The revised Directive will require all revenues generated through the ETS to be invested in climate action, energy transformation and tackling social challenges.[201]

Beyond decarbonisation, the EU has pursued policy efforts to tackle air pollution from the transport sector. In addition to overall directives, air pollutants from transport are regulated through mode-specific legislation.

- In December 2024, the revised Ambient Air Quality Directive came into force, updating air quality standards to ensure closer alignment with WHO guidelines, while facilitating the achievement of the EU's zero-pollution ambition by 2050.[202]
- The Euro 7 standard, adopted in 2024, introduced more stringent limits for heavy-duty buses and trucks for various pollutants, including some that were not regulated previously, such as nitrous oxide (N_2O).[203] It also imposed stricter limits for particle emissions generated by braking vehicles – with dedicated limits for electric vehicles – and stipulated new rules on mileage and lifetime for all vehicles.[204]

As of 2024, the EU's revised Trans-European Transport Network (TEN-T) policy mandates urban nodes to adopt a Sustainable Urban Mobility Plan (SUMP) and to collect and regularly submit data on urban mobility indicators.[205] In 2023, more than three-quarters of the region's residents lived in cities, which generate 23% of total European greenhouse gas emissions and concentrate health-damaging pollution and road traffic injuries.[206] The TEN-T policy strengthens the role of cities in enabling sustainable, efficient, multi-modal and high-quality transport infrastructure.[207]

Many European countries have adopted SUMPs and Urban Vehicle Access Regulations (UVARs) to advance



a balance of transport modes while encouraging a shift towards higher-quality and sustainable transport.[208] **In Europe, 73% of UVARs were low- and zero-emission zones as of 2022.**[209] In addition to low-emission zones (LEZs), ultra low-emission zones (ULEZs), and freight transport LEZs, UVARs include congestion charging and parking schemes. These are key instruments for increasing road safety while limiting congestion and reducing traffic-related CO_2 emissions and air and noise pollution.

- Valencia (Spain) introduced an LEZ in March 2025 to ban highly polluting vehicles from entering its most sensitive areas; it is offering free public transport tickets to those affected to avoid disproportionately impacting lower-income households.[210]
- Amsterdam and Rotterdam (Netherlands) implemented zero-emission zones for freight (ZEZ-F) by 1 January 2025, and another 31 Dutch cities announced aims to implement ZEZ-F, following the National Implementation Agenda for Urban Logistics signed in 2021.[211]
- In April 2025, Paris (France) approved a car ban that includes the pedestrianisation of an additional 500 city streets.[212] To discourage the use of sport utility vehicles (SUVs), a 2024 referendum in Paris resulted in the tripling of parking fees for vehicles of 1.6 tonnes or more (and for electric vehicles of 2 tonnes or more) to USD 18.6 (EUR 18) an hour.[213]
- In the three European cities with the best-known congestion charging schemes – London (United Kingdom), Milan (Italy) and Stockholm (Sweden) – implementation has reduced CO_2 emissions 14%, traffic jams 20% and road crashes 20%.[214]
- In France and Spain, time-differentiated congestion charges have been applied to all vehicles on several short stretches of inter-urban motorways.[215]

Closer integration between urban mobility and land use planning has gained traction in the region. Ireland's 2024 Climate Action Plan seeks to integrate climate action and transport in the spatial planning system to better enhance placemaking and accessibility considerations.[216] It also calls for the widespread development of 15-minute neighbourhoods across major cities.[217]

As of 2025, 13 European countries had national cycling strategies in place. Several countries (Denmark, Estonia, Greece, Malta, Slovenia and Ukraine) began work on such strategies in 2024.[218] Lithuania was the only country to adopt its first-ever national cycling strategy during the 2023-2024 period.[219]

The EU's European Declaration on Cycling in 2024 marked an important turning point, elevating cycling to a strategic policy priority and recognising it as "the most sustainable, accessible and inclusive, low-cost and healthy form of transport and recreation".[220] The Declaration calls for the establishment of safe and coherent cycling networks in cities, better links with public transport, secure parking spaces, the deployment of charging points for e-bikes and bike highways connecting cities with rural areas.[221] It commits to investing USD 4.7 billion (EUR 4.5 billion) under the 2021-2027 EU Cohesion policy to improve cycling infrastructure across the region.[222]

In 2023, 69% of European countries had national walking policies or similar measures, although only 6 countries – Austria, the Czech Republic, Germany, Greece, Norway, Portugal, and the United Kingdom – had specific national walking policies.[223] **The first-ever Pan-European Master Plan on Walking, launched in 2024, has spurred efforts to work with national governments to develop and implement**

walking policies.[224] The Master Plan was elaborated by a regional Partnership on Healthy Active Mobility and aims to: develop and implement national walking policies and plans; integrate walking into national policies and promote implementation at the sub-national level; increase walking activity; enhance the safety and security of pedestrians; and extend and improve the infrastructure for walking.[225]

- Portugal's National Strategy for Active Pedestrian Mobility 2030 seeks to increase the modal share of pedestrian journeys to 35%, expand accessible pedestrian space by 50% and reduce sedentary lifestyles 15% by 2030. It outlines a comprehensive plan to enhance pedestrian travel, accessibility and well-being through measures to transform public spaces, create a pedestrian-friendly environment and address challenges.[226]
- The Netherlands, through a group of more than 60 government and academic institutions, social organisations, and companies, launched a National Walking Masterplan in October 2024 that contains actions aimed at improving pedestrian-friendliness, encouraging people to walk more and better organising public space.[227]

Although Europe has historically invested heavily in road infrastructure compared to rail, this trend has been slowly reversing in recent years.[228]

- In 2024, the European Commission selected 134 sustainable, safe and smart transport infrastructure projects to receive more than USD 7.25 billion (EUR 7 billion) in EU grants from the Connecting Europe Facility, with rail projects receiving an estimated 80% of these funds.[229]
- As part of its National Transportation Plan for 2022-2033, Norway is allocating around USD 35.19 billion (EUR 34 billion) to the rail sector over the decade, with the aim of shifting passenger and freight road transport to rail. Major projects include the InterCity network (which will add 270 kilometres of double tracks and allow speeds up to 250 kilometres per hour), as well as improvement of the 4,000 kilometre network of outdated rail infrastructure by building new tracks, updating the existing network, investing in new digital signalling and strengthening cross-border railway connections.[230]
- Among European countries, the highest increases in the share of rail investment between 2008-2012 and 2018-2022 occurred in France (up 21.7 percentage points) and Denmark (up 20 percentage points); rail investments also grew in Albania, Bulgaria, Croatia, the Czech Republic, Germany, Ireland, Italy, North Macedonia, Norway, Poland, Serbia and Slovenia.[231]

Partnerships in action

SLOCAT partners engaged in dozens of actions during 2023-2024, including:

- The **NetZeroCities** project co-ordinates the European Commission's 100 Climate-Neutral and Smart Cities Mission, supporting cities in developing and implementing Climate City Contracts.[232] These contracts serve as comprehensive roadmaps towards achieving climate neutrality by 2030, integrating specific targets and actions across sectors, including urban mobility.[233] The project brings together more than 30 partners including EIT Climate-KIC (lead), ICLEI Europe, Eurocities and the Urban Transitions Mission Platform.[234]
- **Ricardo** is collaborating with the sustainable hydrogen-powered shipping consortium **sHYpS** to advance zero-emission maritime transport by developing hydrogen fuel cell propulsion systems to power the next generation of passenger ships.[235] By focusing on rapid prototyping, safety protocols, and supply chain logistics, the initiative aims to fast-track the deployment of hydrogen technologies in the maritime sector.[236] The project supports the EU's ambition to decarbonise shipping and strengthen hydrogen infrastructure as part of the broader green transition.
- **TRT Trasporti e Territorio**, an Italian consultancy specialising in transport policy and planning, has led a major study for the European Commission on climate adaptation needs for the Trans-European Transport Network (TEN-T).[237] The study identifies investment priorities to strengthen the climate resilience of critical cross-border infrastructure corridors.[238] As Europe faces escalating impacts from extreme weather, the work supports evidence-based planning to safeguard connectivity, supply chains and regional cohesion while accelerating the shift to sustainable, low-carbon transport.[239]
- The **UPPER project**, co-ordinated by the POLIS Network in collaboration with Eurocities, is driving a transformation in public transport across Europe.[240] Central to this initiative is a new shared platform designed to accelerate innovation, knowledge exchange and capacity building among cities, transport authorities and operators.[241] The platform hosts two key tools: U-KNOW, a knowledge-sharing database, and U-TRANSFER, a tool to adapt and replicate best practices in diverse urban contexts.[242] These resources enable stakeholders to implement inclusive, efficient and low-carbon mobility solutions tailored to local needs.

MODULE 3 | 3.4

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Latin America and the Caribbean Regional Overview



DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	Latin America and the Caribbean	Global
Population size (2023)	651 million	8,000 million
Population growth (2015-2023)	6.5%	8.5%
Urban population share (2023)	85%	57%
Urban population growth (2015-2023)	10.7%	16%
GDP per capita (2023)	USD 8,419 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	8.9%	22.8%
Share of women employed in transport and storage (2023)	14.2%	15.6%
Motorisation rate (2022)	282.1 vehicles per 1,000 people	218.7 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	42.3%	52%
Share of rural population with access to all-weather primary and secondary roads (2020)	35.4%	38%
Transport total GHG emissions (2023)	615 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	0.94 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 486 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport (2022)	12.5%	4.6% for 2023
Carbon intensity of electricity generation (2023)	272.4 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	6.1%	6%
Premature deaths attributable to air pollution by transport (2019)	1.7 per 100,000 people	2.3 per 100,000 people
Road casualties (2021)	14.6 per 100,000 people	15 per 100,000 people

Source: See endnote 1 for this section.

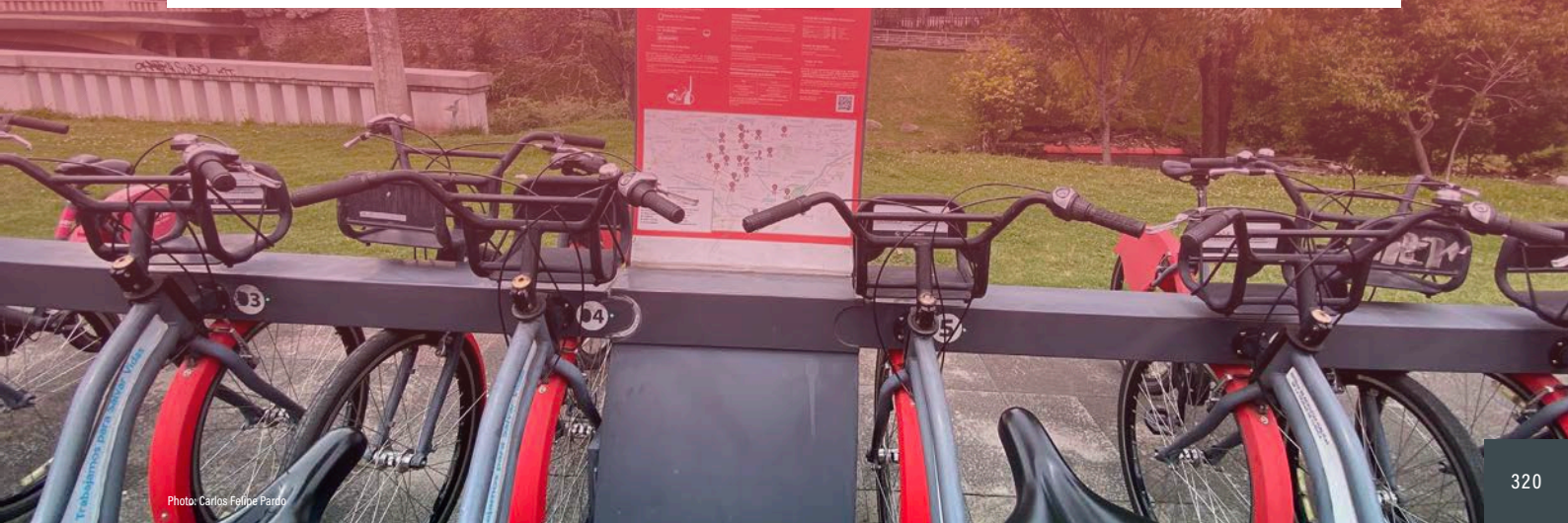


Photo: Carlos Felipe Pardo

KEY FINDINGS

Demand, use and access

- In Latin America and the Caribbean, around 42% of the urban population on average across countries had convenient access to public transport in 2020-2022. This was the third lowest regional value after Africa (33%) and Oceania (41%), and below the global average of 52%. In nearly 46% of assessed cities in the region (130 out of 285), half or more of the population had convenient access to public transport during 2020-2022.

- Although public transport has a higher market share than private transport in most of the region's cities, private motorisation (particularly motorcycles) is increasing due to factors such as service coverage, accessibility, subsidy levels and personal safety.

- In Latin America and the Caribbean, investments in pedestrian infrastructure have remained low, pointing to a key opportunity for inclusive, low-carbon transport planning.

- Passenger mass transport systems continued to expand as countries invest in extending existing metro lines and planning and developing new cable cars and urban rail. The expansion and modernisation of bus systems remained the dominant trend in public transport, although interest in extending passenger rail services has grown.

- At least eight Latin American cities have invested in cable car systems to address the accessibility and connectivity challenges faced by hillside communities, which are mostly informal and lack services.

- Informal transport services still account for a large share of motorised trips in low- and middle-income countries in Latin America and the Caribbean, including more than half of all trips in some cities. Informal transport services – such as minibuses, moto-taxis and tuk-tuks – improve access to opportunities and mobility and are valued for their responsiveness, flexibility and versatility. Despite these advantages, they often suffer from poor service quality—including overcrowding, unsafe driving, unreliable "fill-and-go" operations, limited accessibility for people with disabilities, and unclear routes.



KEY FINDINGS

- Road transport accounted for as much as 70% of the region's surface freight transport (roads, rail, inland waterways) in 2021. This fleet is mostly low-capacity trucks, which offer lower operational efficiency and generate more emissions than other vehicles. The average age of the region's truck fleet between 2015 and 2020 was around 15.6 years (3.9 years older than in the European Union), impacting emissions from the sector.

- The share of rail in the region's freight transport was relatively low, with Brazil and Colombia having the highest levels (27% each for 2017 data). The use of intermodal freight transport in the region remains limited.

- The average motorisation rate (covering four-wheeled motor vehicles) in Latin America and the Caribbean increased to 282 vehicles per 1,000 people in 2016-2022, or 1.3 times higher than the global average of 219 vehicles per 1,000 people. Nearly half of all countries in the region had motorisation rates above the global average during this period. In major cities, rising motorisation has worsened congestion, leading to higher fuel consumption and increased greenhouse gas and pollutant emissions.



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- Sales of new light- and heavy-duty vehicles (not including motorised two- and three-wheelers) increased nearly 1.6% on average in 2024, based on data from nine different automotive associations and chambers in the region.

- E-commerce market transactions in Latin America and the Caribbean increased 39% in 2022 and 20% in 2023, reaching USD 509 billion. The growth in online shopping has driven up demand for "last-mile" deliveries, particularly by motorcycles and vans, and altered trip patterns in urban areas, placing a burden on urban transport systems.

- Motorcycle sales in the region grew 51% between 2012 and 2023, rising from 3.7 million to 5.6 million. Factors include the relatively low acquisition and maintenance costs of motorcycles compared to cars, the limited availability of public transport in some places, rising traffic congestion and the growing prevalence of gig economy jobs related to food and goods delivery.

- Sales of battery electric cars in Latin America and the Caribbean nearly doubled between 2022 and 2023 (from around 22,400 units to 39,000 units) and reached 118,000 units in 2024, with leading markets in Brazil, Colombia, Costa Rica and Mexico. Electric cars represented 4% of total new car sales in the region in 2024, although the market is still considered emerging.

- Despite informal transport's significant contribution in the region, it has received limited attention in countries' decarbonisation strategies, and its electrification remains at an early stage. In 2024, sales shares of electric motorised two- and three-wheelers, trucks and vans were around 0.3% or less each.

- The number of electric public buses in the region grew nearly 75% between 2022 and February 2025, surpassing 6,500 units operating in 67 cities across 12 countries. Nearly 92% of the region's electric public buses are in Brazil, Chile, Colombia and Mexico. The share of electric public buses in the regional public transport fleet increased from 4.7% in 2023 to roughly 7.5% in 2025.

- The region plays a strategic role in the supply of materials for the energy transition and transport electrification; it is a global leader in the production of copper, lithium, and nickel, critical inputs for electric vehicle batteries and renewable energy technologies.

- Besides a strong presence of biofuels, the region is well positioned for electrification: Latin America and the Caribbean had the cleanest electricity grid among all regions in 2023 – at 272 grams of CO_2 equivalent per kilowatt-hour (kWh), while the global average was 417 grams of CO_2 equivalent per kWh.

KEY FINDINGS

Sustainability and climate trends

- Transport greenhouse gas emissions in Latin America and the Caribbean fell 1.5% between 2019 and 2022, reflecting a decline related to the COVID-19 pandemic, but by 2023 they were already 1.1% above 2019 levels. Transport is now among the top two emitting sectors in most of the region's countries, as the relative contribution of transport to national emissions has grown.
- The transport sector accounted for 18% of the region's total regional greenhouse gas emissions in 2023.
- Under a "business as usual" scenario, the region's transport CO_2 emissions are projected to increase 17% by 2050 compared to 2019 levels.
- The average per capita transport greenhouse gas emissions in the region totalled 0.94 tonnes of CO_2 equivalent in 2023, slightly above the global average of 0.89 tonnes.
- Transport greenhouse gas emissions relative to economic output in Latin America and the Caribbean, at 1.1 tonnes of CO_2 equivalent per USD 10,000 in 2023, were second-highest among all world regions after Africa (1.29 tonnes), and above the global average of 0.78 tonnes of CO_2 equivalent per USD 10,000.
- Freight transport accounted for 44% of regional greenhouse gas emissions in 2019, mainly due to road freight. Maritime freight contributed 6% of transport emissions, rail 1% and air 3%. Freight vehicles were responsible for 40% of the region's urban CO_2 emissions in 2022 and contributed to congestion and severe road crashes, even though they accounted for only one-quarter of all urban vehicles in the region in 2022.
- Overall, the region's transition to low-emission freight transport has been slow. Some countries have implemented energy efficiency schemes and pilot programmes for the electrification of urban logistics.
- In 2019, excessive exposure to particulate matter caused by transport contributed to nearly 180,000 deaths, or 6% of total deaths, in Latin America and the Caribbean, similar to the global level of 6.1%. Only 7.8% of cities in Latin America and the Caribbean met the World Health Organization's air quality guidelines in 2024.

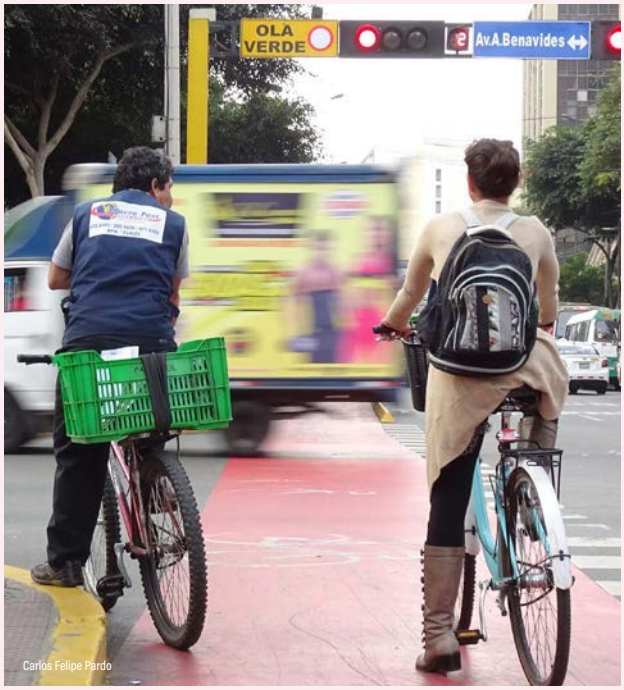

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- In 2021, road traffic deaths in the region averaged 14.6 casualties per 100,000 people, close to the global average of 15 casualties per 100,000 people. By country, they ranged from 5.1 casualties in Trinidad and Tobago to 31.3 casualties in Haiti.
- The region faces persistent road safety challenges, including disproportionately high rates of fatal road incidents, with pedestrians and cyclists accounting for nearly half of all road traffic deaths in some countries in 2021. In the region, less than 40% of the assessed roads met the recommended three-star safety standard for bicyclists and motorcyclists, and less than 20% did so for pedestrians, indicating large infrastructure gaps.
- As of 2024, Latin America and the Caribbean was the third most vulnerable region to extreme weather events, after Africa and Asia. In 2022 and 2023, record droughts near the Panama Canal created bottlenecks and reduced the canal's transit capacity 50% in the second half of 2023, impacting global maritime trade.

KEY FINDINGS

Policy and investment developments

- Several countries in Latin American and the Caribbean have developed policy frameworks to enhance low-emission transport initiatives, sustainable transport infrastructure, and climate-resilient urban mobility, reflecting an ongoing commitment to green and inclusive transport solutions. However, the region's transport systems and infrastructure networks remain underprepared for the extreme weather events exacerbated by climate change.
- Although some countries have taken systemic action, the region continues to lag in public policy and action across all transport modes. Key barriers include limited resources, technological gaps and transport system characteristics.
- As of 25 May 2025, five countries in the region – Brazil, Cuba, Ecuador, Saint Lucia and Uruguay – had submitted to the United Nations their third-generation Nationally Determined Contributions (NDCs) towards reducing greenhouse gas emissions under the Paris Agreement.
- Several countries in the region have joined international frameworks for zero-emission transport.
- As of 25 May 2025, 16 countries in Latin America and the Caribbean had submitted National Adaptation Plans (NAPs) to the United Nations, out of a total of 63 NAPs submitted by low- and middle-income countries. Through NAPs, countries outline activities for enhanced infrastructure resilience and transport system adaptation.
- Cities across the region increased their adoption of local sustainable urban mobility plans (SUMPs), highlighting the role of cities as climate action leaders.
- Fossil fuel subsidies in Latin America and the Caribbean continued to incentivise fossil fuel use, contributing to high greenhouse gas emission levels. In 2023, the region's per capita fossil fuel subsidies totalled USD 486, the second lowest level after Africa (USD 198) and less than half the global average (USD 813). The region's fossil fuel subsidies as a share of total GDP, at 6.8%, were the second highest among global regions in 2023, below Asia's at 12.1%. Fossil fuel subsidies in the region are projected to increase 17% between 2023 and 2030, further undermining climate and sustainability efforts.
- Efforts to improve the efficiency of freight transport have been approached mainly through multi-stakeholder programmes, highlighting a regional shift towards collaborative and inclusive efforts.
- Aligned with a worldwide trend, some cities in the region have initiated parking reforms to reallocate space away from vehicle parking and towards broader needs such as housing, public spaces, and cycling and walking infrastructure.
- Cities continued to expand initiatives and actions to enhance the use of walking and cycling.
- Countries in the region have introduced a range of electric mobility strategies, including laws to promote electric vehicles and charging infrastructure, as well as tariff incentives for imports and taxes. Strategic plans, financial incentives, agreements and regulatory frameworks have helped to accelerate the electrification of road transport.
- The use of electric buses for public transport and other forms of shared transport has grown in the region.
- Since 2022, several cities in the region have expanded or launched bus rapid transit (BRT) systems as part of broader efforts to promote low-emission, high-capacity public transport.
- Countries increased their support for extending existing metro lines, and are planning and developing new cable cars and passenger rail services.



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Context, challenges and opportunities

Latin America and the Caribbean is one of the most urbanised regions in the world, with a majority of its population living in cities in 2023.[2] This rapid urbanisation presents both challenges and opportunities for building sustainable, inclusive transport systems. At the same time, the transport sector remains a significant contributor to regional greenhouse gas emissions, with road transport alone accounting for 92% of the fuel combustion-related carbon dioxide (CO_2) emissions from transport.[3]

Structural and policy challenges persist in the region. In 2023, fossil fuel subsidies represented 6.8% of gross domestic product (GDP) across the region.[4] Informal transport services continue to serve a large share of trips in many cities but are frequently overlooked in national strategies.[5]

Despite these obstacles, Latin America and the Caribbean is undergoing a slow but steady shift towards zero-emission transport. Electric vehicle sales more than quadrupled between 2022 and 2024 as battery electric cars rose from around 22,400 units to 118,000 units, with Brazil, Colombia, Costa Rica and Mexico leading this trend.[6] Electrification of public transport has shown strong momentum, with electric bus fleets growing 75% between 2022 and 2025, surpassing 6,500 units operating in 67 cities in 12 countries and likely representing over 7% of the total public bus fleet.[7]

Public transport is the most commonly used mode in many major cities across Latin America and the Caribbean. While some cities operate rail and aerial cable car systems, most trips are made using traditional buses or bus rapid transit (BRT) systems, which still primarily rely on fossil fuels. Electric buses currently make up only a small share of public transport fleets.

Walking plays an important role in urban mobility in the cities surveyed, often serving as a connection to both public and informal transport. Although bicycle use is increasing in some cities, its overall modal share remains low, and only a few cities have developed extensive cycling infrastructure.

Latin America and the Caribbean plays a strategic global role in both the energy transition and transport electrification. Argentina, Brazil, Chile and Peru are major producers of copper, nickel, and lithium, which are critical material inputs for electric vehicle batteries and renewable energy technologies.[8] These material sources, if harnessed using sustainable practices and industrial policies, could create regional value chains in battery production and electric vehicle assembly.

As of 25 May 2025, only five countries in the region (Brazil, Cuba, Ecuador, Saint Lucia and Uruguay) had submitted to the United Nations their third-generation Nationally Determined Contributions towards reducing greenhouse gas emissions under the Paris Agreement, enhancing climate action to 2035.[9]

Freight activities in the region are dominated by road transport, which accounted for 86% of all freight activity and 80% of freight-related CO_2 emissions in the region in 2019.[10] The existing truck fleet is ageing and has low capacity, resulting in emissions, pollution and health impacts. Progress on freight decarbonisation and intermodal transport has been limited, although some pilot programmes have advanced in Chile, Colombia and Mexico.[11]

Looking ahead, regional co-operation, investment in climate-resilient infrastructure and the scaling of successful pilot programmes will be crucial. With the 2025 United Nations Climate Change Conference (COP 30) to be hosted in Bélem, Brazil, the region has an opportunity to reaffirm its commitment to sustainable, low-carbon transport and to demonstrate leadership.

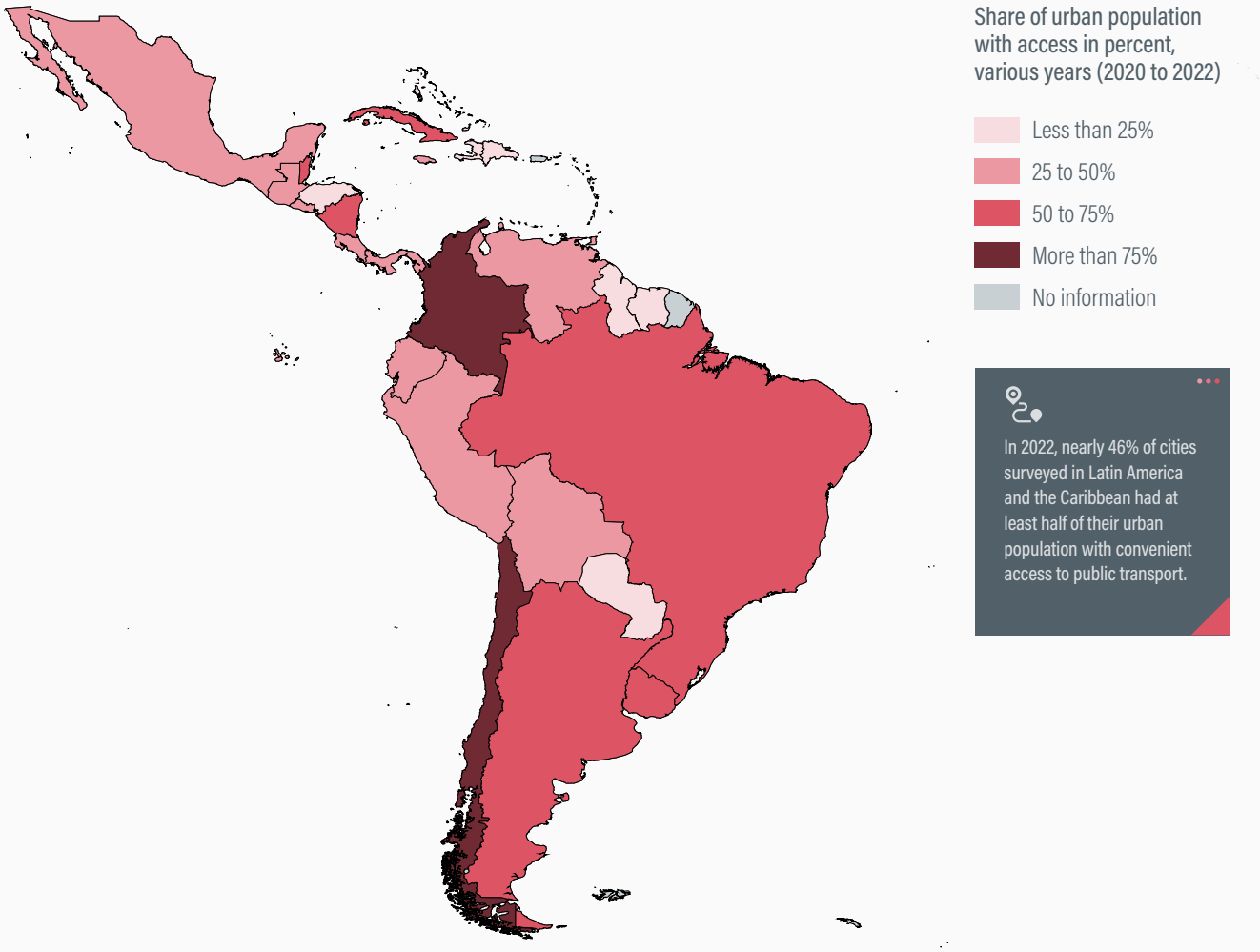
Demand, use and access

Latin America and the Caribbean is one of the most urbanised regions in the world, with 85% of its population living in cities in 2023.[12] Enhancing transport while limiting negative impacts such as traffic congestion, road crashes and environmental pollution is key to ensuring safe, equitable and sustainable access to opportunities for both city dwellers and rural inhabitants in the region.[13]

In Latin America and the Caribbean, around 42% of the urban population on average across countries had convenient access to public transport in 2020-2022.[14] This was the third lowest regional value after Africa (33%) and Oceania (41%), and below the global average of 52%.[15] In nearly 46% of assessed cities in the region (130 out of 285), half or more of the population had convenient access to public transport during 2020-2022 (Figure 1).[16]

Although public transport has a higher market share than private transport in most of the region's cities, private motorisation (particularly motorcycles) is increasing due to factors such as service coverage, accessibility, subsidy levels and personal safety.[17] Regional rural areas and urban peripheries tend to have lower coverage of transport services, and the higher prevalence of unpaved infrastructure in these areas increases their vulnerability to climate-related impacts. Communities that depend on only a few existing public transport routes to access employment opportunities, goods and services are more vulnerable to disruptions that can prevent them from meeting their basic needs.[18]

FIGURE 1. Share of urban population with convenient access to public transport in Latin America and the Caribbean, various years (2020 to 2022)



Source: See endnote 16 for this section.

- Despite an overall decline in public transport ridership, nearly 80% of inter-city trips in Colombia are taken by passenger bus.[19]

Public transport remains the primary mode of mobility for women across much of Latin America and the Caribbean, due to lower rates of vehicle ownership and the nature of their trips, which often involve multiple purposes and off-peak travel. However, most transport systems in the region are not designed with women's safety, comfort or caregiving responsibilities in mind, resulting in accessibility gaps and exposure to harassment.[20]

According to UNDP's 2025 report, recent mobility surveys in selected Latin American cities show that public transport and walking are the most common modes of travel: in Quito, 58% of trips are by public transport and 15% on foot; in Buenos Aires, 38% and 25% respectively; in Mexico City, 43% and 34%; and in Bogotá, 26% and 36%. Bicycle use remains relatively low, ranging from 1% in Mexico City to 6.3% in Bogotá.[21]

In Latin America and the Caribbean, investments in pedestrian infrastructure have remained low, pointing to a key opportunity for inclusive, low-carbon transport planning.[22] Walking remains a critical mode of transport in this region, despite poor pedestrian environments that lack safety or shade.[23]

- In Bogotá (Colombia), the shared bicycle system celebrated two years of operation as of September



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2024 and comprised 3,300 bikes distributed across 300 stations.[24] In 2024, the system facilitated 3 million trips and served 130,000 users, and in its first year of operation it helped reduce 205 tonnes of CO_2 emissions.[25]

- Mexico City (Mexico) had more than 500 kilometres of bike lanes and a bike share system with 10 stations as of 2024, and aimed to add 40 kilometres of lanes and 7 stations in 2025.[26]
- As of 2025, the "Mi Bici Tu Bici" bicycle programme in Rosario (Argentina) had more than 139,000 registered users, 758 bicycles and 89 stations spread across all city districts.[27] In 2024, the subscription system was modernised to enable payment by credit or debit card, digital wallet or cash.[28]
- In Brazil's cycling retail sector (one of the region's largest), sales fell 34.3% on average in 2023 but showed signs of recovery in 2024 as nearly half of retailers reported improved sales, supported by growing demand for higher-value bicycles, greater product diversification and rising use of e-commerce platforms.[29]

Passenger mass transport systems continued to expand as countries invest in extending existing metro lines and planning and developing new cable cars and urban rail.[30] The expansion and modernisation of bus systems remained the dominant trend in public transport, although interest in extending passenger rail services has grown.

- After more than eight decades of discussions, the metro system in Bogotá (Colombia) is becoming a reality, achieving 50% completion as of March 2025.[31] The system will span 23.9 kilometres, include 16 stations, and have a capacity of 1,800 passengers, and is expected to be operational by 2028.[32]
- In Quito (Ecuador), the city's first metro system began operating in December 2023 with 22.5 kilometres and 15 stations.[33]
- In February 2025, Buenos Aires (Argentina) announced its first metro expansion in 25 years, with plans to build Line F with 11 new stations along 9 kilometres, which will cross-cut existing radial lines to improve system integration and reduce travel time by 40%.[34] Civil works are scheduled to begin in 2026, with operations expected by 2031.[35]

At least eight Latin American cities have invested in cable car systems to address the accessibility and connectivity challenges faced by hillside communities, which are mostly informal and lack services.[36] While these systems have provided important spatial and social connectivity benefits, they lack the high capacities of bus and metro systems. Their effectiveness depends heavily on their integration with the rest of the public transport network, including co-ordinated fares, seamless transfers and physical connections to bus and metro systems; otherwise, their potential to reduce travel times and improve modal equity is limited.[37] In some contexts, concerns about safety, particularly for women, have underscored the need for targeted measures to prevent harassment and improve passenger security.[38]

- In La Paz (Bolivia), the passenger cable car system accounted for 14.4% of all public transport trips in 2023, with an average daily capacity of 191,760 passengers.[39]
- The cable car system in Medellín (Colombia) covers nearly 12 kilometres and serves 40,000 daily passengers.[40]
- Mexico City (Mexico) operates three cable car systems. The newest line was inaugurated in 2024 and can transport 70,000 to 80,000 persons per day.[41]
- Panama City (Panama) is evaluating offers to build a 6.6-kilometre cable car to connect the city's peripheries with metro stations.[42]
- Salvador de Bahía (Brazil) is developing its first cable car system to connect the Manoel Dendé community with the city's metro network.[43]

Informal transport services still account for a large share of motorised trips in low- and middle-income countries in Latin America and the Caribbean, including more than half of all trips in some cities.[44] Informal transport services – such as minibuses, moto-taxis and tuk-tuks – improve access to opportunities and mobility and are valued for their responsiveness, flexibility and versatility.[45] Despite these advantages, they often suffer from poor service quality—including overcrowding, unsafe driving, unreliable "fill-and-go" operations, limited accessibility for people with disabilities, and unclear routes.[46]

Although data on the electrification of informal transport remain limited, some cities have launched pilot programmes

for electric minibuses and three-wheelers – notably Bogotá (Colombia), Lima (Peru) and Montego Bay (Jamaica).[47] These efforts aim to reduce emissions from the informal and semi-formal fleets that serve a large share of daily trips, particularly in low-income and peri-urban areas.[48] Research studies, mapping and data collection on these services have continued to grow, despite challenges related to informality. Moving towards a hybrid model with integration, regulation, investment and innovation would transform informal transport services into more efficient, safe and sustainable mobility [49]

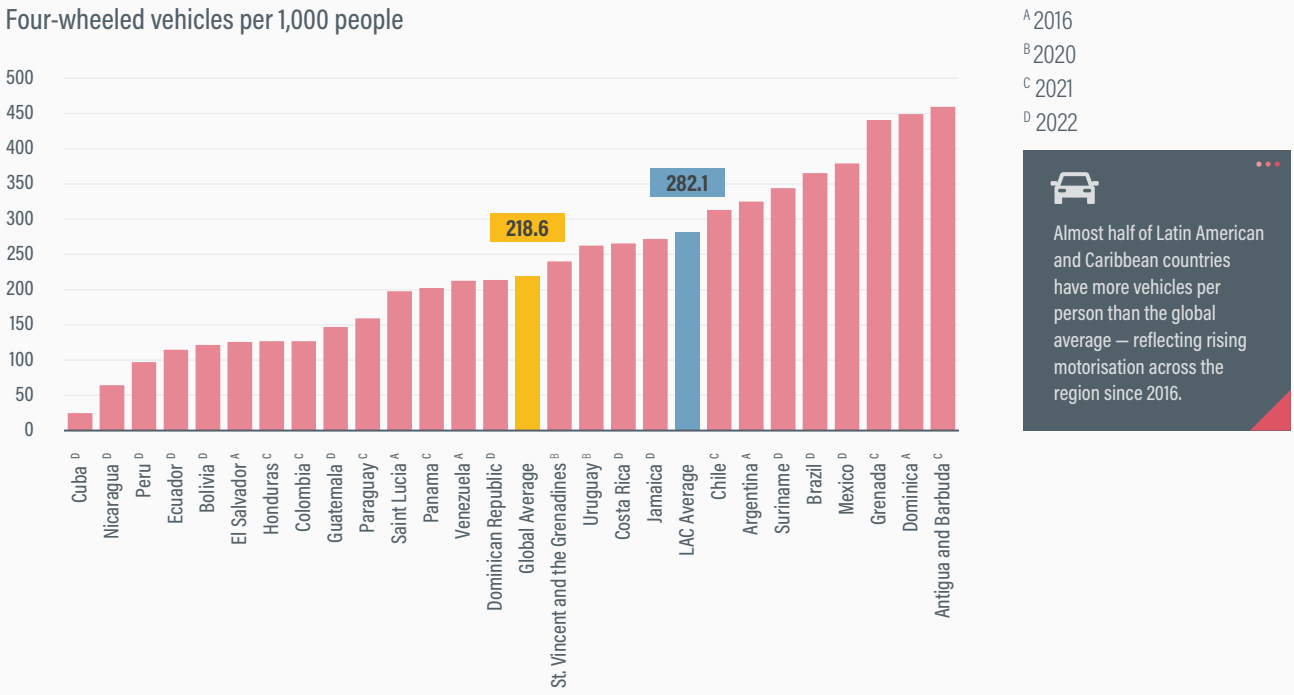
- When informal services were included in the analysis of transport modes, absolute access to public transport increased 54% in the Mexico City Metropolitan Area (Mexico) and 35% in Bogotá (Colombia).[50]
- In San José (Costa Rica), a "Living Lab" case study has been using field research and community engagement to explore the inclusivity, operations and impact of informal transport.[51]

Road transport accounted for as much as 70% of the region's surface freight transport (roads, rail, inland waterways) in 2021.[52] This fleet is mostly low-capacity trucks, which offer lower operational efficiency and generate more emissions than other vehicles.[53] The average age of the region's truck fleet between 2015 and 2020 was around 15.6 years (3.9 years older than in the European Union), impacting emissions from the sector.[54] Ownership of freight vehicles is generally distributed among a variety of small-scale owners, which hinders fleet renewal and affects the sustainability of the sector.[55]

The share of rail in the region's freight transport was relatively low, with Brazil and Colombia having the highest levels (27% each for 2017 data).[56] The use of intermodal freight transport in the region remains limited.[57] However, regarding intermodal transport, Mexico showed the greatest progress in railway construction, while Colombia and Costa Rica have carried out studies to optimise intermodal logistics.[58]

The average motorisation rate (covering four-wheeled motor vehicles) in Latin America and the Caribbean increased to 282 vehicles per 1,000 people in 2016-2022, or 1.3 times higher than the global average of 219 vehicles per 1,000 people (Figure 2).[59] **Nearly half of all countries in the region had motorisation rates above the global average during this period.[60] In major cities, rising motorisation has worsened congestion, leading to higher fuel consumption**

FIGURE 2. Motorisation rates per 1,000 people in Latin America and the Caribbean, 2016-2022



Source: See endnote 59 for this section.

and increased greenhouse gas and pollutant emissions.[61] The average travel time in the region has continued to rise, with people spending around 17 days per year in traffic congestion, according to 2025 reports.[62]

Sales of new light- and heavy-duty vehicles (not including motorised two- and three-wheelers) increased nearly 1.6% on average in 2024, based on data from nine different automotive associations and chambers in the region.[63] Many countries in the region rely on used vehicle imports, particularly in Central America and the Caribbean. [64]

- In Chile, sales of light- and medium-duty vehicles grew 2.9% in January 2025 compared to a year prior, reaching 25,834 units; this sales recovery started in mid-2024 and was driven by improved economic expectations, lower unemployment and favourable credit conditions.[65]
- Sales of cargo trucks in Chile increased 12.6% to 1,163 units in January 2025, and bus sales surged 65.1%, with 213 units sold, driven mainly by higher sales of minibuses, taxi buses and inter-city buses.[66]
- In Peru, sales and registrations of new light vehicles fell 8.2% in 2024, while sales of two- and three-wheeled motorcycles increased 3.8% and heavy vehicle sales increased 5.3%.[67]
- In Brazil, vehicle registrations grew 14% in 2024.[68] In São Paulo, where congestion costs represent up to 8% of the city's GDP, the rise in private vehicle registrations has outpaced public transport improvements and road capacity expansion.[69]

E-commerce market transactions in Latin America and the Caribbean increased 39% in 2022 and 20% in 2023, reaching USD 509 billion.[70] **The growth in online shopping has driven up demand for "last-mile" deliveries, particularly by motorcycles and vans, and altered trip patterns in urban areas, placing a burden on urban transport systems.** This underscores the need for integrated planning of urban freight, digital platforms and sustainable last-mile solutions. The e-commerce expansion is attributed to shifts in consumer behaviour since the COVID-19 pandemic, particularly with increased digital adoption and the growth of new online platforms.[71]

Motorcycle sales in the region grew 51% between 2012 and 2023, rising from 3.7 million to 5.6 million.[72] **Factors include the relatively low acquisition and maintenance costs of motorcycles compared to cars, the limited availability of public transport in some places, rising traffic congestion and the growing prevalence of gig economy jobs related to food and goods delivery.**[73]

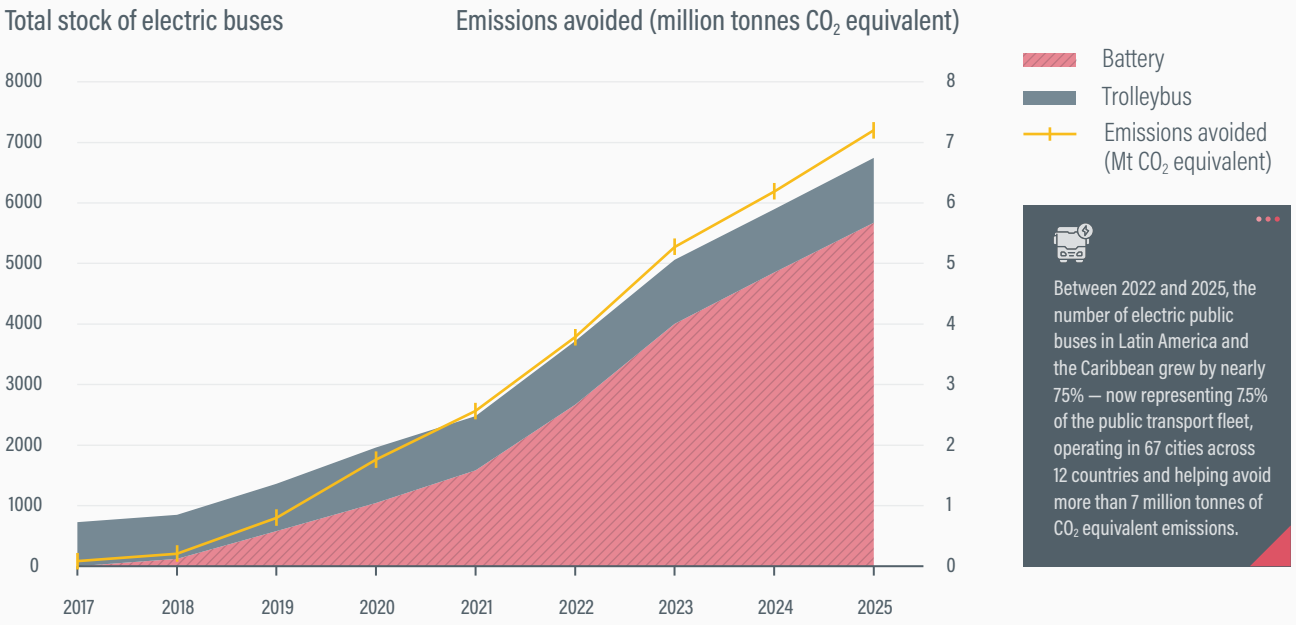
- In Colombia, monthly registrations of new motorcycles increased 45% between March 2024 and March 2025, rising from 58,990 registrations to 85,763.[74]
- In Argentina, the number of new motorcycles registered in the Official National Single Automotive Registry units grew 2.7% in 2024, bringing the total fleet size to more than 7 million vehicles.[75]
- In Brazil, the region's largest motorcycle market, registrations increased 16.1% in 2023, the third consecutive year of strong growth.[76] In 2024, motorcycle sales increased 18.6% to reach 1.9 million units.[77] The rising preference in Brazil for compact, urban-use models – such as city bikes (42.3%) and scooters (33.9%) – reflects a broader shift in mobility, particularly in response to rising congestion, affordability concerns, and the expansion of delivery and ride-hailing services.[78]
- In the Dominican Republic, motorcycle registrations grew 35% between 2022 and 2024, reflecting the increasing reliance on motorcycles as an affordable and flexible transport option, particularly in areas with limited public transport coverage.[79]

Sales of battery electric cars in Latin America and the Caribbean nearly doubled between 2022 and 2023 (from around 22,400 units to 39,000 units) and reached 118,000 units in 2024, with leading markets in Brazil, Colombia, Costa Rica and Mexico.[80] **Electric cars represented 4% of total new car sales in the region in 2024, although the market is still considered emerging.**[81]

- In 2024, the region's electric vehicle stock totalled around 565,000 electric two- and three-wheelers, 215,000 electric cars, 5,600 electric buses and 2,100 electric trucks.[82]
- Brazil led electric vehicle sales in the region in 2024, with more than 62,000 registrations (up nearly three-fold from 2023 and representing 6.4% of total car sales), driven largely by Chinese automakers.[83] However, the country's focus on ethanol-based biofuels has slowed electric vehicle adoption, as biofuels remain a cost-competitive alternative that is supported by existing refuelling infrastructure.[84]
- In 2024, electric car sales neared 11,000 vehicles each in Colombia (7.4% of annual car sales) and Costa Rica (15% of sales), but sales remain limited in other Central and South American countries.[85]

Despite informal transport's significant contribution in the region, it has received limited attention in countries' decarbonisation strategies, and its electrification remains at an early stage.[86] **In 2024, sales shares of electric motorised two- and three-wheelers, trucks and vans were around 0.3% or less each.**[87] In Brazil, the largest market for electric motorcycles, sales grew 15% in 2023, driven by urban adoption and the expansion of delivery services, but then fell 6.7% in 2024, indicating shifting market conditions.[88]

FIGURE 3. Total electric buses in Latin America and the Caribbean, 2017-2025



Source: See endnote 89 for this section.

The number of electric public buses in the region grew nearly 75% between 2022 and February 2025 (Figure 3)**, surpassing 6,500 units operating in 67 cities across 12 countries.**[89] **Nearly 92% of the region's electric public buses are in Brazil, Chile, Colombia and Mexico.**[90] **The share of electric public buses in the regional public transport fleet increased from 4.7% in 2023 to roughly 7.5% in 2025.**[91] The cumulative avoided emissions over the entire lifespan of the electric buses totalled an estimated 7.2 million tonnes of CO_2 equivalent from 2017 to 2025.[92]

- In Brazil, the market for electric public buses remains relatively small but has expanded rapidly, with registrations growing 145% in 2023 (to 86 units) and a further 213% in 2024 (to 285 units).[93]
- In 2024, Santiago (Chile) had the largest electric bus fleet among cities outside of China, with 2,500 electric buses.[94] An additional 1,800 electric buses are planned to be added by the end of 2025, which would represent 68% of the total fleet operating in the city at that time.[95]
- As of April 2025, the countries with the highest numbers of electric buses in the region were Chile (2,729 units) and Colombia (1,590), followed by Brazil (1,059) and Mexico (835).[96] The leading cities were Santiago (2,550 units), Bogotá (1,486) and São Paulo (789).[97]
- Barbados aims to remove all of its remaining diesel vehicles and to transition its bus fleet to 120 fully electric buses by late 2025.[98]

The region plays a strategic role in the supply of materials for the energy transition and transport electrification; it is a global leader in the production of copper, lithium, and nickel, critical inputs for electric vehicle batteries and renewable energy technologies.[99] Chile and Argentina are among the world's top lithium producers, and Brazil and Peru are key copper exporters.[100] These resources, if managed sustainably, offer the potential to create regional value chains through local battery processing and electric vehicle manufacturing.[101]

Regional initiatives demonstrate that despite promising steps, biofuels have not yet been widely adopted, green hydrogen is still at an early stage, and the electrification of heavy-duty transport is low.

- In Brazil, biofuels (particularly ethanol) account for 21% of transport energy demand and are a central part of national energy policy.[102]
- In 2022, 120 electric semi-trailers manufactured by China's BYD were deployed in Mexico; however, more widespread adoption is constrained by cost, infrastructure and regulatory barriers.[103]

Besides a strong presence of biofuels, the region is well positioned for electrification: Latin America and the Caribbean had the cleanest electricity grid among all regions in 2023 – at 272 grams of CO_2 equivalent per kilowatt-hour (kWh), while the global average was 417 grams of CO_2 equivalent per kWh.[104]

Sustainability and climate trends

Transport greenhouse gas emissions in Latin America and the Caribbean fell 1.5% between 2019 and 2022, reflecting a decline related to the COVID-19 pandemic, but by 2023 they were already 1.1% above 2019 levels.[105] **Transport is now among the top two emitting sectors in most of the region's countries, as the relative contribution of transport to national emissions has grown.**[106] This reflects both rising vehicle activity and slower decarbonisation of the transport sector compared to energy and industry.[107]

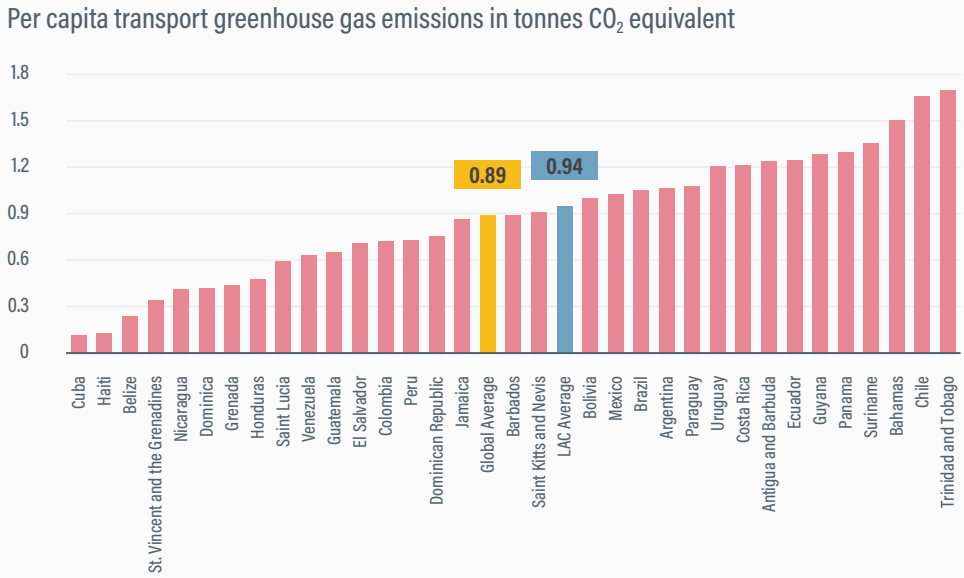
The transport sector accounted for 18% of the region's total regional greenhouse gas emissions in 2023.[108] Road transport contributed the bulk of the transport CO_2 emissions related to fuel combustion, at 92% in 2019, followed distantly by domestic aviation (4%), domestic shipping (2%) and rail transport (1%).[109] Passenger transport contributed 56% of the region's transport CO_2 emissions, of which 46% were from land transport and 9% from air transport in 2019.[110]

Under a "business as usual" scenario, the region's transport CO_2 emissions are projected to increase 17% by 2050 compared to 2019 levels.[111] In this scenario, governments are expected to address decarbonisation only slowly, focusing on incremental measures such as promoting technological advancements to replace internal combustion engine vehicles, managing demand, encouraging modal shifts and investing in alternatives to private vehicles. In contrast, in a high-ambition scenario, governments would adopt more aggressive strategies to decarbonise the sector, such as providing alternatives to private motorised vehicles, enhancing public transport systems, promoting walking and cycling, improving transport efficiency and transforming freight transport.[112]

The average per capita transport greenhouse gas emissions in the region totalled 0.94 tonnes of CO_2 equivalent in 2023, slightly above the global average of 0.89 tonnes.[113] The highest emitting countries were Trinidad and Tobago and Chile (close to 1.7 tonnes each), and the lowest were Haiti, Cuba and Belize (below 0.25 tonnes each) (Figure 4).[114]

Transport greenhouse gas emissions relative to economic output in Latin America and the Caribbean, at 1.1 tonnes of CO_2 equivalent per USD 10,000 in 2023, were second-highest among all world regions after Africa (1.29 tonnes), and above the global average of 0.78 tonnes of CO_2 equivalent per USD 10,000.[115]

FIGURE 4. Per capita transport greenhouse gas emissions in Latin America and the Caribbean, 2023



In 2023, per capita transport emissions in Latin America and the Caribbean matched the global average — but national levels ranged widely, from just 0.1 tonnes in Cuba and Haiti to nearly 1.7 tonnes in Chile and Trinidad and Tobago.

Source: See endnote 114 for this section.



Freight transport accounted for 44% of regional greenhouse gas emissions in 2019, mainly due to road freight. [116] **Maritime freight contributed 6% of transport emissions, rail 1% and air 3%.**[117] **Freight vehicles were responsible for 40% of the region's urban CO_2 emissions in 2022 and contributed to congestion and severe road crashes, even though they accounted for only one-quarter of all urban vehicles in the region in 2022.**[118]

Overall, the region's transition to low-emission freight transport has been slow. Some countries have implemented energy efficiency schemes and pilot programmes for the electrification of urban logistics.[119]

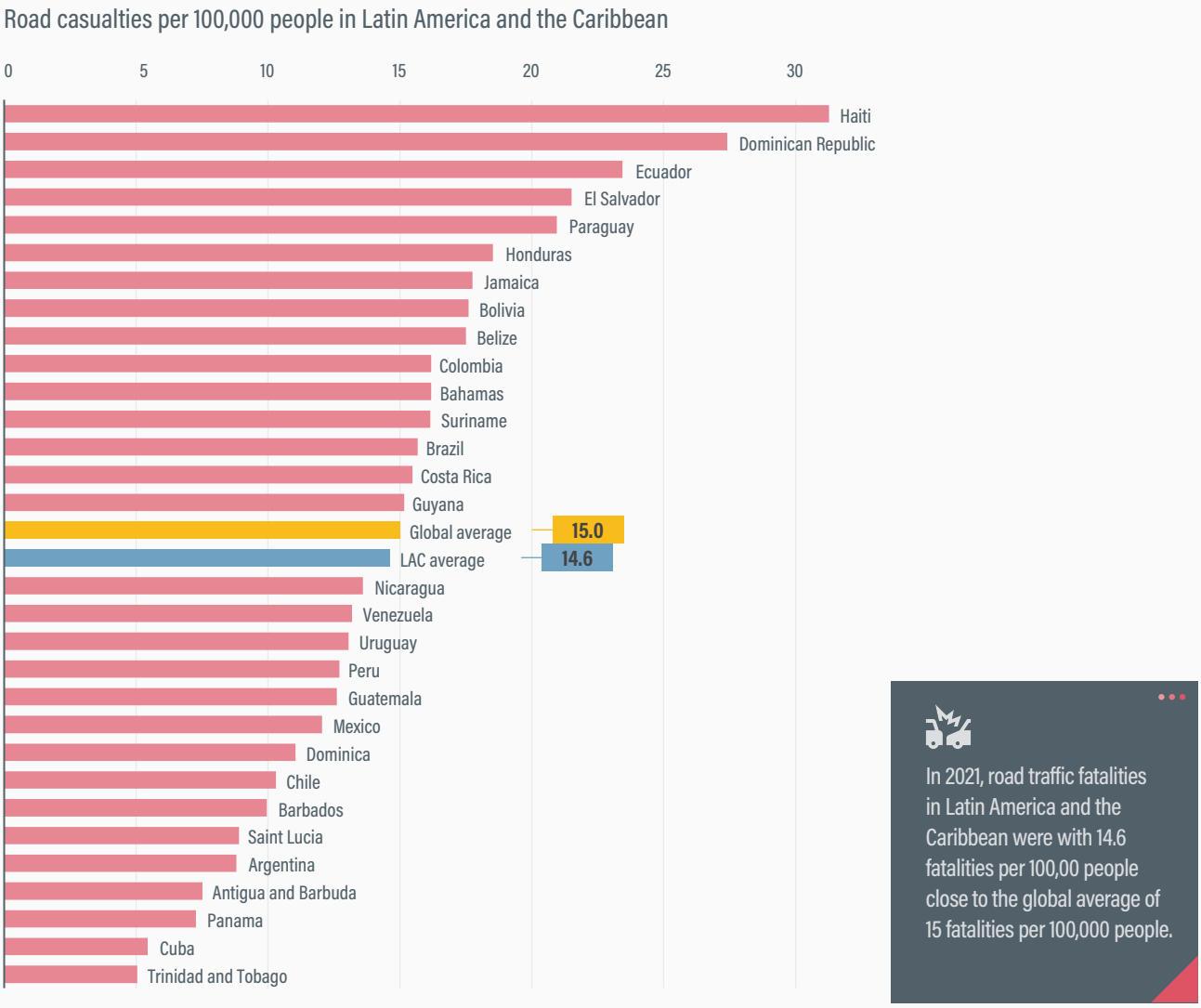
- In 2021, Chile became the first country in the region to have an efficiency law in place for all road vehicle segments.[120] As of 2024, more than 300 companies and 8,000 vehicles were enrolled in Chile's Giro Limpio ("Clean Route") programme, which certifies freight operators based on their fuel efficiency performance and adoption of cleaner technologies, leading to fuel and emissions savings.[121]
- Colombia had upgraded 28,000 heavy goods vehicles to Euro 6 standards as of 2025.[122]
- In 2025, Brazil's Phase L7 of the national Proconve programme came into effect. It sets more stringent emission limits for new light-duty vehicles and requires manufacturers to adopt advanced technologies to meet progressive targets, as part of broader efforts to improve air quality and align with global environmental standards.[123]

In most cases, fossil fuel prices in the region are directly fixed by governments or are regulated in ways that are not fully aligned with market price fluctuations. Countries have introduced a variety of price mechanisms including liberalised prices, fully flexible prices, flexible prices with some degree of smoothing, ad hoc prices and fixed prices.[124]

- As of April 2025, the region's lowest petrol and diesel prices were in Venezuela, Bolivia and Ecuador (ranging from USD 0.004 to USD 0.706 per litre), whereas the highest petrol prices were in Barbados, Uruguay, Belize and Bahamas (ranging from USD 1.43 to USD 1.93 per litre).[125]
- In Peru, the government programme Ahorro GNV facilitated the conversion of 73% of the country's light-duty vehicles from diesel to compressed natural gas in 2022, saving consumers around 50% per month and providing access to a cleaner, more economical and stable fuel.[126]
- Since October 2023, a Peruvian decree has mandated that international land transport vehicles entering its territory must comply with regulations on fuel quality, impacting neighbouring Bolivia.[127]

In 2019, excessive exposure to particulate matter caused by transport contributed to nearly 180,000 deaths, or 6.1% of total deaths, in Latin America and the Caribbean, similar to the global level of 6%.[128] **Only 7.8% of cities in Latin America and the Caribbean met the World Health Organization's air quality guidelines in 2024**; these recommend that annual average concentrations of particulate matter 2.5 should not

FIGURE 5. Road casualties per 100,000 people in Latin America and the Caribbean, 2021



In 2021, road traffic fatalities in Latin America and the Caribbean were with 14.6 fatalities per 100,00 people close to the global average of 15 fatalities per 100,000 people.

Source: See endnote 131 for this section.

exceed 5 micrograms per cubic metre.[129]

In 2021, road traffic deaths in the region averaged 14.6 casualties per 100,000 people, close to the global average of 15 casualties per 100,000 people.[130] By country, they ranged from 5.1 casualties in Trinidad and Tobago to 31.3 casualties in Haiti (Figure 5).[131]

The region faces persistent road safety challenges, including disproportionately high rates of fatal road incidents, with pedestrians and cyclists accounting for nearly half of all road traffic deaths in some countries in 2021.[132] In the region, less than 40% of the assessed roads met the recommended three-star safety standard for bicyclists and motorcyclists, and less than 20% did so for pedestrians, indicating large infrastructure gaps.[133]

As of 2024, Latin America and the Caribbean was the third most vulnerable region to extreme weather events, after Africa and Asia.[134] In 2022 and 2023, record droughts near the Panama Canal created bottlenecks and reduced the canal's transit capacity 50% in the second half of 2023, impacting global maritime trade.[135]

Policy and investment developments

Several countries in Latin American and the Caribbean have developed policy frameworks to enhance low-emission transport initiatives, sustainable transport infrastructure, and climate-resilient urban mobility, reflecting an ongoing commitment to green and inclusive transport solutions. However, the region's transport systems and infrastructure networks remain underprepared for the extreme weather events exacerbated by climate change, with disruptions to roads, ports, airports and public transport affecting markets and industries such as tourism.[136]

- In 2024, Belize submitted to the United Nations its First Biennial Transparency Report on emissions, which provides updates on the national emissions inventory, progress towards achieving the country's Nationally Determined Contribution (NDC), policies, climate impacts, and support provided and received.[137] Belize's second-generation NDC submission of 2021 included mitigation and adaptation targets related to transport.[138]
- To better connect the country, Colombia has made efforts to reactivate the railway system, concession airports, build new roads, strengthen ports, and promote the energy transition and social transformation.[139]
- Ecuador's National Sustainable Mobility Policy, presented in 2023, established strategies and actions for cities to enhance sustainable urban mobility.[140]
- After Mexico adopted the 2020 General Law of Mobility and Road Safety, Jalisco became one of the first states to invest in transport transformation, identifying the need to build streets that prioritise safe access for pedestrians and public transport.[141]
- In 2024, Mexico adopted the National Public Collective Urban Transport Policy (PNTPCU), which aims to promote cleaner alternatives, reduce environmental impact, decrease car dependence, and improve accessibility, sustainability, safety and governance.[142] The goal is to enhance public transport infrastructure and services, reduce inequality and combat climate change while fostering strategic planning for long-term urban mobility improvements.[143]
- In March 2025, Uruguay enacted the regulatory framework for its National Sustainable Urban Mobility Policy, which includes reforms to subsidies, taxes and other incentives to align the tax system with sustainable mobility objectives, and also aims to advance regulations on energy efficiency and the safety of electric vehicles.[144]

Although some countries have taken systemic action, the region continues to lag in public policy and action across all transport modes. Key barriers include limited resources, technological gaps and transport system characteristics.[145]

In Brazil, the government's Mover programme (Mobility and Innovation for the Automotive Sector), launched in 2023, aims to accelerate the transition to low-emission vehicles and to improve the sustainability of domestic manufacturing.[146] The programme adopts a well-to-wheel emission approach and introduces tax incentives, promoting innovation in areas such as energy efficiency, advanced propulsion, biofuels and vehicle recyclability.[147] The programme fosters collaboration among industry, start-ups, and research institutions, with a goal to advance Brazil's progress in long-term decarbonisation and competitiveness.[148]

As of 25 May 2025, five countries in the region – Brazil, Cuba, Ecuador, Saint Lucia and Uruguay – had submitted to the United Nations their third-generation Nationally Determined Contributions (NDCs) towards reducing greenhouse gas emissions under the Paris Agreement.[149] Among these, Saint Lucia is the only country with a mitigation target specifically for transport, while Brazil and Cuba both have non-greenhouse gas transport targets.[150]

- Brazil's 2024 NDC features a target to obtain 50% of transport energy from biofuels by 2033.[151]
- Cuba's 2025 NDC aims for electric vehicles to comprise 10% of the total vehicle fleet by 2030 and 15% by 2035.[152]
- Saint Lucia's NDC commits to a 22% reduction in greenhouse gas emissions from transport and energy by 2035, compared to 2010 levels.[153]

Several countries in the region have joined international frameworks for zero-emission transport.

- At COP 28 in 2023, Colombia signed the Global Memorandum of Understanding (Global MOU) on Zero-Emission Medium- and Heavy-Duty Vehicles, committing to achieve 100% zero-emission new truck and bus sales by 2040.[154]
- In 2024, Costa Rica endorsed the Zero-Emission Vehicle (ZEV) Declaration under the Accelerating to Zero (A2Z) Coalition, reinforcing its ambition to align transport decarbonisation with the goals of its National Decarbonization Plan 2050.[155]

As of 25 May 2025, 16 countries in Latin America and the Caribbean had submitted National Adaptation Plans (NAPs) to the United Nations, out of a total of 63 NAPs submitted by low- and middle-income countries.[156] **Through NAPs, countries outline activities for enhanced infrastructure resilience and transport system adaptation.** Countries in the region that submitted NAPs during 2023 and 2024 were Argentina, Ecuador, Haiti, Trinidad and Tobago, and Uruguay.

- Argentina's 2023 NAP aims to adapt transport infrastructure and operations to climate change by

developing sustainable urban transport, strengthening railways and waterways, and working towards more efficient transport energy use and replacement of fossil fuels with renewable energy.[157]

- In its 2023 NAP, Haiti seeks to enhance infrastructure resilience through better construction standards, zoning, risk and disaster management, maintenance and improved urban planning.[158]
- Uruguay has released several specialised NAPs, with focus areas including cities and infrastructure (2021), agriculture (2021), coastal adaptation (2021) and energy (2024).[159]

Cities across the region increased their adoption of local sustainable urban mobility plans (SUMPs), highlighting the role of cities as climate action leaders. Cities that completed SUMPs through the MobiliseYourCity Partnership between 2022 and 2025 included Arequipa (Peru) and Baixada Santista (Brazil).[160] SUMPs are expected to be completed in the coming years in Córdoba (Argentina), La Paz (Bolivia), Puebla (Mexico), and cities in Paraguay and Uruguay.[161]

- Buenos Aires (Argentina) released its Sustainable Mobility Plan (Plan de Movilidad Sustentable 2030) in 2023, based on a vision for accessible, sustainable, safe and individual transport.[162]
- Córdoba (Argentina) finalised its SUMP in 2023, although information on the implementation of actions remains limited, indicating that the execution phase may still be developing.[163]
- The Brazil National Urban Mobility Policy (PNMU), most recently amended in December 2023, mandates that all municipalities with over 20,000 inhabitants—as well as those located in metropolitan regions, designated as tourist destinations or seeking federal funding for urban mobility—prepare a Mobility Plan. Although most of these cities have not yet submitted their plans, several have finalised theirs in the past two years.[164] Brazilian municipalities often face barriers such as limited technical capacity, institutional support and financial resources, highlighting the urgent need for public policies that offer both technical and financial assistance to enable equitable mobility planning across the country.[165]
- After Costa Rica adopted its Pedestrian Mobility Law in 2021, 15 local governments developed an Intermunicipal Urban Development Plan Oriented to Transport, which aims to shift the paradigm away from car-centred mobility to improve the quality of life for urban residents and visitors.[166]
- In 2024, Peru published its Manual for the Development of Sustainable Urban Mobility Plans, with the objective of guiding and promoting the development of SUMPs in cities across the country.[167]

Fossil fuel subsidies in Latin America and the Caribbean continued to incentivise fossil fuel use, contributing to high greenhouse gas emission levels. In 2023, the region's per capita fossil fuel subsidies totalled USD 486, the second lowest level after Africa (USD 198) and less than half the global average (USD 813).[168] The region's fossil fuel subsidies as a share of total GDP, at 6.8%, were the second highest among global regions in 2023, below Asia's at 12.1%.[169] Fossil fuel subsidies in the region are projected to increase 17% between 2023 and 2030, further undermining climate and sustainability efforts.[170] Although removing fossil fuel subsidies supports the decarbonisation of transport, such subsidies remain politically difficult to reform and are deeply entrenched in most countries of the region.[171]

- Between 2018 and 2022, Brazilian subsidies to the oil and gas industry totalled USD 58 billion (BRL 335 billion), five times higher than those for renewable energy despite an increase in subsidies for renewables, which are a dominant energy source.[172] In 2023, the government reduced consumer subsidies for fossil fuels but increased financial support for the extraction and development of new reserves; this sparked protests against the environmental consequences of these investments, particularly oil exploration in the Amazon.[173]
- In Ecuador, following protests in 2023 and reductions in subsidies in 2024, the consumption of gas oil decreased; however, diesel and petrol consumption by taxis increased.[174]

Efforts to improve the efficiency of freight transport have been approached mainly through multi-stakeholder programmes, highlighting a regional shift towards collaborative and inclusive efforts.

- In Argentina, the government's Plataforma Observatorio Nacional de Transporte Sostenible (PONTS), launched in 2024, supports the decarbonisation of the transport sector, including freight transport, by promoting efficiency, competitiveness, and implementing activities that will support the Argentine government in implementing measures that are part of the National Climate Change Adaptation and Mitigation Plan (PNAyMCC).[175]
- In 2023, Brazil launched the Green Mobility and Innovation Program, offering companies tax incentives to develop and manufacture low-emission road transport vehicles.[176]
- As of December 2023, the Chilean voluntary programme Giro Limpio – which seeks to certify and recognise efforts by transport companies to improve their energy and environmental performance – had expanded to 376 transport companies, 56 freight generators and 11 logistics operators.[177] Next steps include a methodology for quantifying energy savings and emissions associated with the land freight transport sector; a practical guide on



electro-mobility and charging infrastructure for heavy-duty vehicles; and promoting women's participation.[178]

- Through its GiroZero programme, Colombia reduced its CO_2 emissions from freight transport from more than 6.6 million tonnes in 2019 to just over 6.2 million tonnes in 2023.[179] The programme provides tools, research and testing; publishes public policy recommendations; and supports companies in reducing their environmental footprints.[180]
- In 2024, Mexico's Programa Transporte Limpio – a voluntary programme that engages 851 participating cargo transport companies – evaluated 97,800 vehicles and prevented the release of an estimated 3.2 million tonnes of CO_2 emissions.[181]

Aligned with a worldwide trend, some cities in the region have initiated parking reforms to reallocate space away from vehicle parking and towards broader needs such as housing, public spaces, and cycling and walking infrastructure.

- After realising that 42% of the built area in Rio de Janeiro (Brazil) from 2006 to 2015 was dedicated to vehicles, the city changed its building code in 2019 to restrict off-street parking and to promote walking and cycling by removing parking minimums, among other measures.[182]
- The government of Guadalajara (Mexico) has prioritised walking, cycling and transit by expanding regulated parking zones in the city centre, including variable pricing structures where parking fees are higher at peak hours. By discouraging long-term parking in high-demand areas, the reform aims to make spaces available for short-term users and to incentivise alternative mobility options.[183]

Cities continued to expand initiatives and actions to enhance the use of walking and cycling.[184]

- In 2024, Buenos Aires (Argentina) was ranked as the sixth best city in the world for cycling.[185] From 2009 to 2023, the share of bicycle trips in the city grew from 0.4% to 7.0%, to total 400,000 trips per day.[186] Buenos Aires has 300 kilometres of bike lanes and began installing bike parking in 2011, with the total number of spaces reaching 5,000 in 2022.[187]
- Every Sunday, the biggest roads in Bogotá (Colombia) are shut to cars and left open to bikes, skates, and feet, attracting an estimated 1,500 million non-motorised users.[188] In February 2023, the system comprised 608 kilometres of bicycle infrastructure.[189] Although the infrastructure has not yet reached the targets set in the 2020-24 Strategic Plan, the number of trips nearly doubled from 2023 to 2024.[190]
- In 2022, Colombia adopted a National Strategy for Active Mobility that aims to encourage cycling and walking as alternative modes of transport, specifically with a gender and differential approach, to address the challenges of climate change and mobility transformation.[191]
- In 2025, the Ecobici bicycle sharing system in Mexico City (Mexico) totalled 9,300 bicycles distributed at 689 stations across six municipalities.[192]



Carlos Felipe Pardo

- In the first half of 2024, Mexico City added nearly 243 kilometres of cycling infrastructure, bringing the total network to 412 kilometres (up 8% from 2023) and benefiting nearly 1.1 million people.[193]
- Since 2013, Mexico City has built mass bike parking facilities, rising from 968 spaces in 2013 to 2,276 spaces across 10 facilities in 2024, and increasing the storage capacity by 135%.[194]
- At the 2023 UN Climate Change Conference (COP 28), Rio de Janeiro (Brazil) became the first Latin American city to join the Breathe Cities initiative.[195] Its goal is to ensure that 6.7 million residents breathe cleaner air by expanding air quality data, raising awareness with communities, and taking targeted steps to drive climate action, such as providing technical assistance to support the development of a low-emission district and upgraded clean public transport.[196]

Countries in the region have introduced a range of electric mobility strategies, including laws to promote electric vehicles and charging infrastructure, as well as tariff incentives for imports and taxes.[197] Strategic plans, financial incentives, agreements and regulatory frameworks have helped to accelerate the electrification of road transport. Many of these measures focus on facilitating the acquisition and operation of electric vehicles, and supporting the installation of charging points to enable this transition. Developing an electric mobility incentive framework is considered crucial for the early-stage deployment of the technology, but countries in the region are at different stages of development.

- In 2025, Rio de Janeiro was the first city in Brazil to open a public electric vehicle charging station, in line with the municipality's Sustainable Development and Climate Action Plan, which aims to make the city neutral in greenhouse gas emissions and targets a 40% share of electric and hybrid vehicles in the fleet by 2050.[198] Rio de Janeiro's regulation 158/25 seeks to guarantee condominium unit owners the right to install electric vehicle charging infrastructure in their private parking lots.[199]
- Chile's 2024-2026 Roadmap for the Advancement of Electromobility outlines actions including deploying public chargers in urban and inter-urban areas, adding 1,000 zero-emission buses, introducing electric buses to wider regions, and providing scholarships for electromobility-related training.[200]
- Costa Rica updated its Law of Incentives and Promotion for Electric Transportation in 2023 to promote the installation and distribution of fast chargers, reducing the gap between the number of electric vehicles and the availability of charging points.[201]
- Guatemala's Electric Mobility Incentives Law, published in 2022, aims to facilitate and promote the import, sale, and use of electric, hybrid, and hydrogen vehicles and electric transport systems.[202] Between January 2024 and January 2025, sales of light electric vehicles in Guatemala increased 113% and sales of electric motorcycles grew 93%.[203]
- After Panama approved its electro-mobility law in 2022, the country's public charging infrastructure expanded, and electric vehicle sales rose from 21 units in 2020 to 359 units by March 2023.[204]
- Asunción (Paraguay) received its first 30 electric public buses in 2023, following the implementation of the Master Plan for Multimodal Electric Mobility for Public and Logistic Transport in 2022.[205]
- In Uruguay, an agreement to allow electric taxis to recharge at 128 electric bus charging points was signed in 2024 between the National Administration of Power Plants and Electric Transmissions (UTE), the Cooperative of Uruguayan Collective Transport of San José (CUTCSA) and the Unified Taxi Guild (CPATU).[206]

The use of electric buses for public transport and other forms of shared transport has grown in the region.

- The electric ferry *China Zorrilla*, which will operate between Argentina and Uruguay, was launched in 2025. It is expected to contribute to the decarbonisation of regional cross-border maritime transport, with an estimated annual reduction of 37,545 tonnes of CO_2 equivalent.[207]
- In 2022, Barbados set an excise tax for electric vehicle purchases, reduced import duties for used electric vehicles to 10%, and lowered the tariff on both electric and solar

battery-powered vehicles by 10%.[208] Barbados has begun replacing its state-owned bus fleet with electric models.[209]

- In Fortaleza (Brazil), the Re-ciclo project uses solar-powered electric tricycles to collect recyclables, promoting environmental sustainability while creating jobs for female recyclers.[210]
- Antofagasta (Chile) runs 40 electric buses, the first such service outside the metropolitan area of Santiago.[211]
- Costa Rica's National Plan for Decarbonization 2050 aims to transition at least 30% of the public transport fleet to zero emissions by 2035 and 85% by 2050.[212] Under this framework, the National Bank of Costa Rica launched the country's first Electromobility Investment Fund in 2025.[213]
- In 2025, Guatemala introduced a 100% electric minibus service aimed at connecting six neighbourhoods to a key shopping centre while integrating with TransMetro and TuBus; the service includes two initial free trips for all users and two free trips per day for seniors.[214]
- Both Jamaica and Trinidad and Tobago have committed to adding electric buses to their fleets.[215]
- Veracruz (Mexico) launched a pilot project of 60 electric taxis in 2025 and plans to modify its regulatory framework to allow electric vehicles to offer taxi services.[216]

Since 2022, several cities in the region have expanded or launched bus rapid transit (BRT) systems as part of broader efforts to promote low-emission, high-capacity public transport.

- Feira de Santana (Brazil) launched a 27-kilometre BRT line in early 2024 along a major urban corridor reducing travel times and increasing access to services for citizens.[217]
- The TransBrasil, a new BRT corridor in Rio de Janeiro (Brazil), partially opened in 2024 with 20 stations along a 26-kilometre route and is expected to expand to 60 kilometres by 2030. The network aims to serve 250,000 people per day and increase employment opportunities for low-income households by 23%.[218]
- Guadalajara (Mexico) inaugurated its Mi Macro Periférico BRT corridor in 2022, operating along a 41.5-kilometre ring road and serving more than 170,000 passengers daily with a fleet of buses.[219]

Countries increased their support for extending existing metro lines, and are planning and developing new cable cars and passenger rail services.

- In October 2024, Belize launched its first public transport commuter app, which will transform the commuting experience for residents and visitors and set a new standard for reliability, safety and efficiency in the country's public transport services.[220]
- Santo Domingo (Dominican Republic) expects to complete the extension of its metro Line 2C by the end of 2026, as part of a metro-teleferic connection in the city.[221]
- In 2024, Mexico approved a reform to Article 28 of the Constitution that prioritises rail passenger transport service and compensates the State for the allocation of public or private concessions, without affecting freight transport.[222] With an initial budget of USD 7,500 million, the government has started work on two of the five planned rail lines.[223]
- Panama aims to install its first cable car system by 2028 and is evaluating proposals for a 6.6 kilometre line with six stations.[224]
- The proposed Transcontinental electric train mega-project, presented in 2024 at the Institute of Mining Engineers of Peru (IIMP), envisions connecting 12 countries across 3,000 kilometres, enhancing connectivity while strengthening regional commerce, logistics and economic development.[225]

In November 2025, Belem (Brazil) will host the annual UN Climate Change Conference (COP 30). Stated priorities include defending multilateralism and science; focusing on action and implementation by translating words into transformative actions on the ground; supporting the implementation of robust NDCs and NAPs; building developing countries' capacity to engage in government-led, systematic and institutionalised national reporting; and designing holistic investment strategies.[226] Other focus areas include the urgency of fulfilling the mandate on indicators, advancing the Baku adaptation roadmap, and establishing a "Circle of Indigenous Leadership" to integrate traditional knowledge into global climate strategies and negotiations.[227] Regional co-operation, investment in climate-resilient infrastructure and the scaling of successful pilot programmes will be crucial. With COP 30, the region has an opportunity to reaffirm its commitment to sustainable, low-carbon transport and demonstrate leadership.

Partnerships in action

SLOCAT partners engaged in dozens of actions during 2023-2024, including:

- **EUROCLIMA**, the European Union's flagship programme for climate action in Latin America, has been restructured along thematic action lines, including urban mobility, energy, resilience and forests. The mobility component extends beyond an earlier focus on NUMPs, SUMPs and pilot projects to support countries through technical assistance, policy support, capacity development and knowledge exchange. The programme is implemented by agencies such as GIZ and AFD and works across multiple levels of government to promote regional co-operation through its communities of practice.[228]

- The **GEF-8**, through its Sustainable Cities Integrated Program, promotes integrated, systems-based strategies to foster net zero carbon, nature-positive, inclusive and climate-resilient urban development.[229] The Greening Transportation Infrastructure Development initiative supports countries in designing transport infrastructure portfolios at the national or land/seascape levels that embed sustainability from the start, while aligning with broader urban transformation goals.[230] As part of GEF-8, countries in Latin America and the Caribbean – including Costa Rica, Guatemala, and Trinidad and Tobago – also receive assistance in preparing their Biennial Transparency Reports for the UN.[231]
- The 2023 report ***Transportation 2050: Pathways to Decarbonization and Climate Resilience in Latin America and the Caribbean*** analyses the state of transport and climate change, identifies country gaps relevant to the sector's transformation, and proposes policy recommendations based on best practices, in order to build an institutional and policy architecture to accelerate the pace of systemic change that the sector needs to comply with international objectives.[232] The report was published by the Inter-American Development Bank (IDB) in collaboration with the Airport Council International, the International Association of Ports and Harbors, the International Road Federation, the International Transport Forum and the International Association of Public Transport (UITP).
- The **MobiliseYourCity Partnership** focuses on comprehensive, integrated and participatory urban mobility planning at the local and national levels by providing methodological guidelines for developing sustainable urban mobility plans (SUMPs) and national urban mobility plans (NUMPs). As of December 2023, the Latin America and Caribbean region had seen the completion of 8 SUMPs and 3 NUMPs, of which 4 SUMPs and 2 NUMPs were in the implementation stage.[233]
- The **International Association of Public Transport (UITP)** aims to promote best practices in public transport and to develop co-operation to provide alternatives for mobility within cities in Latin America and the Caribbean. UITP develops publications, training, debates, meetings and seminars and includes members from Argentina, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama and Uruguay.[234]
- **Asociación Sustentar**, as part of its coordination of the Transport and Resource Efficiency Working Group of the LEDS LAC Platform, delivered a knowledge product that summarises the challenges and opportunities in the region to advance on decarbonisation of the transport sector, with a focus on the electrification of public transport. Based on input from discussions with the High Ambition Group (HAG) for the Energy Transition of Transport and other sources, the analysis evaluated the strategies and action plans that countries are adopting through their NDCs and stakeholders in the region.[235]
- **Despacio** focuses on improving the well-being of communities and individuals by managing slow, human, friendly and sustainable cities.[236] In 2024, Despacio, with support by the C40 Climate Leadership Group, started the "C40 Inclusive e-freight LATAM" project to identify and assess gaps and barriers in access to knowledge, as well as to strengthen the technical and financial skills of the workforce in urban freight transport.[237] The project seeks to enable a just transition towards decarbonising the freight transport sector in cities like Bogotá, Curitiba, Medellín, Mexico City, Quito and Rio de Janeiro.[238]
- In April 2025, at the eighth meeting of the **Forum of the Countries of Latin America and the Caribbean on Sustainable Development** (held by the United Nations Economic Commission for Latin America and the Caribbean), intergovernmental parties recognised that improving environmental quality in cities is necessary to achieve sustainable development and will require efforts in areas such as air, soil, and water pollution, water scarcity, sanitation, sustainable transport, sustainable production and consumption, and energy efficiency.[239]
- **E-Motion** is a regional Green Climate Fund programme supporting the large-scale transition to electro-mobility in Latin America. The first implementation phase includes Paraguay, Panama, and Uruguay, combining financial assistance from CAF with technical support from GIZ.[240]

MODULE 3 | 3.5

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North America Regional Overview





DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	North America	Global
Population size (2023)	381 million	8,000 million
Population growth (2015-2023)	5.9%	8.5%
Urban population share (2023)	82.2%	57%
Urban population growth (2015-2023)	7.9%	16%
GDP per capita (2023)	USD 61,470 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	18.7%	22.8%
Share of women employed in transport and storage (2023)	28.1%	15.6%
Motorisation rate (2022)	804.6 vehicles per 1,000 people	218.7 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	66.9%	52%
Share of rural population with access to all-weather primary and secondary roads (2020)	No data	38%
Transport total GHG emissions (2023)	1,905 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	4.99 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 2,172 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport (2022)	5.8%	4.6% for 2023
Carbon intensity of electricity generation (2023)	279 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	12.6%	6%
Premature deaths attributable to air pollution by transport (2019)	1.7 per 100,000 people	2.3 per 100,000 people
Road casualties (2021)	13.2 per 100,000 people	15 per 100,000 people

Source: See endnote 1 for this section.



Photo: Carlos Felipe Pardo

KEY FINDINGS

Demand, use and access

- Transport is a key pillar of the North American economy. In Canada, the sector directly contributed 4% to the gross domestic product (GDP) in 2023 and employed 844,000 people in 2024. In the United States, transport accounted for 6.5% of GDP in 2023 and employed 6.7 million people as of January 2025.
- Access to sustainable, zero-emission transport, especially public transport and safe walking and cycling, remains limited in the region. In 2020, only 57% of the US urban population had convenient access to public transport – above the global average of 52%, yet below Canada's share of 77%.
- Freight transport by road, pipeline and rail continued to play a significant role in economic activity in North America.
- Across the region, passenger transport activity increased again after the sharp declines experienced during the COVID-19 pandemic in 2020. Passenger transport activity in the United States increased 12% in 2021 but then fell 2% in 2022.


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- Rail passenger transport in the United States grew 19% in 2023 to reach 9,376 million passenger-kilometres; rail ridership was up 104% from the historic low of 4,603 million passenger-kilometres in 2021 but still 10% below the 2019 level (10,440 million passenger-kilometres).
- Four out of five workers in North America commuted primarily by private vehicle in 2022.
- US public transport ridership increased 17% in 2023 – reaching 6.9 billion trips and 56 billion passenger-kilometres – but it still did not recover from pandemic-related declines in 2020 and 2021.
- Walking and cycling play important roles in regional transport but are often overlooked and undercounted.
- Shared micromobility (bicycles and electric scooters) in North America reached a new record high in 2023, with 157 million rides taken in the United States, surpassing the 147 million rides recorded in 2019.
- Although average US petrol prices have fallen from their historic peak in 2022, transport costs place a higher household burden on North America than most regions due to high dependency on private vehicles.
- The region's motorisation levels (covering four-wheeled motor vehicles) remained at an all-time high in 2022, at four times the global average and 15 times higher than in Africa. Canada had a motorisation rate of 654 vehicles per 1,000 people in 2022, while the rate in the United States was even higher at 822 vehicles per 1,000 people.
- Electric passenger car sales in North America continued their near-exponential growth until 2023, then grew modestly in 2024.
- The United States accounted for 11% of global battery electric passenger car sales in 2024, surpassing 1 million units for the first time with 1.1 million new registrations in 2023 and 1.2 million in 2024.
- More electric buses and heavy-duty trucks have entered service in North America, including in both municipal and private fleets.

KEY FINDINGS

Sustainability and climate trends



- In 2023, North America was responsible for 26.7% of global transport greenhouse gas emissions (excluding international aviation and shipping), the second highest regional share after Asia (40.3%).
- Transport emissions in North America increased 0.72% in 2023 – reaching 1.9 gigatonnes of CO_2 equivalent – but were still below 2019 levels.
- Per capita transport emissions totalled 4.3 tonnes of CO_2 equivalent in Canada and 5.1 tonnes in the United States in 2023 – roughly five times higher than the global average of 0.9 tonnes. Key factors behind high per capita emissions are high private motorisation levels and long travel distances.
- In 2023, transport was the largest contributor to US greenhouse gas emissions (accounting for 29% of total emissions) and the second largest contributor to Canadian emissions (22.6%).
- The United States was the world's largest emitter of transport greenhouse gases in 2023, contributing nearly a quarter of the global total (excluding international aviation and shipping), at 1,735 million tonnes of CO_2 equivalent.
- Road transport continued to dominate North American transport greenhouse gas emissions, contributing 81.7% of US transport emissions in 2022 and 62% of Canada's in 2023.
- In Canada, road passenger transport was responsible for 54.4% of transport emissions, road freight transport for 24.3%, and maritime transport for 3%, in 2021 (latest data available).
- In the United States, freight transport was responsible for 31.9% of transport greenhouse gas emissions in 2022, up from only 27% in 2010.
- The average energy efficiency of new light-duty vehicles sold in the United States reached its highest value in 2022, marking the largest improvement in nine years, but it still lagged behind other countries.
- The carbon intensity of electricity has improved steadily in North America in recent years.
- Several North American cities experienced among the highest congestion levels globally in 2024, with motorists in the region's 10 most congested cities facing more than 60 hours of traffic delay annually.
- The transport sector was responsible for around 12.6% of North America's air pollution in 2019, more than double the global average (6%).
- Transport contributed 15% of US air pollutant emissions in 2019 and 9.8% in Canada – resulting in 2.29 premature deaths per 100,000 people in the United States (consistent with the global average) and 1.01 premature deaths in Canada (half the global average).
- North America recorded 13.2 road casualties per 100,000 people in 2021, close to the global average of 15 casualties per 100,000 people.
- Road traffic fatalities and injuries accounted for 1.9% of Canada's GDP and 5% of the US GDP in 2021.
- Less than 40% of the road length assessed in North America meets the recommended three-star or better safety standard for pedestrians and cyclists, compared to 60% for motorcyclists and more than 80% for vehicle occupants.
- The United States has experienced a record number of climate-induced disasters, with 28 events in 2023 costing USD 96 billion in damages and 27 events in 2024 costing USD 182.7 billion.
- Climate change threatens the supply networks of Canada's Indigenous communities, with around 50 communities (56,000 people) relying on a 6,000-kilometre winter road network.

KEY FINDINGS

Policy and investment developments

- Canada continued to advance its 2019 vision calling for "a transport system…that is recognised worldwide as safe and secure, efficient and environmentally responsible", including by integrating the Sustainable Development Goals (SDGs) into nationwide strategies starting in 2023.
- In 2024, Canada announced its 2030 Emissions Reduction Plan, which calls for a 23% reduction in transport greenhouse gas emissions from 186 million tonnes of CO_2 equivalent in 2019 to 143 million tonnes by 2030. Additional government actions explore opportunities for rail, aviation, maritime transport, and other modes, and address zero emission vehicles and fuels, electrification and charging infrastructure.
- In January 2023, the United States released its inter-agency National Blueprint for Transportation Decarbonization, a landmark strategy to drastically reduce transport greenhouse gas emissions towards net zero by 2050.
- The Bipartisan Infrastructure Law of 2021 authorised USD 1.2 trillion for transport and infrastructure investment across the country, including USD 550 billion for new projects between 2022 and 2026.
- The Inflation Reduction Act, signed in August 2022, was the largest investment focused on climate change in US history. Transport-related investments under the Act focused mainly on providing tax incentives to electric vehicle owners as well as auto manufacturers.
- In January 2025, the Trump administration halted the disbursements of funds through the Inflation Reduction Act and the Bipartisan Infrastructure Law through an executive order, which eliminated electric vehicle mandates.
- The United States and Canada have both submitted to the United Nations their third Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, which include transport actions. The two countries also released new national adaptation strategies between 2023 and 2025.
- In the United States, policy for clean freight transport advanced with the release of the National Zero-Emission Freight Corridor Strategy in March 2024 and the hosting of the "first-ever White House Sustainable Freight Workshop" in December 2024.
- US land use policy reforms have supported a shift towards integrated transport planning in various jurisdictions.
- In 2023, fossil fuel subsidies in North America totalled USD 2,172 per capita, nearly 3 times the global average (USD 813) and more than 10 times the African average (USD 199). The region's fossil fuel subsidies are projected to rise 17% between 2023 and 2030, further undermining climate and sustainability efforts.
- In January 2025, New York City became the first US city to implement congestion pricing, with each passenger vehicle that enters the "Congestion Relief Zone" facing a daily charge of up to USD 9 at peak times.
- North America has pledged greater investments in infrastructure for walking and cycling.



KEY FINDINGS

- Very few new public transport services were launched in North America between 2022 and 2024. Additional developments in US public transport were focused on fare-free programmes.
- North American rail systems have not seen significant expansion in years. In February 2025, Canada announced plans to build its first high-speed rail between Quebec and Toronto. In the United States, new ambitions set in 2024 aimed to improve the rail network and address major challenges including the lack of electrified railways, high-speed rail services and strong labour protections for rail workers.
- Progress was made in 2024 to improve US vehicle emission standards, but this was rolled back in 2025 under the new administration.
- In 2025, advances in vehicle technologies continued in Canada but were largely rolled back in the United States. Canada finalised its Electric Vehicle Availability Standard in 2023, requiring that 100% of new light-duty vehicles sold in the country be zero-emission by 2035.
- US states have continued their ambition on sustainable, low-carbon transport by focusing mainly on cleaner vehicle fleets. California has spearheaded the nationwide transition to zero-emission vehicles, although in May 2025 the US Senate repealed waivers that allow the state to set its own air pollution standards for road vehicles.
- The Trump administration's cancellation of US federal funding for electric vehicle activities will reportedly lead to job losses in the transport sector, including in electric vehicle production, as well as negative health outcomes; however, efforts may continue at the state level.
- Proposed increases in US import tariffs could have significant impacts on the automobile industry, especially on the electric vehicle industry, although such tariffs are not necessarily new in the region.
- Major North American airlines took initial steps towards the adoption of sustainable aviation fuel (SAF) in support of their long-term sustainability strategies.



Carlos Felipe Pardo

Context, challenges and opportunities

North America comprises the high-income economies of Canada and the United States as well as the territories of Bermuda (United Kingdom), Greenland (Denmark) and Saint Pierre and Miquelon (France). This regional overview focuses on Canada and the United States, both of which have high personal motorisation rates, strong contrasts between urban and rural transport, and high levels of polluting transport emissions that contribute to climate change. North America accounted for 5% of the global population in 2023 yet contributed 27% of the world's transport greenhouse gas emissions – 1.9 gigatonnes of carbon dioxide (CO_2) equivalent – the second highest share among regions.[2]

Between 2023 and early 2025, North America experienced numerous severe weather events accelerated by climate change. Record-breaking wildfires in Canada in 2023 burned more than 15 million hectares of land (an area roughly the size of the US state of Florida), releasing CO_2 emissions comparable to the annual emissions of India, the world's third largest emitter globally.[3] The fires were likely exacerbated by climate change, as 2023 was the warmest and driest year on record in Canada since at least 1980.[4]

In the United States, the deadliest wildfire in modern history occurred in August 2023 in Hawaii, where the Lahaina Fire claimed 102 lives and destroyed large parts of Maui.[5] The Eaton and Palisades wildfires in the Los Angeles area in January 2025 were the second and third most destructive wildfires in California's history as of March 2025, destroying more than 16,000 structures, burning 15,000 hectares and resulting in 29 fatalities.[6] Severe natural disasters, exacerbated by climate change, have destroyed transport infrastructure and disrupted transport systems. Meanwhile, the sector remains a major source of greenhouse gas emissions in the region, further accelerating climate change and its associated impacts.

Between 2021 and 2024, the US Biden administration introduced a range of policies, strategies and frameworks that marked the first steps towards a comprehensive decarbonisation of transport in the United States. Many of these measures were described as "landmark" activities, spanning all major areas including overall transport, passenger transport and freight transport. However, in 2025 the Trump administration took steps to reverse or pause many of these efforts.

Greater progress on transport climate action and sustainability has been made in Canada than in the United States. While US national efforts have stagnated, individual states and cities have continued to advance climate- and sustainability-related initiatives in transport. Meanwhile, Canada has demonstrated at the national level how transport sustainability and decarbonisation can go hand-in-hand by establishing new funding streams for public transport, walking and cycling, and electric vehicles, as well as linking activities to the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs).

North America's efforts on sustainable, zero-emission transport have advanced amid growing uncertainty about the durability of policies and legislation on climate, equity and sustainable development. Public budgets have faced increasing strain due to high national debt levels, while shifting policy and expenditure priorities raise concerns about the long-term commitment to sustainability goals. As governments grapple with competing demands, the question remains whether recent progress – particularly in electric mobility, infrastructure investment, and more and better collective transport options – can be sustained in the face of fiscal tightening and evolving political agendas.

Demand, use and access

Transport is a key pillar of the North American economy. In Canada, the sector directly contributed 4% (USD 61.95 billion or CAD 88.5 billion) to the gross domestic product (GDP) in 2023 and employed 844,000 people in 2024.[7] In the United States, transport accounted for 6.5% (USD 1,826.5 billion) of GDP in 2023 and employed 6.7 million people as of January 2025.[8]

- The largest US employment in transport as of January 2025 was in warehousing and storage (1.8 million people) and trucking (1.5 million people), while public transport employed 490,000 people.[9] The job growth rate in the US public transport industry was twice the national average in 2023.[10]
- In Canada, the unemployment rate in the transport sector in 2023 was 2.8%, nearly half the national average of 5.3%.[11] In the United States, the transport unemployment rate remained slightly above the national rate until January 2025, when it reached 3.6%, compared to 4.4% nationally.[12]
- Women accounted for 25% of the transport-related workforce in Canada in 2023.[13] In the United States, women made up 28.5% of those employed in transport and storage, the highest share among all regions and more than double the global average of just 15.6% in 2023.[14]

Access to sustainable, zero-emission transport, especially public transport and safe walking and cycling, remains limited in the region. In 2020, only 57% of the US urban population had convenient access to public transport – above the global average of 52%, yet below Canada's share of 77%.[15]

- Only 30% of people in the United States lived within walking distance (within one kilometre) of both healthcare and education services in 2023, compared to 50% of people in Canada.[16]
- Just 9% of the US population lived within 300 metres of a protected bike lane in 2023, compared to 29% in Canada.[17]
- A 2023 survey showed that in Canada, 38% of Black workers and 29% of mixed-race workers relied on public transport for commuting.[18]
- Access to all-weather roads is an issue of growing importance for Indigenous communities in Canada's remote regions. The Northwest Territories, Yukon and Nunavut account for a large share (40%) of the country's land area but only 1% of its population.[19] In the Northwest Territories, 35% of the road network consists of ice roads that rely on stable cold conditions to remain usable.[20]

Freight transport by road, pipeline and rail continued to play a significant role in economic activity in North America. Freight activity in the United States totalled 7,816 billion tonne-kilometres in 2022, a level similar to 2017 but still 3.7% below the all-time high of 2018.[21] US freight activity grew 1.7% in 2021 and 1.8% in 2022, driven mainly by an increase in rail freight.[22]

- In Canada, road freight accounted for 50% of total freight activity, followed by pipelines at 36% and railways at 14%, as of 2014 (latest data available).[23] Since then, rail freight activity has increased 155%, reaching 463.9 billion tonne-kilometres in 2022.[24]
- Road freight accounted for the largest share of US freight activity (40.6%), followed by rail (28.6%) and pipelines (19.9%).[25] In 2022, US pipeline freight activity reached its highest level since 2000.[26]
- In 2023, 1.7 billion metric tonnes of goods were transported by rail in the United States, with fossil fuels accounting for the largest share at 43%.[27] The highest-value commodity transported by US rail in 2022 was vehicles, at a total value of USD 125.6 billion, three times above the commodity value of fossil fuels, the second largest category.[28]
- The United States added more than 100,000 kilometres of pipelines for liquid fuels between 2010 and 2024, and several natural gas pipelines were completed in recent years.[29]

Across the region, passenger transport activity increased again after the sharp declines experienced during the COVID-19 pandemic in 2020. Passenger transport activity in the United States increased 12% in 2021 but then fell 2% in 2022.[30]

- US passenger transport activity declined from 10,290 billion passenger-kilometres in 2019 to 8,490 billion in 2020, before rebounding to 9,550 billion in 2021.[31] Passenger activity fell to 9,324 billion passenger-kilometres in 2022, likely due to ongoing concerns about a volatile economy.[32]
- Domestic aviation in the United States grew 9% in 2023 to a record high of 1.25 billion passenger-kilometres.[33]
- Although all modes of US passenger transport experienced steady growth in 2022, road transport activity on highways fell 5.8%.[34]

Rail passenger transport in the United States grew 19% in 2023 to reach 9,376 million passenger-kilometres; rail ridership was up 104% from the historic low of 4,603 million passenger-kilometres in 2021 but still 10% below the 2019 level (10,440 million passenger-kilometres).[35] A total of 28.5 million US rail trips were taken in 2023, with nearly every route experiencing double-digit growth in ridership that year.[36] Rail passenger activity in Canada doubled in 2022 – from 542 million to 1,228 million passenger-kilometres – but was still below the 2019 level of 1,729 million passenger-kilometres.[37]

Four out of five workers in North America commuted primarily by private vehicle in 2022.[38]

- As of 2022, 140 million people in the United States commuted to work daily, while 20 million worked remotely (15.2% of the workforce).[39] Compared to 2019, this was a shift of 9 million people from office work to remote work.[40]
- More than three-quarters (77.3%) of people in the United States used their private vehicle for commuting in 2022, with 88% of them driving alone.[41] Only 2.9% of US workers walked or biked to work in 2023.[42]
- The average commute time was 26.4 minutes in both the United States (2022 data) and Canada (2024 data).[43]
- In Canada, the number of commuters has continued to increase, totalling 16.5 million in May 2024.[44] The vast majority of people in the country (81.5%) used a private vehicle to travel to work that month.[45]
- In Canada, 18.7% of employed people worked mostly from home as of May 2024, down 3.7 percentage points compared with May 2022.[46]

US public transport ridership increased 17% in 2023 – reaching 6.9 billion trips and 56 billion passenger-kilometres – but it still did not recover from pandemic-related declines in 2020 and 2021.[47] In Canada, passenger trips on public transport grew 12% between January 2023 and January 2024 – to a total of 127 million trips – but was still 29% below January 2020 levels, with revenues down 20%.[48]

- As of 2023, public transport use in the United States remained below 1980 levels, with 7 billion passenger trips recorded, compared to 9 billion in 2019, before the COVID-19 pandemic.[49]
- New York City accounted for nearly half (46%) of all US public transport trips in 2023; however, the city's ridership



Carlos Felipe Pardo

remained at around half of its 2019 level.[50]

Walking and cycling play important roles in regional transport but are often overlooked and undercounted. During a typical week, only around 7% of people in the United States rely entirely on non-auto modes of transport, whereas 65% use a car plus another mode at least once a week, around half use non-auto modes at least three times a week, and 25% use a non-auto mode seven or more times each week.[51] In 2022, less than 8% of all US trips were made by walking or cycling, compared with 87% using primarily personal motorised vehicles (cars, vans, trucks, motorcycles).[52] However, large disparities exist between rural and urban areas, as well as within urban regions.[53] Walking and cycling remain undercounted in key statistics due to methodological issues that ignore multi-modality and the trips made to and from public transport.[54]

- Although 2.2 billion bicycle trips were taken in the United States in 2022, they totalled fewer than 10,000 million passenger-kilometres, representing just 0.1% of all passenger travel activity.[55] Walking accounted for an estimated 25,000 million US passenger-kilometres (0.28% of total passenger travel activity) in 2022, down sharply from 54,156 million passenger-kilometres in 2017.[56]
- The 2022 National Household Travel Survey found that 6.9% of all US trips were made by walking and 0.9% by bicycle.[57] More than half (52%) of US cycling trips in 2022 were for social or recreational purposes.[58]
- New York City had the highest share of sustainable transport modes among major US cities in 2022, with 44% of all trips conducted by walking and 2.6% by bicycle, compared to 34% by vehicles.[59]

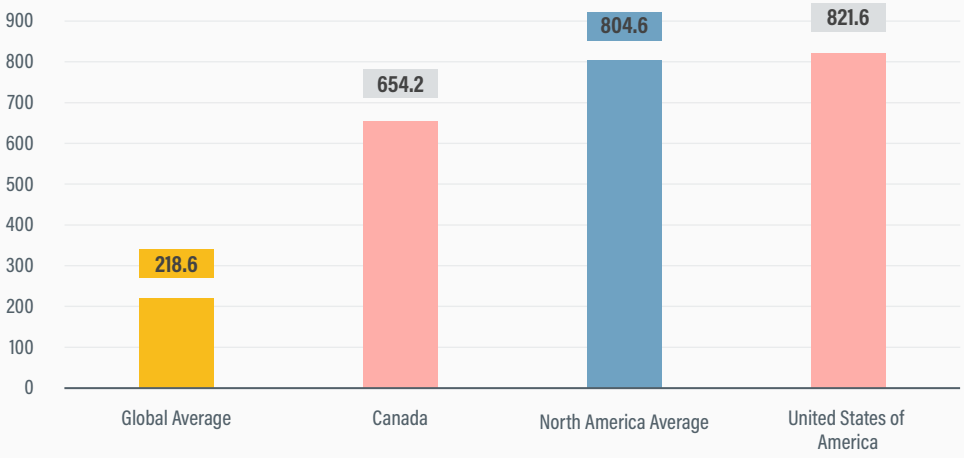
Shared micromobility (bicycles and electric scooters) in North America reached a new record high in 2023, with 157 million rides taken in the United States, surpassing the 147 million rides recorded in 2019.[60] However, fares for annual passes increased 20-30% between 2019 and 2023, raising growing concerns about affordability.[61]

- Shared micromobility grew nearly 20% in the United States and Canada in 2023.[62]
- In recent years, bike share fares have exceeded public transport fares, and prices for shared electric bicycles and electric scooters were even higher, despite offering shorter trips than conventional bike sharing services.[63]

Although average US petrol prices have fallen from their historic peak in 2022, transport costs place a higher household burden on North America than most regions due to its high dependency on private vehicles.

- The average US petrol price fell to USD 0.87 per litre (USD 3.3 per gallon) in 2024, down from more than USD 1.05

FIGURE 1. Motorisation rates per 1,000 people in North America, 2022



Vehicle ownership in North America is nearly four times the global average — driven primarily by the United States, where there are over 820 vehicles per 1,000 people.

Source: See endnote 69 for this section.

per litre (USD 4 per gallon) in 2022 and USD 0.92 per litre (USD 3.5 per gallon) in 2023.[64] US petrol prices remained the lowest among member countries of the Organisation for Economic Co-operation and Development (OECD) in 2024.[65]

- On average, US households allocated 16% of their total expenditures to transport in 2023, compared to 11% for European households, despite facing higher taxes, priced parking and toll roads in Europe.[66]
- Between 2003 and 2019, a link was found between rising US fuel prices and the increased use of public transport, walking, and cycling – mainly in urban areas, as rural commuters often lack access to public transport networks.[67]
- The typical US pattern of rising petrol prices leading to reduced vehicle-kilometres travelled has been disrupted since 2020. Both petrol prices and vehicle-kilometres travelled were exceptionally low in 2020 and then increased sharply in 2021; in early 2022, vehicle-kilometres travelled declined before petrol prices dropped, leading to a reduction in total passenger-kilometres for road transport.[68]

The region's motorisation levels (covering four-wheeled motor vehicles) remained at an all-time high in 2022, at four times the global average and 15 times higher than in Africa (Figure 1).[69] Canada had a motorisation rate of 654 vehicles per 1,000 people in 2022, while the rate in the United States was even higher at 822 vehicles per 1,000 people.[70]

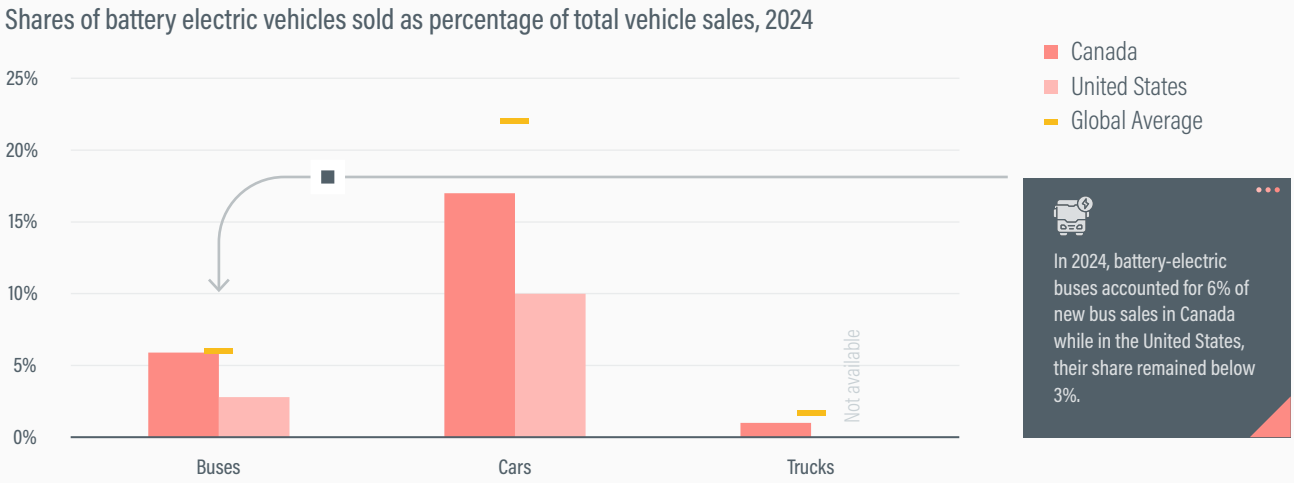
Vehicle sales in Canada increased 13% in 2023 to 1.76 million units.[71] The US vehicle market showed similar growth, with sales totalling 16 million units that year.[72]

- In the United States, sport utility vehicles (SUVs) reached a record-high market share of 57% for the model year 2023 production (including both car-based and truck-based SUV models).[73]
- As of mid-2023, the new vehicle market in the United States was described as the "least affordable car market in modern history", with only 8% of new vehicles retailing for under USD 30,000.[74]

Electric passenger car sales in North America continued their near-exponential growth until 2023, then grew modestly in 2024.[75] The United States accounted for 11% of global battery electric passenger car sales in 2024, surpassing 1 million units for the first time with 1.1 million new registrations in 2023 and 1.2 million in 2024.[76] After a strong increase of 37.5% in 2023, US sales of battery electric cars grew only 9% in 2024.[77] In Canada, sales increased 43% in 2023 and 46% in 2024, rising from 91,000 in 2022 to 190,000 units in 2024.[78] Battery electric cars comprised 17% of total vehicle sales in Canada and 10% in the United States in 2024 (Figure 2).[79]

- Between 2022 and 2024, the share of electric cars in the total car stock doubled from 1.3% to 2.7% in the United States and from 1.7% to 4.2% in Canada.[80]
- The share of battery electric vehicles in the United States is projected to reach only 16% in 2030 and 21% in 2050.[81]

FIGURE 2. Shares of battery electric vehicles sold in Canada and the United States, 2024



Source: See endnote 79 for this section.

This is well below the pathway needed to achieve the goals of the Paris Agreement, which requires that electric vehicle sales exceed 60% globally by 2030 and that no new cars with internal combustion engines are sold after 2035.[82]

- US interest in electric vehicles appeared to wane in 2024, as consumer surveys showed a 10-percentage point decline in the share of people considering an electric vehicle for their next vehicle purchase (to only 30-34% of Americans).[83]

More electric buses and heavy-duty trucks have entered service in North America, including in both municipal and private fleets.

- US adoption of zero-emission buses surged 100% in 2022, with 2,400 electric and 140 fuel-cell electric buses sold.[84] By 2023, diesel-powered buses made up less than half of the US public transport fleet, and hybrid plug-in electric buses had an 18% market share.[85] In total, 9,500 electric buses were in use in the United States in 2024.[86]
- Electric buses accounted for 24% (790 units) of all buses sold in Canada in 2023, falling to just 5.9% (210 buses) in 2024.[87]
- As of 2024, 5,300 electric trucks (1.2% of all sold trucks) were operating on Canada's roads.[88]
- In 2023, DHL announced the deployment of its first Class 8 electric trucks, supporting the company's 2030 target for a North American supply chain based on 30% zero- or near-zero emission vehicles.[89]
- Amazon deployed 35 Class 8 electric trucks in southern California in 2024, accompanied by the installation of more than 45 direct current fast chargers across 11 sites.[90]
- In 2024, Hyundai completed the largest single commercial deployment of hydrogen fuel cell electric trucks, delivering 30 Class 8 units to a freight company in northern California.[91]

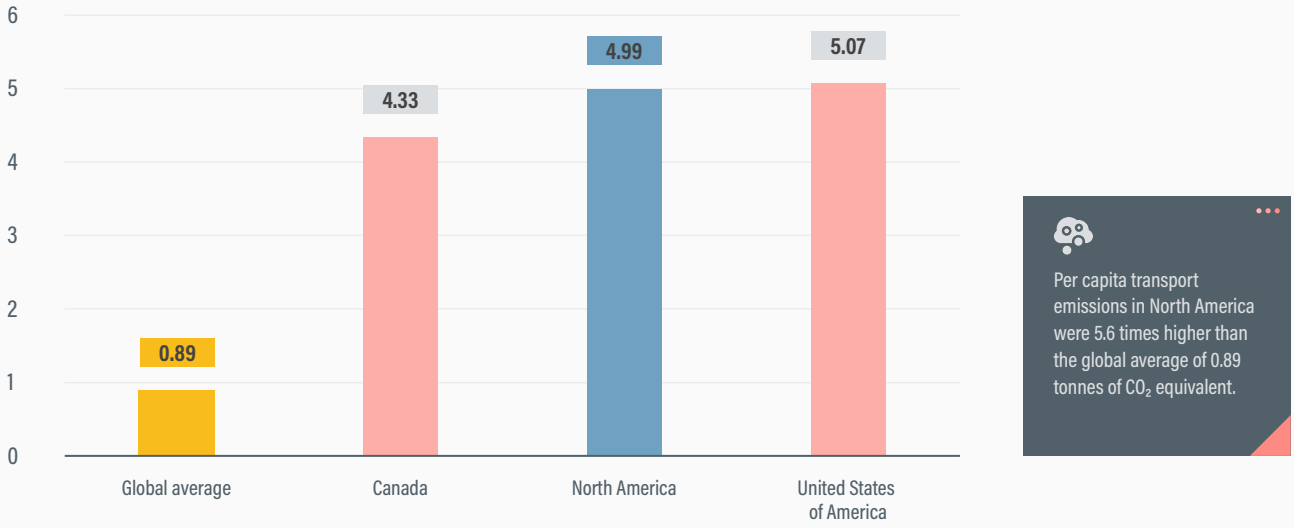
Sustainability and climate trends

In 2023, North America was responsible for 26.7% of global transport greenhouse gas emissions (excluding international aviation and shipping), the second highest regional share after Asia (40.3%).[92] Transport emissions in North America increased 0.72% in 2023 – reaching 1.9 gigatonnes of CO_2 equivalent – but were still below 2019 levels.[93] Between 2019 and 2023, the region's annual emissions growth rate was the third lowest globally due to already very high emission levels.[94] (Europe achieved absolute reductions in transport emissions in 2023, while Africa's grew only 0.11%.[95])

Per capita transport emissions totalled 4.3 tonnes of CO_2 equivalent in Canada and 5.1 tonnes in the United States in 2023 – roughly five times higher than the global average of 0.9 tonnes (Figure 3).[96] Key factors behind high per capita emissions are high private motorisation levels and long travel distances. Light-duty vehicles had an average fuel consumption of 8.5 litres of petrol-equivalent per kilometre in Canada and 8.4 litres in the United States in 2022.[97]

In 2023, transport was the largest contributor to US

FIGURE 3. Per capita transport greenhouse gas emissions in North America, 2023



Source: See endnote 96 for this section.

greenhouse gas emissions (accounting for 29% of total emissions) and the second largest contributor to Canadian emissions (22.6%).[98] The transport sector became the largest US emitter in 2019 when it surpassed the power sector, which benefited from significant increases in renewable energy.[99] In Canada, transport was the largest greenhouse gas-emitting sector until 2005, when it became the second largest after fuel exploitation.[100]

The United States was the world's largest emitter of transport greenhouse gases in 2023, contributing nearly a quarter of the global total (excluding international aviation and shipping), at 1,735 million tonnes of CO_2 equivalent.[101] US transport greenhouse gas emissions fell 14% in 2020 due to the effects of the COVID-19 pandemic, and as of 2023 they remained at 2015/16 levels.[102] In Canada, transport emissions have plateaued at around 170 million tonnes of CO_2 equivalent since 2007, totalling 169 million tonnes in 2023.[103]

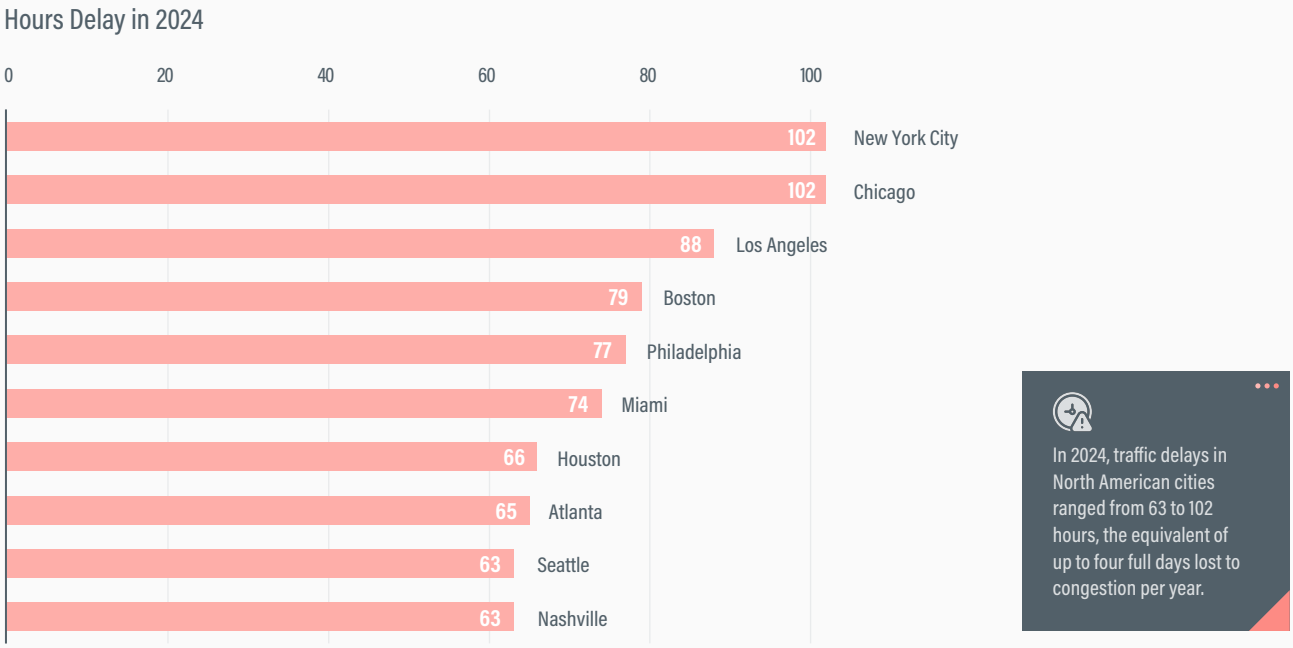
Road transport continued to dominate North American transport greenhouse gas emissions, contributing 81.7% of US transport emissions in 2022 and 62% of Canada's in 2023.[104] In Canada, road passenger transport was responsible for 54.4% of transport emissions, road freight transport for 24.3%, and maritime transport for 3%, in 2021 (latest data available).[105] In the United States, freight transport was responsible for 31.9% of transport greenhouse gas emissions in 2022, up from only 27% in 2010.[106]

- Canada's second highest emitter of transport emissions in 2023, at 29%, was pipelines and "vehicles not licensed to operate on roads", including all-terrain vehicles and dirt bikes.[107]
- Since 2015, road freight transport greenhouse gas emissions in Canada have been affected by the economic slowdown of 2018 and the COVID-19 pandemic of 2020, resulting in lower emissions compared to the 2010s.[108]
- In 2022, trucks contributed the largest share of US freight-related emissions at 72.2%, followed by pipelines at 12.2%.[109]
- With an 18.9% increase between 2010 and 2022, freight was the main driver of growth in US transport emissions.[110]

The average energy efficiency of new light-duty vehicles sold in the United States reached its highest value in 2022, marking the largest improvement in nine years, but it still lagged behind other countries.[111]

- The average energy efficiency of new vehicles in the United States increased 4% between 2020 and 2022 – to reach 8.4 litres of petrol-equivalent per 100 kilometres in 2022 – although this was still well above the European average of 5.4 litres.[112]
- For US vehicle models produced in 2023, real-world CO_2 emissions showed significant improvements. Due largely to the higher share of battery electric vehicles among car-based SUVs (36%), this category emitted 190 grams of

FIGURE 4. Hours of annual average traffic delays in major North American cities, 2024



Source: See endnote 118 for this section.

CO_2 per mile.[113] In contrast, truck-based SUVs emitted 356 grams of CO_2 per mile, while pick-up trucks recorded even higher emissions at 432 grams per mile.[114]

The carbon intensity of electricity has improved steadily in North America in recent years. Increasing the share of renewable and low-carbon energy sources in the region's power grids can help maximise the positive impacts of the electric vehicle transition.

- In Canada, the carbon intensity of electricity improved 27% between 2010 and 2022 – reaching 156.8 grams of CO_2 equivalent per kilowatt-hour (kWh) – but then worsened to 174.8 grams of CO_2 per kWh in 2024.[115]
- The United States recorded a 12% improvement in carbon intensity between 2019 and 2024, although levels remained high at 384 grams of CO_2 equivalent per kWh in 2024.[116] Progress was due largely to a 10-fold increase in US solar power generation between 2015 and 2024, alongside a halving of coal use.[117]

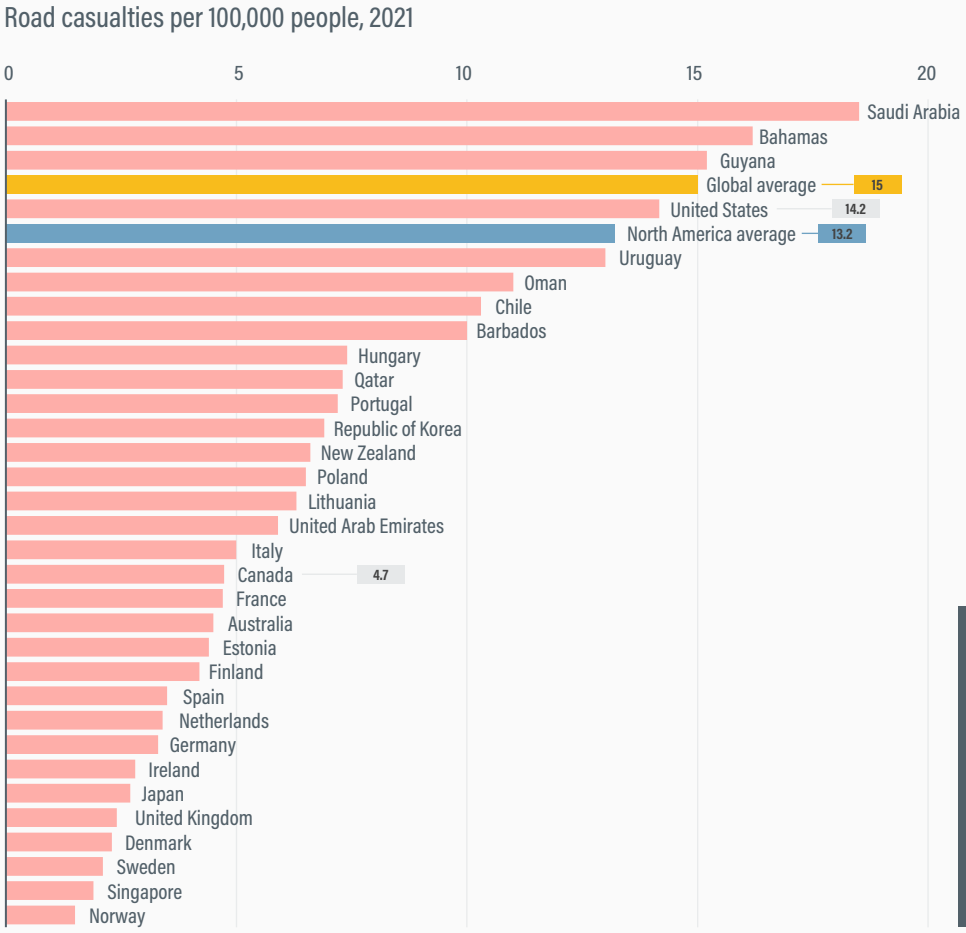
Several North American cities experienced among the highest congestion levels globally in 2024, with motorists in the region's 10 most congested cities facing more than 60 hours of traffic delay annually (Figure 4).[118] These data and impacts focus mainly on private vehicle commuters. In cities with high delays but lower overall shares of car use (such as New York City and Boston), the average delay (and thus congestion cost) on a per capita basis is lower than in more car-dependent regions (such as Atlanta and Houston).[119]

- New York City had the highest average level of traffic delay worldwide in 2023 (101 hours) and the second highest level in 2024 (102 hours), after Istanbul (Türkiye) at 105 hours.[120]

The transport sector was responsible for around 12.6% of North America's air pollution in 2019, more than double the global average (6%).[121] Transport contributed 15% of US air pollutant emissions in 2019 and 9.8% in Canada – resulting in 2.29 premature deaths per 100,000 people in the United States (consistent with the global average) and 1.01 premature deaths in Canada (half the global average).[122]

North America recorded 13.2 road casualties per 100,000 people in 2021, close to the global average of 15 casualties per 100,000 people (Figure 5).[123] Road traffic fatalities and injuries accounted for 1.9% of Canada's GDP and 5% of the US GDP in 2021.[124] Less than 40% of the road length assessed in North America meets the recommended three-star or better safety standard for pedestrians and cyclists, compared to 60% for motorcyclists and more than 80% for vehicle occupants.[125]

FIGURE 5. Road casualties per 100,000 people in selected high-income countries, 2021



In 2021, the United States had one of the highest road traffic fatality rates among high-income countries — despite being slightly below the global average.

Source: See endnote 123 for this section.

- Among high-income countries, the United States had one of the most dangerous road safety records in 2021, ranking just behind Saudi Arabia, the Bahamas and Guyana.[126]
- Road traffic fatalities have been rising in the United States.[127] In 2021, 42,939 people died in US road crashes, and pedestrian fatalities reached a record high.[128] Around 20% of the people killed in US road traffic crashes in 2021 were pedestrians or cyclists.[129]
- The United States recorded 14.2 road casualties per 100,000 people in 2021, well above the average rate across high-income countries (7.7 road casualties) and in Europe (5.8 road casualties).[130]
- Canada had 4.7 road casualties per 100,000 people in 2021, with around 20% of those killed being pedestrians or cyclists.[131]

The United States has experienced a record number of climate-induced disasters, with 28 events in 2023 costing USD 96 billion in damages and 27 events in 2024 costing USD 182.7 billion.[132] This was up sharply from an annual average of nine climate-induced disaster events between 1980 and 2024.[133]

Climate change threatens the supply networks of Canada's Indigenous communities, with around 50 communities (56,000 people) relying on a 6,000-kilometre winter road network.[134] The winter of 2024-25 was too warm for sufficient surface freezing, disrupting vital deliveries.[135]

Policy and investment developments

The change in administration in the United States has affected the outlook for equitable, sustainable, and zero-emission transport in the country, resulting in the halting of several policies and a reversal in ambition. In Canada, it remained unknown (as of the publication of this report) whether the new administration would maintain or revisit the approach of the outgoing administration.

Canada continued to advance its 2019 vision calling for "a transport system...that is recognised worldwide as safe and secure, efficient and environmentally responsible", including by integrating the Sustainable Development Goals (SDGs) into nationwide strategies starting in 2023.[136]

- In its 2022-2026 Federal Sustainable Development Strategy, Canada's first strategy to outline implementation of all SDGs, Transport Canada committed to advancing six SDGs: SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 14 (Life Below Water) and SDG 16 (Peace, Justice and Strong Institutions).[137]
- Under SDG 11, the target is to increase – from 60% in 2005 to 85% by 2030 – the share of the population living in areas where air pollutant concentrations meet or fall below the Canadian Ambient Air Quality Standards.[138]

In 2024, Canada announced its 2030 Emissions Reduction Plan, which calls for a 23% reduction in transport greenhouse gas emissions from 186 million tonnes of CO_2 equivalent in 2019 to 143 million tonnes by 2030.[139] Additional government actions explore opportunities for rail, aviation, maritime transport, and other modes, and address zero emission vehicles and fuels, electrification and charging infrastructure.[140] The latter include: zero-emission vehicle sales mandates for light-duty vehicles, an integrated strategy to support zero-emission medium- and heavy-duty vehicles, investments in charging infrastructure, purchase incentives, heavy-duty vehicle retrofitting, hydrogen demonstration projects and government fleet electrification.

In January 2023, the United States released its inter-agency National Blueprint for Transportation Decarbonization, a landmark strategy to drastically reduce transport greenhouse gas emissions towards net zero by 2050.[141] The strategy outlines how to "deliver safe, effective, affordable, and sustainable solutions to existing and emerging challenges" and lays out targets and actions for 2030, 2040 and 2050.

- The strategy summarises actions in three areas: "convenient" – improve community design and land-use planning (planning, telework, e-commerce, travel demand management, active mobility); "efficient" – increase options to travel more efficiently (pool riding, operational improvement, public transport, rail and shipping, vehicle fuel economy); and "clean" – clean electricity, sustainable biofuels, e-fuels, clean hydrogen).[142]
- The strategy highlights that the Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law) and the Inflation Reduction Act are essential enablers towards a safer and more sustainable US transport system.[143] The Inflation Reduction Act supports climate action, while the Bipartisan Infrastructure Law aims to improve infrastructure in the United States.[144]

The Bipartisan Infrastructure Law of 2021 authorised USD 1.2 trillion for transport and infrastructure investment across the country, including USD 550 billion for new projects between 2022 and 2026.[145] The Law supported "historic investments in transport" and the opportunity to embrace equity and sustainability in transport investments.[146] However, a review of more than 56,000 funded projects in early 2024 (marking the halfway point of the Law) revealed that 50% of the investments were allocated to the modernisation or expansion of highways.[147] Less than 20% were directed towards public transport and passenger rail initiatives, suggesting that the Law might result in additional emissions of around 178.5 million tonnes of CO_2 equivalent by 2040.[148] The highway expansions that are already obligated for spending will add an estimated 69 million tonnes by 2040.[149]

The Inflation Reduction Act, signed in August 2022, was the largest investment focused on climate change in US history.[150] Transport-related investments under the Act focused mainly on providing tax incentives to electric vehicle owners as well as auto manufacturers. Following the Act's passage, manufacturers announced plans to invest around USD 125 billion in US electric vehicle and battery manufacturing.[151]

In January 2025, the Trump administration halted the disbursements of funds through the Inflation Reduction Act and the Bipartisan Infrastructure Law through an executive order, which eliminated electric vehicle mandates.[152] The stated purpose was to "promote true consumer choice" and to remove any "ill-conceived government-imposed market distortions that favour EVs over other technologies".[153]

The United States and Canada have both submitted to the United Nations their third Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, which include transport actions. The new US NDC, which updates efforts in the previous (2021) NDC, was submitted in December 2024, just before President Trump signed a January 2025 order to again withdrew the country from the Paris Agreement.[154] Canada submitted its third-generation NDC in February 2025.[155]


Carlos Felipe Pardo

- The US NDC of 2024 features an economy-wide target to reduce net greenhouse gas emissions 61-66% below 2005 levels by 2035.[156] On transport, the NDC highlights the roles of the Inflation Reduction Act and the Bipartisan Infrastructure Law to shift towards cleaner and convenient transport and to scale up domestic manufacturing.[157] The focus is on electrification across all modes, increasing public transport and walking and cycling options, and supporting low-carbon fuels.[158]
- Analysis suggests that, to be aligned with the Paris Agreement's target of keeping global temperature rise below 1.5 degrees Celsius, the new US NDC should have aimed for reductions of 65% by 2030 and 80% by 2035, compared with 2005 levels.[159]
- Canada's new NDC sets an economy-wide target to reduce emissions 45-50% below 2005 levels by 2035, and highlights the decarbonisation of road transport and the phase-out of fossil fuel-powered cars by 2035.[160]
- Canada's NDC features additional targets for several provinces and territories, including increasing the sales share of light-duty zero-emission vehicles in British Columbia to 90% by 2030 and 100% by 2035; reducing transport emissions in Prince Edward Island 25-30% by 2030; and reducing road transport emissions in Yukon 30% below 2010 levels.[161]

For the latest analysis of transport commitments in NDCs, including those expected ahead of COP30, see the NDC Transport Tracker by GIZ and SLOCAT*, a database on ambition, targets and policies in NDCs and Long-Term Strategies.*[162]

The two countries also released new national adaptation strategies between 2023 and 2025. The United States submitted a National Adaptation Plan (NAP) to the United Nations in January 2025 (under the Biden administration), and Canada released a National Adaptation Strategy in 2023.[163]

- The US NAP is an extensive document combining several strategies, such as the National Climate Resilience Framework (2023) and the Department of Transportation's 2024-2027 Climate Adaptation Plan (2024).[164]
- Canada's National Adaptation Strategy outlines that, starting in 2024, all new federal infrastructure funding programmes should reflect resilience to climate change impacts, and by 2026 the Canadian Highway Bridge Design Code should reflect resilience considerations.[165]
- Canada's complementary Adaptation Action Plan of 2024 sets specific actions and funding, including using the National Trade Corridors Fund of USD 3.22 billion (CAD 4.6 billion) to help the transport system withstand the effects of climate change and better adapt to new technologies and innovation, while addressing mobility needs in Arctic and northern communities.[166] In 2021, the Canadian government opened the 97-kilometre Tłı̨chǫ All-Season Road in 2021 in the Northwest Territories.[167]

In the United States, policy for clean freight transport advanced with the release of the National Zero-Emission Freight Corridor Strategy in March 2024 and the hosting of the "first-ever White House Sustainable Freight Workshop" in December 2024.

- The National Zero-Emission Freight Corridor Strategy – a "landmark" strategy towards zero-emission freight transport – notes that 75% of US heavy truck traffic uses only 4% of the road network, but has negative health effects on vulnerable communities.[168] Providing electric vehicle charging stations along these corridors could support the US targets for sales of zero-emission medium- and heavy-duty vehicles (at least 30% by 2030 and 100% by 2040), as laid out in the National Blueprint for Transportation Decarbonization.[169]
- The White House sustainable freight workshop brought together more than 100 stakeholders to discuss emission reductions in the freight sector.[170]

US land use policy reforms have supported a shift towards integrated transport planning in various jurisdictions. The aim is to counteract a severe housing shortage that drives inflation and displaces people, with mortgage rates at an all-time high and the growth in rents exceeding overall inflation.[171] Analysts note that much of the US housing shortage could be addressed by enabling higher-density housing around public transport stations through effective transit-oriented development.[172] However, the country continues to lack nationwide frameworks that could enable systematic transformation through integrated land use and transport planning.

- Several studies on zoning and land use confirmed that jurisdictions with reformed and updated zoning approaches (such as California, Houston, New York State and Washington, D.C.) were able to provide more housing units than state-wide averages.[173]
- The state of Massachusetts adopted a transit-oriented development strategy with the passage of a bill in 2021, and as of mid-2025 around 100 cities and towns in the state had met the new regulations.[174]
- In December 2022, Santa Monica (California) implemented the first US pilot of a low-emission zone, designating a one-square-mile area as a "Zero Emission Delivery Zone."[175] By 2024, seven more US cities – Los Angeles, Louisville, New York City, Oakland, Pittsburgh, Portland (Oregon) and Washington, D.C. – as well as Miami-Dade County were implementing zero-emission delivery policies.[176]

In 2023, fossil fuel subsidies in North America totalled USD 2,172 per capita, nearly 3 times the global average (USD 813) and more than 10 times the African average (USD 199).[177] The region's fossil fuel subsidies are projected to rise 17% between 2023 and 2030, further undermining climate and sustainability efforts.[178] The substantial subsidies have incentivised fossil fuel use, contributing to high greenhouse gas emission levels.

In January 2025, New York City became the first US city to implement congestion pricing, with each passenger vehicle that enters the "Congestion Relief Zone" facing a daily charge of up to USD 9 at peak times.[179] The aim is to reduce vehicle trips and to increase the attractiveness of public and other forms of transport, helping the state of New York achieve its goal to reduce greenhouse gas emissions 40% below 1990 levels by 2030.[180] As much as 80% of the revenue, estimated to reach USD 15 billion per year, will be used to improve the city's public transport system.[181] From day one, the congestion pricing scheme reduced traffic and cut the average commute time, which fell by half on some major routes during evening rush hours.[182] Between January and March 2025, the number of vehicles entering the regulated zone daily fell 12% (by 80,000 vehicles per day), while travel times for drivers within the zone fell 10-30%.[183]

North America has pledged greater investments in infrastructure for walking and cycling.

- In 2024, British Columbia (Canada) agreed to invest an additional USD 35 million (CAD 50 million) in walking and cycling over three years, adding to the USD 70 million (CAD 100 million) allocated in 2023.[184] The new funds are aimed at closing gaps in the active transport network by building new bicycle lanes and enhancing the safety of people walking and cycling.[185]
- The US Department of Transportation's strategic plan for 2022-2026 aims to increase the percentage of trips by public transport, walking, and cycling 50% by 2026, compared to 2020 levels.[186]
- In 2024, the US Biden administration announced USD 45 million in funds to improve connectivity and safety for cycling and walking.[187]

Very few new public transport services were launched in North America between 2022 and 2024. In 2024, Canada announced the Canada Public Transit Fund (CPTF), which will pursue major improvements in public transport, walking, and cycling and is expected to distribute USD 2.1 billion (CAD 3 billion) annually starting in 2026-27.[188] In the United States, the Biden administration announced in 2024 USD 4 billion to support 14 major public transport construction projects across 11 states.[189]

- In Montreal (Canada), the REM light rail, launched in 2023, served five stations along a 16.6-kilometre route as of 2025; once completed, the urban rail network will serve 26 stations along 67 kilometres.[190]
- Ottawa (Canada) reopened its 19-kilometre Line 2 light rail service in January 2025.[191]
- In the United States, around 170 kilometres were added to the urban rail and bus rapid transit in 2024, with a further 150 kilometres expected in 2025.[192] (Comparable data for Canada were not available.)
- In Honolulu (United States), the first rail-based public transport system began passenger operations in June 2023.[193]



- Seattle (United States) recorded several new light rail expansions and bus rapid transit services in 2024.[194] Also that year, Seattle ordered the country's first double-decker electric buses with inductive wireless charging technology, to be delivered by 2026.[195]

Additional developments in US public transport were focused on fare-free programmes. However, more promising approaches to reduce vehicle travel and emissions include policies that improve public transport service quality, integrate public transport with compact development and pedestrian improvements, and support transport-demand management.[196]

- In Boston, a successful fare-free bus service on specific routes, implemented in 2022, has been extended until 2026.[197]
- Los Angeles provides free public transport to 400,000 students through the Metro GoPass programme, which was made permanent in April 2024.[198]
- The state of Connecticut is using federal funding of USD 38.9 million to electrify its bus rapid transit system, in support of a commitment to be carbon-free by 2035.[199]

North American rail systems have not seen significant expansion in years. In February 2025, Canada announced plans to build its first high-speed rail between Quebec and Toronto.[200] In the United States, new ambitions set in 2024 aimed to improve the rail network and address major challenges including the lack of electrified railways, high-speed rail services and strong labour protections for rail workers.[201] Most of the rail improvements in 2023 and 2024 were to the rolling stock. Because electrified rail remains rare in the region, alternative solutions such as carbon-free hydrogen are being explored.

- In February 2025, Canada announced plans for the Toronto-Quebec City High-Speed Rail Network (Alto) – the country's largest-ever infrastructure project – which includes 1,000 kilometres of passenger-dedicated electrified track connecting seven cities in Ontario and Quebec. The federal government allocated USD 2.7 billion (CAD 3.9 billion) in 2025 for the initial design phase, and the entire project (to be completed by 2043) is expected to cost USD 55-83 billion (CAD 80-120 billion).[202]
- In 2023, Amtrak announced a "new era of rail" in the United States, coupled with a USD 50 billion investment to modernise rolling stock and infrastructure.[203] In December 2024, the All Aboard Act was introduced, proposing USD 200 billion over five years to establish an accessible, reliable, and electrified rail network, with improved protections for rail workers.[204]
- The Biden administration announced in 2024 that USD 2.4 billion under the Bipartisan Infrastructure Law would be used to support 122 rail improvement projects in 41 US states and Washington, D.C.[205]

- Caltrain introduced new electric trains in San Francisco (United States) in 2024.[206]
- The first hydrogen-powered passenger train began testing in California (United States) at the end of 2024.[207] California expanded its hydrogen-powered passenger rail vehicles in 2024, to total 10 vehicles.[208]
- The first section (275 kilometres between Merced and Bakersfield) of the high-speed rail project in California is expected to be operational from 2030.[209] The Trump administration has said it would investigate the project due to alleged poor management and high costs.[210]

Progress was made in 2024 to improve US vehicle emission standards, but this was rolled back in 2025 under the new administration. In 2024, the US Environmental Protection Agency (EPA) finalised improved emission standards to reduce harmful air pollutants from light- and medium-duty vehicles, for model years 2027-2032.[211] However, in March 2025 the EPA rolled back the rules on vehicle tailpipe emissions, among other emission regulations.[212] The improved standards were anticipated to reduce greenhouse gas emissions from light-duty vehicles 11% per year from 2027 to 2032, and were seen as a key support tool to allow the United States to catch up globally on the transition to electric vehicles.[213] The regulations ensured that light-duty vehicles would not emit more than 170 grams of CO_2 per mile in 2027 and 85 grams in 2032, while medium-duty vehicles would not emit more than 461 grams of CO_2 per mile in 2027 and 274 grams in 2032.[214] For non-methane organic gases (NMOG) and nitrogen oxides (NO_x), the standards aimed to achieve 30 milligrams of NMOG+NO_x per mile in 2027 and 15 milligrams per mile in 2033, while medium-duty vehicles would target 75 milligrams per mile in 2033.[215]

In 2025, advances in vehicle technologies continued in Canada but were largely rolled back in the United States. Canada finalised its Electric Vehicle Availability Standard in 2023, requiring that 100% of new light-duty vehicles sold in the country be zero-emission by 2035.[216] In the United States, President Trump signed an executive order in 2025 to remove the target for 50% of all new vehicles sold to be zero-emission by 2030, which had prompted the auto industry to shift towards cleaner vehicles.[217] The removal of the target was coupled with the reversal of other Biden-era electric vehicle policies, resulting in a halt in federal incentives and subsidies for electric vehicle purchases, and funding for charging infrastructure.[218]

- Under Canada's new standard, the interim targets aim for at least 20% zero-emission vehicle sales by 2026 and at least 60% by 2030.[219] The transition is supported through the USD 462 million (CAD 660 million) Incentives for Zero-Emission Vehicles programme.[220] Under the policy, Canada's electric light-duty fleet is projected to grow from 480,000 in 2024 to 21 million in 2040, and its fleet of zero-emission medium- and heavy-duty vehicles could reach 414,000 in 2030 and 2.4 million in 2040.[221]
- To achieve these targets, Canada estimates that the number of public charging ports for light-duty vehicles would need to increase from 100,000 in 2025 to 679,000 by 2040.[222] For medium- and heavy-duty vehicles, the number of public and private charging ports would need to grow from near-zero in 2024 to 41,000 in 2030 and 275,000 in 2040.[223]
- The US Postal Service announced plans in 2022 to acquire 106,000 new vehicles – with at least 66,000 of them designated as electric delivery vehicles – representing a USD 10 billion investment in fleet modernisation.[224] In 2023, the US Congress allocated USD 3 billion to the Postal Service to support electric vehicle acquisition as part of the country's USD 430 billion climate bill.[225] As of early 2025, the Trump administration had criticised this contract, but it was unlikely to be fully cancelled.[226]
- By January 2025, around 206,000 public charging ports were available in the United States, of which 38,000 were added in 2024.[227]
- A 2023 report on the auto industry in Michigan (United States) showed that the electric vehicle transition could create 56,000 jobs by 2030 and that the state could avoid 4,700 health-related deaths by 2050, mainly in low-income communities.[228]
- The US Inflation Reduction Act accelerated investments in electric vehicle charging infrastructure for medium- and heavy-duty trucks: investments were around USD 5 billion per year in 2022 (prior to the Act) then grew rapidly to USD 30 billion in 2024.[229]

US states have continued their ambition on sustainable, low-carbon transport by focusing mainly on cleaner vehicle fleets. California has spearheaded the nationwide transition to zero-emission vehicles, although in May 2025 the US Senate repealed waivers that allow the state to set its own air pollution standards for road vehicles.[230] This poses risks for all clean car, trucks and electric vehicle initiatives within the state and nationwide.

- In 2023, to support its 2050 net zero emission target, Washington state released a Transportation Carbon Reduction Strategy that covers land use strategies, public and active transport, zero-emission vehicles, and low-carbon fuels for efficient passenger and freight transport.[231]
- As of mid-2024, 12 US states (California, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York State, Oregon, Pennsylvania, Rhode Island, Vermont and Washington) intended to ban sales of passenger vehicles with internal combustion engines by 2035 through the Advanced Clean Cars II rule, initiated by California in 2022.[232]
- In 2020, California introduced the Advanced Clean Trucks (ACT) regulation for road freight transport, and as of late



2023 a total of 11 states had adopted the ACT rule.[233]

- California initiated further advances in clean medium- and heavy-duty vehicles in 2023 through the Advanced Clean Fleets regulation, which aimed to require fleet owners operating in the state to transition to zero-emission vehicles.[234] However, California announced in 2025 that it would repeal the regulation after a coalition of 17 states (led by Nebraska, along with trucking associations), successfully filed a lawsuit against it.[235]
- As part of its strategy to achieve carbon neutrality by 2045, California aims to reduce the daily vehicle-kilometres travelled in the state from 39.6 kilometres per person in 2019 to 29.6 kilometres by 2030 (a 25% reduction) and 27.7 kilometres by 2045 (a 30% reduction).[236]
- The Bipartisan Infrastructure Law of 2021 allocated USD 7.5 billion to establish a nationwide network of 500,000 charging stations by 2030; although a federal order in February 2025 halted the funding, individual states may continue to expand the network.[237]

The Trump administration's cancellation of US federal funding for electric vehicle activities will reportedly lead to job losses in the transport sector, including in electric vehicle production, as well as negative health outcomes; however, efforts may continue at the state level. Studies estimate that cancellation of funding from the Inflation Reduction Act could result in a loss of 130,000 jobs across the electric vehicle industry in 2030, compared to a scenario with the Act; without the Act, the job market could be negatively impacted as soon as 2026.[238]

Proposed increases in US import tariffs could have significant impacts on the automobile industry, especially on the electric vehicle industry, although such tariffs are not necessarily new in the region.

- Effective 1 October 2024, Canada imposed a 100% surtax on Chinese-produced electric vehicles to counteract unfair trade practices by China's government, including subsidisation and lax labour and environmental standards.[239]
- In 2024, the United States increased tariffs on imported Chinese electric vehicles from 25% to 100% and raised tariffs on Chinese batteries from 7.5% to 25%.[240]
- In early 2025, the Biden administration banned the import of any cars and trucks made by Chinese companies as part of a strict crackdown on vehicle software and hardware from China.[241]

Major North American airlines took initial steps towards the adoption of sustainable aviation fuel (SAF) in support of their long-term sustainability strategies.

- In November 2023, Virgin Atlantic completed the world's first transatlantic flight powered entirely by SAF on a trip from London's Heathrow airport to New York, demonstrating the feasibility of long-distance flights using 100% SAF.[242]
- In December 2024, Air Canada made its first purchase of SAF, imported from a Finnish company and produced entirely from renewable waste and residue materials, such as used cooking oil and animal fat waste.[243] In 2021, the airline committed to achieve net zero greenhouse gas emissions by 2050.[244]
- US airlines were among the major investors in SAF, although prices remained two to three times higher than those of conventional fuels as of 2024.[245] Four US carriers – American Airlines, Delta Air Lines, Southwest Airlines and United Airlines – ranked in the top six SAF investors among global aviation companies in 2024.[246]

- Between August 2024 and the end of 2024, United Airlines purchased 3.7 million litres of SAF for use at Chicago O'Hare International Airport, the first company to do so at this airport; SAF was expected to account for 3% of the airline's fuel use at O'Hare in the second half of 2024.[247]
- Delta Air Lines reported a four-fold increase in its use of SAF from 2023 to 2024, although no specific volumes were disclosed.[248] In September 2024, the airline opened its first SAF blending facility in the US state of Minnesota, with a future capacity of up to 110 million litres.[249] For the first time, SAF was transported via pipeline to two Delta hubs (Minneapolis–St. Paul International Airport and Detroit Metropolitan Airport) delivering around 30,000 litres for use in aircraft.[250]

Partnerships in action

SLOCAT partners engaged in dozens of actions during 2023-2024, including:

- The non-profit consortium **CALSTART** is advancing clean transport solutions across North America. It administers the New York Truck Voucher Incentive Program, which supports fleet operators in transitioning to cleaner vehicles by reducing the upfront cost of zero-emission trucks and buses up to 80%.[251] As of early 2024, funding caps for several vehicle categories were raised by 50%, with higher incentives introduced for Class 4–8 electric trucks.[252]
- The **Canadian Urban Transit Research & Innovation Consortium** (**CUTRIC**) spearheads industry-academic collaborations to develop low-carbon mobility technologies across Canada. As the federally designated National Planning Service for the Zero Emission Transit Fund, it supports transit agencies in decarbonising their fleets through predictive modelling, infrastructure planning and technology assessments.[253] Its Canadian ZEB Database tracks national progress towards deploying 5,000 zero-emission buses by 2026, with over 5,400 buses at various stages of deployment as of mid-2024.[254]
- The **Institute for Transportation and Development Policy** (**ITDP**) supports sustainable and equitable transport through technical advocacy, policy reform and strategic partnerships. Its US programme focuses on transformative transport systems in major cities like Boston and Los Angeles.[255] ITDP promotes the Gold Standard Bus Rapid Transit in Boston and advocates for people-centred streets, connected cycling infrastructure, and improved bus services in underserved areas in Los Angeles.[256]
- The **Institute of Transportation Studies at the University of California, Davis** (**ITS-Davis**) is a leading research centre advancing sustainable and low-carbon transport. It houses the Plug-in Hybrid & Electric Vehicle Research Center, which informs the design of zero-emission vehicle policies, and the 3 Revolutions Future Mobility Program, which explores how automation, shared mobility and electrification can serve the public good.[257]
- The **Shared Mobility 2030 Action Agenda**, convened by the Shared-Use Mobility Center, is a collaborative initiative aimed at making shared mobility (such as public transit, on-demand shuttles, ride-hailing, carpooling and micromobility options) the preferred choice over private car ownership by 2030.[258] It outlines actionable steps to enhance the reliability, accessibility, and sustainability of shared transport modes, and emphasises cross-sectoral collaboration among 70 organisations.[259]
- The **Urban Sustainability Directors Network** (**USDN**) supports US local governments in advancing equitable and sustainable urban development. In 2023, USDN supported a federally funded USD 61 million project to improve access across I-10, a major interstate highway that has long divided historically disadvantaged communities.[260] The initiative seeks to create safer walking and cycling routes, reconnect neighbourhoods, and expand access to employment, retail and essential services.[261]
- The **Electric School Bus Initiative** is a partnership between the World Resources Institute and the Bezos Earth Fund aimed at equitably transitioning the entire US school bus fleet to electric vehicles by 2030, bringing health, climate and economic benefits to children and families.[262] As of October 2024, the Initiative was providing technical assistance in 11 US states.[263]

MODULE 3 | 3.6

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Oceania Regional Overview





DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	Oceania	Global
Population size (2023)	444 million	8,000 million
Population growth (2015-2023)	12.8%	8.5%
Urban population share (2023)	66.2%	57%
Urban population growth (2015-2023)	11.7%	16%
GDP per capita (2023)	USD 42,456 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	20.9%	22.8%
Share of women employed in transport and storage (2023)	24.4%	15.6%
Motorisation rate (2022)	586.7 vehicles per 1,000 people	218.7 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	41.3%	52%
Share of rural population with access to all-weather primary and secondary roads (2020)	No data	38%
Transport total GHG emissions (2023)	119 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	2.7 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 1,037 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport (2023)	No information	4.6%
Carbon intensity of electricity generation (2023)	478.9 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	2%	6%
Premature deaths attributable to air pollution by transport (2019)	0.3 per 100,000 people	2.3 per 100,000 people
Road casualties (2021)	4.9 per 100,000 people	15 per 100,000 people

Source: See endnote 1 for this section.



KEY FINDINGS

Demand, use and access

- Across Oceania countries, the average share of the urban population with convenient access to public transport was 41.3% in 2020, below the world average of 52%. However, this figure masks sharp contrasts across countries.
- The average share of people living near protected bikeways in 2023 was 34% in Australia and 17% in New Zealand, whereas data for Pacific SIDS were not readily available.
- Freight activity across the region has increased, albeit to varying extents.
- Passenger transport activity in Australia reached 434.6 billion passenger-kilometres in 2023, on par with the 2015 level of 434.5 billion passenger-kilometres.
- Due to its geography, Oceania remains highly dependent on air transport (domestic, regional and international) for its socio-economic development, connectivity and competitiveness.
- Maritime transport plays a critical role in meeting socio-economic and connectivity needs in Oceania, especially in Pacific SIDS where many dispersed small islands have limited or no land-based alternatives for transporting goods and people. Although shipping connectivity in the region has improved, this trend is not shared evenly among countries.
- In 2022, Oceania had a motorisation rate (covering four-wheeled motor vehicles) of 586.7 vehicles per 1,000 people. This represents an increase from 544 vehicles per 1,000 people during the 2016-2020 period and is well above the world average of 218.6 vehicles per 1,000 people in 2022.
- The region's motorisation landscape varies greatly by country. Despite well-developed public transport networks, New Zealand and Australia have the highest motorisation rates in the world, at 850.4 and 753.4 vehicles per 1,000 people, respectively, in 2022.
- The COVID-19 pandemic had profound impacts on public transport ridership across Oceania, especially in New Zealand and Australia, which have the region's most developed networks.
- Oceania's electric vehicle market remains in its early stages and continues to lag behind other world regions, although momentum has increased, with electric car sales reaching a double-digit share of new car sales in 2024.
- As of 2022, the share of renewable energy used in transport across the region was low, at only 2.2% in Australia and 0.4% in New Zealand.
- Despite some improvement since 2015, Oceania had the second highest carbon intensity of electricity generation globally in 2023 – at 478.9 grams of CO_2 equivalent per kilowatt-hour (kWh) – and was surpassed only by Asia (559.5 grams of CO_2 equivalent per kWh).



KEY FINDINGS

Sustainability and climate trends



- Oceania has the lowest transport greenhouse gas emissions among regions globally, contributing 119 million tonnes of CO_2 equivalent in 2023 and accounting for 1.7% of global transport emissions (excluding international aviation and shipping). These emissions are very unevenly distributed, with the bulk occurring in Australia and New Zealand. For many of Oceania's island states (Cook Islands, Fiji, Kiribati, Palau, Papua New Guinea, Samoa, Solomon Islands and Tonga), transport is the largest source of greenhouse gas emissions.
- Oceania's per capita transport greenhouse gas emissions, at 2.7 tonnes of CO_2 equivalent, were well above the global average of 0.9 tonnes and the second highest after North America in 2023.
- Despite Oceania's relatively small contribution to global transport greenhouse gas emissions, emissions within the region have grown steadily in recent decades, with only a brief decline in 2020 during the COVID-19 pandemic.
- Passenger cars continued to account for the majority of total transport emissions in the region.
- Heavy-duty vehicles, primarily trucks, have tended to dominate freight transport operations and emissions in Oceania. Freight emissions have continued to increase, with emissions from road freight in particular rising 17% between 2015 and 2024.
- The average energy efficiency of new light-duty vehicles sold in Australia and New Zealand in 2021 was around 6.7 litres per 100 kilometres (150 grams of CO_2 per kilometre), trailing other high-income countries and regions such as the European Union, Japan and the United States. Both Australia and New Zealand have targets to achieve emission levels of 58-59 grams CO_2 per kilometre for new vehicles by 2029.
- Car commuters in cities across Australia and New Zealand experienced significant delays due to traffic congestion in 2024, with the highest delays in Brisbane (84 hours annually), Melbourne (65 hours) and Auckland (63 hours).
- Other forms of transport – such as aviation, shipping and rail – contributed relatively low shares of transport emissions in Australia and New Zealand in 2019-2023.
- In Oceania, the transport sector contributes much less to health-damaging air pollution than in other regions, accounting for 2% of air pollutant emissions and 0.3 premature deaths per 100,000 people in 2019. The region's road casualties were below the global average in 2021, with 4.9 deaths per 100,000 people compared to 15 deaths per 100,000 people globally.
- Oceania is one of the most vulnerable regions to the impacts of climate change. Many Pacific SIDS are located in the world's most disaster-prone areas, and with their small economies they can incur GDP losses of up to 200% from a single climate-exacerbated disaster, threatening lives, transport infrastructure, connectivity, livelihoods and development.

KEY FINDINGS

Policy and investment developments

- In recent years, very few national strategies have been released in Oceania that support a transition towards sustainable, zero-emission transport; however, examples exist in Australia and New Zealand. Notably, New Zealand's Decarbonising Transport Action Plan (2022-2025) aims to pursue transport emission reduction interventions that simultaneously enhance resilience to natural hazards while delivering benefits for biodiversity and air quality.
- As of 25 May 2025, only two countries in Oceania – New Zealand and Marshall Islands – had submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement.
- Among the seven countries in the region that submitted Long-Term Low Emission Development Strategies (LT-LEDS) as of 25 May 2025, only Australia, New Zealand, Solomon Islands and Vanuatu included national targets to reduce transport-related greenhouse emissions.
- Transport adaptation and resilience actions in the region's NDCs focus mainly on road transport and port infrastructure and fall short in devising tailored actions for specific transport modes or contexts.
- Five island states in Oceania – Fiji, Kiribati, Marshall Islands, Papua New Guinea and Tonga – had submitted National Adaptation Plans (NAPs) to the UNFCCC as of 25 May 2025.
- Countries in the region, including several SIDS notably Fiji, Kiribati, Tuvalu, have made increasing investments towards enhancing transport resilience.
- In 2023, countries in Oceania provided fossil fuel subsidies totalling USD 1,037 per capita – the third highest levels after North America (USD 2,172 per capita) and Europe (USD 1,265 per capita) – incentivising fossil fuel use and contributing to rising emissions.



KEY FINDINGS



- Fossil fuel subsidies in Oceania are projected to increase around 26% between 2023 and 2030, further undermining climate and sustainability efforts globally. Fossil fuel subsidies as a share of GDP ranged from 1% in Papua New Guinea to 1.8% in New Zealand, 2.4% in Australia, 6.5% in Fiji and 6.6% in Tonga in 2023.
- Countries across Oceania have adopted various measures to support people in choosing active, shared, and public transport, and have also supported closer integration between urban mobility and land use planning.
- Australia and New Zealand have increasingly adopted dedicated policies and targets to promote the electrification of transport, including at the sub-national level.
- The region's SIDS have pursued vehicle electrification, although progress has been slower than in Australia and New Zealand.
- A growing number of countries in the region have pursued efforts to increase the use of renewable energy in transport.
- Pacific SIDS have taken steps to address the emissions from maritime shipping, both at the global level and domestically.
- A growing number of countries in Oceania have implemented green shipping corridors to decarbonise maritime transport.
- Countries in the region have shown strong interest in advancing low-carbon maritime transport through electrification, biofuels and other alternative low-carbon fuels.
- To decarbonise its freight transport sector, New Zealand has set two related targets: to reduce emissions from freight 35% below 2019 levels by 2035, and to reduce the emissions intensity of transport fuel by 10%.
- New Zealand provides grants to support the uptake of low- and zero-emission trucks.
- Australia has explored deploying electric trucks for urban deliveries, and hydrogen as a solution for longer-haul road freight transport.
- Australia is expanding and modernising its rail infrastructure for freight, inter-city passenger and urban transport. High-speed rail is a key element in the country's strategy to achieve net zero emissions by 2050.
- In 2023, Australia launched a comprehensive review of its National Freight and Supply Chain Strategy dating from 2019, which resulted in the release of the strategy's Review Report in 2024.
- To enhance transport connectivity, Pacific SIDS have emphasised the improvement of rural access.

Context, challenges and opportunities

Oceania comprises the large economies of Australia and New Zealand along with diverse small island developing states (SIDS) in the Pacific Ocean, presenting a complex and varied transport landscape. With a total population of 444 million, or just 0.55% of the global population, Oceania has the lowest transport greenhouse gas emissions among all regions globally, contributing 119 million tonnes of carbon dioxide (CO_2) equivalent in 2023.[2] This accounted for 1.7% of total global transport emissions (excluding international aviation and shipping).[3]

Access to transport is a key enabler of socio-economic opportunities. However, in Oceania less than half (41.3%) of the urban population had convenient access to public transport in 2020, below the global average of 52%.[4] Australia and New Zealand have well-developed transport systems with high motorisation rates and significant freight activity, whereas the region's SIDS have lower motorisation rates and rely heavily on maritime and air transport to meet their transport needs.

Emissions in Oceania have grown steadily over the past decade, declining only briefly due to the COVID-19 pandemic in 2020. The distribution of transport emissions remains highly uneven across the region, with Australia and New Zealand accounting for the vast majority, and Kiribati and the Cook Islands being the lowest emitters. The COVID-19 pandemic, which triggered the collapse of transport activity and tourism, highlighted the profound socio-economic challenges facing the region. This underscores the need to pursue climate change mitigation and adaptation efforts in parallel with socio-economic development.

Despite their relatively small contribution to climate change, Pacific SIDS are particularly vulnerable to the impacts of climate change because of their unique geography and environment, the fragility of their economic systems and their distinctive demographics. As a result, SIDS experience annual losses from natural disasters and climate-exacerbated events that amount to between 1% and 9% of their gross domestic product (GDP).[5] Sustained economic growth has remained a challenge in Pacific SIDS due to heavy reliance on a narrow range of industries and exports, associated with high transport costs and tight government budgets. These structural vulnerabilities, coupled with limited technical and financial capacities, leave SIDS particularly exposed to external shocks such as climate change, pandemics and geopolitical conflicts.

Although recent comprehensive data from the Rural Access Index (RAI) are not available for Oceania, the region scores below the world average on rural populations' access to all-weather roads and therefore under-performs in achieving Sustainable Development Goal (SDG) 9.2 on rural access. Australia and New Zealand have more developed rural infrastructure, whereas Pacific SIDS have lower RAI scores, reflecting limited infrastructure and challenging geographical conditions that hinder rural accessibility.[6]

Among global regions, Oceania had the third largest share of women employed in transport and storage in 2023, at 24.4% (although this has not changed since 2014), well above the global average of 15.6%.[7]

Mirroring its relatively low climate footprint, Oceania's transport sector contributes much less health-damaging air pollution than the global average, accounting for 2% of the region's air pollutant emissions and 0.3 premature deaths per 100,000 people in 2019.[8] Similarly, Oceania observed the lowest per capita road casualties (4.9 deaths per 100,000 people) among regions, at less than a third of the global average (15 deaths per 100,000 people) in 2021.[9]



Demand, use and access

Across Oceania countries, the average share of the urban population with convenient access to public transport was 41.3% in 2020, below the world average of 52%.[10] **However, this figure masks sharp contrasts across countries.** Whereas 94.4% of urban residents in New Zealand and 84.4% in Australia enjoyed convenient access to public transport in 2020, only 7.1% of urban residents in the Solomon Islands had such access (Figure 1).[11]

The average share of people living near protected bikeways in 2023 was 34% in Australia and 17% in New Zealand, whereas data for Pacific SIDS were not readily available.[12] Regionally, Point Cook in the Wyndham Vale area (Australia) had the highest share (68%) of people living within 300 metres' walking distance of a physically protected bikeway, a key parameter in encouraging people to use cycling.[13]

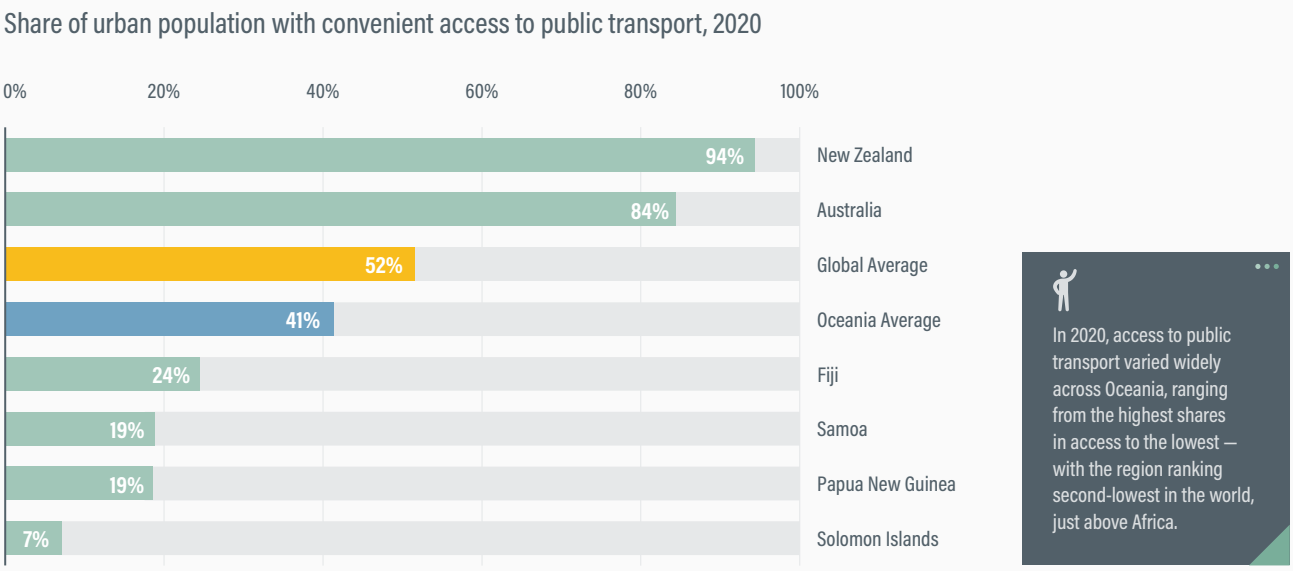
Freight activity across the region has increased, albeit to varying extents. Australia's domestic freight activity – dominated by road and rail – has grown strongly over the last 30 years.[14] Although it fell slightly during the pandemic – dropping from a peak of 780 billion tonne-kilometres in 2018-19 to 759.7 billion tonne-kilometres in 2020-21 – it has since rebounded, reaching its second highest level at 778.7 billion tonne-kilometres in 2022-23.[15] Australia's urban freight volumes alone are projected to increase 60% to 2040, putting growing pressure on freight networks.[16] In New Zealand, freight volumes are expected to rise 55% from 237 million tonnes in 2012-13 to 366 million tonnes in 2042-43.[17]

Passenger transport activity in Australia reached 434.6 billion passenger-kilometres in 2023, on par with the 2015 level of 434.5 billion passenger-kilometres.[18] Passenger cars dominated in the country, with 63.6% of travel activity (276.2 billion passenger-kilometres), followed distantly by air transport (17.1%, or 51.7 billion passenger-kilometres) and buses and railways (around 4% each, or 17.2 billion and 15.2 billion passenger-kilometres, respectively).[19] In New Zealand, 80% of household trips were undertaken as a car driver or passenger in 2012-13 (most recent data).[20] Reliable regional data on passenger transport activity are lacking.

Due to its geography, Oceania remains highly dependent on air transport (domestic, regional and international) for its socio-economic development, connectivity and competitiveness. In 2023, the Asia-Pacific region (which includes Oceania) accounted for 34.7% of global passenger air travel; this market employed 42 million people in the region and contributed USD 890 billion to the GDP.[21] Across Oceania, the recovery of air traffic in the wake of the COVID-19 pandemic has been varied.

- Air connectivity in the Asia-Pacific region (measured as the number of flights per 1,000 people) has grown from an average of 1.0 in 2000 to 2.9 in 2019, although it dropped

FIGURE 1. Share of urban population with convenient access to public transport in Oceania, 2020



Source: See endnote 11 for this section.



to 1.8 in 2021 due to the effects of COVID-19.[22]

- In 2024, air traffic in Australia and New Zealand rebounded robustly across both international and domestic travel as well as the leisure and business sectors, driven by the reopening of borders and increased travel demand.[23]
- In Pacific SIDS, the number of registered carrier departures per 1,000 people declined steadily from 1990 to 2021, indicating a deterioration in aviation connectivity.[24]

Maritime transport plays a critical role in meeting socio-economic and connectivity needs in Oceania, especially in Pacific SIDS where many dispersed small islands have limited or no land-based alternatives for transporting goods and people. Although shipping connectivity in the region has improved, this trend is not shared evenly among countries. The collapse of tourism in the early years of the COVID-19 pandemic had devastating impacts on the already vulnerable economies of Pacific SIDS (such as Fiji, Palau, Samoa and Tonga), where passenger maritime transport fell 18% in the first half of 2020.[25] Inefficient ports are a key obstacle to trade expansion, impeding socio-economic development.[26]

- Since 2015, shipping connectivity in Oceania has improved steadily, with Micronesia registering a more than 50% improvement in its score on the Liner Shipping Connectivity Index[i] (LSCI).[27]
- The LSCI scores of Pacific SIDS, ranging from 4 to 50, have remained much lower than in the broader Asia-Pacific region.[28]
- Pacific islands rank poorly in the Container Port Performance Index[ii], with Papua New Guinea's Port Moresby ranking the highest among them at 289th place in 2023.[29]

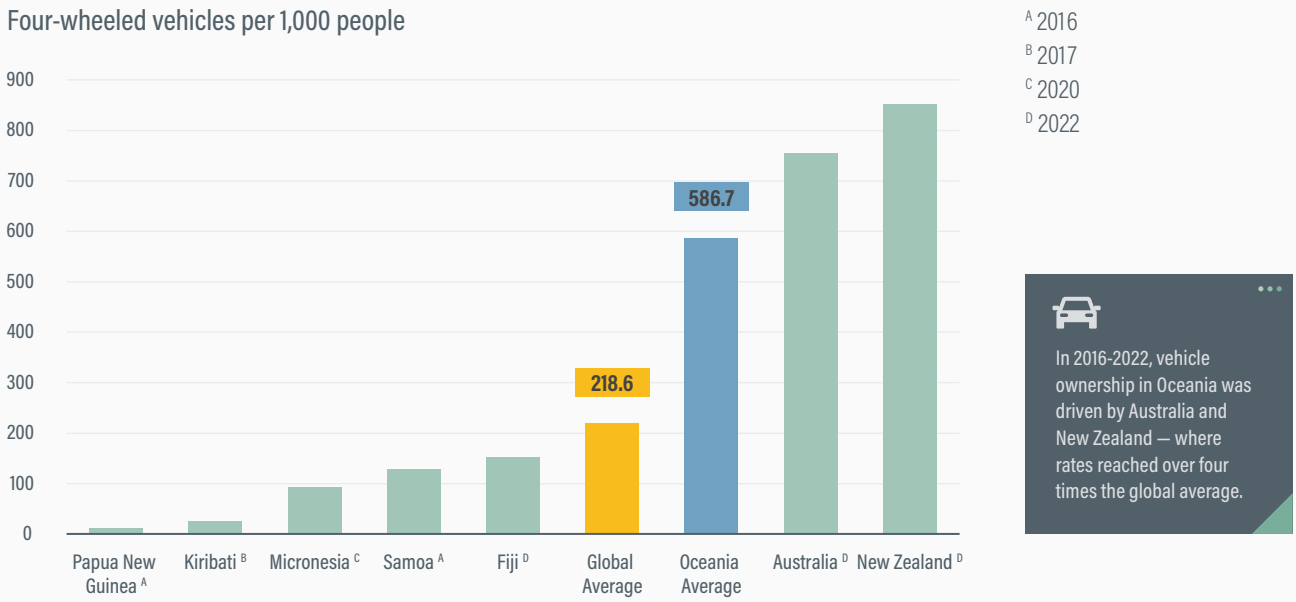
In 2022, Oceania had a motorisation rate (covering four-wheeled motor vehicles) of 586.7 vehicles per 1,000 people (Figure 2).[30] **This represents an increase from 544 vehicles per 1,000 people during the 2016-2020 period and is well above the world average of 218.6 vehicles per 1,000 people in 2022.**[31] Oceania's motorisation rate is comparable to that in Europe (588.5 vehicles per 1,000 people in 2024) and much higher than in Asia (140.4 vehicles per 1,000 people in 2022).[32]

The region's motorisation landscape varies greatly by country, with New Zealand and Australia the highest motorisation rates in the world, at (850.4 and 753.4 vehicles per 1,000 people, respectively, in 2022).[33] In contrast, the

i The Liner Shipping Connectivity Index (LSCI) is a comprehensive tool for quantifying a nation's integration into the global maritime network. By aggregating data on ship call frequency, container capacity, service regularity, shipping carrier diversity, largest ship size, and network reach, the LSCI provides a standardised metric to assess a country's access to and efficiency within international liner shipping.

ii The Container Port Performance Index is a benchmarking tool created by the World Bank and S&P Global Market Intelligence to analyse port efficiency and provide essential insights into international shipping connectivity.

FIGURE 2. Motorisation rates per 1,000 people in Oceania, various years



Source: See endnote 30 for this section.

world's lowest motorisation rates globally are in Papua New Guinea (12.3 vehicles per 1,000 inhabitants in 2016) and Kiribati (25.3 vehicles per 1,000 inhabitants in 2017).[34] In many Pacific SIDS, the limited access to transport services in urban and rural areas has led to the expansion of road infrastructure, contributing to rising motorisation.[35] Given the high numbers of unregistered vehicles across SIDS, precise data on vehicle stocks and use are limited.

The COVID-19 pandemic had profound impacts on public transport ridership across Oceania, especially in New Zealand and Australia, which have the region's most developed networks. In New Zealand, public transport ridership fell 23% between 2018-19 and 2022-23, and passenger numbers have only recently neared pre-COVID levels.[36] Australia's public transport activity incurred a similar dip but has also shown signs of recovery, with ridership on buses increasing 38.7% in 2023 and on railways increasing 61%.[37]

Oceania's electric vehicle market remains in its early stages and continues to lag behind other world regions, although momentum has increased, with electric car sales reaching a double-digit share of new car sales in 2024.[38] In New Zealand, electric vehicle uptake has increased considerably due to a government rebate scheme, a broader range of electrified offerings and competitive pricing for entry-level models. Although data remain limited, Pacific Island countries hold significant potential for the adoption of small electric vehicles (e.g., two-wheelers and compact cars) for short- to medium-distance travel, and for the piloting of electric minibuses and larger buses in island cities.[39]

- In Australia, around 250,000 battery-electric passenger cars were on the roads in 2024 – a 15-fold increase since 2020 – although electric vehicles still represented only 1.9% of the total car fleet.[40]
- In 2024, electric vehicles accounted for 13% of all new cars purchased in Australia (around 21,000 battery-electric vehicles) and for around 2.5% of motorised two- and three-wheelers; no data were available for buses, trucks and vans.[41]
- Electric vehicles accounted for 3.3% of New Zealand's car fleet in 2024 (with a total of 78,000 battery-electric cars on the road) and for 11% (around 21,000 units) of all new car sales.[42]
- Electric drivetrains covered 1.3% of New Zealand's motorised two- and three-wheelers, 1% of buses and 0.3% of vans in 2024.[43] Zero-emission heavy-duty vehicles made up less than 0.13% of the country's heavy truck fleet in 2024.[44]

As of 2022, the share of renewable energy used in transport across the region was low, at only 2.2% in Australia and 0.4% in New Zealand.[45] Although Pacific SIDS have actively pursued the uptake of renewables (particularly in electricity and transport) to reduce their reliance on fossil fuel imports and boost their energy security, the integration of renewables in transport remains scarce, and comprehensive data are limited.

Despite some improvement since 2015, Oceania had the second highest carbon intensity of electricity generation globally in 2023 – at 478.9 grams of CO_2 equivalent per kilowatt-hour (kWh) – and was surpassed only by Asia (559.5 grams of CO_2 equivalent per kWh).[46]

Sustainability and climate trends

Oceania has the lowest transport greenhouse gas emissions among regions globally, contributing 119 million tonnes of CO_2 equivalent in 2023 and accounting for 1.7% of global transport emissions (excluding international aviation and shipping).[47] **These emissions are very unevenly distributed, with the bulk occurring in Australia and New Zealand. For many of Oceania's island states (Cook Islands, Fiji, Kiribati, Palau, Papua New Guinea, Samoa, Solomon Islands and Tonga), transport is the largest source of greenhouse gas emissions.**[48]

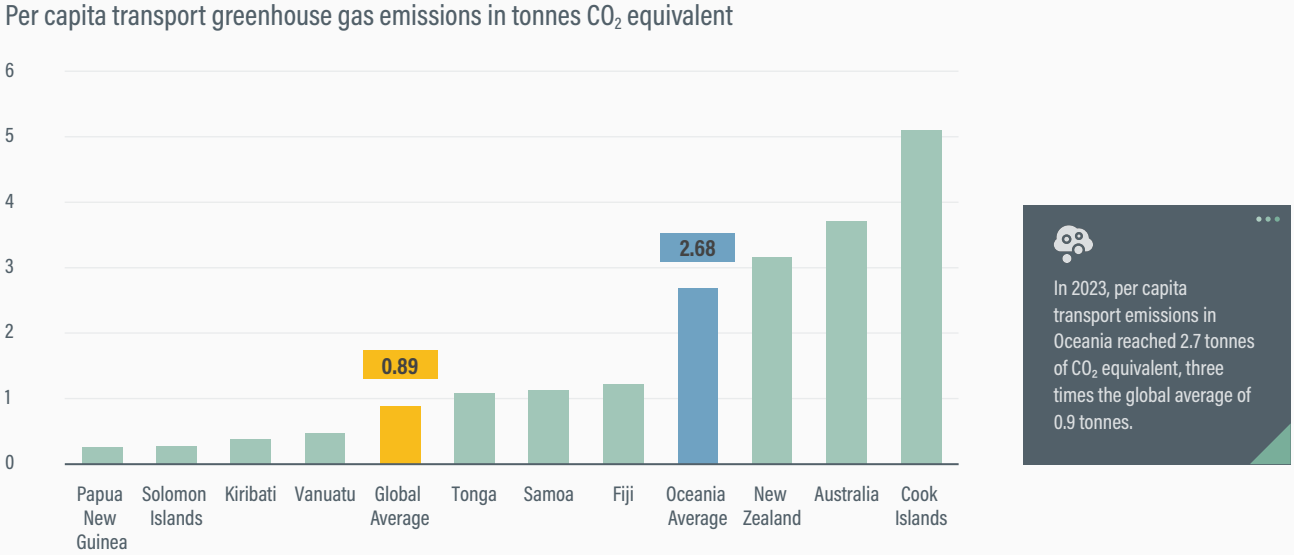
- Australia accounted for the vast majority of the region's transport greenhouse gas emissions (97.5 million tonnes), followed by New Zealand (16.2 million tonnes) and, more distantly, Papua New Guinea (2.6 million tonnes).[49]
- The region's lowest transport emitters were Kiribati (0.05 million tonnes) and the Cook Islands (0.07 million tonnes).[50]

Oceania's per capita transport greenhouse gas emissions, at 2.7 tonnes of CO_2 equivalent, were well above the global average of 0.9 tonnes and the second highest after North America in 2023.[51] By comparison, Asia's per capita transport greenhouse gas emissions were 0.6 tonnes in 2023, and Europe's were 1.66 tonnes; only North America had higher per capita transport emissions at 5 tonnes.[52] In 2023, Oceania's highest per capita transport emissions were in the Cook Islands (5.1 tonnes) and Australia (3.7 tonnes), and the lowest were in Papua New Guinea and the Solomon Islands (both around 0.3 tonnes) (Figure 3).[53]

Despite Oceania's relatively small contribution to global transport greenhouse gas emissions, emissions within the region have grown steadily in recent decades, with only a brief decline in 2020 during the COVID-19 pandemic.

- In 2023, Australia's transport greenhouse gas emissions increased 7.2% (a surplus of 6.6 million tonnes of CO_2 equivalent), reflecting a return to pre-COVID-19 transport activity levels, driven mainly by the rise in passenger

FIGURE 3. Per capita transport greenhouse gas emissions in Oceania, 2023



Source: See endnote 53 for this section.

vehicle use, air travel and diesel use in heavy transport.[54]

- In New Zealand, the transport sector emitted 16.2 million tonnes of CO_2 equivalent in 2023, accounting for 19% of the country's total greenhouse gas emissions.[55]
- Transport greenhouse gas emissions in New Zealand grew 7% from 2022 to 2023 and 11% from 2015 to 2023.[56]

Passenger cars continued to account for the majority of total transport emissions in the region. In Australia, light-duty vehicles (including passenger and light commercial vehicles) contributed 59.7% of transport emissions in 2023, whereas trucks and buses contributed 23.4%.[57] Similarly, the bulk of New Zealand's transport emissions (65.1%) in 2019 came from light-duty vehicles such as cars.[58]

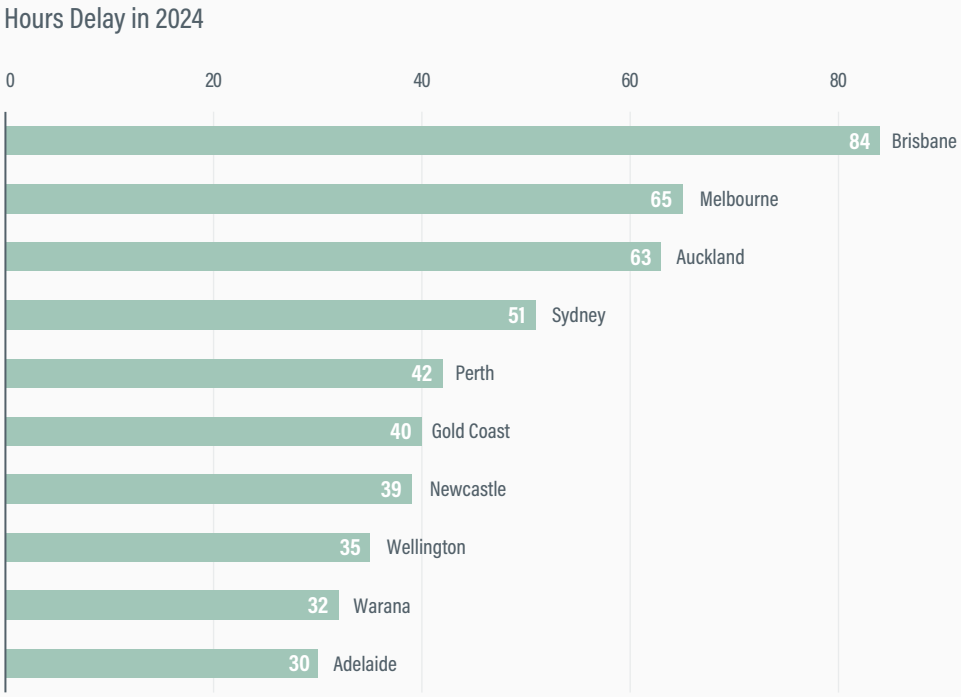
Heavy-duty vehicles, primarily trucks, have tended to dominate freight transport operations and emissions in Oceania. Freight emissions have continued to increase, with emissions from road freight in particular rising 17% between 2015 and 2024.[59] However, the emissions contribution of different freight transport modes is not necessarily equivalent to their total share in freight operations.

- In New Zealand, trucks carried 93% of total freight volumes in 2019 and were the second largest source of transport emissions, at 24.4%.[60]
- Heavy-duty vehicles were responsible for 86% of Australia's freight emissions in 2023-24, while making up 31% of total freight activity.[61]
- Railways are Australia's main mode for transporting bulk goods (such as coal and iron), accounting for 57% of total freight activity in 2023-24, yet their share of emissions remained low at 11%.[62]

The average energy efficiency of new light-duty vehicles sold in Australia and New Zealand in 2021 was around 6.7 litres per 100 kilometres (150 grams of CO_2 per kilometre), trailing other high-income countries and regions such as the European Union, Japan and the United States.[63] **Both Australia and New Zealand have targets to achieve emission levels of 58-59 grams CO_2 per kilometre for new vehicles by 2029.**[64]

Car commuters in cities across Australia and New Zealand experienced significant delays due to traffic congestion in 2024, with the highest delays in Brisbane (84 hours annually), Melbourne (65 hours) and Auckland (63 hours) (Figure 4).[65] The combination of population growth,

FIGURE 4. Average annual hours of traffic delay in major Oceanic cities, 2024



In 2024, drivers in major cities across Australia and New Zealand spent between 24 and 85 hours, equivalent to one to four full days, stuck in traffic congestion.

Source: See endnote 65 for this section.

dispersed land use patterns, and rising vehicle ownership has contributed to growing road congestion in the region, leading to delays, added economic costs, decreased productivity and environmental damage.

Other forms of transport – such as aviation, shipping and rail – contributed relatively low shares of transport emissions in Australia and New Zealand in 2019-2023. In Australia, domestic aviation accounted for 9% of transport emissions and 1.6% of total national emissions, while domestic maritime transport accounted for 2.2% of transport emissions and 0.4% of total national emissions.[66] Railways contributed 3.5% of Australia's transport emissions.[67] In New Zealand, domestic aviation and maritime emissions together accounted for 9.3% of the country's transport greenhouse gas emissions in 2019.[68]

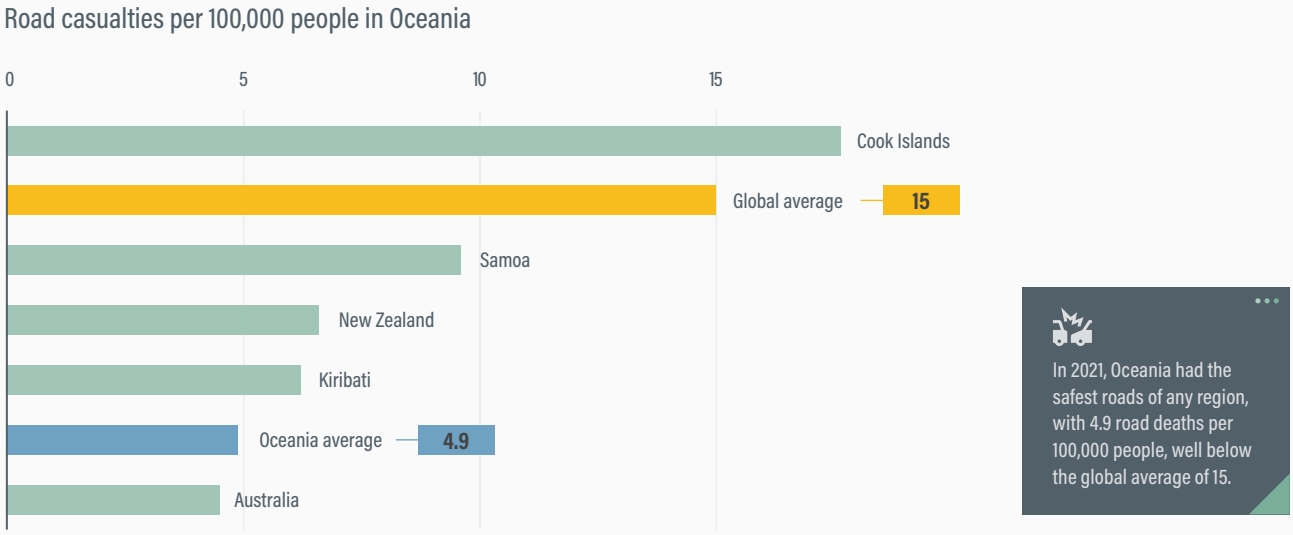
In Oceania, the transport sector contributes much less to health-damaging air pollution than in other regions, accounting for 2% of air pollutant emissions and 0.3 premature deaths per 100,000 people in 2019.[69] The region's road casualties were below the global average in 2021, with 4.9 deaths per 100,000 people compared to 15 deaths per 100,000 people globally (Figure 5).[70]

- Road traffic deaths in 2021 totalled 4.5 fatalities per 100,000 people in Australia, 6.21 in Kiribati, 6.6 in New Zealand, 9.6 in Samoa and 17.6 in Cook Islands.
- the share of assessed roads in Oceania designated as three-star or above was only 18% for pedestrians, 25% for bicyclists, and 32% for motorcyclists, highlighting the urgent need for infrastructure upgrades across the region.[71]

Oceania is one of the most vulnerable regions to the impacts of climate change. Many Pacific SIDS are located in the world's most natural disaster-prone areas, and with their small economies they can incur GDP losses of up to 200% from a single climate-exacerbated disaster, threatening lives, transport infrastructure, connectivity, livelihoods and development.[72] Natural hazards – such as earthquakes, floods and landslides – as well as climate change-induced impacts such as sea-level rise and more-frequent and more intense extreme weather events, can greatly disrupt transport networks and damage infrastructure.

- Globally, SIDS make up two-thirds of the countries that suffer the highest relative losses from natural disasters – between 1% and 9% of their GDP each year.[73]
- In Fiji, transport damage from flooding in 2009 totalled USD 28.5 million (43% of total infrastructure damage), and transport damage from Cyclone Winston in 2016 totalled USD 63 million (61% total infrastructure damage).[74] Cyclone Yasa in 2020 led to significant infrastructure damage across Fiji.[75]
- The Solomon Islands faced USD 12 million in transport damage from flooding in 2014, making up 90% of the country's total infrastructure damage.[76]

FIGURE 5. Road casualties per 100,000 people in Oceania, 2021



Source: See endnote 70 for this section.

Policy and investment developments

In recent years, very few national strategies have been released in Oceania that support a transition towards sustainable, zero-emission transport; however, examples exist in Australia and New Zealand. Notably, New Zealand's Decarbonising Transport Action Plan (2022-2025) aims to pursue transport emission reduction interventions that simultaneously enhance resilience to natural hazards while delivering benefits for biodiversity and air quality.[77]

- In New Zealand's Decarbonising Transport plan, interventions include creating green spaces and ecological corridors as part of new and improved transport infrastructure and services.[78] Drawing on the Avoid-Shift-Improve (A-S-I) Framework[iii], the Plan prioritises three focus areas: reducing reliance on cars and encouraging active and public transport, promoting wider uptake of electric mobility and deepening efforts to decarbonise heavy transport and freight.[79] The plan sets some concrete targets including reducing the vehicle-kilometres travelled by light-duty vehicles 20% by 2035 through improved urban form and the provision of better travel options.[80]
- Following consultations in 2024, the Australian government has been finalising its Transport and Infrastructure Net Zero Roadmap and Action Plan, which outlines net zero pathways for each transport mode (light-duty and heavy-duty road vehicles, rail, maritime and aviation) and contains specific time frames for 2030, 2040 and 2050.[81]

As of 25 May 2025, only two countries in Oceania – New Zealand and Marshall Islands – had submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their third-generation Nationally Determined Contributions[iv] (NDCs) towards reducing emissions under the Paris Agreement.[82] Although both countries' NDCs include transport-related content, neither establishes transport-specific activities on adaptation. Marshall Islands' NDC, published in 2025, refers directly to the outcomes of the First Global Stocktake adopted at the 2023 United Nations Climate Change Conference (COP 28), committing the country to accelerate emission reductions from road transport through pathways such as infrastructure development and rapid deployment of zero- and low-emission vehicles. The NDC also features a target to reduce domestic shipping emissions 40% below 2010 by 2030 and achieve complete decarbonisation by 2050.[83]

For the latest analysis of transport commitments in NDCs, including those expected ahead of COP 30, see the NDC Transport Tracker by GIZ and SLOCAT*, a database on ambition, targets and policies in NDCs and Long-Term Strategies.*[84]

Among the seven countries in the region that submitted Long-Term Low Emission Development Strategies (LT-LEDS) as of 25 May 2025, only Australia, New Zealand, Solomon Islands and Vanuatu included national targets to reduce transport-related greenhouse emissions.[85] LT-LEDS complement NDCs and reflect countries' strategies to 2050 and beyond.

- In its Net Zero Plan of 2021, Australia set a target to reduce its economy-wide emissions 43% below 2005 levels by 2030, with a view to achieving net zero emissions by 2050.[86] The country's updated LT-LEDS from 2023 reaffirms the 2050 net zero objective across all transport modes.[87]
- New Zealand's LT-LEDS of 2021 commits to achieving net zero emissions for transport by 2050 while building a healthy, safe, equitable and accessible transport system.[88] This requires reducing the country's transport emissions 41% by 2035 compared to 2019 levels, according to pathways modelled by the Climate Change Commission.[89]
- In 2023, Vanuatu published an LT-LEDS with a target to reduce transport emissions 50% below business as usual by 2050, and Solomon Islands released an LT-LEDS with a dedicated transport section but without specific ambitions for reducing emissions from the sector.[90]

Transport adaptation and resilience actions in the region's NDCs focus mainly on road transport and port infrastructure and fall short in devising tailored actions for specific transport modes or contexts. As of 25 May 2025, Micronesia and Papua New Guinea were the only two countries in Oceania to feature transport adaptation targets in their second-generation NDCs.

- Micronesia's NDC, published in 2022, aims to climate-proof all major island ring roads, airport access roads, and arterial roads, as well as major ports, by 2030.[91]
- In its NDC, Papua New Guinea has committed to building and rehabilitating USD 1.2 billion worth of transport (air, sea, and land) infrastructure in line with climate-resilient codes and standards.[92]
- Australia's NDC of 2022 sets out to ensure that the country is disaster-proof by spending up to USD 200 million annually on disaster preparation and resilience projects.[93]

iii The Avoid-Shift-Improve (A-S-I) framework seeks to guarantee access to transport and mobility while prioritising policy measures that "*Avoid*" unnecessary motorised trips based on proximity and accessibility; "*Shift*" to less carbon-intensive modes (e.g., from private vehicles to public transport, shared and active mobility, etc.); and "*Improve*" vehicle design, energy efficiency and clean energy sources for different types of freight and passenger vehicles. Growing evidence shows that "*Avoid*" and "*Shift*" strategies can account for 40-60% of transport emission reductions, at lower costs than "*Improve*" strategies.

iv Every NDC submitted since November 2024 is regarded as a 3.0/third-generation NDC, regardless of the document title, version number or content.



Five island states in Oceania – Fiji, Kiribati, Marshall Islands, Papua New Guinea and Tonga – had submitted National Adaptation Plans (NAPs) to the UNFCCC as of 25 May 2025.[94] All of these contain transport-specific references, recognising the sector's key role in supporting adaptation and enhancing resilience to climate change impacts. NAPs support countries, especially developing and least-developed countries, in planning and implementing medium- and long-term adaptation to climate change.

- The Marshall Islands' NAP of 2023 underlines the importance of careful design, construction and maintenance of public facilities (including roads and runways) to improve the overall resilience of infrastructure, as well as the need for infrastructure planning to avoid negative impacts such as coastal erosion and pollution.[95]
- In its 2023 NAP, Papua New Guinea echoes its NDC commitment on transport adaptation to build or rehabilitate transport assets totalling USD 1.2 billion (PGK 4.2 billion) to meet climate-resilient codes and standards. The NAP outlines a plan to conduct rigorous risk and vulnerability assessments of inland road networks and coastal roads and to update road design standards to reflect climate change considerations, among others.[96]

Countries in the region, including several SIDS notably Fiji, Kiribati, Tuvalu, have made increasing investments towards enhancing transport resilience.

- New Zealand's National Land Transport Programme (2024-2027) establishes a new Coastal Shipping Resilience Fund of USD 30 million over three years (2024-25 to 2026-27) for activities that enhance the resilience of coastal shipping freight connections.[97]
- In Fiji, a USD 199.6 million project aims to enhance the resilience of four major bridges on the main island of Viti Levu against natural hazards and climate change, thereby benefiting 62% of the country's total population.[98] The project, funded by the Government of Fiji, the World Bank, and the Asian Development Bank, kicked off in 2025 and is slated for completion by 2031.[99]
- Kiribati is retrofitting coastal infrastructure – such as roads, causeways and jetties – to withstand climate threats through a USD 110 million World Bank grant approved in 2025, while also upgrading air and sea transport infrastructure to maintain connectivity and ensure food and water security.[100]
- In 2023, the World Bank approved a USD 23 million project in Tuvalu to enhance the resilience of the island's airport infrastructure to disasters and the impacts of climate change.[101]

In 2023, countries in Oceania provided fossil fuel subsidies totalling USD 1,037 per capita – the third highest levels after North America (USD 2,172 per capita) and Europe (USD 1,265 per capita) – incentivising fossil fuel use and contributing to rising emissions.[102] **Fossil fuel subsidies in Oceania are projected to increase around 26% between**

2023 and 2030, further undermining climate and sustainability efforts.[103] **Fossil fuel subsidies as a share of GDP ranged from 1% in Papua New Guinea to 1.8% in New Zealand, 2.4% in Australia, 6.5% in Fiji and 6.6% in Tonga in 2023.**[104]

Countries across Oceania have adopted various measures to support people in choosing active, shared, and public transport, and have also supported closer integration between urban mobility and land use planning.

- Kiribati offers financial incentives for bicycles and electric bicycles, and Tuvalu is exploring the possibility of introducing solar-powered electric bikes.[105]
- Samoa is promoting shared and electric micro-mobility through a phased approach from 2026 onwards, starting with pilot trials of 50 e-bikes and 5 e-minibuses, followed by a full rollout of 2,000-3,000 e-bikes and 80-100 e-minibuses to enhance village mobility.[106]
- In its Second Biennial Update Report of 2022, Papua New Guinea set out to reduce vehicle-kilometres through more compact development.[107]
- Tonga's Low Emission Development Strategy (2021-2050) aims to decentralise services from urban to rural areas to decrease traffic congestion around Tongatapu as well as the centre of island districts.[108]
- At the sub-national level, South Australia's Transport Strategy of 2025 identifies the integration of transport with land use planning and growth trends as a strategic priority to secure a fit-for-purpose transport system. As part of this effort, the government targets the improvement of active and public transport networks as well as corridor infrastructure to connect new growth areas.[109]

Australia and New Zealand have increasingly adopted dedicated policies and targets to promote the electrification of transport, including at the sub-national level. In Australia, sub-national governments have also been the first movers in phasing out internal combustion engine vehicles

- In 2022, New Zealand set a target for 30% zero-emission vehicles in its light-duty vehicle fleet by 2035, which it aims to achieve by boosting the roll-out of charging infrastructure and introducing further measures to shift away from international combustion engines (especially high-emitting vehicles).[110]
- To match its commitment to net zero emissions by 2050, Australia adopted the Powering Australia Plan in 2022, including a USD 28 million (AUD 45.8 million) fund over six years for implementation.[111] The Plan includes a new vehicle efficiency standard, applicable to new cars from January 2025, that seeks to incentivise the production and import of fuel-efficient, low- and zero-emission vehicles.[112] Adoption of the standard is expected to generate USD 58.7 billion (AUD 95 billion) in fuel savings and USD 3 billion (AUD 5 billion) in health savings by 2050.[113]
- Australia has implemented an Electric Car Discount to reduce the purchase price of electric vehicles and is expanding charging infrastructure through a USD 309 million (AUD 500 million) Driving the Nation Fund.[114]
- The Zero Emissions Vehicles Strategy 2022-30 of July 2022 aims to ensure that 80-90% of new light vehicle sales in the Australian Capital Territory (ACT) are zero-emission vehicles by 2030.[115]
- In 2020, the Tasmanian Government set a target of transitioning its fleet to 100% electric by 2030.[116]
- South Australia and Queensland set targets to phase out petrol and diesel cars and vans by 2035 and 2036, respectively.[117]

Zero-emission buses have gained in popularity in recent years for their economic, health and emissions benefits.

- Starting in July 2025, public authorities in New Zealand will be obliged to procure only zero-emission buses, with this shift supported by at least USD 44.7 million through the 2024 budget.[118]
- The Australian government joined the international Zero-Emission Government Fleet Declaration and aims to procure 100% zero-emission vehicles across all categories for the government fleet by 2035.[119]
- At the sub-national level, the Zero Emissions Vehicle (ZEV) Roadmap of Victoria (Australia) includes a target for all public transport bus purchases to be zero-emission vehicles starting in 2025.[120]

The region's SIDS have pursued vehicle electrification, although progress has been slower than in Australia and New Zealand.

- Vanuatu's LT-LEDS of 2023 strives to transition 10% of the public bus fleet to electric models by 2030 and to grow the electric share of total land and maritime transport demand from 0% in 2030 to 50% in 2050.[121]
- The Solomon Islands, through its Climate Technology Centre and Network (CTCN), developed an Electric Mobility Policy and Roadmap in 2022 and undertook a pre-feasibility testing of electric buses for Honiara.[122]
- Tuvalu's NDC of 2022 highlights a USD 35,000 pilot project to procure 12 e-bikes in the country.[123]

A growing number of countries in the region have pursued efforts to increase the use of renewable energy in transport. Several countries, including Marshall Islands, Palau, Papua New Guinea, Solomon Islands, and Vanuatu, have policy documents that refer directly to the use of renewables in road transport. Countries have adopted varying targets to reach shares of electricity generation from renewable sources.



- In its LT-LEDS of 2023, Australia references its aspirations to become a renewable energy superpower by developing a renewable hydrogen industry to help decarbonise hard-to-abate sectors such as heavy transport.[124] The Hydrogen Headstart programme, announced in the 2023-24 Budget, will invest USD 1.24 billion (AUD 2 billion) to accelerate the development of Australia's renewable hydrogen industry by covering the gap between the cost of producing renewable hydrogen and its market price.[125]
- Palau's Voluntary National Review (VNR) of its implementation of the Sustainable Development Goals (SDGs) mentions an ideal mix of land use and transport integration (including active mobility infrastructure), combined with public and marine transport powered by renewable energy.[126]
- In its second-generation NDC of 2022, Micronesia sets targets to increase the renewable electricity share to more than 70% of total generation by 2030, and to reduce CO_2 emissions from electricity generation more than 65% below 2000 levels.[127]

Pacific SIDS have taken steps to address the emissions from maritime transport, both at the global level and domestically. Although SIDS have contributed minimally to the emissions from international shipping, they have been vocal advocates for more stringent measures to reduce shipping emissions because of their heavy reliance on maritime transport for trade and connectivity and their vulnerability to the impacts of climate change. Measures include targets, a universal carbon levy, corridors and low-carbon fuels.

- SIDS have called for a universal carbon levy on shipping emissions through the International Maritime Organization (IMO), both to decarbonise maritime transport and to generate much-needed revenue to support climate adaptation and mitigation efforts in SIDS.[128]
- At the April 2025 gathering of the IMO's Marine Environment Protection Committee (MEPC 82), governments approved the first-ever Net-Zero Framework for the maritime sector, which includes new annual emission reduction targets for 2028-2035 along with penalties for non-compliance.[129] However, some SIDS have criticised the IMO decision for its lack of incentives for industry to make the shift to cleaner technologies.[130] Under the new framework, ship owners will be required to reduce the emissions intensity of their vessels 30% below 2008 levels by 2035 and 65% by 2040, with targets for 2035-2040 to be decided in 2032.[131] Ship owners that fail to meet the targets will be obliged to purchase "remedial units" from the IMO to make up the difference, priced at USD 380 per tonne of CO_2 equivalent.[132]
- Marshall Islands' 2023 Sustainable Domestic Maritime Transport Roadmap aims to reduce domestic maritime transport emissions at least 40% below 2010 levels by 2030 and to fully decarbonise the sector by 2050.[133] To meet these objectives, the roadmap calls for replacing petrol outboards, introducing wind-assisted ship propulsion, generating electrical loads with wind turbines and solar panels, and implementing ship operational and design efficiency measures, among others.[134]

A growing number of countries in Oceania have implemented green shipping corridors to decarbonise maritime transport. By focusing on specific trade routes and fostering close collaboration among key port hubs and stakeholders, green shipping corridors can be instrumental in eliminating barriers to the uptake of zero-emission solutions for the maritime sector.

- Fiji, Kiribati, Marshall Islands, Solomon Islands, Tonga, Tuvalu and Vanuatu have joined the Pacific Blue Shipping Partnership (PBSP), aiming to reduce their greenhouse gas emissions from domestic shipping 40% by 2030 and 100% by 2050.[135]
- In 2024, Australia and Singapore signed a Memorandum of Understanding on establishing a Green and Digital Shipping Corridor, which will pilot solutions to enhance the resilience, efficiency and sustainability of global supply chains and logistics between the two countries.[136]
- A pre-feasibility study for an Australia–New Zealand green shipping corridor, which could allow commercially operating ships to use alternative fuels, was carried out jointly with industry stakeholders in 2023.[137]

Countries in the region have shown strong interest in advancing low-carbon maritime transport through electrification, biofuels and other alternative low-carbon fuels.

- In 2024, the "Low Carbon Sea Transport" partnership between Marshall Islands and Germany's GIZ launched a prototype low-emission vessel that combines wind-assisted propulsion, fuel-efficient engines and solar power.[138]
- New Zealand's Decarbonising Transport Action Plan 2022-2025 recognises the decarbonisation of shipping and aviation as "longer-term projects" due to the cost and availability of low-carbon technologies for these sectors.[139] It underlines the need for a modal shift to cleaner modes, such as coastal shipping and rail freight.[140] As part of these efforts, New Zealand's Transport Agency Waka Kotahi made available USD 16.78 million (NZD 30 million) for investment in the coastal shipping sector as part of the 2021-24 National Land Transport Programme.[141]
- The Australian government, in the framework of its Transport and Infrastructure Net Zero Roadmap and Action Plan, is developing a Maritime Emissions Reduction National Action Plan to set maritime transport on a path to net zero emissions. It is intended to decarbonise domestic maritime transport, advance the development of green shipping corridors from Australia and contribute to reductions in international shipping emissions.[142]

To decarbonise its freight transport sector, New Zealand has set two related targets: to reduce emissions from freight 35% below 2019 levels by 2035, and to reduce the emissions intensity of transport fuel by 10%.[143] To this end, the country seeks to promote a modal shift from road to railways and coastal shipping while accelerating the uptake of low-emission heavy-duty vehicles. The national strategy commits to decarbonising the aviation and maritime sectors by encouraging the production and uptake of low-carbon fuels such as biofuels, electricity and green hydrogen.[144]

New Zealand provides grants to support the uptake of low- and zero-emission trucks. The government's Low Emissions Heavy Vehicles Fund (LEHVF), supported with a 2024 budget allocation of USD 15.52 million (NZD 27.75 million), aims to promote innovation and offset the costs of hundreds of heavy-duty vehicles powered by clean technologies. This intends to help early adopters overcome upfront cost barriers and accelerate the uptake of battery electric, hydrogen fuel cell or hybrid vehicles. The fund is expected to support replacing up to 500 diesel vehicles with low- and zero-emission vehicles by 2028.[145]

Australia has explored deploying electric trucks for urban deliveries, and hydrogen as a solution for longer-haul road freight transport. The government is establishing hydrogen refuelling networks for key freight routes.[146] The Australian Renewable Energy Agency (ARENA) awarded logistics solutions company Team Global Express a grant of USD 12.4 million (AUD 20 million) to support a USD 27.2 million (AUD 44 million) "Depot of the Future" project to make metropolitan deliveries using small electric trucks that recharge when they return to base.[147] In addition to 60 new trucks, the project includes back-to-base charging infrastructure and a 500-kilowatt battery to power a third of the company's Sydney-based express parcel fleet.[148]

Australia is expanding and modernising its rail infrastructure for freight, inter-city passenger and urban transport. High-speed rail is a key element in the country's strategy to achieve net zero emissions by 2050.[149]

- As of 2025, the largest infrastructure project in Australia was the Inland Rail project, a 1,600-kilometre railway line from Brisbane to Melbourne that is intended mainly for freight and is expected to be completed by 2027.[150] In 2023, the 176-kilometre section between Narrabri and North Star became operational.[151]
- Rail projects under way in and around Sydney include a 30.2-kilometre upgrade to the metro system, which is expected to be completed by 2026.[152] The first phase – a 12-kilometre light rail line – became operational in 2024.[153]
- In 2023, an Australian mining company ordered the world's first 100% battery-powered heavy-haul freight locomotive, which has an energy capacity of 7 megawatt-hours and will operate on the Roy Hill railway to transport iron ore in Western Australia.[154]

- Australia's High Speed Rail Authority released plans in 2024 for a high-speed rail between Sydney and Melbourne, which would be the first and only high-speed rail in Oceania and is targeted for completion in 2037.[155]

In 2023, Australia launched a comprehensive review of its National Freight and Supply Chain Strategy dating from 2019, which resulted in the release of the strategy's Review Report in 2024.[156] Recognising decarbonisation as a critical emerging theme for Australia's freight sector, the report calls for incorporating a new goal on "decarbonising the freight and supply chain sector" along with dedicated resilience and decarbonisation key performance indicators to enable the monitoring and measurement of the updated Strategy.[157]

To enhance transport connectivity, Pacific SIDS have emphasised the improvement of rural access.

- The Solomon Islands' National Development Strategy 2016-2035 targets the expansion of road networks to connect inland communities to coastal roads and maritime networks, which is seen as crucial in fostering access to agricultural land, rural connectivity and sustainable development.[158]
- Palau is striving to ensure that 100% of its rural population lives within 2 kilometres of an all-season road by 2030.[159]
- Vanuatu's 2030 strategy seeks to provide equitable and affordable access to efficient transport in rural and urban areas, including by establishing effective partnerships that facilitate the development of the private sector and rural communities as service suppliers in providing transport and infrastructure.[160]

Partnerships in action

SLOCAT partners engaged in dozens of actions during 2023-2024, including:

- In 2024, the **Asian Development Bank** (**ADB**) approved a USD 280 million financing package in Papua New Guinea for the Sustainable Highlands Region Core Road Network Project, which aims to improve road transport efficiency, boost accessibility for people, goods, and services, enhance disaster responsiveness, and strengthen road safety.[161]
- The **ADB** is providing the Government of Solomon Islands with a second tranche of USD 53 million for the Land and Maritime Connectivity Project, which strengthens transport infrastructure and better connects people in rural areas to markets, health and education services.[162] Tranche 2 continues the rehabilitation and climate-proofing of road infrastructure initiated under Tranche 1, and has a strong focus on institutional improvements, including developing a gender strategy to support women in technical and leadership roles within the Ministry of Infrastructure Development.[163]
- Between 2023 and 2025, the **United Nations Economic and Social Commission for Asia and the Pacific** (**ESCAP**) has supported sustainable transport transitions in Pacific Island nations through regional workshops and consultations. It convened a Pacific sub-regional consultation in Fiji in 2023 to align national transport goals with climate objectives, followed by two key dialogues in 2024 on setting low-carbon transport targets and identifying green transport corridors.[164] In 2025, ESCAP held a capacity-building workshop to equip Pacific SIDS with tools to leverage smart mobility solutions.[165]
- The **Pacific Office of the United Nations Development Programme** (**UNDP**), based in Fiji, works with island nations that face development challenges such as geographic isolation and high vulnerability to climate change. In 2023, UNDP Pacific launched a Multi-Country Programme Document (2023-2027) outlining its commitment to addressing critical regional issues such as high transport costs and heavy reliance on maritime transport. Recognising the need for resilient and cost-effective mobility systems, UNDP Pacific prioritises sustainable transport initiatives that reduce fossil fuel dependency, enhance connectivity across dispersed populations, and support achievement of the SDGs.[166]
- The **Pacific Islands Development Forum** (**PIDF**) proclaimed 2020-2030 as the Pacific Decade for Sustainable Transport, during the 2019 PIDF Leaders' Summit in Nadi, Fiji. This initiative recognises the urgent need to address transport emissions and calls for reducing carbon emissions, investing in renewable energy-powered transport, reviving traditional maritime practices combined with modern technology, and integrating sustainable transport in NDCs and LEDS.[167] It urges co-ordinated efforts among national stakeholders and international partners to promote public transport, clean energy use and climate-resilient mobility across all Pacific Island nations.[168]

MODULE 3 | SIDS

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SPOTLIGHT

Small Island Developing States Overview



DEMOGRAPHICS, TRANSPORT AND SUSTAINABILITY DATA

Indicators	SIDS	Global
Population size (2023)	55.3 million	8,000 million
Population growth (2015-2023)	10%	8.5%
Urban population share (2023)	57.5%	57%
Urban population growth (2015-2023)	16.2%	16%
GDP per capita (2023)	USD 11,826 (constant 2015 USD)	USD 11,337 (constant 2015 USD)
GDP growth (2015-2023)	25%	22.8%
Share of women employed in transport and storage (2023)	18%	15.6%
Motorisation rate (2022)	137 vehicles per 1,000 people	218.66 vehicles per 1,000 people
Share of urban population with convenient access to public transport (2020)	42.4%	52%
Share of rural population with access to all-weather primary and secondary roads (2019)	42.2%	38%
Transport total GHG emissions (2023)	35 million tonnes CO_2eq	7,123 million tonnes CO_2eq
Per capita transport GHG emissions (2023)	0.63 tonnes CO_2eq	0.89 tonnes CO_2eq
Fossil fuel subsidies (explicit and implicit) (2023)	USD 761 per capita (constant 2021 USD)	USD 813 per capita (constant 2021 USD)
Share of renewable energy sources in transport	No data	4.6% (2023)
Carbon intensity of electricity generation (2023)	546.6 gCO_2/kWh	417 gCO_2/kWh
Transport contribution to air pollution (2019)	3.43%	6%
Premature deaths attributable to air pollution by transport (2019)	0.86 per 100,000 people	2.29 per 100,000 people
Road casualties (2021)	21 per 100,000 people	15 per 100,000 people

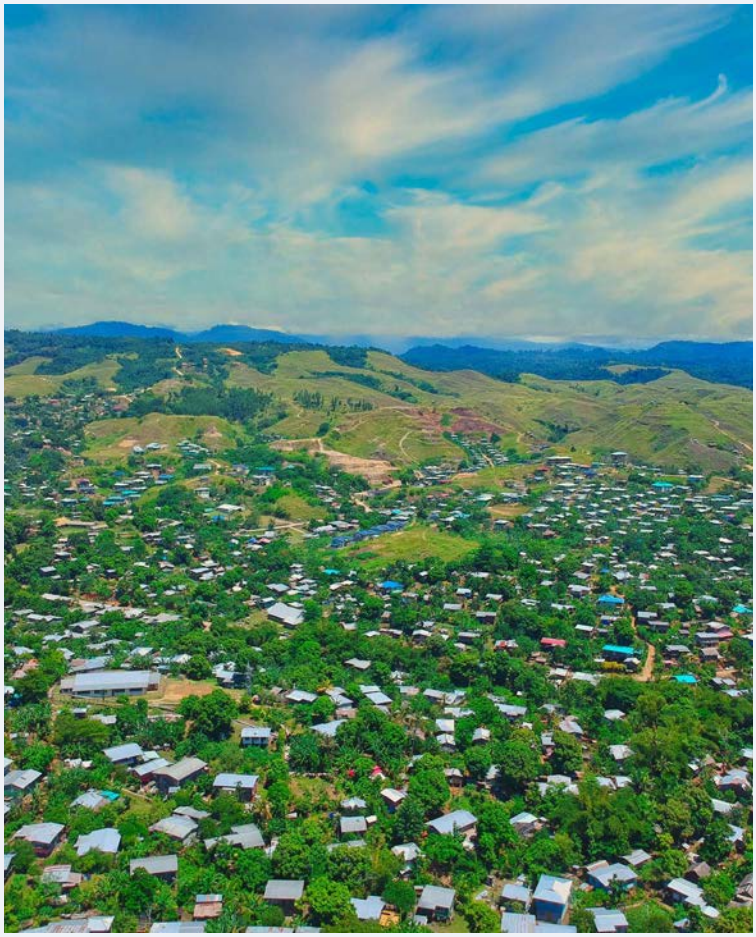
Source: See endnote 1 for this section.



KEY FINDINGS

Demand, use and access

- Small island developing states (SIDS) refer to a group of 39 States and 18 Associate Members of United Nations regional commissions that face unique social, economic and environmental vulnerabilities across the Caribbean Sea, the Atlantic and Pacific Oceans, the Indian Ocean and the South China Sea.
- The population of SIDS grew 10% between 2015 and 2023, outpacing global growth of 8.5% to reach a total of around 55 million people. Despite their relatively small populations, SIDS have experienced rising transport demand.
- SIDS' economies are closely tied to tourism and transport. Whereas in many low- and middle-income countries, tourism accounted for less than 5% of the gross domestic product (GDP) in 2019, in two-thirds of SIDS it represented more than 20% of GDP, including 65% in Maldives and 58% in Palau.
- The share of women employed in the transport and storage industries in SIDS was around 18% in 2023, well below the levels in North America (28.5%), Oceania (23.3%) and Europe (22.3%) but above the global average of 15.6%.
- The lack of transport infrastructure, including formal public transport and road infrastructure, is a fundamental challenge to sustainable and resilient transport development in many SIDS. In 2020, just 42.4% of the urban population on average across SIDS had convenient access to public transport, compared to 52% globally. For Pacific SIDS, only 27% of the urban population had convenient access to public transport in 2020.
- Rising passenger transport demand due to population growth has been met by a mix of private vehicle use and informal transport, along with non-motorised transport.
- Access to all-weather roads remains a major challenge for rural populations in SIDS. As of 2019, only 15.3% of the rural population lived within two kilometres of an all-season primary or secondary road in the seven SIDS where data were available.
- The average motorisation rate in SIDS (covering four-wheeled motor vehicles) in 2022 was 137 vehicles per 1,000 people, well below the global average of 219 vehicles per 1,000 people. The low levels of public transport and other modes (such as walking and cycling) result in relatively high motorisation rates. However, the majority of SIDS in the Pacific have low road quality.
- Maritime ports and airports serve as crucial lifelines for SIDS, supporting external trade of essential goods and food as well as key economic activities such as tourism and disaster response.
- For freight maritime transport, 16 SIDS (44% of the total) experienced declines in their Liner Shipping Connectivity Index score between 2020 and 2025. Except for the Dominican Republic, Jamaica, and Singapore, all SIDS scored below the indexed average value of 100.



KEY FINDINGS

Sustainability and climate trends

- In 2023, the transport sector contributed around 15% of the total greenhouse gas emissions from SIDS (excluding international aviation and shipping), well above transport's global emission share of 0.5%. Transport emissions in SIDS increased 16% between 2015 and 2023 and 5.3% in 2023, to reach 35 million tonnes of carbon dioxide (CO_2) equivalent.
- In 2023, transport greenhouse gas emissions represented around half of the total economy-wide CO_2 emissions in five SIDS: Seychelles (54% of total emissions), Palau (51%), and Cabo Verde, Cook Islands and Maldives (48% each). Transport emissions in SIDS will likely continue to rise alongside transport demand, unless mitigation policies are developed and implemented.
- Per capita transport greenhouse gas emissions in SIDS totalled 0.63 tonnes of CO_2 equivalent in 2023. This was under the global average of 0.89 tonnes, below levels in Europe (1.66 tonnes) and Latin America and the Caribbean (0.94 tonnes), similar to levels in Asia (0.61 tonnes), and higher than in Africa (0.26 tonnes).
- The electricity grids of SIDS rely heavily on fossil fuels, resulting in a carbon intensity of 546 grams of CO_2 per kilowatt-hour in 2023.
- Transport-induced air pollution contributed around 3.4% of total air pollutant emissions in SIDS, resulting in 0.86 premature deaths per 100,000 people in 2019, well below the global averages of 6% of air pollutant emissions and 2.3 premature deaths.
- Road safety remains a persistent public health challenge in SIDS, where road deaths averaged 21 casualties per 100,000 people in 2021, above the global average of 15.0 casualties.
- The impacts of climate change have been especially severe in SIDS due to the low resilience of infrastructure as well as geographical characteristics such as remoteness, mountainous terrain, and low-lying coastal areas, which make them more vulnerable to external shocks and disruptions.
- SIDS account for two-thirds of the countries that suffer the highest relative losses from natural disasters globally – between 1% and 9% of their GDP each year. Between 1970 and 2020, SIDS lost USD 153 billion due to natural hazards, equivalent to 0.9% of their GDP during this period.
- Climate change can especially impact urban areas and tourism infrastructure: a 25% reduction in tourism in SIDS could result in losses of USD 7.4 billion or 7.3% of GDP.
- Many SIDS have low shares of paved roads, making their road networks vulnerable to climate impacts and limiting access to alternative routes when disruptions occur.
- Climate-induced disruptions hinder the accessibility and connectivity of aviation and maritime transport for both passengers and freight, as stronger storms and changing sea conditions affect shipping lanes and infrastructure that is vital for trade and transport.
- Climate change affects communities differently across SIDS, with poverty and inequality expected to worsen in many places due to disproportionate impacts on women and children as well as increased health risks from undernutrition and vector-borne disease.



Photo: Silke von Brockhausen / UNDP

KEY FINDINGS

Policy and investment developments

- SIDS have developed and implemented a range of policy actions to respond and adapt to climate change and evolving transport demand.
- Adaptation measures for the transport sector include increased infrastructure resilience and early warning systems, while mitigation policies focus mainly on electric mobility in urban areas and sustainable maritime transport. Additionally, SIDS have sought to strengthen public transport, walking and cycling.
- Many SIDS have prioritised sustainable maritime transport connectivity.
- In 2023, fossil fuel subsidies in SIDS totalled USD 761 per capita, slightly below the global average of USD 813 per capita. Several Pacific SIDS adopted the 2023 Port Vila Call to Action, which aims for a "just and equitable transition towards a fossil fuel free Pacific".
- In their Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, SIDS have outlined and implemented measures to mitigate their transport emissions, including through the adoption of new technologies.
- All six of the third-generation NDCs submitted by SIDs as of 1 August 2025 featured actions aimed at reducing greenhouse gas emissions from transport. The third-generation NDCs of Belize, Marshall Islands and Saint Lucia featured specific targets for mitigating transport emissions, while those for Maldives, Niue and Singapore did not.
- SIDS have responded to the impacts of climate change by developing and implementing adaptation measures for transport infrastructure – including climate-resilient roads, transport emergency or disaster plans, National Adaptation Plans (NAPs), and disaster notification and early warning systems.
- Some SIDS are developing climate-resilient codes and standards for transport infrastructure and pursuing airport rehabilitation to meet international and climate-resilient standards.
- Global policy dialogues and inter-governmental processes have created opportunities for greater co-operation across SIDS.
- The United Nations, recognising the special needs and characteristics of SIDS and their sustainable development challenges, has initiated various programmes and efforts to help mitigate vulnerabilities.



Context, challenges and opportunities

Small island developing states (SIDS) refer to a group of 39 States and 18 Associate Members of United Nations regional commissions[i] that face unique social, economic and environmental vulnerabilities across the Caribbean Sea, the Atlantic and Pacific Oceans, the Indian Ocean and the South China Sea.[2] Many of these countries have historically been dependent on ocean resources and ecosystems and are now increasingly vulnerable to the impacts of climate change, extreme weather, natural disasters, and other external shocks and disruptions. A key driver of SIDS' challenges is their remote geography, which leads to high transport costs and irregular connectivity, high dependence on air and sea transport for socio-economic development and competitiveness, and heavy reliance on imports. Due to their smaller populations, SIDs often cannot benefit from economies of scale, contributing to the high cost of transport.

For both passenger and freight transport, SIDS face limited supply and services, but as demand grows, a variety of shared transport challenges have arisen. For passenger transport, challenges facing SIDS in the Pacific include high shares of private vehicle use, congestion, increasing vessel demand and emissions, the need for alternative energy resources, and difficulties financing sustainable transport, including electric vehicles.[3] For freight transport, resilient and efficient maritime connectivity remains a critical need for sustainable economic development in SIDS, in addition to support for the 2030 Agenda for Sustainable Development, greenhouse gas reduction targets, technological innovation and public-private sector collaboration to improve the performance of shipping and ports.[4]

Improving the resilience of SIDS, especially to future disruptions, is an existential and development priority. To ensure efficient transport adaptation and decarbonisation, countries have expressed the need to form new collaborations, co-ordination mechanisms for multi-stakeholder engagement, and legal frameworks to ensure the implementation of appropriate measures.[5] As technical expertise and capacity are still lacking in many SIDS, technology transfer focused on low- or zero-carbon transport development and adaptation is critical. Implementing existing low-carbon transport plans and roadmaps to transition to energy efficiency will also require sustainable financing mechanisms.

Demand, use and access

The population of SIDS grew 10% between 2015 and 2023, outpacing global growth of 8.5% to reach a total of around 55 million people.[6] **Despite their relatively small populations, SIDS have experienced rising transport demand.** In Pacific SIDS, population growth accelerated notably after 2015, showing the steepest curve among Asian sub-regions.[7]

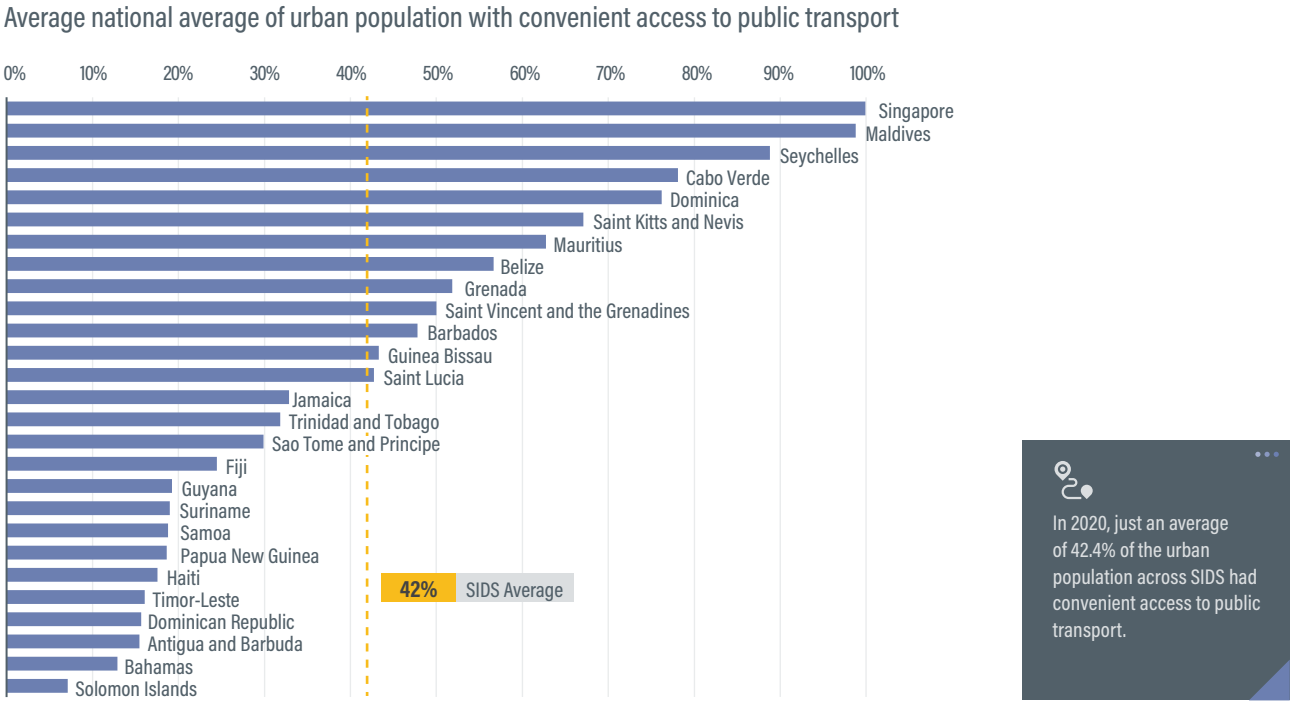
SIDS' economies are closely tied to tourism and transport. Whereas in many low- and middle-income countries, tourism accounted for less than 5% of the gross domestic product (GDP) in 2019, in two-thirds of SIDS it represented more than 20% of GDP, including 65% in Maldives and 58% in Palau.[8] **The share of women employed in the transport and storage industries in SIDS was around 18% in 2023, well below the levels in North America (28.5%), Oceania (23.3%) and Europe (22.3%) but above the global average of 15.6%.**[9]

The lack of transport infrastructure, including formal public transport and road infrastructure, is a fundamental challenge to sustainable and resilient transport development in many SIDS.[10] **In 2020, just 42.4% of the**



i The 39 States are: Antigua and Barbuda, Bahamas, Barbados, Belize, Cabo Verde, Comoros, Cook Islands, Cuba, Dominica, Dominican Republic, Fiji, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia (Federated States of), Nauru, Niue, Palau, Papua New Guinea, Samoa, São Tomé and Príncipe, Seychelles, Singapore, Solomon Islands, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu and Vanuatu. The 18 Associate Members of United Nations regional commissions are: American Samoa, Anguilla, Aruba, Bermuda, British Virgin Islands, Cayman Islands, Commonwealth of Northern Marianas, Curacao, French Polynesia, Guadeloupe, Guam, Martinique, Montserrat, New Caledonia, Puerto Rico, Sint Maarten, Turks and Caicos Islands, U.S. Virgin Islands.

FIGURE 1. Average access to public transport for urban population in SIDS, 2020



Sources: See endnote 11 for this section.

urban population on average across SIDS had convenient access to public transport, compared to 52% globally (Figure 1)**.**[11] **For Pacific SIDS, only 27% of the urban population had convenient access to public transport in 2020.**[12] **Rising passenger transport demand due to population growth has been met by a mix of private vehicle use and informal transport, along with non-motorised transport.**

Access to all-season roads remains a major challenge for rural populations in SIDS. As of 2019, only 15.3% of the rural population lived within two kilometres of an all-season primary or secondary road in the seven SIDS where data were available.[13] Access shares were lowest in Guinea-Bissau (15.3%) and Belize (26.7%) and were higher in São Tomé and Príncipe (46%), Jamaica (48.1%), the Dominican Republic (49.3%), Dominica (53.1%) and Cabo Verde (56.8%).[14]

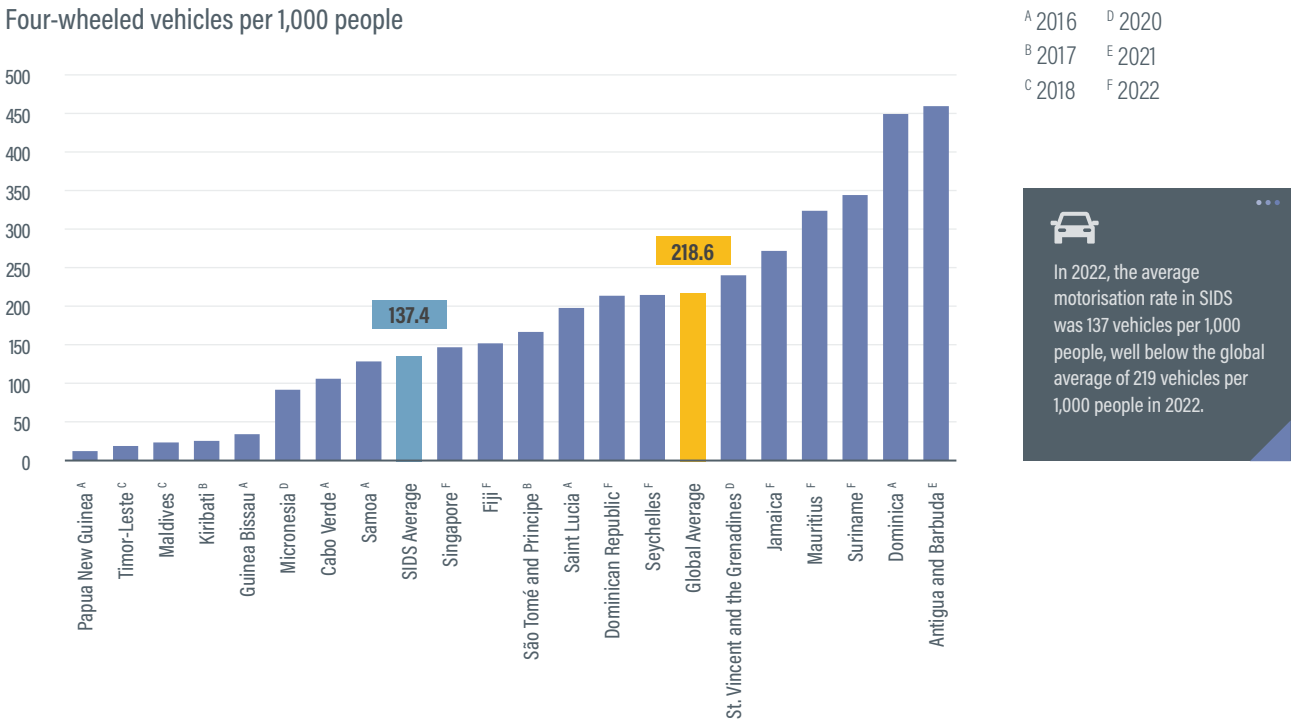
The average motorisation rate in SIDS (covering four-wheeled motor vehicles) in 2022 was 137.4 vehicles per 1,000 people, well below the global average of 218.6 vehicles per 1,000 people (Figure 2)**.**[15] **The low levels of public transport and other modes (such as walking and cycling) result in relatively high motorisation rates. However, the majority of SIDS in the Pacific have low road quality.**[16]

Maritime ports and airports serve as crucial lifelines for SIDS, supporting external trade of essential goods and food as well as key economic activities such as tourism and disaster response.[17] External air connectivity (i.e., long-haul flights) has improved in SIDS, whereas connectivity within the region (short-haul flights between islands) has stagnated or even declined.[18] In Caribbean SIDS, air passenger traffic grew 50% between 2007 and 2017, due mostly to flights from outside the region.[19]

For freight maritime transport, 16 SIDS (44% of the total) experienced declines in their Liner Shipping Connectivity Index[ii] **score between 2020 and 2025** (Figure 3)**.**[20] **Except for the Dominican Republic, Jamaica, and Singapore, all SIDS scored below the indexed average value of 100.**[21] This decline may reflect the deterioration of port infrastructure (which impacts goods delivery) and demonstrates the need to improve maritime transport and port connectivity in island nations and globally. (See 4.10 Shipping.)

ii The Liner Shipping Connectivity Index is a comprehensive tool for quantifying integration in the global maritime network, providing a standardised metric to assess a country's access to and efficiency within international liner shipping.

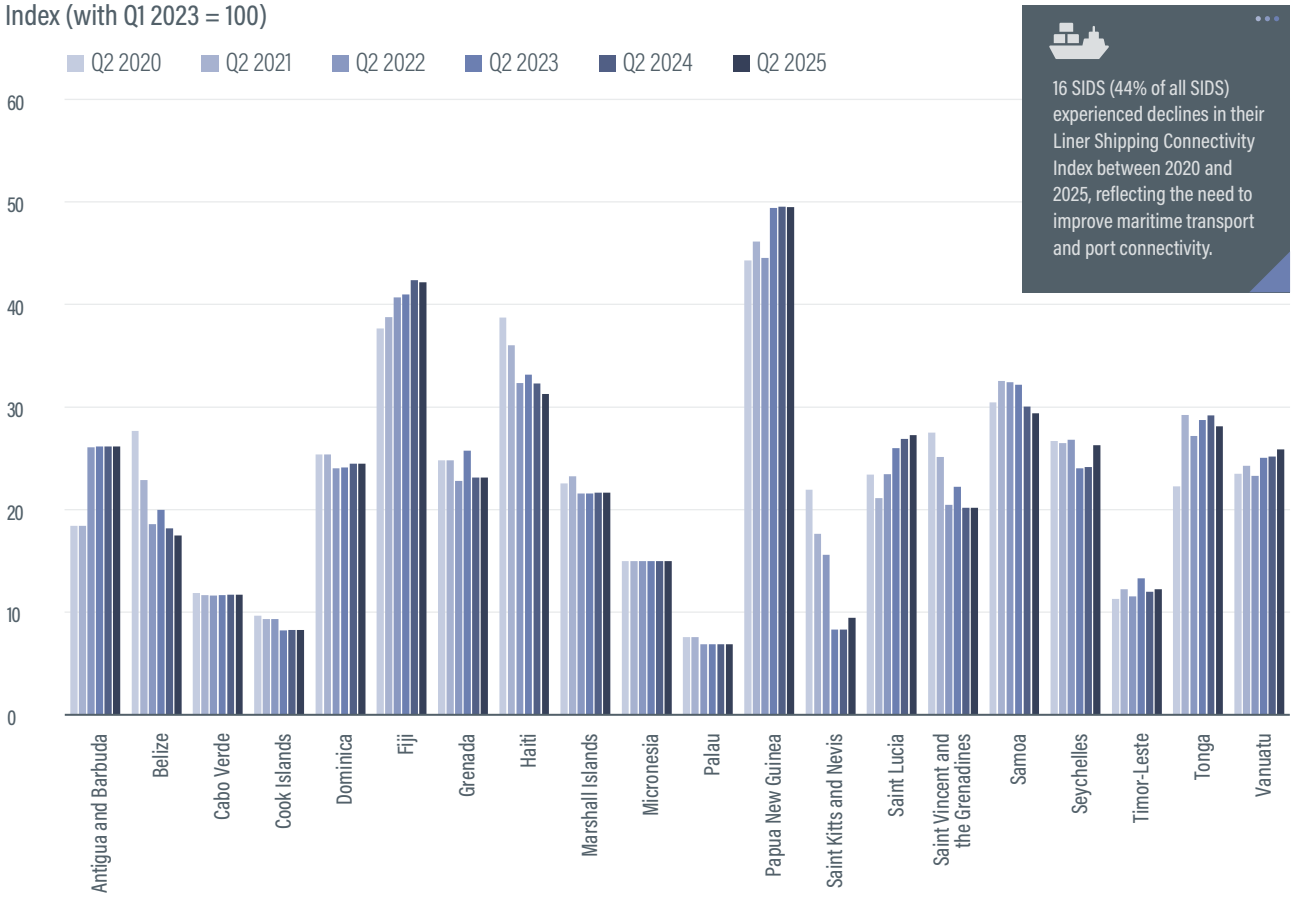
FIGURE 2. Average motorisation rate (four-wheeled vehicles per 1,000 people) in SIDS, 2016-2022



In 2022, the average motorisation rate in SIDS was 137 vehicles per 1,000 people, well below the global average of 219 vehicles per 1,000 people in 2022.

Source: See endnote 15 for this section.

FIGURE 3. Liner Shipping Connectivity Index for selected SIDS, Q2 2020 to Q2 2025



16 SIDS (44% of all SIDS) experienced declines in their Liner Shipping Connectivity Index between 2020 and 2025, reflecting the need to improve maritime transport and port connectivity.

Source: See endnote 20 for this section.

Sustainability and climate trends



In 2023, the transport sector contributed around 15% of the total greenhouse gas emissions from SIDS (excluding international aviation and shipping), well above transport's global emission share of 0.5%.[22] **Transport emissions in SIDS increased 16% between 2015 and 2023 and 5.3% in 2023, to reach 35 million tonnes of carbon dioxide (CO_2) equivalent.**[23] **The region's largest emitter was the Dominican Republic, with 8.5 million tonnes of CO_2 equivalent in 2023.**[24] Singapore showed the greatest increase in emissions that year, rising 11% to 6.8 million tonnes of CO_2 equivalent.[25]

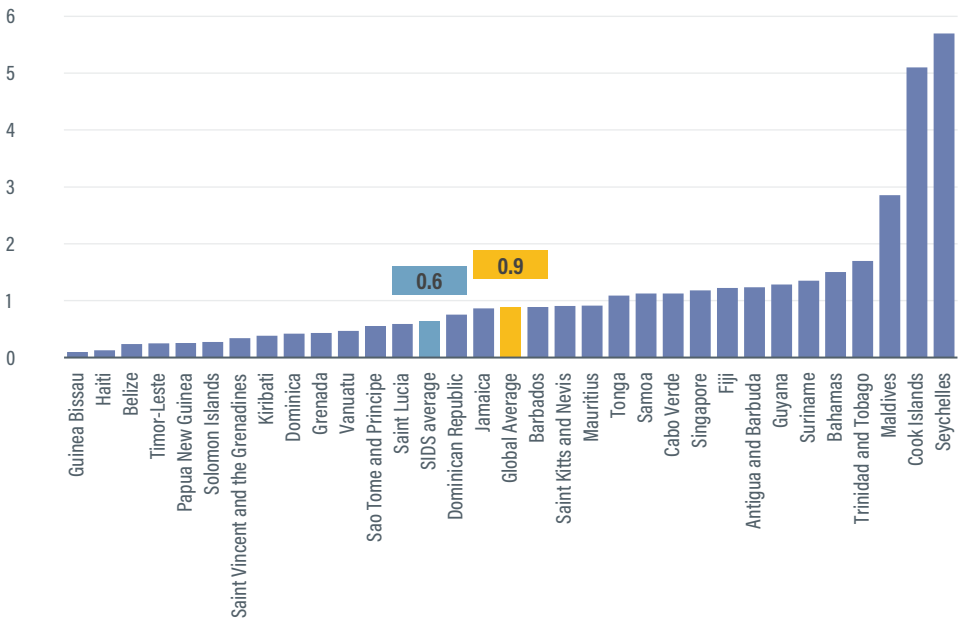
In 2023, transport greenhouse gas emissions represented around half of the total economy-wide CO_2 emissions in five SIDS: Seychelles (54% of total emissions), Palau (51%), and Cabo Verde, Cook Islands and Maldives (48% each).[26] **Transport emissions in SIDS will likely continue to rise alongside transport demand, unless mitigation policies are developed and implemented.** Transport is the largest emission source in one-third of all SIDS (13 countries: Cabo Verde, Cook Islands, Fiji, Jamaica, Kiribati, Maldives, Palau, Papua New Guinea, Samoa, São Tomé and Príncipe, Seychelles, Solomon Islands and Tonga).[27]

Per capita transport greenhouse gas emissions in SIDS totalled 0.63 tonnes of CO_2 equivalent in 2023 (Figure 4).[28] **This was under the global average of 0.89 tonnes, below levels in Europe (1.66 tonnes) and Latin America and the Caribbean (0.94 tonnes), similar to levels in Asia (0.61 tonnes), and higher than in Africa (0.26 tonnes).**[29]

The electricity grids of SIDS rely heavily on fossil fuels, resulting in a carbon intensity of 546 grams of CO_2 per kilowatt-hour in 2023.[30] Belize had a relatively cleaner grid, with only 155 grams of CO_2 per kilowatt-hour, whereas 17 SIDS had grid carbon intensities above 500 grams of CO_2 per kilowatt-hour.[31]

FIGURE 4. Per capita transport greenhouse gas emissions in SIDS, 2023

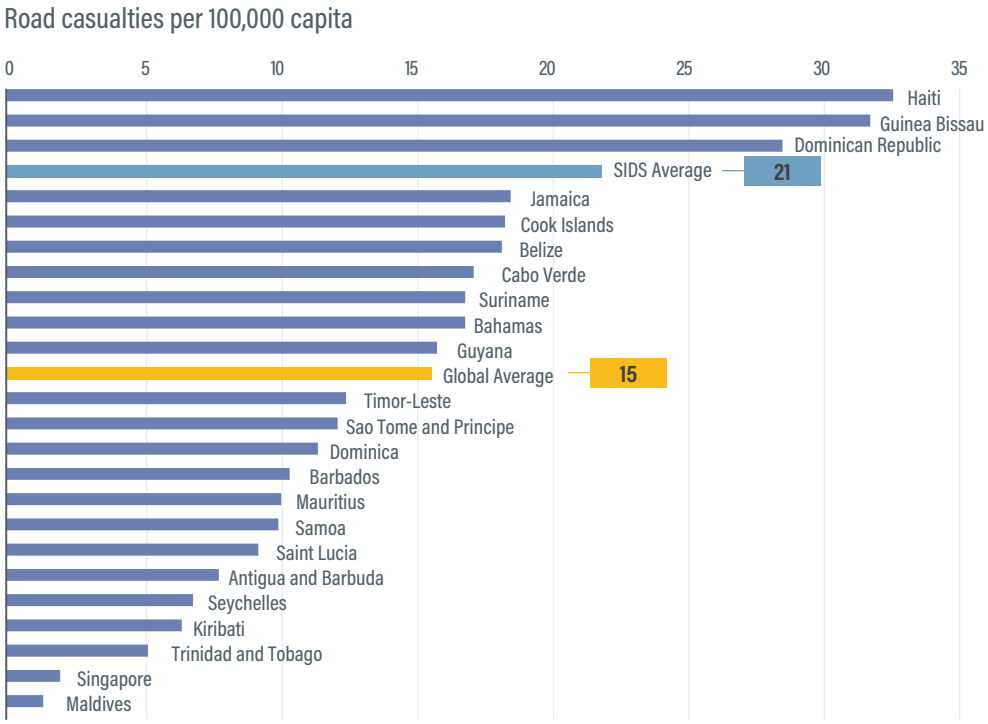
Per capita transport greenhouse gas emissions in tonnes, 2023 in tonnes CO_2 equivalent



In 2023, SIDS had per capita transport emissions of 0.63 tonnes — below the global average of 0.89 and close to Asia's 0.61. However, emissions varied widely, with the Maldives, Cook Islands and Seychelles standing out due to high tourism-related demand.

Source: See endnote 28 for this section.

FIGURE 5. Road casualties per 100,000 people in SIDS, 2021



On average, SIDS have per capita road fatality rates above the global average of 15 deaths per 100,000 people. Among those with available data, half of the countries have rates below the global average.

Source: See endnote 33 for this section.



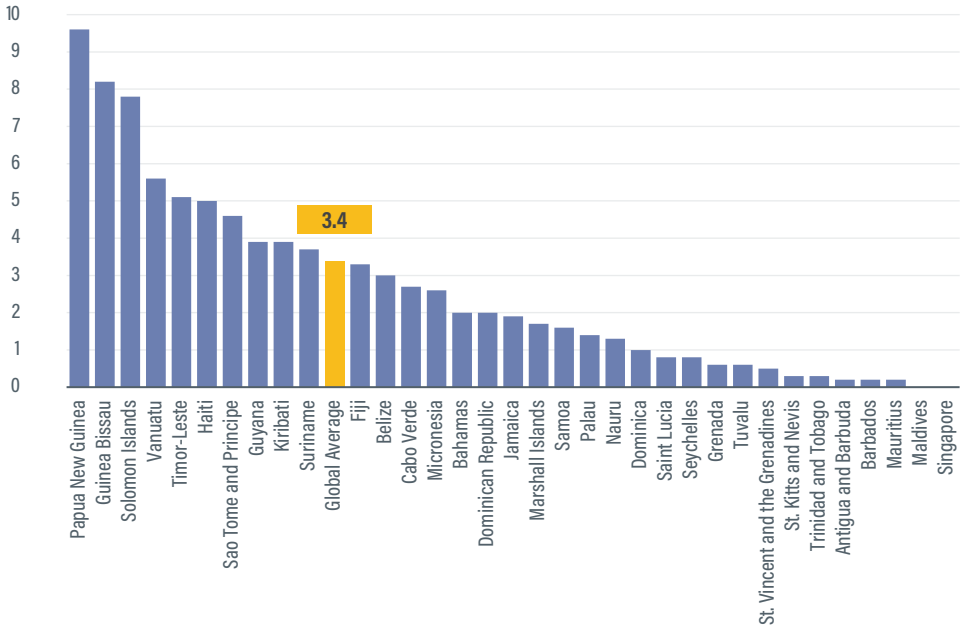
Transport-induced air pollution contributed around 3.4% of total air pollutant emissions in SIDS, resulting in 0.86 premature deaths per 100,000 people in 2019, well below the global averages of 6% of air pollutant emissions and 2.3 premature deaths.[32]

Road safety remains a persistent public health challenge in SIDS, where road deaths averaged 21 casualties per 100,000 people in 2021, above the global average of 15.0 casualties (Figure 5).[33]

The impacts of climate change have been especially severe in SIDS due to the low resilience of infrastructure as well as geographical characteristics such as remoteness, mountainous terrain, and low-lying coastal areas, which make them more vulnerable to external shocks and disruptions.[34] Impacts such as sea-level rise, increased storm intensity and frequency, heavy rainfall and flooding, and excessive heat lead to infrastructure damage, economic and cultural loss, loss of lives and livelihoods, loss of biodiversity and forced displacement.[35] More intense rainfall can trigger landslides, wash out roads, and damage bridges, especially in mountainous areas. Smaller or less economically developed SIDS tend to face greater challenges in building and maintaining infrastructure.[36]

FIGURE 6. Physical infrastructure risk in SIDS, 2025

Physical Infrastructure Risk (0-10, higher value means higher risk), 2025 scores



The impacts of climate change tend to be more severe in SIDS than in other countries due to inadequate resilient infrastructure and geographical characteristics. In 2023, one-third of SIDS faced infrastructure risk levels above the global average of 3.4.

Source: See endnote 37 for this section

- As of 2025, the risk to physical infrastructure – measured on a scale of 0-10, with 10 being the greatest risk – was much higher in Papua New Guinea (9.6), Guinea-Bissau (8.2) and Solomon Islands (7.8) than in other countries in their regions (Figure 6).[37]
- Lower physical infrastructure risk scores occurred in SIDS with stronger economies, such as Maldives and Singapore (both at 0) and Antigua and Barbuda, Barbados and Mauritius (all at 0.2).[38]

SIDS account for two-thirds of the countries that suffer the highest relative losses from natural disasters globally – between 1% and 9% of their GDP each year.[39] Between 1970 and 2020, SIDS lost USD 153 billion due to natural hazards, equivalent to 0.9% of their GDP during this period.[40] Climate change can especially impact urban areas and tourism infrastructure: a 25% reduction in tourism in SIDS could result in losses of USD 7.4 billion or 7.3% of GDP.[41] Urban transport infrastructure faces increased flooding, strain on energy systems, and heat stress, as rising temperatures affect road surfaces, potentially leading to pavement deterioration and higher maintenance costs. In lowland areas and river valleys, intensified flooding events (including flash floods), storm surges, and landslides can damage culverts, roadways, bridges, and other water crossings, leading to connectivity challenges and community isolation.[42]

- In Fiji, damage to transport infrastructure from flooding in 2009 totalled USD 28.5 million (43% of total infrastructure damage); transport damage from Cyclone Winston in 2016 totalled USD 63 million (61% of total infrastructure damage); and Cyclone Yasa in 2020 led to significant infrastructure damage.[43]
- Flooding in the Solomon Islands in 2024 led to USD 12 million in transport damage, or 90% of the country's total infrastructure damage.[44]
- After Cyclone Seroja in 2021, Timor-Leste spent an estimated USD 245 million on efforts to make transport infrastructure more resilient, including through improved standards to reduce disaster risks.[45]

Many SIDS have low shares of paved roads, making their road networks vulnerable to climate impacts and limiting access to alternative routes when disruptions occur.[46] Low-lying coastal roads are increasingly threatened by saltwater intrusion, flooding and erosion from the combined impacts of cyclones, storm surges, and sea-level rise, rendering them impassable or requiring frequent repairs.[47]

Climate-induced disruptions hinder the accessibility and connectivity of aviation and maritime transport for both passengers and freight, as stronger storms and changing sea conditions affect shipping lanes and infrastructure



that is vital for trade and transport. Low-elevation airports and seaports are susceptible to sea-level rise and storm surges, leading to inundation and erosion that can submerge runways and docks – causing disruptions to emergency services, domestic and international air travel, and shipping. Most SIDS depend on small vessel transport, which can become more hazardous and unpredictable in the face of riskier seas and more intense storms.[48]

Climate change affects communities differently across SIDS, with poverty and inequality expected to worsen in many places due to disproportionate impacts on women and children as well as increased health risks from undernutrition and vector-borne disease.[49] Increasing storm surges can contaminate freshwater reserves, damage crops and flood homes. When infrastructure is damaged and roads become impassable, rural isolation affects people's access to markets, health care and education.[50]

Policy and investment developments

SIDS have developed and implemented a range of policy actions to respond and adapt to climate change and evolving transport demand. Adaptation measures for the transport sector include increased infrastructure resilience and early warning systems, while mitigation policies focus mainly on electric mobility in urban areas and sustainable maritime transport. Additionally, SIDS have sought to strengthen public transport, walking and cycling.

- Maldives has introduced several measures that are not common across most SIDS, including vehicle-free days and islands, shifting work hours to reduce travel demand and using solar-powered vessels.[51]
- Palau has set specific targets for walking and cycling (adding 5 kilometres of pedestrian and bicycle lanes per year) and public transport expansion (adding two buses annually), while linking its mitigation efforts to conditional international support.[52]
- Timor-Leste has limited imports of older used vehicles and is considering a vehicle scrappage scheme to replace old vehicles used for taxis.[53]

Many SIDS have prioritised sustainable maritime transport connectivity.

- Dominica plans to develop detailed emission inventories for road and maritime transport and to assess hydrogen-powered shipping as part of its transition strategy to a low-carbon transport system.[54]
- Kiribati has developed a decarbonisation plan that supports transitioning to fuel-efficient outboards, implementing zero-impact cruise liners, investing in low-carbon ships and using biofuel blends.[55]

In 2023, fossil fuel subsidies in SIDS totalled USD 761 per capita, slightly below the global average of USD 813 per capita.[56] Several Pacific SIDS adopted the 2023 Port Vila Call to Action, which aims for a "just and equitable transition towards a fossil fuel free Pacific".[57] Fossil fuel subsidies as a share of GDP in 2023 were relatively low in Cabo Verde (0.4%), Papua New Guinea (1%), and Kiribati (1.8%) but higher in the Bahamas (5.8%), Fiji (6.5%), Tonga (6.6%), Trinidad and Tobago (14.1%) and Suriname (19.5%).[58]

In their Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, SIDS have outlined and implemented measures to mitigate their transport emissions, including through the adoption of new technologies. Measures in first- and second-generation NDCs (submitted between 2015 and 2024) included switching to advanced vehicle and vessel technologies for road and maritime transport (such as electric vehicles, renewable hydrogen fuels and biofuels) and retrofitting vessels for low-carbon fuels. For non-motorised urban transport, Fiji, Kiribati and Timor Leste targeted the promotion of cycling and electric bikes, public transport investments through public-private partnerships, the use of biofuel blends and developing infrastructure for clean energy vehicles.[59]

- Dominica has offered full tax exemptions on electric vehicles since 2019 to accelerate uptake.[60]
- Grenada has introduced biofuel blends, implemented petrol and diesel taxes, and applied vehicle fuel efficiency standards through incentives to reduce transport emissions.[61]
- Nauru is conducting technical assessments for low-carbon transport options and seeks to achieve 30% energy savings, including through public campaigns to promote energy-efficient transport behaviour.[62]
- Papua New Guinea is aiming for 50% carbon neutrality by 2030 and 100% by 2050.[63] To reduce its transport emissions, it is focusing on electric mobility, biofuels and other cleaner fuels, vehicle replacement programmes, low-carbon fuel standards, incentives for energy-efficient vehicles, a shift in freight to rail or waterways, and tracking efficiency measures for fuels and carbon emissions.[64]
- The Solomon Islands aims for net zero greenhouse gas emissions by 2050 and is setting targets for electric vehicle sales, developing charging infrastructure, introducing vehicle efficiency standards, exploring the use of biofuels, and implementing zero-emission vessels and port electrification.[65]
- In Tonga, transport mitigation efforts include a 2% annual efficiency gain target for new light-duty vehicles and a goal for 10% of newly registered light-duty vehicles to be electric or hybrid by 2030.[66]

All six of the third-generation NDCs submitted by SIDs as of 1 August 2025 featured actions aimed at reducing greenhouse gas emissions from transport.[67] The third-generation NDCs of Belize, Marshall Islands and Saint Lucia featured specific targets for mitigating transport emissions, while those for Maldives, Niue and Singapore did not.[68]

- Belize's NDC targets reducing transport emissions by 127 gigagrams of CO_2 equivalent by 2030 and 312 gigagrams by 2035.[69]
- The Marshall Islands' NDC features a target to reduce domestic shipping emissions 40% below 2010 by 2030 and to achieve complete decarbonisation by 2050.[70]
- Saint Lucia's NDC commits to a 22% reduction in greenhouse gas emissions from transport and energy by 2035, compared to 2010 levels.[71]

SIDS have responded to the impacts of climate change by developing and implementing adaptation measures for transport infrastructure – including climate-resilient roads, transport emergency or disaster plans, National Adaptation Plans (NAPs), and disaster notification and early warning systems. Some SIDS have reviewed and revised laws, regulations and standards to improve the climate resilience of transport infrastructure.

- Fiji is fortifying or replacing jetties to withstand category 4 cyclones or above.[72] It is also investing in a USD 200 million project to improve domestic transport connectivity, focusing on replacing critical bridges to enhance resilience against climate change and disasters, with funding from the Asian Development Bank and the World Bank.[73]
- Kiribati is retrofitting coastal infrastructure – including roads, causeways and jetties – to withstand climate threats and is enhancing air and sea transport infrastructure to better withstand climate impacts, maintain connectivity, and ensure food and water security.[74]
- Marshall Islands' 2023 NAP emphasises careful design, construction and maintenance of public facilities – including roads and runways – to improve overall infrastructure resilience.[75]

(See Spotlight on Transport in NAPs for more examples from SIDS.)

- Timor-Leste is developing a transport master plan to build sector resilience and reduce emissions, while conducting a national infrastructure assessment and audit to improve investment planning and implementing climate-proofed infrastructure development.[76]

Some SIDS are developing climate-resilient codes and standards for transport infrastructure and pursuing airport rehabilitation to meet international and climate-resilient standards.

- Kiribati is formulating marine spatial plans for effective management, considering climate change and disaster risks.[77]
- Papua New Guinea is updating its road design standards to include climate change considerations and conducting risk and vulnerability assessments of transport assets, as well as considering the relocation of public facilities and infrastructure in post-disaster reconstruction.[78]
- Solomon Islands is committed to enhancing transport resilience, focusing on road and wharf rehabilitation projects, with a total cost of almost USD 171 million.[79]

Global policy dialogues and inter-governmental processes have created opportunities for greater co-operation across SIDS. These mechanisms have supported the development and implementation of relevant policies to improve transport and climate change mitigation and adaptation through greater partnerships with stakeholders (including international and regional organisations, multilateral development banks and the private sector) and among countries with common priorities and challenges.

The United Nations (UN), recognising the special needs and characteristics of SIDS and their sustainable development challenges, has initiated various programmes and efforts to help mitigate vulnerabilities.

- The 1992 UN Conference on Environment and Development (Earth Summit) defined SIDS as a distinct group of developing countries with specific economic, social and environmental vulnerabilities.[80]
- In 1994, the Programme of Action for the Sustainable Development of Small Island Developing States (Barbados Programme of Action) was finalised and adopted at the first global conference on the Sustainable Development of Small Island Developing States.[81]
- The Programme of Action was reviewed and revamped in 2005 through the Mauritius Strategy for the Further Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States.[82]
- In 2014, the Third International Conference on Small Island Developing States in Samoa provided the international community with an opportunity to revisit the vulnerabilities of SIDS in light of changing global circumstances and new insights, including in relation to the impacts of climate change.[83]

Partnerships in action

- The **Fourth International Conference on Small Island Developing States**, held in Antigua and Barbuda in May 2024, focused on reviewing SIDS' sustainable development progress and proposed a new decade of partnerships and solutions to supercharge their path to resilient prosperity.[84]
- The **Asia-Pacific Regional Dialogue on Sustainable Maritime Connectivity**, created in 2021, brings together countries and relevant stakeholders to address challenges in maritime transport, including technology gaps among countries and the rising climate mitigation and adaptation burden on SIDS.[85]
- In 2024, the **World Bank**, supported by the **Global Facility to Decarbonize Transport (GFDT)**, released the two-part *Guide to Mobility for Livable Pacific Cities*, which has a focus on mobility within the Pacific SIDS and comprises "Priority Actions for a Car-Lite Future" and a "Practitioners' Handbook to Implement the Priority Actions". The guide is the result of a comprehensive study and workshops by Leaders in Urban Transport Planning (LUTP) in Fiji, Kiribati, Solomon Islands and Tonga.[86]

Climate and Sustainability Responses in Transport Sub-Sectors and Modes

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION

MODULE 4

4.1  Freight Transport and Logistics 399

4.2  Integrated Transport Planning 417

4.3  Walking 439

4.4  Cycling 455

4.5  Public Transport 470

4.6  Informal Transport 491

4.7  Rail 512

4.8  Road Transport 528

  Second-hand Vehicles 549

4.9  Aviation 563

4.10  Shipping 584

LIST OF FIGURES

Freight Transport and Logistics

Figure 1. Global freight transport by modal share, based on transport performance, 2025 estimates **405**
Figure 2. Freight transport growth, by region and mode, under a business-as-usual scenario, 2025-2055 . . . . . **406**
Figure 3. Global CO_2 emissions by mode of transport, 1990-2023 . . . . . **408**
Figure 4. Rail length and share of electrification in selected countries, 2022 . . . . . **410**
Figure 5. Number of ships capable of using alternative fuels (excluding liquefied natural gas carriers), 2015-2024 . . . **411**
Figure 6. ZEVWISE green corridors as of 2024 . . . . . **413**

Integrated Transport Planning

Figure 1. Urban transport modal shares by region, as of 2024 . . . . . **425**
Figure 2. Implemented and planned zero-emission zones and variants as of April 2025 . . . . . **436**

Walking

Figure 1. Survey results on walking for at least 10 minutes at a time for EU countries, 2022 . . . . . **444**
Figure 2. Surveys related to the walking component of a public transport journey **445**
Figure 3. Share of people who feel safe walking alone at night where they live, by region and gender, 2020-2022 . . . . **447**
Figure 4. Assessed quality of the world's roads for safety, as of May 2025 . . . . . **448**
Figure 5. Status of national policies on walking by region, 2023 . . . . . **450**
Figure 6. Status of speed laws by country, 2022 . . . . . **452**
Figure 7. Estimated pedestrian road crash casualties and costs, 2021 . . . . . **453**

Cycling

Figure 1. Enablers to cycling for transport, based on a 2022 study **462**
Figure 2. Share of population with access to protected bike lanes, by region, 2023 . . . . . **462**
Figure 3. Energy efficiency of different modes of transport **464**

Public Transport

Figure 1. Share of urban population with convenient access to public transport (population-weighted average), by country, 2022 . . . . . **476**
Figure 2. Ratio of monthly pass cost to average monthly income (%) in selected cities, 2025 . . . . . **477**
Figure 3. Metro network length by region, 2015-2023 . . . . . **479**
Figure 4. Comparison of life-cycle emissions of 12-15 metre buses in Latin America, 2024 . . . . . **482**
Figure 5. Transport operating costs and revenue recovery in European cities, 2019-2020 and 2019-2023 . . . . . **484**
Figure 6. Impacts of extreme heat (left) and flooding (right) on public transport users, service providers and physical assets **485**

Informal Transport

Figure 1. Scale of informality of transport services according to their context **496**
Figure 2. Share of informal transport trips in selected cities and years **498**
Figure 3. Share of households able to access transport modes within a 10-minute walk, in four Latin American cities, 2017 . . **501**
Figure 4. Absolute access using public transport and informal modes in Mexico City and Bogotá, 2019 . . . . . **501**
Figure 5. Typical carbon dioxide emission factors and energy efficiency for different informal transport modes **504**
Figure 6. Informal transport's share of emissions in selected cities globally **505**
Figure 7. Insights on boda boda operations collected by Lubyanza Research Group during 2024 . . . . . **506**

Rail

Figure 1. Passenger rail activity by region, 2015 to 2022 . . . . . **517**
Figure 2. Freight rail activity by region, 2015-2022 . . . . . **519**
Figure 3. Tonnes of rail freight carried per unit of gross domestic product, by country, 2023 . . . . . **519**
Figure 4. High-speed rail activity by country, 2010-2022 . . . . . **520**
Figure 5. Life-cycle greenhouse gas emissions intensity of motorised passenger transport modes, 2022 . . . . . **522**

Road Transport

Figure 1. Vehicle ownership rates by region in 2022 . . . . . **535**
Figure 2. Growth in oil demand for road transport, 2021-2024 . . . . . **537**
Figure 3. Greenhouse gas emissions from road transport compared to other modes, 2015-2023 . . . . . **539**
Figure 4. Per capita greenhouse gas emissions from road transport by country, 2023 . . . . . **540**
Figure 5. Road casualities per 100,000 people by region and compared to the global average **542**
Figure 6. Mitigation potential of feasible emission reduction strategies for road transport **545**

Second-hand Vehicles

Figure 1. Schematic flowchart of global vehicle flows **553**
Figure 2. Global used vehicle flows by region, 2015-2020 . . . . . **555**
Figure 3. Age of vehicle imports versus GDP in selected countries, 2020 . . . . . **556**
Figure 4. Regulatory environments for light-duty and heavy-duty vehicles, by region, as of 2023 . . . . . **561**

Aviation

Figure 1. Aviation passenger volumes (in billion revenue passenger kilometres), 2020-2024 . . . . . **570**
Figure 2. Freight aviation volumes (in billion cargo tonne kilometres), 2017-2024 . . . . . **571**
Figure 3. Assessment of potential risks to the global economy that can affect aviation, as of 2025 . . . . . **572**
Figure 4. Global aviation emissions (domestic and international), 2000-2023 . . . . . **573**
Figure 5. Consumption of aviation carbon budget from cumulative lifetime emissions of projected fleet **575**
Figure 6. Estimation of the contrail cirrus climate impact on global surface temperature **577**

Shipping

Figure 1. World seaborne trade by type, 2010-2024 and forecast for 2025 . . . . . **590**
Figure 2. Monthly trade transit volume of major shipping routes **591**
Figure 3. World's top five countries for ship registration, 2010-2025 . . . . . **592**
Figure 4. Greenhouse gas emissions from shipping (international and domestic), 2010-2023 . . . . . **594**
Figure 5. Potential emission trajectories for shipping, 2020-2050 . . . . . **595**

LIST OF TABLES

Public Transport

Table 1. Selected fare-free transit systems and their funding mechanisms, as of January 2025 . . . . . **488**

Informal Transport

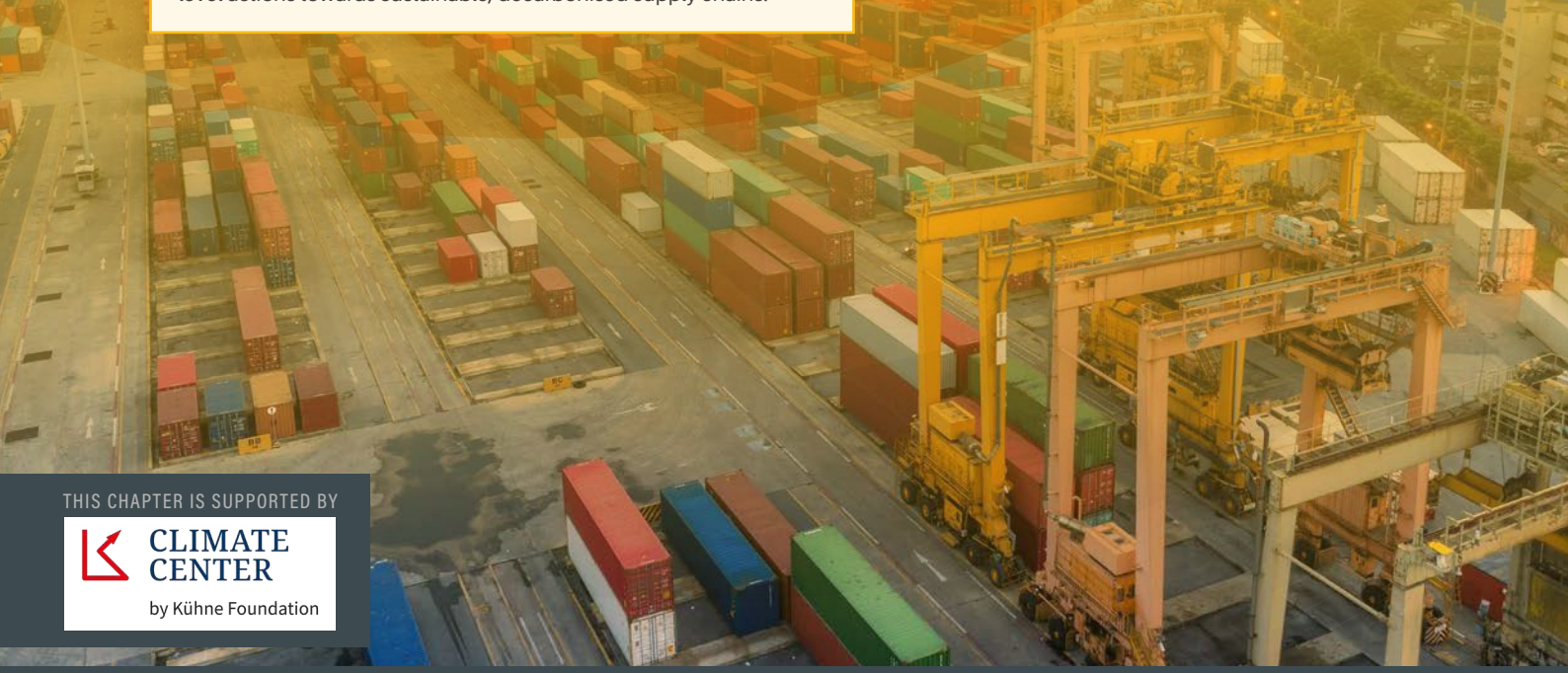
Table 1. Examples of data collection and policy initiatives contributing to cleaner, more sustainable and just informal transport services **508**

Table 2. Guiding documents and resources to accelerate progress towards development, climate, safety and equity goals in the informal transport sector **509**

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Freight Transport and Logistics

NOTE: *4.1 Freight Transport and Logistics* focuses on freight transport, supply chains and logistics on a global and regional level as well as on sustainability and climate trends by specific freight transport modes. Additional content on freight transport and logistics can be found in *1.3 Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet*, which focuses on markets, supply chains, and the movement of goods in the context of global challenges, with high-level actions towards sustainable, decarbonised supply chains.



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KEY FINDINGS

Demand, use and access

- Freight transport is intertwined with the economy. Logistics services – including warehousing, administration and management – generated revenues of around USD 10 trillion in 2024, or 5-10% of the global gross domestic product (GDP), with annual growth of 6-10% depending on the region. Freight transport has grown continuously in recent decades, slowing only briefly during periods of global economic crisis.
- Global freight activity grew an estimated 8% between 2020 and 2025 to surpass 171 trillion tonne-kilometres. Most of the world's freight is carried by water – in 2025, international maritime shipping accounted for 74% of all freight tonne-kilometres, and domestic maritime shipping for 5% – followed by rail (11%), road transport (10%) and aviation (0.1%).
- Shares of inland freight transport have remained relatively stable for decades, although rail's share has declined in countries that have growing market economies, such as China and India, putting into question the ambition of a modal shift from road to rail.
- Because rail transport is much less energy intensive than road transport, sustainability advocates have long supported shifting the movement of goods from road to rail. Yet so far, public policies and investments have had limited success, as the share of rail globally has dropped sharply.
- As the share of the world's people living in cities surges from 55% in 2018 to a projected 68% by 2050, urban freight transport will continue to grow. Most of this urban growth is anticipated in Africa and Asia. In 2019, urban freight activities accounted for an estimated 5% of global freight activity.
- The focus of sustainable urban freight has mainly been on technical and economic solutions, but there is a need to address pressing social issues such as health effects and social inequity.
- The weight of goods moved by maritime transport tripled over a 30-year period, rising from 4 billion tonnes in 1993 to 12 billion tonnes in 2023; by comparison, e-commerce flows achieved similar growth in less than 10 years – rising from 1.3 billion to 6.5 billion tonnes between 2014 and 2023.
- Under business as usual, freight tonne-kilometres are expected to increase 55% by 2050; Africa is likely to double its share in global freight, whereas growth in the Global North will be around 33%. International shipping and rail are expected to grow by half their 2025 volumes, while trucking activity will double and domestic shipping will reach nearly 2.5 times its 2025 volume.



KEY FINDINGS



Sustainability and climate trends

- Since the pandemic, other major disruptions to global transport, combined with the costly impacts of extreme weather events, have increased awareness among freight transport stakeholders of the importance of network and service resilience. In 2024, shipping incidents, safety threats and droughts led to dramatic declines in vessel passages in the Red Sea (down 67%), the Suez Canal (down 42%) and the Panama Canal (down 36%). As a result, global shipping rates between continents doubled or tripled.

- Global trade continued to show remarkable resilience, with few indications of regionalisation reversing globalisation – despite continued impacts such as inflation and higher costs for consumers. However, in 2025 the new US administration announced historic tariff hikes for most of its important trading partners. The impact on global trade remained unclear, given the international nature of many supply chains and the varying impacts of trade barriers. In response to the new geopolitical tensions, Europe re-balanced its sustainable development ambitions against its efforts to maintain economic competitiveness.

- The freight transport sector accounted for an estimated 5-7% of total employment in 2023, while the logistics sector – which includes transport, warehousing, administration, and information and communications technology management – had an even higher employment share (10%).

- Some sub-sectors, such as road freight, face acute shortages of workers. Challenges affecting the transport workforce include mismatches in skill requirements, new "gig markets" for e-commerce delivery that are associated with poor social conditions, and emerging technologies for autonomous and digital logistics.

- Women have been greatly under-represented in the transport workforce, accounting for only 15.6% of workers in the sector overall, and 23% in senior leadership roles, as of 2023.

- The safety of freight transport remains a serious concern, as road crashes involving heavy-goods vehicles are associated with a higher risk of fatality.

- Globally, freight transport was responsible for around 10% of energy-related CO_2 emissions and 43% of CO_2 emissions from the transport sector (including international aviation and shipping) in 2023.

- After falling slightly during the COVID-19 pandemic (in 2020), CO_2 emissions from freight transport rose to a record high of 3.5 gigatonnes in 2023. Roughly 85% of these emissions were from freight transport itself, and the rest were from the storage and handling of goods.

- By mode, the largest contributor to freight transport emissions was road freight, responsible for 70% of freight transport-related CO_2 emissions in 2023. Despite the high volume of global trade carried via water, maritime transport was responsible for 22% of emissions. Railways contributed 2.3% of emissions, the lowest share among freight transport modes.

- Aviation (domestic and international passenger and freight) contributed nearly 950 million tonnes of CO_2 emissions in 2023; of this, close to 155 million tonnes was directly linked to air freight transport (including both belly freight and air freighter transport), representing around 6% of all freight transport-related CO_2 emissions. Air cargo demand grew 11.3% in 2024, and further growth of 5.8% was expected in 2025.

- Urban freight transport was responsible for an estimated 5% of global greenhouse gas emissions and for 28% (1.1 gigatonnes) of freight transport emissions in 2023. A 2022 study found that urban freight transport represents around 15-25% of all vehicle-kilometres travelled, occupies 20-40% of the motorised road-space, and contributes 20-40% of greenhouse gas emissions and 30-50% of air pollutants.

- Modes of transport that (until recently) have relied mostly on self-regulation for emission reduction – such as maritime and air transport – have relatively high emissions and often still use less environmentally friendly propulsion technologies.

- As a result of freight growth, both greenhouse gas emissions and local emissions are predicted to increase in the future. Moreover, as emissions from passenger transport decline, freight transport's share of overall emissions is expected to rise, from 43% in 2023 to 57% in 2050.

- According to one scenario, substantially reducing freight emissions by more than two-thirds is only possible by reducing overall demand, together with shifts in transport modes and the electrification of transport.

- Battery electric trucks that run on low-carbon electricity are considered the main technology for decarbonising

KEY FINDINGS

road freight transport. As electrification accelerates, battery electric trucks are expected to reach cost parity with conventional trucks in the coming years. In contrast, cost parity between hydrogen-fuelled electric vehicles and conventional trucks is not expected anytime soon.

- Global sales of medium- and heavy-duty electric trucks remained low in 2024, with shares of around 4.4% in China, 2.3% in Europe and 1.7% globally. Meanwhile, governments and industry are targeting sales shares of 50-60% by 2030 and have supported the electric truck transition through investments in charging infrastructure.
- Industrial collaborations are taking advantage of key business opportunities to drive the shift to electric trucks, enabling new actors to enter the scene. Electric mobility also opens possibilities for new business models for freight services (such as offering fleet charging services, or flexibility services to the electricity market), while digitalisation will be key to optimising routing and charging.
- The aviation industry has made some progress in using sustainable aviation fuel (SAF), the central pillar of its near- to medium-term decarbonisation strategy; however, SAF still accounted for less than 1% of aviation's total fuel consumption in 2024.
- In the rail freight sector, electrification and efficiency improvements led to a halving of emissions (both greenhouse gas and local emissions) between 2005 and 2022, even with increases in performance. As of 2022, around one-third of all railways worldwide had been electrified, mainly in India, Japan and China. With the energy demand for freight rail transport in China and India projected to nearly double by 2050 (surpassing that for passenger rail), electrification of rail networks is expected to continue.
- For maritime transport, greenhouse gas emissions per unit of dry bulk shipping fell 4% between 2019 and 2023, whereas emissions from refrigerated transport increased. Most emission improvements in the sector are attributed to efficiency measures that have relatively low or negative abatement costs.



Policy and investment developments

- The freight transport and logistics sector has remained overlooked in countries' Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. As of 1 August 2025, only 9 of the 29 third-generation NDCs that had been submitted to the United Nations Framework Convention on Climate Change included mitigation actions covering freight or a combination of freight and passenger transport.
- To reach climate targets, industry will need strong support at the national level, and many international organisations have provided comprehensive roadmaps for decarbonising freight transport. In practice, however, the scope of policies tends to be narrower, with only limited attention to demand reduction but broad support for modal shift (despite limited success). Active, successful policies have focused on efficiency improvements and electrification.
- Due to the high volume of sea transport, efforts to achieve the International Maritime Organization's (IMO) target for net zero greenhouse gas emissions by 2050 are imperative.
- Because nearly half of air freight capacity is belly freight, emission targets for air freight are directly linked to the overall emission targets for aviation, which are supported by both industry and governments. The 41st ICAO Assembly adopted the Long Term Global Aspirational Goal in 2022 and member states aim for net zero carbon emissions from international aviation by 2050. In 2021, representatives of the world's major aviation industry associations and largest aircraft and engine makers also signed the "Commitment to Fly Net Zero 2050" declaration.
- Targets for reducing pollutants from road transport have generally been harmonised across continents, despite some variations in scope and coverage.
- Governments have shown widespread support for the electrification of road freight. While several countries have official targets for reducing greenhouse gas emissions from transport, others present visions and ambitions.

KEY FINDINGS

- In some regions, green corridors are being implemented to induce a transition to sustainable, low-carbon long-haul freight transport.
- In the context of road safety, several governments and other stakeholders have adopted Vision Zero strategies to end road traffic-related fatalities. For commercial drivers, interventions include safety technology standards for vehicles, infrastructure and driver behaviour/training.
- In the EU, reporting and improvement of transport emissions will become mandatory for bigger companies from 2026 and 2028 onwards, with the introduction of the EU Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive (CSDDD). Pressure for small and medium-sized enterprises to follow suit will increase in Europe.
- Industry-driven initiatives at different levels have shown that companies and organisations already gain advantages from emissions accounting and reporting. A proposed EU regulation related to freight and passenger transport emissions, CountEmissionsEU, outlines a methodology for calculating and reporting greenhouse gas emissions from transport services. Such efforts are further strengthened by mode-specific efforts to measure and control emissions.
- Three key concepts for measuring and reporting the emissions of organisations are the product carbon footprint (PCF), the corporate carbon footprint (CCF) and logistics network emissions. The key challenges faced by all three concepts are similar: emissions accounting and reporting need to be based on the primary data of the organisation.
- In addition to introducing and tightening legislation on vehicle emission standards, a growing number of governments have implemented biofuel regulations – including California's Low Carbon Fuel Standard, the EU's Renewable Energy Directive (RED III) and Canada's Clean Fuel Regulations.
- At the EU level, in 2024 the region's Emissions Trading Scheme began covering all vessels entering EU ports. FuelEU Maritime, a legislative package for the use of clean energy in the maritime sector within the EU's "Fit for 55" programme, was expected to take effect in 2025. Globally, to further expand the use of sustainable fuels, the maritime industry has highlighted the need for contributions at the regional and national levels.
- The main policies that countries have adopted for rail electrification are reducing the use of diesel trains, creating dedicated rail freight infrastructure and providing subsidies for operators. Recent major investments have focused on dedicated rail corridors over very long distances in Asia (within India, and China's Belt and Road Initiative). Although many countries offer operational subsidies, experience in Europe suggests that these are not always effective.
- To meet the challenges of rising urban populations, different urban last-mile concepts have been explored and developed, including consolidation hubs, off-peak deliveries and delivery robots.





Context, challenges and opportunities

Freight transport volumes have grown nearly continuously in recent decades, propelled by population growth, industrial development, increased global trade and the acceleration of material consumption. Technology is also a strong driver of demand for freight transport. Digitalisation is propelling e-commerce services, leading to both increased long-distance air freight transport and more pressure on last-mile delivery.[1] At the same time, digitalisation helps to consolidate freight flows through digital platforms, increasing the efficiency of movements through economies of scale, and keeping costs low.[2]

Globally, freight transport was responsible for around 10% of energy-related carbon dioxide (CO_2) emissions in 2023 and for 43% of the CO_2 emissions from transport (including international aviation and shipping).[3] Urban freight transport contributed an estimated 5% of global greenhouse gas emissions and 28% of global freight transport emissions in 2023.[4] Most progress towards sustainable freight transport has been achieved through efficiency improvements in individual modes of freight transport (i.e., rail, medium- and heavy-duty trucks, vessels), with growing attention to electrification and the use of alternative fuels.[5]

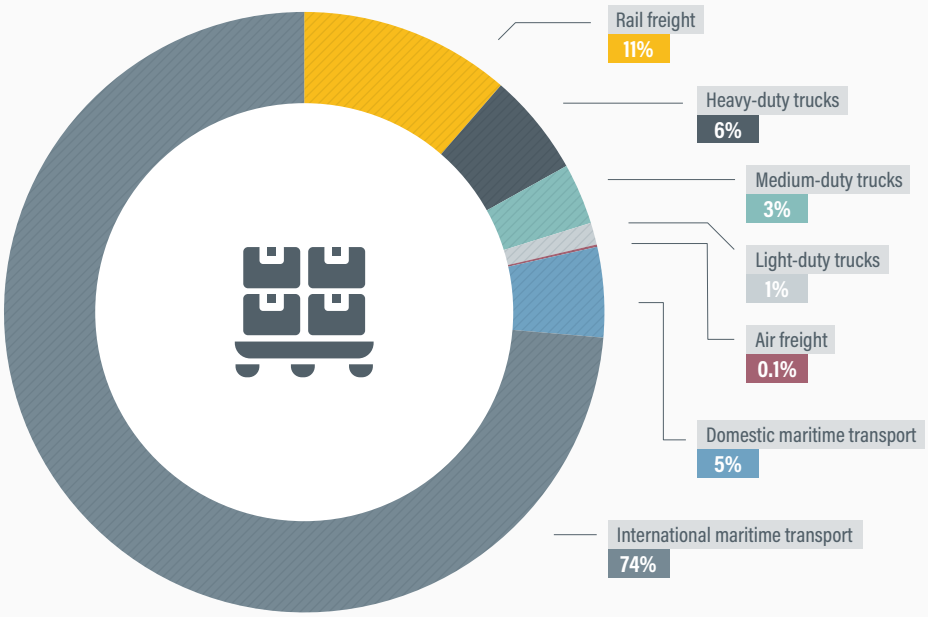
The freight transport sector supports millions of jobs worldwide and comprised an estimated 5-7% of total employment in 2023; for the whole freight transport and logistics sector, the share neared 10%.[6] Freight transport provides jobs at all training levels, including for companies and individuals that operate informally, as well as ample opportunities for upward mobility due to the strong interconnection between operations and senior management.[7] Social challenges related to rapidly evolving job markets include pressures facing logistics professionals (such as mismatches in skill requirements, rewards and absolute volumes), new "gig markets" for e-commerce delivery that are associated with poor social conditions, and emerging technologies for autonomous and digital logistics.[8]

Demand, use and access

Freight transport is intertwined with the economy. Its long-term development is driven by a growing global population, an expanding variety of products and services, and increased international trade. Efforts to deal with the climate crisis, such as rebuilding climate-damaged infrastructure and transport for carbon capture, also generate transport demand.[9]

FIGURE 1. Global freight transport by modal share, based on transport performance, 2025 estimates

Freight transport modes by freight activity in tonnes-kilometers



Most of the world's freight is carried by water – in 2025, international maritime shipping accounted for 74% of all freight tonne-kilometres, and domestic maritime shipping for 5% – followed by rail (11%), road transport (10%) and aviation (0.1%).

Note: Total = 171 trillion tonne-kilometres.

Source: See endnote 13 for this section.

Logistics services – including warehousing, administration and management – generated revenues of around USD 10 trillion in 2024, or 5-10% of the global gross domestic product (GDP), with annual growth of 6-10% depending on the region.[10] **Freight transport has grown continuously in recent decades, slowing only briefly during periods of global economic crisis.** Strong and resilient logistics performance facilitates the movement of essential goods, such as the distribution of vaccines during the COVID-19 pandemic as well as humanitarian aid, for which 14% of the cost is related to its supply chain.[11]

Global freight activity grew an estimated 8% between 2020 and 2025 to surpass 171 trillion tonne-kilometres.[12] **Most of the world's freight is carried by water – in 2025, international maritime shipping accounted for 74% of all freight tonne-kilometres, and domestic maritime shipping for 5% – followed by rail (11%), road transport (10%) and aviation (0.1%)** (Figure 1).[13] **Shares of inland freight transport have remained relatively stable for decades, although rail's share has declined in countries that have growing market economies, such as China and India, putting into question the ambition of a modal shift from road to rail** (Box 1).[14] Roughly half of global rail freight movements take place in China and the United States, 20% in the Russian Federation and 30% in other countries.[15]

Box 1. Shifting freight from road to rail?

Because rail transport is much less energy intensive than road transport, sustainability advocates have long supported shifting the movement of goods from road to rail. Yet so far, public policies and investments have had limited success, as the share of rail globally has dropped sharply. Studies indicate that the effect of rail subsidies has been limited and that greatly increasing the share of rail freight transport will require not only improved services and lower costs, but also extensions in railway networks and service capacity. It is unclear to what extent governments and industry are able and willing to successfully implement modal shift policies to help decarbonise freight transport.

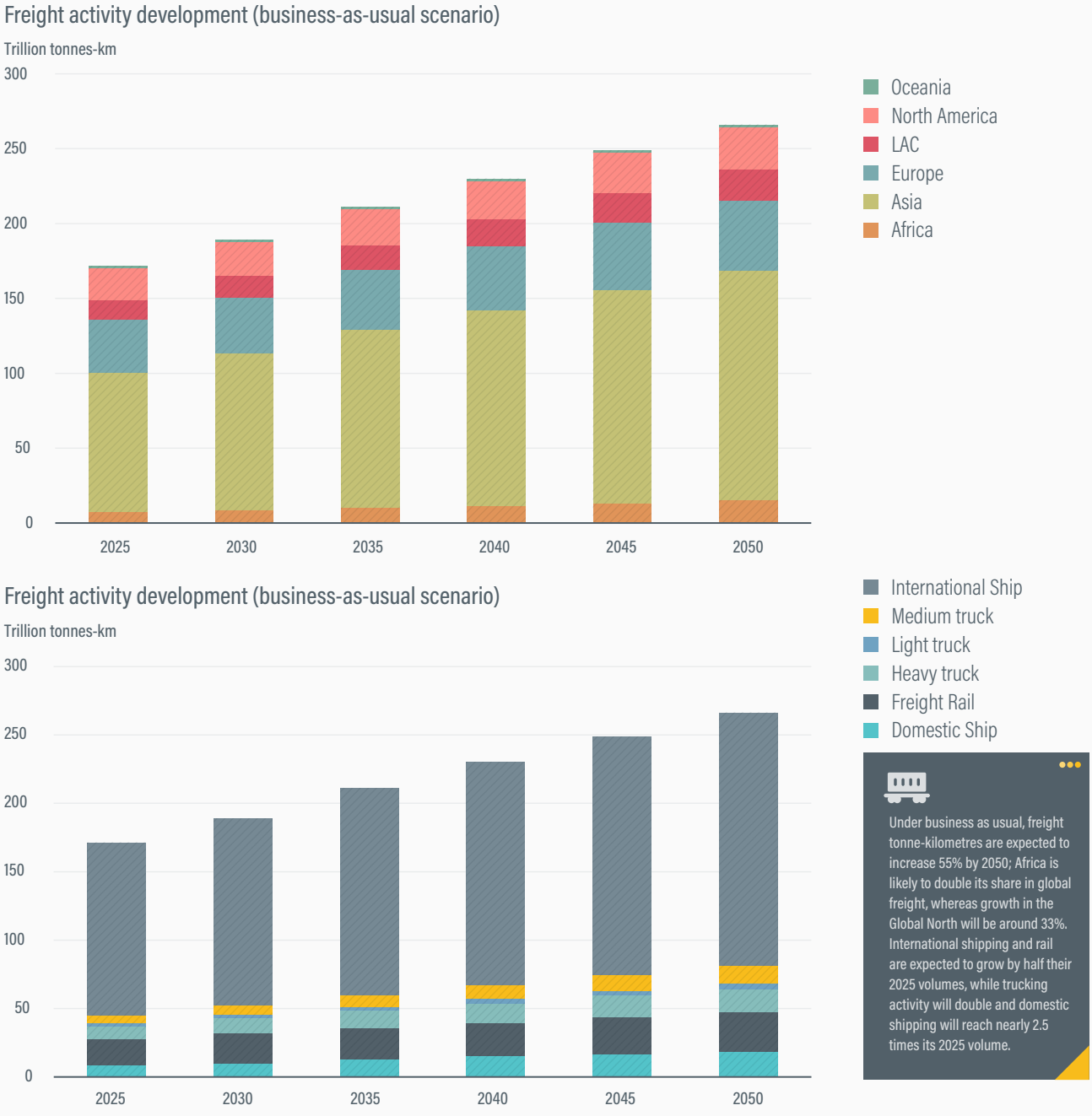
Source: See endnote 14 for this section.

As the share of the world's people living in cities surges from 55% in 2018 to a projected 68% by 2050, urban freight transport will continue to grow.[16] **Most of this urban growth is anticipated in Africa and Asia.**[17] **In 2019, urban freight activities accounted for an estimated 5% of global freight activity.**[18] Every day, cities require around 200 to 400 freight trips and deliveries per 1,000 residents, with volumes varying according to city size, economic activity and urban structure.[19] **The focus of sustainable urban freight has mainly been on technical and economic solutions, but there is a need to address pressing social issues such as health effects and social inequity.**[20]

The weight of goods moved by maritime transport tripled over a 30-year period, rising from 4 billion tonnes in 1993 to 12 billion tonnes in 2023; by comparison, e-commerce flows achieved similar growth in less than 10 years – rising from 1.3 billion to 6.5 billion tonnes between 2014 and 2023.[21]

Under business as usual, freight tonne-kilometres are expected to increase 55% by 2050; Africa is likely to double its share in global freight, whereas growth in the Global North will be around 33%.[22] **International shipping and rail are expected to grow by half their 2025 volumes, while trucking activity will double and domestic shipping will reach nearly 2.5 times its 2025 volume** (Figure 2).[23]

FIGURE 2. Freight transport growth, by region and mode, under a business-as-usual scenario, 2025-2055



Under business as usual, freight tonne-kilometres are expected to increase 55% by 2050; Africa is likely to double its share in global freight, whereas growth in the Global North will be around 33%. International shipping and rail are expected to grow by half their 2025 volumes, while trucking activity will double and domestic shipping will reach nearly 2.5 times its 2025 volume.

Source: See endnote 23 for this section.

Sustainability and climate trends

The COVID-19 pandemic, starting in 2020, increased global awareness of the importance of logistics and supply chains for everyday life. It sent severe shocks through global supply chains due to temporary changes in economic demand related to precautionary buying, online purchases and changes in consumption patterns. Consequences included dynamic acceleration (bullwhip) effects[i] in supply chains, unavailability of the labour force in manufacturing and logistics, and volatility in capacities and prices in transport chains.

Since the pandemic, other major disruptions to global transport, combined with the costly impacts of extreme weather events, have increased awareness among freight transport stakeholders of the importance of network and service resilience. In 2024, shipping incidents, safety threats and droughts led to dramatic declines in vessel passages in the Red Sea (down 67%), the Suez Canal (down 42%) and the Panama Canal (down 36%).[24] As a result, global shipping rates between continents doubled or tripled.[25]

Global trade continued to show remarkable resilience, with few indications of regionalisation reversing globalisation – despite continued impacts such as inflation and higher costs for consumers.[26] However, in 2025 the new US administration announced historic tariff hikes for most of its important trading partners. The impact on global trade remained unclear, given the international nature of many supply chains and the varying impacts of trade barriers. In response to the new geopolitical tensions, Europe re-balanced its sustainable development ambitions against its efforts to maintain economic competitiveness.[27]

The freight transport sector accounted for an estimated 5-7% of total employment in 2023, while the logistics sector – which includes transport, warehousing, administration, and information and communications technology management – had an even higher employment share (10%).[28] Some sub-sectors, such as road freight, face acute shortages of workers. Challenges affecting the transport workforce include mismatches in skill requirements, new "gig markets" for e-commerce delivery that are associated with poor social conditions, and emerging technologies for autonomous and digital logistics.[29] Despite regional variations, a global shortage of drivers could result in 3.6 million unfilled positions, a situation that is expected to worsen due to difficulties in recruiting younger drivers.[30]

Women have been greatly under-represented in the transport workforce, accounting for only 15.6% of workers in the sector overall, and 23% in senior leadership roles, as of 2023.[31] Although increases in female participation and leadership have been linked to improved economic and environmental performance, such advancements are constrained by gender norms, security and safety challenges, and a lack of educational opportunities for women.[32]

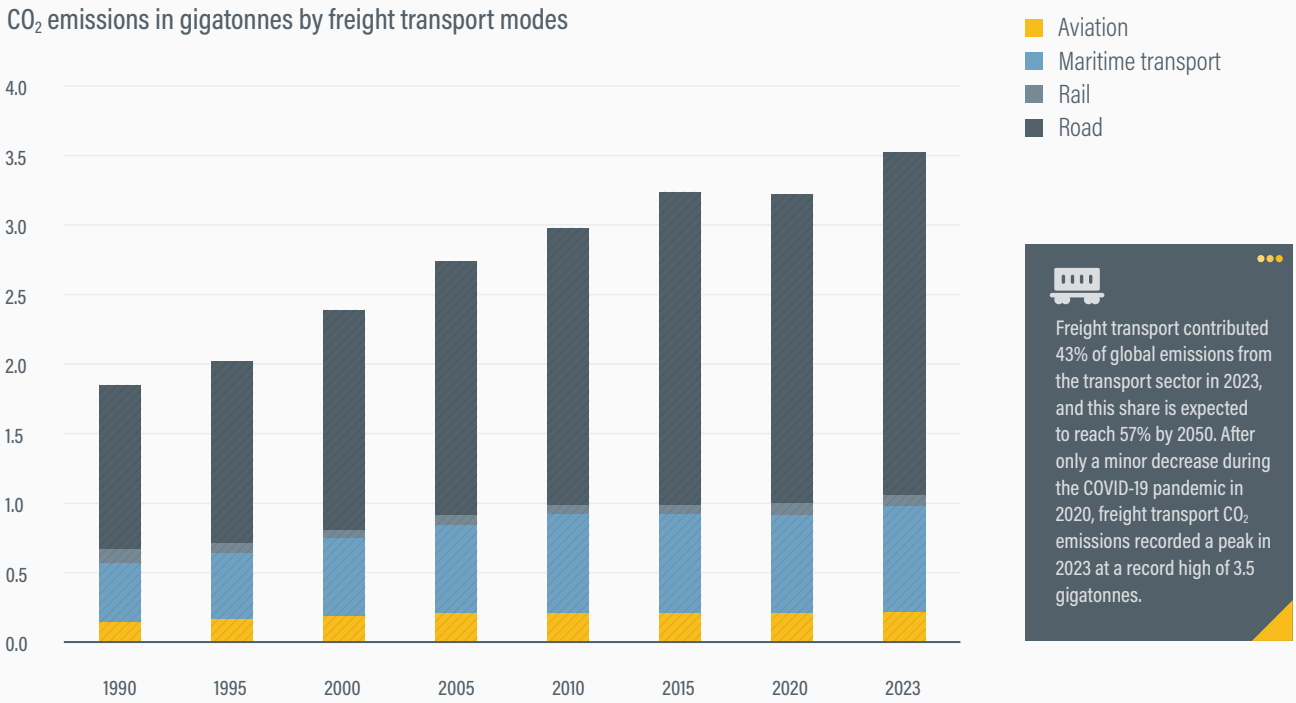


The safety of freight transport remains a serious concern, as road crashes involving heavy-goods vehicles are associated with a higher risk of fatality. In the EU, the fatality rate for crashes with heavy-goods vehicles is 2-5 times as high as with light vehicles, and such incidents resulted in around 14% of road fatalities in 2019.[33]

Globally, freight transport was responsible for around 10% of energy-related CO_2 emissions and 43% of CO_2 emissions from the transport sector (including international aviation and shipping) in 2023.[34] After falling slightly during the COVID-19 pandemic (in 2020), CO_2 emissions from freight transport rose to a record high of 3.5 gigatonnes in 2023 (Figure 3)**.[35] Roughly 85% of these emissions were from freight**

i A dynamic acceleration (bullwhip) effect occurs when small changes in consumer demand are amplified at later stages of the supply chain. By the time manufacturers react to these shifts, the demand they face often bears little resemblance to the original customer demand. Source: A. Preston (2022), Bullwhip Effect in Supply Chain, Skill Dynamics, https://skilldynamics.com/blog/understanding-the-bullwhip-effect-in-supply-chains/.

FIGURE 3. Global CO_2 emissions by mode of transport, 1990-2023



Source: See endnote 35 for this section.

transport itself, and the rest were from the storage and handling of goods.[36]

By mode, the largest contributor to freight transport emissions was road freight, responsible for 70% of freight transport-related CO_2 emissions in 2023.[37] **Despite the high volume of global trade carried via water, maritime transport was responsible for 22% of emissions.**[38] **Railways contributed 2.3% of emissions, the lowest share among freight transport modes.**[39]

Aviation (domestic and international passenger and freight) contributed nearly 950 million tonnes of CO_2 emissions in 2023; of this, close to 155 million tonnes was directly linked to air freight transport (including both belly freight and air freighter transport), representing around 6% of all freight transport-related CO_2 emissions.[40] **Air cargo demand grew 11.3% in 2024, and further growth of 5.8% was expected in 2025.**[41] This rising demand is attributed mainly to the surge in international e-commerce: Amazon, for example, aims to double its freight transport air fleet in the coming years.[42] In addition, two-thirds of aviation's climate impact is not related to CO_2 but stems from factors such as water vapour and contrails.[43] (See 4.9 Aviation.)

Urban freight transport was responsible for an estimated 5% of global greenhouse gas emissions and for 28% (1.1 gigatonnes) of freight transport emissions in 2023.[44] **A 2022 study found that urban freight transport represents around 15-25% of all vehicle-kilometres travelled, occupies 20-40% of the motorised road-space, and contributes 20-40% of greenhouse gas emissions and 30-50% of air pollutants.**[45]

Modes of transport that (until recently) have relied mostly on self-regulation for emission reduction – such as maritime and air transport – have relatively high emissions and often still use less environmentally friendly propulsion technologies. Compared to a truck, a container ship can carry up to 25,000 times more containers, but it also can emit 1 million times more harmful substances (by volume).[46]

In addition to CO_2, harmful substances emitted by combustion engines include nitrogen oxides (NO_x); greenhouse gas agents such as methane (CH_4) and non-methane compounds like nitrous oxide (N_2O), sulphur dioxide (SO_2); and particulate matter (PM_{10} and $PM_{2.5}$). With the electrification of propulsion, non-exhaust emissions will become more relevant, especially small particulate matter originating from tyre and brake wear, as well as road abrasion. Black carbon, or soot, emitted during the incomplete combustion of fuel has negative health impacts in addition to being a potent greenhouse gas agent.[47]

As a result of freight growth, both greenhouse gas emissions and local emissions are predicted to increase in the future. Moreover, as emissions from passenger transport decline, freight transport's share of overall emissions is expected to rise, from 43% in 2023 to 57% in 2050.[48] Although various scenarios predict the effects of a radical decarbonisation of transport, only a few of these analyses are at a global level, and contexts vary widely.

According to one scenario, substantially reducing freight emissions by more than two-thirds is only possible by reducing overall demand, together with shifts in transport modes and the electrification of transport.[49] Another key lever is reducing the carbon content of the energy used in freight transport.[50] Such analyses have enabled insights into the combined framing and global potential of measures implemented at scale, albeit with strong assumptions about their political, technological, behavioural and economic feasibility. Also, these scenarios are formulated at a high level, leaving room for many operational variants that can only be assessed jointly by stakeholders in a policy-making process. Further scrutiny and collaborative development of such roadmaps is needed.

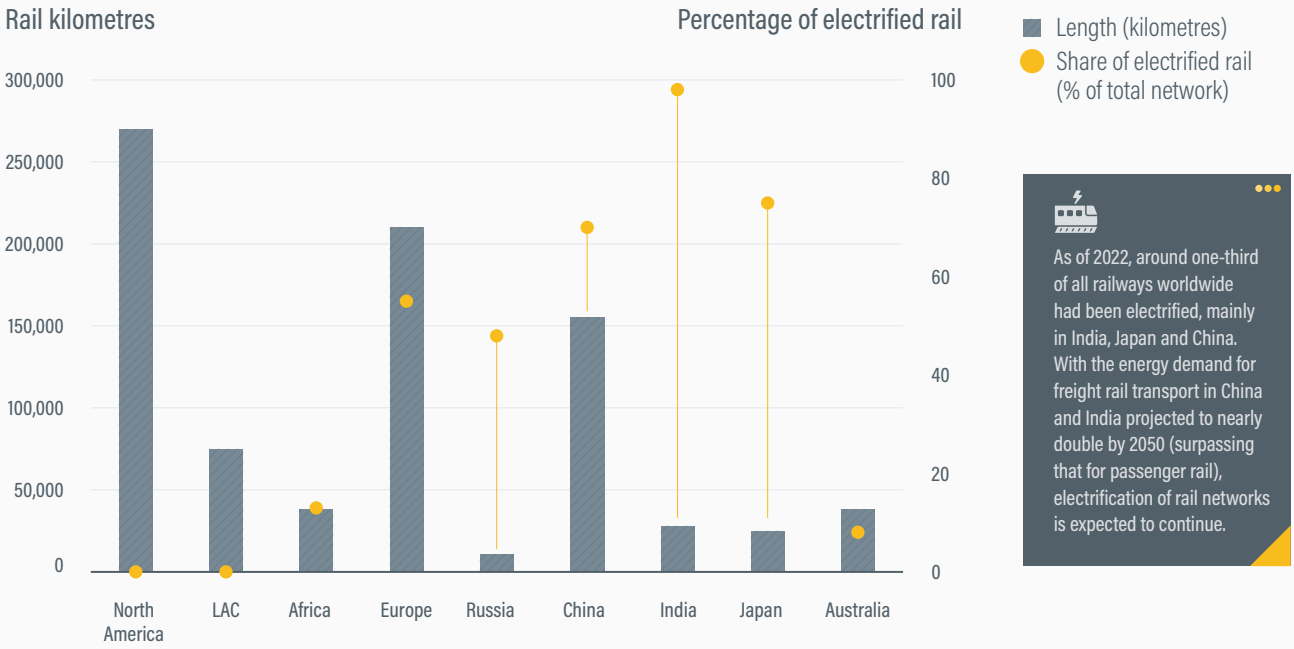
Battery electric trucks that run on low-carbon electricity are considered the main technology for decarbonising road freight transport.[51] **As electrification accelerates, battery electric trucks are expected to reach cost parity with conventional trucks in the coming years.**[52] **In contrast, cost parity between hydrogen-fuelled electric vehicles and conventional trucks is not expected anytime soon,** as the costs of hydrogen production and distribution are prohibitive for business.[53]

Global sales of medium- and heavy-duty electric trucks remained low in 2024, with shares of around 4.4% in China, 2.3% in Europe and 1.7% globally.[54] **Meanwhile, governments and industry are targeting sales shares of 50-60% by 2030 and have supported the electric truck transition through investments in charging infrastructure.**[55] Achieving this goal will require a significant transition of the road freight sector in the coming five years. Truck manufacturers expect electric drivetrains to be the main technology in Europe in the foreseeable future, accounting for more than 60% of sales by 2030.[56]

Industrial collaborations are taking advantage of key business opportunities to drive the shift to electric



FIGURE 4. Rail length and share of electrification in selected countries, 2022



Source: See endnote 72 for this section.

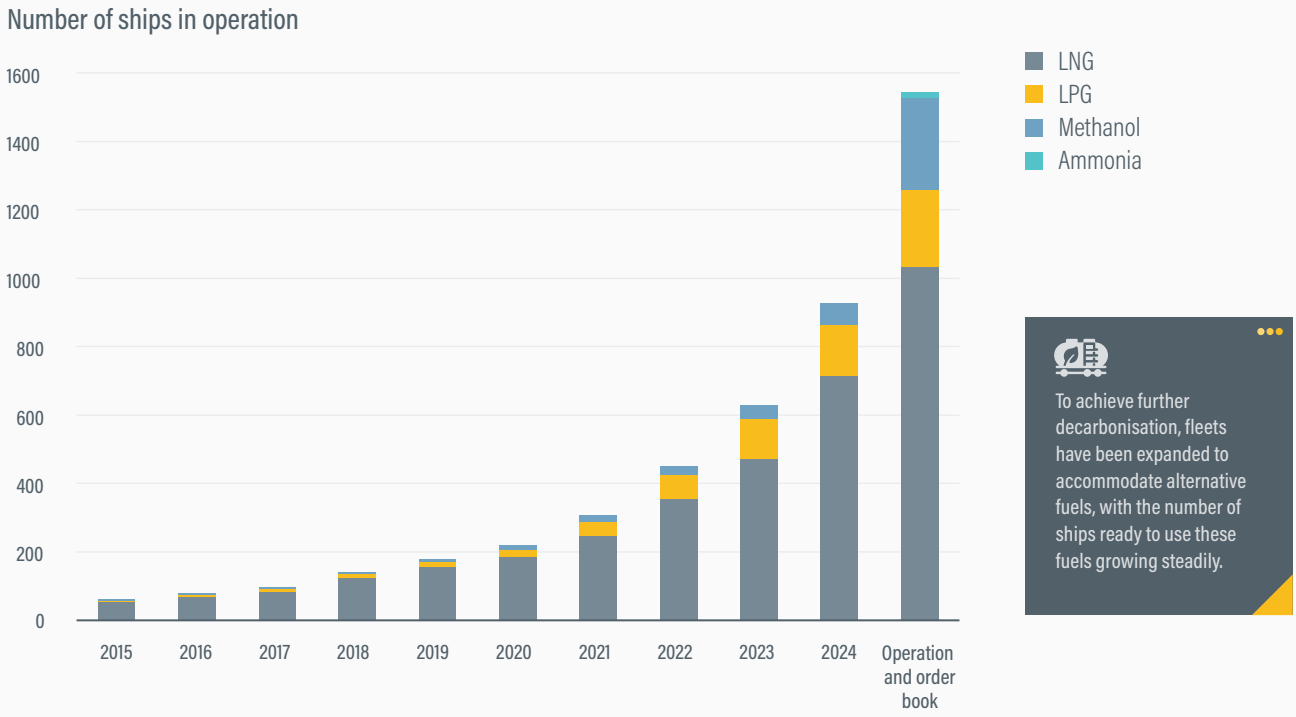
trucks, enabling new actors to enter the scene.[57] **Electric mobility also opens possibilities for new business models for freight services (such as offering fleet charging services, or flexibility services to the electricity market), while digitalisation will be key to optimising routing and charging.** Manufacturers now offer trucks with ranges of up to 600 kilometres, and Europe relies on Megawatt Charging Standards (MCS) for power above 600 kilowatts.[58] Continued development of batteries will reduce their costs and weight.[59]

- The Swedish forestry industry aims to be fossil-free by 2040 through renewable energy, electric vehicles and greater use of rail.[60]
- As of October 2024, Amazon had 10,000 electric vehicles in its delivery fleet in India.[61]
- In California (United States), as of 2025, around 500 zero-emission (electric) trucks were in service or being delivered to major ports for drayage operations (moving of shipping containers).[62]
- Europe's Alternative Fuel Infrastructure Facility incentivises the expansion of charging stations along the main freight corridors in the TEN-T road network.[63]
- The United Kingdom has adopted a scheme to boost charging infrastructure along motorways.[64]
- In South Africa, ultra-fast charging stations have been installed that are off-grid and zero-emission.[65]
- As of 2024, Germany had implemented 7 out of the 15 projects in Europe aimed at developing electric road systems for the dynamic charging of trucks.[66]
- In China, half of the electric medium- and heavy-duty trucks in operation as of 2023 relied on battery swapping.[67]

The aviation industry has made some progress in using sustainable aviation fuel (SAF), the central pillar of its near- to medium-term decarbonisation strategy; however, SAF still accounted for less than 1% of aviation's total fuel consumption in 2024.[68] Since 2016, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) – developed by the International Civil Aviation Organization (ICAO) – has called on participating airlines to offset at least 85% of their CO_2 emission growth above 2019 levels, including by using "eligible fuels" such as SAF.[69] However, SAF faces challenges related to high costs, feedstock availability, lack of investment and slow technology uptake.[70] (See 4.9 Aviation and 5.1 Transport Energy Sources.)

In the rail freight sector, electrification and efficiency improvements led to a halving of emissions (both greenhouse gas and local emissions) between 2005 and 2022, even with increases in performance.[71] **As of 2022, around one-third of all railways worldwide had been electrified, mainly in India, Japan and China** (Figure 4)**.**[72] **With the energy demand for freight rail transport in China and India projected to nearly double by 2050 (surpassing**

FIGURE 5. Number of ships capable of using alternative fuels (excluding liquefied natural gas carriers), 2015-2024



Source: See endnote 77 for this section.

that for passenger rail), electrification of rail networks is expected to continue.[73] Alternatives to the conventional catenary-based charging of freight trains include battery electric and fuel cell trains. Projects such as the Trans-Siberian rail line show that electrification can be implemented on long-distance dedicated rail corridors.[74]

For maritime transport, greenhouse gas emissions per unit of dry bulk shipping fell 4% between 2019 and 2023, whereas emissions from refrigerated transport increased.[75] **Most emission improvements in the sector are attributed to efficiency measures that have relatively low or negative abatement costs.** These include reductions in port congestion; improved vessel construction, retrofits and capacity use; slow steaming; and advancements in marine propulsion technology.[76] To achieve further decarbonisation, fleets have been expanded to accommodate alternative fuels, with the number of ships ready to use these fuels growing steadily (Figure 5).[77]

Policy and investment developments

The freight transport and logistics sector has remained overlooked in countries' Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. As of 1 August 2025, only 9 of the 29 third-generation NDCs that had been submitted to the United Nations Framework Convention on Climate Change included mitigation actions covering freight or a combination of freight and passenger transport.[78] These included the NDCs from Brazil, Canada, Maldives, Monaco, Montenegro, Niue, the Republic of Moldova, Uruguay and the United States.

- The recent NDCs of Brazil, Canada, Maldives and Montenegro focus on vehicle efficiency and the electrification of heavy-duty vehicles.[79]
- Two of the third-generation NDCs focus on maritime transport: Monaco commits to banning fuel bunkering in its waters and to supplying electricity to ships in its ports, while Niue will pursue lower-emission energy for the fishery sector and other transport.[80]
- In its third-generation NDC of 2025, the United States aims to establish zero-emission freight hubs and corridors and to expand inter-modal freight operations through improved collaboration with stakeholders.[81]

- Uruguay's NDC includes pursuing intra-modality for freight and passenger transport.[82]

To reach climate targets, industry will need strong support at the national level, and many international organisations have provided comprehensive roadmaps for decarbonising freight transport (e.g., the European Technology Platform Alliance for Logistics Innovation through Collaboration in Europe, ALICE).[83] In practice, however, the scope of policies tends to be narrower, with only limited attention to demand reduction but broad support for modal shift (despite limited success).[84] Active, successful policies have focused on efficiency improvements and electrification.

Due to the high volume of sea transport, efforts to achieve the International Maritime Organization's (IMO) target for net zero greenhouse gas emissions by 2050 are imperative.[85] A key IMO objective for 2025 is "to support safe, secure, efficient and sustainable shipping through robust international regulations, supported by technical assistance to Member States".[86] The IMO ambitions are supported by initiatives, such as the Global Maritime Forum, the Getting-to-Zero Coalition and the Poseidon Principles for Finance and Insurance.[87] (See 4.10 Shipping.)

Because nearly half of air freight capacity is belly freight, emission targets for air freight are directly linked to the overall emission targets for aviation, which are supported by both industry and governments.[88] The 41st ICAO Assembly adopted the Long Term Global Aspirational Goal in 2022 and member states aim for net zero carbon emissions from international aviation by 2050.[89] In 2021, representatives of the world's major aviation industry associations and largest aircraft and engine makers also signed the "Commitment to Fly Net Zero 2050" declaration.[90] This builds on the Four Pillar Strategy of the IATA, which includes 1) development of new, more efficient aircraft and engines; 2) operational measures, including weight savings; 3) infrastructure measures, such as navigational improvements, and 4) market-based measures. (See 4.9 Aviation.)

Targets for reducing pollutants from road transport have generally been harmonised across continents, despite some variations in scope and coverage. As of 2025, emission standards for internal combustion engine vehicles were at comparable levels across China (Euro 6), Europe (Euro 6), India (Bharat VI), Japan (2016 Standards) and the Republic of Korea (Euro 4).[91] Europe, the United States and China planned to further reduce nitrogen oxide (NO_x) and PM emissions in their regulations around 2027-2028.[92] CO_2 emission standards are generally less stringent in the United States, Japan (fleet-level restrictions), India (vehicle-level fuel consumption restrictions) and China (vehicle-level fuel consumption restrictions).[93] (See 4.8 Road Transport.)

- EU standards aim to progressively reduce emissions from heavy-duty fleet vehicles 90% by 2040, compared to 2025 levels.[94]
- In the United States, CO_2 emission reductions from new road vehicles were targeted to reach 40-60% below 2027 levels by 2032.[95] However, in March 2025 the Trump administration revoked these targets for vehicle emission reduction.[96]
- Through its Advanced Clean Fleets regulation, California (United States) targets that state and local agencies acquire only zero-emission trucks from 2035 onwards (depending on vehicle size up to 2042).[97]

Governments have shown widespread support for the electrification of road freight. While several countries have official targets for reducing greenhouse gas emissions from transport, others present visions and ambitions. A growing number of countries (including Ghana, the Netherlands and Tonga) have signed a global memorandum of understanding for zero-emission medium- and heavy-duty vehicles, aiming for 100% zero-emission vehicle (ZEV) sales by 2040 and net zero emissions by 2050.[98] The idea is to support and accelerate the transition to ZEVs through collaboration among governments. In several cases, actions towards the adoption of electric vehicles go beyond emission reduction to also target factors such as wellbeing, health and job creation. (See 5.2 Road Vehicle Electrification.)

- Australia has a national vision to increase the uptake of electric vehicles to reduce emissions and improve wellbeing.[99]
- Chile, Pakistan and several US states have official governmental targets for the adoption of electric trucks.[100]
- In the EU, truck manufacturers are mandated to cut the average emissions of new trucks 45% by 2030, 65% by 2035 and 90% by 2040.[101]
- India's government set a target for 30% of all vehicles sold in 2030 to be electric.[102]
- Norway uses public procurement regulations to foster the adoption of zero-emission vans.[103]
- Uganda's e-mobility strategy aims to increase electric vehicle adoption to reduce emissions and create green jobs.[104]

In some regions, green corridors are being implemented to induce a transition to sustainable, low-carbon long-haul freight transport (Box 2).[105] Green corridors support the development of infrastructure and financial models, and have been deployed across many forms of transport, including maritime shipping and road freight transport.

Box 2. Green corridors to speed the transition to sustainable long-haul freight transport

Shifting long-haul freight transport to sustainable solutions requires support and commitment from many countries, including for developing the necessary infrastructure. Collaborative efforts exist for different modes of transport to align regulation and investments along critical international trade and development corridors.

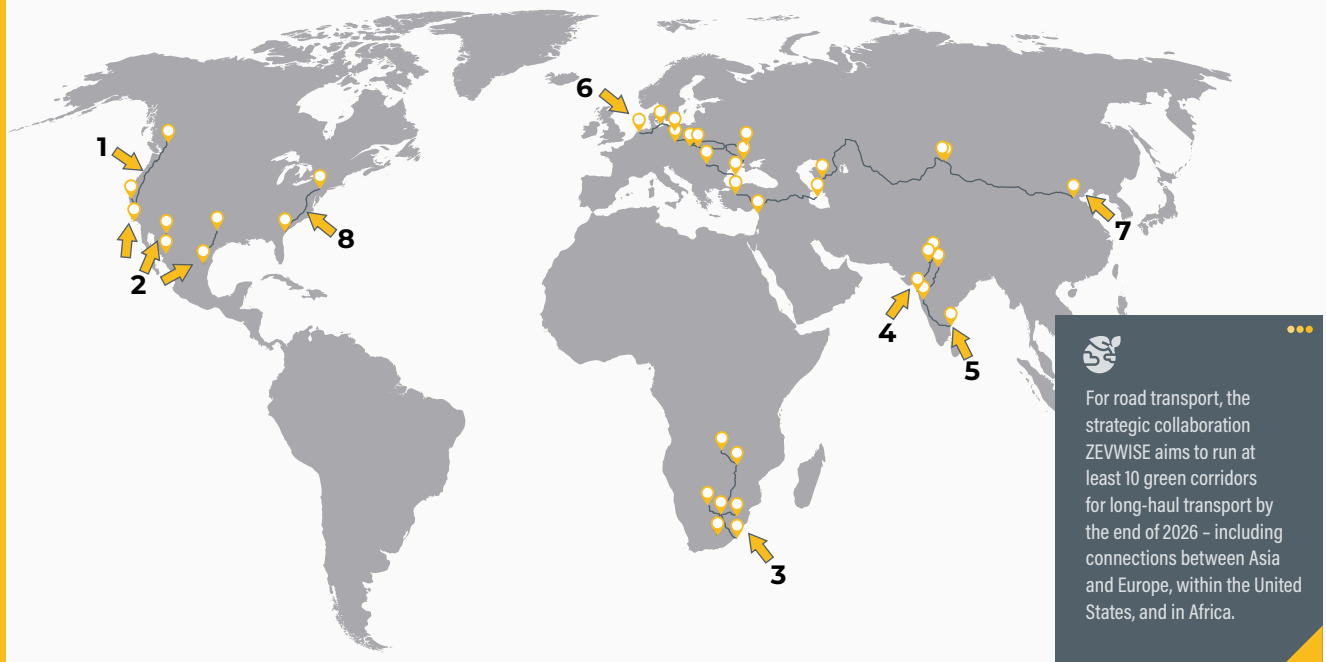
Green corridors are an approach to develop and pilot successful infrastructure and financial models, and have been deployed across many forms of transport. Pilot initiatives not only contribute to low-carbon transitions in the targeted areas, but also create blueprints and reference models for further roll-outs in other locations. By narrowing in on clearly defined corridors, public infrastructure investments can be focused, and private sector stakeholder groups can be approached, integrated and supported in targeted manner.

The International Maritime Organization (IMO) and the International Air Transport Association (IATA) have promoted green shipping corridors and the shift to low-emission solutions on a global scale for international sea and air transport, respectively. (See 4.9 Aviation and 4.10 Shipping.)

For road transport, the strategic collaboration ZEVWISE aims to run at least 10 green corridors for long-haul transport by the end of 2026 – including connections between Asia and Europe, within the United States, and in Africa (Figure 6). Co-ordinating partners include CALSTART / Drive to Zero, the Electric Vehicles Initiative, the International Council on Clean Transportation, the International Transport Forum, the Smart Freight Centre, the United Nations Environment Programme, the World Bank, and the World Business Council for Sustainable Development, as well as the Netherlands, the UK Department for Energy Securing & Net Zero and the US Department of Energy.

In China, the Shenzhen-Dongguan-Huizhou green corridor, initiated by Smart Way China in co-operation with the Smart Freight Centre, provides an example of how such pilots can be deployed successfully. The project focuses on the viability of using electric trucks (and related charging networks and battery swapping services) along this critical trading route, with the aim of addressing the operational, financial and environmental challenges of transitioning to zero-emission freight solutions.

FIGURE 6. ZEVWISE green corridors as of 2024



Source: See endnote 105 for this section

In the context of road safety, several governments and other stakeholders have adopted Vision Zero strategies to end road traffic-related fatalities.[106] **For commercial drivers, interventions include safety technology standards for vehicles, infrastructure and driver behaviour/training.**[107] As of mid-2025, 139 companies had joined the Vision Zero network maintained by the International Social Security Association.[108]

In the EU, reporting and improvement of transport emissions will become mandatory for bigger companies from 2026 and 2028 onwards, with the introduction of the EU Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive (CSDDD).[109] **Pressure for small and medium-sized enterprises to follow suit will increase in Europe.** Elsewhere in the world, measuring and reporting transport emissions has been voluntary, with a few exceptions such as France, which introduced a law making it compulsory in 2010.[110]

Industry-driven initiatives at different levels have shown that companies and organisations already gain advantages from emissions accounting and reporting. The process of evaluation can help companies identify inefficiencies, realise energy savings, and strengthen brand images and customer commitment. Increasingly, more investors have judged sustainability commitments and efforts positively, recognising that the impacts of climate change can affect the stability of companies and economies in the form of credit risks, market risks, liquidity risks, operational risks and reputational risks.[111]

- The Global Logistics Emissions Council (GLEC), a voluntary partnership of companies, industry associations, and green freight programmes, has developed the GLEC Framework to help providers and users calculate and report their operating emissions from freight transport.[112]
- At the company level, Schneider Electric (2024), DHL (2025) and Procter & Gamble (2025) regularly measure and communicate their transport emissions and set reduction targets in their annual reporting.[113]

A proposed EU regulation related to freight and passenger transport emissions, CountEmissionsEU, outlines a methodology for calculating and reporting greenhouse gas emissions from transport services.[114] The regulation is aligned with ISO 14083:2023 "Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from transport chain operations", which itself builds on and is aligned with the GLEC Framework.[115] This alignment is the result of a co-operation among industry, government bodies, and non-governmental organisations to ensure continued progress in emission accounting and reporting. Such alignment, globally and across transport modes, is key, as transport chains tend to be international and multi-modal, and the industry can benefit from a single approach applicable over all transport networks.[116]

Such efforts are further strengthened by mode-specific efforts to measure and control emissions.

- For the shipping industry, the IMO introduced regulations in 2013 that require new vessels to contribute to the industry's sustainability improvement (Energy Efficiency Design Index, or EEDI); these regulations were strengthened in 2023 by an EEXI (Energy Efficiency Existing Ship Index) that requires the operational efficiency of existing vessels to be made transparent and improved (Carbon Intensity Indicator CII).[117]
- A planned amendment to the International Convention for the Prevention of Pollution from Ships (MARPOL) will require ships to comply with emission controls in new areas including the Mediterranean Sea (SO_x), Canadian Arctic (NO_x and SO_x) and Norwegian Sea (NO_x and SO_x).[118] Existing areas with NO_x and SO_x emission controls are the US Caribbean Sea, the Baltic Sea and the North Sea.[119]
- The IMO's GreenVoyage2050 provides financial support to developing countries, with the aim of achieving the IMO GHG Strategy's target of net zero emissions by 2050 at the latest.[120]

Three key concepts for measuring and reporting the emissions of organisations are the product carbon footprint (PCF), the corporate carbon footprint (CCF) and logistics network emissions.[121] The two leading global standards for calculating the greenhouse gas emissions of value chains and organisations are the Greenhouse Gas Protocol and the ISO 14000 series. Both are voluntary and rely on references and applying organisations such as CDP and the Science Based Targets initiative (SBTi).[122] With the GLEC Framework and ISO 14083:2023, standardisation covering all modes of transport is provided.[123] These two are aligned, and further alignment could be achieved with the current review of SBTi and GHG protocol Scope 3 standards.

The key challenges faced by all three concepts – PCF, CCF and logistics networks – are similar: emissions accounting and reporting need to be based on the primary data of the organisation.[124] However, the complexity of supply chains, which often include numerous sub-contractors operating in different countries and jurisdictions, can make access to primary data difficult. Secondary data, modelled data or default data can help estimate emissions from supply chains.[125] Standardisation for the development and update of a database for secondary data is key to achieving meaningful calculations and reporting.

In addition to introducing and tightening legislation on vehicle emission standards, a growing number of



governments have implemented biofuel regulations – including California's Low Carbon Fuel Standard, the EU's Renewable Energy Directive (RED III) and Canada's Clean Fuel Regulations.[126] These regulations dictate how sustainability is defined, verified, and monitored, and set targets for fuel suppliers to increase the supply share or blending of biofuel with existing fuels. The regulations aim to decrease the well-to-wheel carbon intensity of transport (at least 65% under the RED III), while ensuring that the full life cycle of the fuels is globally sustainable. They also help reduce reliance on biofuels that are produced from crops with a high risk of indirect land use, such as palm oil. (See 5.2 Transport Energy Sources.)

At the EU level, in 2024 the region's Emissions Trading Scheme began covering all vessels entering EU ports.[127] **FuelEU Maritime, a legislative package for the use of clean energy in the maritime sector within the EU's "Fit for 55" programme, was expected to take effect in 2025.**[128] **Globally, to further expand the use of sustainable fuels, the maritime industry has highlighted the need for contributions at the regional and national levels.** As in the aviation sector, the use of book and claim systems is considered an important tool for the transition to sustainable maritime fuels.[129] The development of green corridors also facilitates the use of alternative or sustainable fuels, including e- or bio-methanol, electricity, green ammonia, green hydrogen and advanced biofuels.[130]

The main policies that countries have adopted for rail electrification are reducing the use of diesel trains, creating dedicated rail freight infrastructure and providing subsidies for operators. Recent major investments have focused on dedicated rail corridors over very long distances in Asia (within India, and China's Belt and Road Initiative).[131] **Although many countries offer operational subsidies, experience in Europe suggests that these are not always effective.**[132] Electrification appears to be the most effective approach to reduce emissions for existing users. Satisfying the growing demand for rail requires an improvement of service levels, cost reductions and significant infrastructure extension. Challenges are manifold, given the poor inter-connectivity and inter-operability of networks across countries.

To meet the challenges of rising urban populations, different urban last-mile concepts have been explored and developed, including consolidation hubs, off-peak deliveries and delivery robots. These solutions are technically and socially intertwined, and each city offers its unique context.[133] Important tensions include the trade-off between using many smaller vehicles (robots, delivery bikes and motorcycles) versus fewer and more efficient larger vehicles, together with consolidation schemes and off-peak deliveries.

- Cities in China, France, the Netherlands, Sweden and the United Kingdom are implementing zero-emission zones, with a strict ban on all petrol and diesel vehicles.[134]
- Through government-supported recognition schemes, many companies commit to emission reductions and social sustainability towards their customers and employees.[135]
- Although many studies and projects showcase technological solutions (such as consolidation hubs, e-bikes and delivery robots), there is less focus on social implications, wellbeing and workforce conditions.[136]

Partnerships in action

In 2023, **C40 Cities** launched the **Laneshift** initiative to decarbonise freight transport in low- and middle-income countries, in partnership with The Climate Pledge (co-founded by Amazon and Global Optimism).[137] Electric trucks will be deployed in cities in India as well as in Latin America and the Caribbean (Brazil, Colombia, Ecuador and Mexico).[138]

The **EcoLogistics** project of **ICLEI–Local Governments for Sustainability** released a guide in 2023 on how to implement zero-freight-emission zones in cities, through a collaborative effort involving C40, the California Air Resources Board, CALSTART, Concito, Freight Matters, ICLEI, POLIS, the Transport Decarbonisation Alliance, the Transport Research Lab and the World Resources Institute.[139]

The Swedish forestry sector's **TREE** (**"transition to efficient electrified forestry transport"**) partnership is aligned around a target to have 50% of new heavy-duty long-haul trucks be electric by 2030.[140] The 23-member partnership integrates partners both horizontally and vertically in the value chain, and includes transport buyers, logistic companies, and technology and service suppliers. The partnership helps to implement heavy electric trucks (gross vehicle weight of 70 tonnes and above) in commercial operation, including solving challenges related to charging infrastructure and transport planning. It also demonstrates novel technological solutions, such as a battery electric 94-tonne truck and electric trailers.[141]

The **Ship Recycling Transparency Initiative** (**SRTI**), hosted by the Smart Freight Centre, is launching a collaborative initiative to accelerate steel decarbonisation in India by unlocking the potential of sustainable ship recycling as a reliable source of high-quality scrap.[142] Recognising the maritime industry's critical role in the circular economy, the project connects shipowners, recyclers and steelmakers to establish traceable, certified scrap supply chains that feed into India's low-carbon steel production. With more than 15,000 vessels expected to reach end-of-life in the next decade, this effort addresses an environmental imperative and an industrial opportunity, linking the decarbonisation goals of the steel sector with the growing need for responsible ship dismantling.[143] The initiative emphasises regulatory alignment, material certification, and innovative contracting mechanisms, while drawing on global best practices and active stakeholder engagement, particularly from the Global South. It seeks to deliver measurable emission reductions and systemic change across both the maritime and steel industries.

The **Zero Emission Maritime Buyers Alliance** (**ZEMBA**) is committed to accelerating sustainable, scalable and economically viable solutions for the maritime sector.[144] In 2024, Amazon and IKEA led a new ZEMBA initiative to demand green fuels to support shipping decarbonisation.[145] In 2025, a tender by ZEMBA kicked off the first-ever commercial deployment of e-fuels in the maritime sector, with the aim of aggregating 86 billion tonne-nautical miles of demand for shipping powered by e-fuels from 2027 onwards (equal to transporting around 1.5 million twenty-foot equivalent units (TEU) from Shanghai to Los Angeles).[146]

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Integrated Transport Planning

This section covers developments in integrated transport planning mainly for passenger and urban transport, with some content related to freight transport. For more on freight transport, see 4.1 Freight Transport and Logistics.



KEY FINDINGS

- Integrated transport planning supports the integration of transport, land use, and governance, with the aim of efficiently and resiliently combining low-emission transport services that are affordable, safe, accessible and sustainable for all users. It has received greater attention in recent years, particularly in rapidly urbanising low- and middle-income countries.
- As urban areas continue to expand, more than two-thirds (68%) of the global population is projected to live in cities by 2050, up from 55% in 2018. Most of this growth is anticipated in Africa and Asia. Urban transport activity is estimated to grow from 24 trillion passenger-kilometres in 2023 to 39.1 trillion passenger-kilometres in 2050.
- Urban growth is putting additional pressure on freight transport and logistics in cities. Urban freight activity accounted for an estimated 5% of global freight activity in 2023 and is projected to grow from 9.8 trillion tonne-kilometres in 2023 to 22.7 trillion tonne-kilometres by 2050.
- Meanwhile, some high-income countries have experienced a trend of urban-to-rural movement – or counter-urbanisation – typically in the periphery of large urban areas.
- Despite rising interest in integrated transport planning in the wake of the COVID-19 pandemic, more recent political shifts have resulted in reversals and slowdowns in related policies since 2023.



Demand, use and access

- Most conventional data on transport performance reflect an automobile-centric paradigm, evaluating systems based on traffic speeds, congestion and crash rates. However, some indicator sets have evolved to prioritise additional economic, social and environmental factors – in line with more sustainable and integrated transport planning.
- Transport modal shares in cities vary by world region and depend on factors such as city size (including urban density), income level and access to transport options. A 2024 analysis of nearly 800 cities across 61 countries found that, on average, 51% of journeys are by car, compared with 26% by public transport and 22% by active transport (walking and cycling), with trends varying by region.
- However, global data on urban modal shares has tended to oversimplify trends: clustering walking and cycling under "active transport"; neglecting freight transport; and overlooking important regional variables, such as informal transport in Africa and the wide use of two- and three-wheelers for moving goods and people in many low- and middle-income countries.
- Walking and cycling remain far more common than most transport statistics indicate. In a 2022 survey of more than 45,000 people across 48 countries, large majorities of respondents identified as pedestrians, including 94.9% in Europe, 93.8% in Asia and Oceania, 94.4% in Africa, and 86% in the United States, Canada and Colombia.
- The global bicycle fleet totalled an estimated 1 billion in 2022, and around 42% of households worldwide owned at least one bicycle, according to a 2015 study. Since 2023, most of the growth in the cycling sector has been in electric bicycles (e-bikes), with rising sales in the Global North.
- Ride hailing activity, another urban transport service that is often overlooked in data collection, grew an estimated 94% between 2018 and 2022, but still accounted for only 0.5% of private motorised passenger travel.
- Although working remotely increased during the COVID-19 pandemic, its decline since 2023 – especially in large urban areas – contributed to record-high traffic congestion levels in 2024. In 2024, 55% of urban areas experienced more congestion than in 2023, while only 28% of cities witnessed a reduction in delays.
- The largest increase in public transport ridership in 2024 was in the Middle East and North Africa, followed by the Asia-Pacific region, whereas rates in North America and Latin America remained low compared to 2019. The pandemic had a lasting impact in most public transport markets, with more than half of operators in 2024 still reporting ridership below 2019 levels.

KEY FINDINGS

- Some locations have focused on improving the reliability of (formal) public transport services to increase ridership, as this can play a role in commute time and is important to keep travel flowing smoothly in an integrated transport system.
- Digitalisation can contribute to more efficient and integrated transport systems; however, as of 2024 an estimated 86% of cities globally lacked published data on their public transport systems.
- Use of digital platforms has helped to consolidate freight flows, increasing the efficiency of movements through economies of scale, and keeping costs low.
- Accessibility measures in public transport have remained incomplete and fragmented. Inclusive access (also known as universal design) – accommodating diverse users such as the elderly and people with disabilities or difficulties and other special needs – remains far from the norm.
- Affordability of transport remains a concern in many places, as transport costs often comprise a large share of household budgets and place a particular burden on low-income users. Household spending for transport varies greatly by country and region.



Sustainability and climate trends

- In 2023, transport was the second largest greenhouse gas-emitting sector globally – contributing 15.9% of global emissions – with three-quarters of the sector's emissions coming from road transport. Transport emissions tend to be higher in less-dense urban areas that lack effective public transport networks.
- Transport emissions vary greatly by region, with Asia continuing to contribute the largest share (40%) in 2023, followed by North America (26%) and Europe (17%) (excluding international aviation and shipping). North America leads by far in per capita transport emissions, followed by Oceania and Europe.
- Freight transport contributed 43% of global transport CO_2 emissions in 2023. Transforming the freight and logistics sector to ensure integrated, co-ordinated and efficient goods transport is key to reducing emissions, enabling economic development and local production, supporting circularity, and increasing resilience to shocks while reducing energy consumption.
- Mass public transport, rail, walking and cycling have much lower carbon intensities over their lifetimes – and per kilometre of people transported and goods moved – than cars or trucks, despite recent gains in vehicle fuel efficiency and electrification.
- Compact land-use planning and transit-oriented development can greatly reduce emissions by shortening travel distances and reducing the need for car ownership and use, in addition to providing health benefits and improving social inclusion.
- Adaptation to the impacts of climate change has become increasingly important to transport and land planners at the national, sub-national and local levels. However, it is unclear whether integrated transport planning approaches for passenger and freight transport are sufficiently addressing adaptation and resilience.

KEY FINDINGS

Policy and investment developments

- The Avoid-Shift-Improve (A-S-I) framework is key for translating integrated transport planning into a comprehensive implementation tool. A-S-I is aligned with integrated transport planning principles and amplifies the implementation of sustainable transport from multiple angles. Although policies tend to focus on "Improve" measures, "Avoid" and "Shift" measures can reduce an estimated 40-60% of transport emissions at a lower cost.
- During 2023-2025, political shifts and global geopolitical challenges led some countries to reverse policies supporting sustainable and integrated transport systems. Public and political opposition to such policies is related to perceptions around their impacts on driving behaviour and the built environment, threats to long-held habits and excessive burdens on certain populations.
- Among the numerous governance and planning strategies for integrated transport planning, a strong focus has been on National Urban Policy and Investment Programmes (NUMPs) and Sustainable Urban Mobility Plans (SUMPs).
- The development and implementation of SUMPs has expanded in most regions, although a lack of continuous global tracking impedes measurement. During 2023-2024, regional and national regulations enforced the use of SUMPs in more municipalities, enabling integrated planning of urban transport and land use.
- As of 2025, 32 SUMPs and 9 NUMPs had been developed in consultation with MobiliseYourCity across Africa, Asia, Eastern Europe, and Latin America and the Caribbean.
- Integrated transport planning has increasingly been adapted to low- and middle-income countries, in recognition of their specific institutional, social, and infrastructural conditions and of the complex urban dynamics shaped by rapid population growth, informal development patterns and limited institutional capacities.
- As of 1 August 2025, a total of 7 of the 29 third-generation Nationally Determined Contributions (NDCs) that had been submitted to the United Nations (UN) featured activities on transport demand management and enhanced integrated planning; the 7 submissions were from Brazil, Canada, Ecuador, Kenya, Moldova, United Kingdom and Uruguay.
- Several recent initiatives have adopted a corridor-based approach to infrastructure development, recognising the strategic importance of strengthening regional connectivity beyond just linking cities.
- Governments have increasingly recognised the importance of developing rural transport programmes, stimulated by their potential to boost economic growth and opportunities and improve quality of life.



KEY FINDINGS

- As part of public transport recovery measures since 2022, many cities in Asia, Europe and North America have explored free or reduced fare programmes to make services more accessible to everyone, particularly the vulnerable. However, the financial sustainability of public transport systems depends on a balance between operational costs and revenue generation.
- A handful of transport plans – such as in Scotland and some US states – have emphasised strategies to reduce vehicle travel as part of more people-centred, integrated approaches to satisfy mobility needs and improve quality of life.
- Since 2022, some European cities have revised their parking policies to adjust for the increased use of larger vehicles (mainly sport utility vehicles, or SUVs), which have been shown to take up more public space, produce more emissions and be more lethal in crashes.
- Increasing bicycle parking near public transport hubs and train stations can facilitate integrated travel. In 2019, Utrecht (Netherlands) expanded bicycle parking at its central train station by 12,500 parking spaces, for a total of 22,000 spaces, making it the largest such hub in the world.
- Several jurisdictions have taken actions to improve the road safety of pedestrians and cyclists in connection to the Vision Zero approach. The greatest improvements in road safety have been achieved in countries where the Safe System approach has been adopted.
- Digitalisation efforts have the potential to greatly reduce transport emissions by increasing efficiency. Research in Amsterdam (Netherlands) in 2022 found that Mobility-as-a-Service (MaaS) offers potential emissions savings of 3-54%, depending on the attractiveness of these services to users.
- During 2023-2025, several implementation and planning efforts around congestion pricing were in the spotlight; such efforts can have direct positive impacts on traffic, emissions and pollution levels.
- Some cities have implemented low-emission zones (LEZs), ultra-low-emission zones (ULEZs), zero-emission zones (ZEZs) and low-traffic neighbourhoods to reduce emissions, congestion, and air and noise pollution in specific areas.
- While there is typically popular support for LEZs and similar strategies, implementation can be highly contested. To reduce resistance, some governments have introduced these policies incrementally and grown them progressively over time, either increasing the strictness or expanding the geographic coverage.



- More recently, some places, such as in France and Spain, have scaled back plans to strengthen LEZs in response to intensified political debate.
- Overall, the number of LEZs in operation in Europe is estimated to have doubled between 2019 and 2025, from 228 to more than 500.
- Despite the growth of LEZs, few cities are taking the next steps towards ZEZs. Between 2023 and 2025, only Brussels (Belgium), Oslo (Norway) and Oxford (United Kingdom) were identified as new examples of cities with plans for ZEZ implementation.
- Some cities have established specific zero-emission zones for freight transport (ZEZ-Fs) – ranging from urban delivery vans to medium- and heavy-duty trucks – to address the large contribution of freight transport to air pollution and greenhouse gas emissions.
- LEZ, ULEZ and ZEZ policies can be supported by targets for 100% electric vehicle sales and mandates for phasing out internal combustion engine vehicles. By the end of 2023, at least 74 countries and 26 states/provinces across all major continents had targets promoting electric vehicles, while 49 of these jurisdictions had a 100% electric vehicle sales target or a targeted ban on internal combustion engine vehicles.



Context, challenges and opportunities

Integrated transport planning supports the integration of transport, land use, and governance, with the aim of efficiently and resiliently combining low-emission transport services that are affordable, safe, accessible and sustainable for all users. It has received greater attention in recent years, particularly in rapidly urbanising low- and middle-income countries.[1] A wide range of tools are available to enable integrated planning in the transport sector, ranging from transit-oriented development and low-emission zones to congestion pricing (Box 1).[2]

By designing integrated, multi-modal systems for moving people and goods, governments can support inclusive communities and shared prosperity.[3] In an integrated transport system, the key is to ensure both efficiency and access to mobility, enabling greater opportunity, poverty reduction, and participation in economic and social activities.[4] A holistic form of integrated transport planning – "triple access planning" – seeks to support these goals by focusing on the transport system (physical mobility), the land-use system (spatial proximity) and the telecommunications system (digital connectivity).[5]

Box 1. Overview of planning tools and approaches for integrated transport planning

A variety of planning tools are available to decision makers to address the interconnections among transport, land use and other factors to support the creation of sustainable transport systems, including:

- **Transit-oriented development** – the creation of compact, walkable, pedestrian-oriented, mixed-use communities centred around high-quality public transport systems.
- **15-minute cities and 20-minute neighbourhoods** – prioritising compact, mixed-use development and efficient land use, allowing citizens to reach necessary services within 15 to 20 minutes of walking. In both cases – transit-oriented development and 15-minute cities – dense, transit-oriented development can greatly reduce the need for long commutes and dependency on private vehicles and bring essential services closer to where people live, to reduce travel demand and improve urban resilience.
- **Transport demand management** – efforts to increase the efficiency of transport systems by promoting low-impact travel modes and shifting demand away from peak times (and for freight, shifting from road transport to rail or water transport). Strategies to reduce car dependency include "pull" strategies (e.g., mixed-use zoning and transit-oriented

development) and "push" measures (e.g., parking management and traffic restrictions).

- **Complete streets** – an approach to planning, designing, building, operating and maintaining streets that enables safe access for all people, including pedestrians, cyclists, motorists and public transport riders of all ages and abilities.
- **Low-, ultra-low and zero-emission zones** – areas that restrict access for more-polluting vehicles.
- **Parking policy reforms** – reducing parking mandates and pricing parking more efficiently so motorists pay directly for using parking facilities, with higher prices at peak times and locations.
- **Congestion pricing** – levying fees on automobile use to reduce both emissions and fuel consumption, leading to reductions in vehicle-kilometres travelled, stop-and-go traffic, urban traffic and traffic-related noise pollution – with the aim of creating a more liveable and pedestrian-friendly environment
- **Safe System approach** – designing the road system to account for human error and vulnerabilities to avoid injury and death.
- **Vision Zero** – a concept originating in Sweden in 1994 aiming for zero road deaths through the Safe System approach, which builds into planning the view that humans make mistakes.

Source: See endnote 2 for this section.

As urban areas continue to expand, more than two-thirds (68%) of the global population is projected to live in cities by 2050, up from 55% in 2018.[6] Most of this growth is anticipated in Africa and Asia.[7] Urban transport activity is estimated to grow from 24 trillion passenger-kilometres in 2023 to 39.1 trillion passenger-kilometres in 2050.[8] Cities around the world are physically expanding faster than their population growth: between 1990 and 2014, around three-quarters of the incoming urban population was accommodated in the newly built areas of cities.[9]

Urban growth is putting additional pressure on freight transport and logistics in cities. Urban freight activity accounted for an estimated 5% of global freight activity in 2023 and is projected to grow from 9.8 trillion tonne-kilometres in 2023 to 22.7 trillion tonne-kilometres by 2050.[10]

Meanwhile, some high-income countries have experienced a trend of urban-to-rural movement – or counter-urbanisation – typically in the periphery of large urban areas.[11] Factors behind this trend include amenity migration (whereby people choose to live in places based on quality of life) as well as increases in teleworking, housing costs and retirements of "baby boomers".[12]

- In 2020 and 2021, during the COVID-19 pandemic, Europe experienced counter-urbanisation in the south and west, but rising urbanisation in the north and east.[13] People in large European cities showed greater willingness to move to rural places or secondary cities, although this was mostly short-lived.[14] Overall, the European Union (EU) is projected to see a slight increase in urbanisation and a slight decrease in movement to rural areas and intermediate regions.[15]
- Following a decade of loss, the rural population of the United States grew around 0.25% annually between 2020 and 2023, adding 220,000 people between mid-2022 and mid-2023 to reach a total of 46 million rural dwellers.[16] As of 2024, people were increasingly moving more than 32 kilometres (20 miles) from US city centres, which could result in greater driving distances and increased emissions.[17] However, populations in large US cities such as Los Angeles and New York have continued to grow.[18]

Despite rising interest in integrated transport planning in the wake of the pandemic, more recent political shifts have resulted in reversals and slowdowns in related policies since 2023. Integrated transport planning received increasing attention in 2020 and 2021 and even up to 2022, which created an opportunity to rethink passenger and freight transport in both urban and rural settings.

Conventional (mostly auto-centric) transport systems have tended to be fragmented and lacking in efficiency and reliability due to traffic congestion, greenhouse gas emissions, air pollution, noise and crashes.[19] Through integrated transport planning, governments and the private sector have sought to create more seamless transport systems, particularly in locations where walking, cycling and public transport already compete with private vehicles.[20] In the freight sector, integrated planning can result in efficiency gains, operational improvements and cost reductions: in the United States alone, empty truckloads pose a high fuel burden and result in around 87 million tonnes of CO_2 emissions every year.[21]

Demand, use and access

Most conventional data on transport performance reflect an automobile-centric paradigm, evaluating systems based on traffic speeds, congestion and crash rates. However, some indicator sets have evolved to prioritise additional economic, social and environmental factors – in line with more sustainable and integrated transport planning.[22] (For a summary of such performance indicators, see 3.1 Integrated Transport Planning in SLOCAT's Transport, Climate and Sustainability Global Status Report, 3rd edition.)

Transport modal shares in cities vary by world region and depend on factors such as city size (including urban density),



income level and access to transport options.[23] **A 2024 analysis of nearly 800 cities across 61 countries found that, on average, 51% of journeys are by car, compared with 26% by public transport and 22% by active transport (walking and cycling), with trends varying by region** (Figure 1)**.**[24]

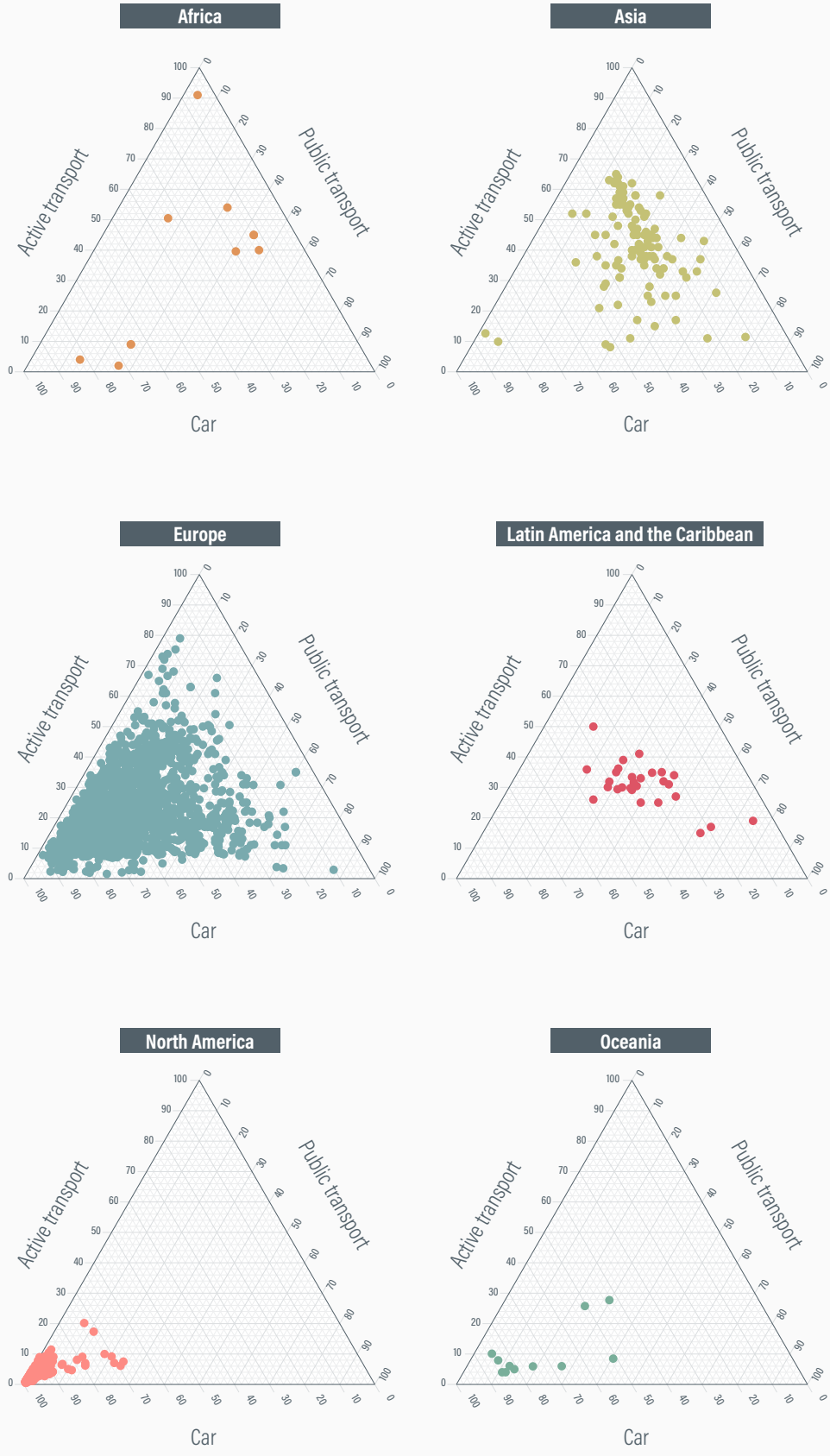
- The limited data available for Africa revealed that 5 out of 6 journeys were by public transport, walking, and cycling, whereas car use was the lowest among world regions at 22%.[25]
- Asia had the highest share of public transport use, at 43% on average, followed by walking and cycling (34%) and car use (23%); by sub-region, public transport use surpassed 46% in Eastern Asia but was only 28% in Western Asia.[26]
- In Europe, car use dominated at 45%, with near-equal shares for active mobility (28%) and public transport (27%).[27]
- In South and Central America, public transport accounted for 40-42% of trips and active mobility for 31-35%, while car use ranged from 23% in Central America to 29% in South America.[28]
- Car use dominated in North America, accounting for nearly 74% of all travel.[29]
- In Oceania (Australia and New Zealand), average modal shares were 76% by car, 18% by public transport and 6% by active mobility.[30]

However, global data on urban modal shares has tended to oversimplify trends: clustering walking and cycling under "active transport"; neglecting freight transport; and overlooking important regional variables, such as informal transport in Africa and the wide use of two- and three-wheelers for moving goods and people in many low- and middle-income countries.[31] (See 4.6 Informal Transport.)

- Data for different African cities for 2019 to 2025 showed that informal transport accounted for more than two-thirds of trips in some cities and exceeded 70% in at least five cities: Addis Ababa (Ethiopia), Gaborone (Botswana), Kinshasa (Democratic Republic of the Congo, DRC), Lagos (Nigeria) and Maseru (Lesotho).[32]
- As of 2022, informal transport systems in China were increasing rapidly in more than 300 cities, with many of these systems integrated fully with public transport to cover first-/last-mile demand, or used to replace private vehicles entirely.[33]
- In Mexico City (Mexico), where informal transport accounts for around two-thirds of all shared travel, the development of mass transit systems incentivised data collection on informal transport, revealing its critical role in providing last-mile connections where formal public transport does not reach.[34] (See 4.6 Informal Transport.)

Walking and cycling remain far more common than most transport statistics indicate. In a 2022 survey of more than 45,000 people across 48 countries, large majorities of respondents identified as pedestrians, including 94.9% in Europe, 93.8% in Asia and Oceania, 94.4% in Africa, and 86% in the United States, Canada and Colombia.[35] Most travel surveys overlook or undercount non-commute trips, longer trips, travel by children, recreational travel, and the walking and cycling links of automobile and public transport trips. For example, a commute that involves biking, public transport, and walking is generally coded as a public transport trip, and trips between parked vehicles and destinations are ignored even if they involve several blocks of walking on public streets. (See 4.3 Walking and 4.4 Cycling.)

FIGURE 1. Urban transport modal shares by region, as of 2024



Transport modal shares in cities vary by world region and depend on factors such as city size (including urban density), income level and access to transport options. A 2024 analysis of nearly 800 cities across 61 countries found that, on average, 51% of journeys are by car, compared with 26% by public transport and 22% by active transport (walking and cycling), with trends varying by region.

Source: See endnote 24 for this section.

In Africa, walking is by far the most common travel mode – either by itself or in combination with public transport – accounting for 50-90% of daily trips in many African cities as of 2021.[36] Yet most African cities are not walkable, and most of the region's walkers are low-income residents, especially women, who cannot afford bus fares and struggle to access services.[37]

- European capitals with the highest shares of walking trips in 2023 were London (United Kingdom) at 46% and Paris (France) at 42%.[38] However, walking is likely far more common than statistics indicate.

The global bicycle fleet totalled an estimated 1 billion in 2022, and around 42% of households worldwide owned at least one bicycle, according to a 2015 study.[39] Since 2023, most of the growth in the cycling sector has been in electric bicycles (e-bikes), with rising sales in the Global North.[40] (See 4.4 Cycling.)

Ride hailing activity, another urban transport service that is often overlooked in data collection, grew an estimated 94% between 2018 and 2022, but still accounted for only 0.5% of private motorised passenger travel.[41]

Although working remotely increased during the COVID-19 pandemic, its decline since 2023 - especially in large urban areas - contributed to record-high traffic congestion levels in 2024.[42] In 2024, 55% of urban areas experienced more congestion than in 2023, while only 28% of cities witnessed a reduction in delays.[43] Such challenges reveal how inefficient many current transport systems are, as commuters often travel long distances yet have few reliable and available transport options.

- In the United States, the total number of people telecommuting fell up to 33% in some major cities in 2024, such as San Jose.[44] That year, the share of US workers commuting by car increased 3%, while the share commuting by public transport increased 15%.[45]
- In Istanbul (Türkiye), London (United Kingdom), and Chicago and New York City (United States), more than 100 hours per person are lost in traffic congestion annually on average due to road congestion –the equivalent of around 2.5 work weeks, assuming a 40-hour work week.[46]
- In South Africa, commuters in Cape Town lost 94 hours in traffic per year on average in 2024, followed by 55 hours in Johannesburg and 45 hours in Pretoria.[47]
- In Asian cities, car commuters lost 89 hours in traffic in Jakarta (Indonesia) and 74 hours in Bangkok (Thailand) annually on average in 2024.[48]

The largest increase in public transport ridership in 2024 was in the Middle East and North Africa, followed by the Asia-Pacific region, whereas rates in North America and Latin America remained low compared to 2019.[49] The pandemic had a lasting impact in most public transport markets, with more than half of operators in 2024 still reporting ridership below 2019 levels.[50] However, some locations have focused on improving the reliability of (formal) public transport services to increase ridership, as this can play a role in commute time and is important to keep travel flowing smoothly in an integrated transport system. (See 4.5 Public Transport.)

- In the United States, public transport and rail passenger ridership grew 17% in 2023 but did not fully recover from pandemic-related declines.[51] New York City accounted for nearly half (46%) of all US public transport trips in 2023, although the city's ridership was at around half of its 2019 level.[52] US passenger train use grew 19% – with double-digit growth on nearly every route – yet remained 10% below 2019 levels.[53]
- In Canada, public transport trips grew 12% in 2023 but remained 29% below 2020 levels, with revenues down 20%.[54]
- In Oceania, the pandemic had profound lasting impacts on public transport ridership. Between 2019 and 2023, ridership fell 23% in New Zealand, which has the region's most developed networks, while ridership in Australia nearly recovered to pre-pandemic levels.[55]
- In 2024, public transport ridership increased 13% each in Chicago (United States) and Sydney (Australia), 9% in Toronto (Canada), 8% in Washington, D.C. (United States), 7% in Sevilla (Spain), 4% in Paris (France) and 1% in Hong Kong (China).[56] Ridership fell 4% in Rio de Janeiro (Brazil).[57]
- A 2025 study in 16 major Brazilian cities found significant disparities in public transport service quality, infrastructure, and data transparency, with citizen satisfaction remaining low and dependency on private vehicles remaining high.[58] In Brasilia, progress included the implementation of a bus rapid transit system and an integrated fare card.[59]

Digitalisation can contribute to more efficient and integrated transport systems; however, as of 2024 an estimated 86% of cities globally lacked published data on their public transport systems.[60] Mapping walking, cycling and public transport networks – as well as informal transport – is a critical step towards improving system efficiency.

- Starting in 2024, US public transport agencies were required to publish their data publicly in General Transit Feed Specification (GTFS).[61]
- The EU has been developing a legal framework for automated vehicles, aiming for uninterrupted 5G coverage on major transport routes, boosting semiconductor production and implementing greater cybersecurity standards.[62]
- Jakarta (Indonesia) has developed a smartphone app



to provide optimised bus directions, and different bus providers now accept the same smartcard with free transfers, making the city's bus network more efficient, accessible and convenient without having to add additional buses.[63]

- In Bogotá (Colombia), people use resources such as OpenStreetMap to find directions, since cycle lanes have been implemented so quickly that apps like Google Maps are not sufficiently updated.[64]
- In 2022, Rio de Janeiro (Brazil) began implementing a digital system based on cloud technologies to optimise the efficiency of its bus rapid transit network.[65]

Use of digital platforms has helped to consolidate freight flows, increasing the efficiency of movements through economies of scale, and keeping costs low.[66] Connectivity is also crucial for freight transport efficiency and resilience, as freight provides an essential lifeline for recovery during disasters or shocks.[67]

Accessibility measures in public transport have remained incomplete and fragmented.[68] **Inclusive access (also known as universal design) – accommodating diverse users such as the elderly and people with disabilities or difficulties and other special needs – remains far from the norm.**[69] Some jurisdictions might have in place directives or guidelines for the infrastructure of buildings to accommodate people with special needs, but they may lack similar directives or guidelines for road infrastructure and transport services. (For more on universal design, see 1.2 The Right to Mobility.)

- Around 15% of the world's people – more than 1 billion – live with a disability, most of them in developing countries and often also experiencing poverty, marginalisation and social exclusion.[70] This can be mitigated through inclusive integrated transport planning.
- After a study in Mekelle (Ethiopia) revealed that people with disabilities faced significant safety and mobility challenges, an accessible design and infrastructure guide was developed to support inclusive urban mobility in the city (as well as other cities in low-income countries).[71]
- According to a 2023 study, access was the second greatest theme in Sustainable Urban Mobility Plans (SUMPs) in Europe, after cycling, highlighting that equity and inclusion are important to planners in sustainable transport planning.[72]

Affordability of transport remains a concern in many places, as transport costs often comprise a large share of household budgets and place a particular burden on low-income users. Household spending for transport varies greatly by country and region. Global trends such as rising fuel prices, geopolitical tensions and uncertain economic conditions also have an impact on households. Although recent fuel price increases did not appear to impact the distances travelled in many locations, they created a higher financial burden for drivers and freight operators.[73] In some countries, rising fuel prices have led to higher public transport costs, contributing to a "cost of living crisis".[74]

- In 2023, the highest shares of household spending on transport were in Mexico (20.5%) and Türkiye (19.7%) in a study across 47 countries (mostly consisting of member countries of the Organisation for Economic Co-operation and Development).[75]
- The lowest shares of household spending on transport in 2023 among the 47 countries were in the Slovak Republic (5.6%) and Albania (6%).[76]

Sustainability and climate trends

In 2023, transport was the second largest greenhouse gas-emitting sector globally – contributing 15.9% of global emissions – with three-quarters of the sector's emissions coming from road transport.[77] **Transport emissions tend to be higher in less-dense urban areas that lack effective public transport networks.**[78] Current transport systems rely on fossil fuels to meet nearly all of their energy demand (95.4% in 2023).[79]

Transport emissions vary greatly by region, with Asia continuing to contribute the largest share (40%) in 2023, followed by North America (26%) and Europe (17%) (excluding international aviation and shipping).[80] **North America leads by far in per capita transport emissions, followed by Oceania and Europe.**[81] (See Module 3. Regional Overviews: Trends and Policy Development.)

- Africa was home to one-fifth (18%) of the world's population in 2023 yet emitted only 5.3% of global transport greenhouse gas emissions (excluding international aviation and shipping).[82] The region's per capita transport emissions, at 0.26 tonnes of CO_2 equivalent, were the lowest globally and well below the global average of 0.89 tonnes.[83]
- Asia's per capita transport emissions remained below the global average in 2023, at 0.61 tonnes of CO_2 equivalent, but disparities across countries ranged from very low to very high.[84]
- In Europe, transport is among the largest sources of greenhouse gas emissions, contributing 18% of the region's total emissions and 17.4% of global transport emissions (excluding international aviation and shipping).[85] Europe had the world's third highest per capita transport emissions in 2023, at 1.66 tonnes of CO_2 equivalent, consistent with high motorisation rates and rising emissions from aviation.[86]
- Latin America and the Caribbean contributed 8.6% of global transport emissions in 2023.[87] The region's per capita transport emissions were slightly above the global average, at 0.94 tonnes of CO_2 equivalent.[88]
- North America contributed more than a quarter (26.7%) of global transport greenhouse gas emissions (excluding international aviation and shipping) in 2023.[89] Per capita transport emissions were the highest among regions, at roughly five times than the global average.[90]
- Oceania had the lowest transport greenhouse gas emissions among regions in 2023, contributing 1.7% of the global total (excluding international aviation and shipping).[91] However, it had the second highest per capita transport emissions (2.7 tonnes of CO_2 equivalent) after North America.[92]

Freight transport contributed 43% of global transport CO_2 emissions in 2023.[93] **Transforming the freight and logistics sector to ensure integrated, co-ordinated and efficient goods transport is key to reducing emissions, enabling economic development and local production, supporting circularity, and increasing resilience to shocks while reducing energy consumption.**[94] Critical enablers for sustainable integrated freight include inter-modal, low-carbon, efficient and resilient corridors across borders; land planning



for multi-modal freight transport and facilities; and resilience and adaptation plans across freight transport and logistics systems.[95] (See 1.3 Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet.)

Mass public transport, rail, walking and cycling have much lower carbon intensities over their lifetimes – and per kilometre of people transported and goods moved – than cars or trucks, despite recent gains in vehicle fuel efficiency and electrification.[96]

- In 2022, the CO_2 emissions per passenger-kilometre from an average fossil fuel vehicle were nearly twice those of a fossil fuel bus, nearly five times those from rail, and more than six times those of a tram.[97]
- The last mile of the logistics chain represents up to 28% of total delivery costs, 20% of energy consumption and up to 25% of emissions emitted by the transport of goods.[98] Electric cargo bikes could satisfy around 20% of urban freight demand, depending on the delivery type.[99]

Compact land-use planning and transit-oriented development can greatly reduce emissions by shortening travel distances and reducing the need for car ownership and use, in addition to providing health benefits and improving social inclusion. Similarly, land-use planning for multi-modal freight transport and facilities is critical for supporting low-carbon, efficient and resilient freight corridors.

- In 2022, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change highlighted that transit-oriented development could reduce transport greenhouse gas emissions 23-26% below business-as-usual projections by 2050.[100]
- Decision makers in many regions and at different scales have implemented transit-oriented development, recognising that support for public transport, walking and cycling can greatly reduce transport emissions and create vibrant urban spaces – including in Arlington and Denver (United States), Curitiba (Brazil), Hong Kong (China), Melbourne (Australia), Seoul (Republic of Korea) and Stockholm (Sweden).[101]
- Ireland's 2024 Climate Action Plan integrates climate action and transport in spatial planning through considerations of placemaking and accessibility, and calls for the widespread development of 15-minute neighbourhoods.[102]

Adaptation to the impacts of climate change has become increasingly important to transport and land planners at the national, sub-national and local levels. However, it is unclear whether integrated transport planning approaches for passenger and freight transport are sufficiently addressing adaptation and resilience.

- The congestion pricing scheme in New York City (United States), implemented in January 2025, directs revenues from the scheme to fund infrastructure upgrades as part of a resilience roadmap.[103]
- Digital models that have mapped London and Reading (United Kingdom) estimated that multi-modal commuting systems could reduce CO_2 emissions 12.6% while improving system flexibility during disruptions.[104]

Policy and investment developments

The Avoid-Shift-Improve (A-S-I) framework[i] is key for translating integrated transport planning into a comprehensive implementation tool. A-S-I is aligned with integrated transport planning principles and amplifies the implementation of sustainable transport from multiple angles. Although policies tend to focus on "Improve" measures, "Avoid" and "Shift" measures can reduce an estimated 40-60% of transport emissions at a lower cost (Box 2)**.**[105]

Box 2. Avoid-Shift-Improve Framework

The Avoid-Shift-Improve (A-S-I) framework dates back to the 1990s, when decision makers began using it to prioritise environmental sustainability actions in the transport sector. It aims to reduce the climate impacts of transport and improve access to clean mobility. The framework contains three pillars:

- **Avoid**: encourage users to avoid or reduce the need for motorised transport; this encompasses behavioural change, supply chain optimisation and demand management.
- **Shift**: foster the transition to more sustainable modes over carbon-intensive ones; this involves strategies that promote public transport, renewable energy-powered mobility services and energy-efficient logistics solutions.
- **Improve**: improve efficiency, technology, and energy sources through technology advancement and system optimisation.

A distinctive feature of this framework is its focus on the demand side, transforming the entire transport system –

i The Avoid-Shift-Improve framework has been central to sustainable, low-carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

from vehicle models to travel patterns. Research shows that "Avoid" and "Shift" policy components could contribute to 40-60% of decarbonisation targets, while offering benefits such as reduced congestion, increased safety and mobility equity.

In recent years, the A-S-I framework has been applied in the energy sector to reduce energy needs, promote renewable energy use and increase energy efficiency. As a result, various policies based on the three pillars at different levels are designed. For instance, when considering electricity use, actions to reduce energy consumption consist of fluctuating electricity prices ("Avoid"), installing solar rooftops on buildings ("Shift"), and using efficient appliances and smart grids ("Improve"). Notably, energy experts consider feedstocks and fuels to be the core policy targets, whereas for transport they are vehicles, mode connection and efficient mobility.

Although the A-S-I framework has a positive impact on sustainability and energy efficiency, it comes at a cost, particularly in public investment and infrastructure development. For example, efficient public transport, well-planned bicycle lanes and accessible electric vehicle chargers can dramatically drive down private car use, air pollution and noise. At the same time, a huge amount of public spending is needed for improving road planning, public transport services and relevant infrastructure.

Overall, the A-S-I framework provides a holistic and effective method for sustainable development, not only in transport but also in the energy sector. By addressing demand-side solutions, it can reduce resource consumption, lower emissions and create socio-economic value. However, striking a balance between benefits and financial costs is essential for its successful implementation.

Source: See endnote 105 for this section.

During 2023-2025, political shifts and global geopolitical challenges led some countries to reverse policies supporting sustainable and integrated transport systems. Public and political opposition to such policies is related to perceptions around their impacts on driving behaviour and the built environment, threats to long-held habits and excessive burdens on certain populations.[106] In some cases, this has led to challenges in enforcement and in establishing clear policy criteria (such as determining vehicle eligibility for low-emission zones).[107]

- Nigeria reinstated fossil fuel subsidies in late 2023 after having abruptly removed them in May 2023, a move that had resulted in inflation on top of already high unemployment and poverty.[108]
- In 2023, the Swedish government reversed many climate policies – including pausing an electric road project and cutting biofuel requirements – putting the country on track to miss its 2030 climate goals.[109]
- The Netherlands reversed many climate- and environment-related policies in 2024, including removing subsidies for electric vehicles and reintroducing higher speed limits.[110]
- The Czech Republic adopted higher speed limits in 2025, as did the state of Styria in Austria, despite the positive air pollution impacts of Austria's previous reduced speed limits.[111]
- In Berlin (Germany), the expansion of cycling infrastructure, pedestrianisation and new public transport projects has slowed since 2023.[112]
- In 2025, the European Commission provided flexibility for carmakers by extending the 2025 CO_2 targets for passenger cars until 2027, which might result in carmakers selling up to 880,000 fewer electric cars between 2025-2027 and delay further transition to electric vehicles.[113]
- In 2025, the Trump administration in the United States rolled back vehicle emission standards and support for electric vehicles, and cancelled important funding streams for infrastructure development.[114]



Among the numerous governance and planning strategies for integrated transport planning, a strong focus has been on National Urban Policy and Investment Programmes (NUMPs) and Sustainable Urban Mobility Plans (SUMPs) (Box 3)**.**[115] There has been rising interest in integrated urban-rural planning to improve social inclusion and synergies among communities, particularly in light of rapid urbanisation in low- and middle-income countries.[116] Despite the inter-dependence of urban and rural areas, development has lagged in rural areas, home to 85% of the lower-income population globally.[117]

Box 3. National Urban Policy and Investment Programmes (NUMPs) and Sustainable Urban Mobility Plans (SUMPs)

NUMPs and SUMPs are strategic, action-oriented frameworks that take an integrated approach to planning, with the goal of supporting sustainable urban mobility and improving quality of life. At the country level, NUMPs serve as strategic frameworks to enhance the capabilities of cities to meet their mobility needs in a sustainable way, while at the local level SUMPs can have a significant impact in reshaping how cities approach transport planning.

The development of NUMPs and SUMPs requires efficient co-ordination across various levels of governance and sectoral responsibilities, including transport, land use, environment and finance. Some plans have begun leveraging the digitalisation of ticketing systems to mainstream data for better equity – including data disaggregated by gender and age. NUMPs and SUMPs also have proven to be powerful tools for unlocking substantial climate and infrastructure financing. (See Partnerships in Action section.) For freight, Sustainable Urban Logistics Plans (SULPs), although rare, focus on city-level logistics to achieve sustainable freight operations in urban mobility planning.

Although less common than SUMPs, the adoption of NUMPs in low- and middle-income countries has increased since 2019. NUMPs that offer a clear policy framework and practical support can enable local governments to comprehensively plan and implement projects, especially where they face limitations in authority and resources. They can promote horizontal co-ordination between national ministries and vertical co-ordination with sub-national entities, ensuring that mobility planning is aligned across sectors and levels. For example, Peru's Ministry of Transport and Communications created a programme to help cities implement the four objectives of the country's NUMP.

SUMPs seek to make cities more liveable and environmentally friendly, with benefits including reduced carbon emissions and traffic congestion and improved air quality and public health. By balancing the needs of residents, businesses, and the environment, SUMPs can help cities become more sustainable and resilient in the face of urbanisation and climate change. SUMPs also integrate emission reduction directly into scenario development and strategic planning, such as comparing future scenarios to allow stakeholders to see the emission-cutting potential of policy and investment choices early in the planning phase. SUMPs can provide a structured and inclusive approach to overcome these challenges by promoting polycentric city structures, targeted densification and corridor-based transit development that aligns land-use decisions with mobility strategies.

Source: See endnote 115 for this section.

The development and implementation of SUMPs has expanded in most regions, although a lack of continuous global tracking impedes measurement. During 2023-2024, regional and national regulations enforced the use of SUMPs in more municipalities, enabling integrated planning of urban transport and land use.

- Brazil's National Urban Mobility Policy (PNMU), amended in December 2023, mandates that all municipalities with over 20,000 inhabitants – as well as those located in metropolitan regions, designated as tourist destinations or seeking federal funding for urban mobility – prepare a Mobility Plan.[118] Although most cities had not yet submitted their plans as of mid-2025, several had finalised them.[119]
- In 2024, Peru published its Manual for the Development of SUMPs, aimed at guiding and promoting the development of SUMPs in cities across the country.[120]
- In 2024, the EU's revised Trans-European Transport Network (TEN-T) policy entered into force, designating 431 cities as urban nodes and mandating them to adopt a SUMP and to collect and regularly submit data on urban mobility indicators.[121]

As of 2025, 32 SUMPs and 9 NUMPs had been developed in consultation with MobiliseYourCity across Africa, Asia, Eastern Europe, and Latin America and the Caribbean.[122] Cities designing SUMPs in consultation with MobiliseYourCity are encouraged to reduce their transport emissions at least 50% by 2050, whereas guidance in the EU suggests a 90% reduction in transport emissions.[123] MobiliseYourCity welcomed eight new members in 2024: Aizwal (India), Davao (Philippines), Harare (Zimbabwe), Kaduna (Nigeria), Kinshasa (DRC), Nairobi (Kenya), Toamasina (Madagascar) and Antsirabe (Madagascar).[124]

Integrated transport planning has increasingly been adapted to low- and middle-income countries, in recognition of their specific institutional, social, and infrastructural conditions and of the complex urban dynamics shaped by rapid population growth, informal development patterns and limited institutional capacities.[125] Compared to high-income countries, most cities in low- and middle-income countries still have low levels of private motorisation, which offers the potential for "leapfrog" development that helps to avoid "lock-in" to an automobile-centric paradigm; however, motorisation rates are growing quickly in many of these places. (See Module 3. Regional Overviews: Trends and Policy Development.)

- Many cities in Latin America have increasingly adopted SUMPs – including Arequipa (Peru) and Baixada Santista (Brazil) during 2022-2025 – even as national transport policies lag across the region due to resource and other constraints. (See 3.4 Latin America and the Caribbean Regional Overview.)
- Many cities have acknowledged informal transport as part of SUMPs and NUMPs – such as Antofagasta (Chile),

Bouaké (Côte d'Ivoire), Dire Dawa (Tanzania), Havana (Cuba), Medan (Indonesia) and Trujillo (Peru).[126]

As of 1 August 2025, a total of 7 of the 29 third-generation Nationally Determined Contributions (NDCs) that had been submitted to the UN Framework Convention on Climate Change (UNFCCC) featured activities on transport demand management and enhanced integrated planning; the 7 submissions were from Brazil, Canada, Ecuador, Kenya, Moldova, United Kingdom and Uruguay.[127]

- Brazil's third-generation NDC commits to reducing dependency on individual transport through sustainable urban development and the expansion of public transport and active mobility; the country's Green and Resilient Cities Plan aims to ensure integrated and sustainable urban planning.[128]
- Kenya's NDC commits to promoting low-carbon, climate-resilient and efficient transport systems with a strong emphasis on gender-responsiveness and accessibility for all; it will be achieved through, through electrification, modal shifts, public transport and other sustainable transport activities.[129]

Several recent initiatives have adopted a corridor-based approach to infrastructure development, recognising the strategic importance of strengthening regional connectivity beyond just linking cities.

- Starting in 2025, a new railway in Tanzania spanning more than 2,500 kilometres will enable a rail freight corridor for several East African countries, connecting key Tanzanian ports (from Dar es Salaam on the Indian Ocean to Mwanza on Lake Victoria) as well as Burundi, the DRC and Rwanda.[130]
- In West Africa, the 393-kilometre Kano-Maradi single-track rail line between Kano (Nigeria) and Maradi (Niger) is set for completion in 2025, with a capacity to transport 9,300 passengers and 3,000 tonnes of freight per day.[131]
- In Europe, the TEN-T programme connects urban and rural areas through multi-modal networks to foster sustainable economic growth.[132] One TEN-T project, the Fehmarnbelt tunnel between Denmark and Germany, is a combined rail and road link built using low-carbon technologies that aims to greatly reduce travel times, promoting rail travel and supporting integrated transport across the region.[133]
- The EU's Global Gateway Strategy, aligned with the African Union's Agenda 2063 and the ambitions of the African Continental Free Trade Area, seeks to support quality connectivity infrastructure across Africa through Strategic Corridors.[134] These corridors aim to facilitate sustainable, efficient, and secure mobility and trade – linking urban and rural areas, creating jobs and supporting value chains that benefit industries on both continents.

Governments have increasingly recognised the importance of developing rural transport programmes, stimulated by their potential to boost economic growth and opportunities and improve quality of life. Because rural areas face different challenges than urban areas, rural transport plans must take a different approach. Rural populations are typically more spread out, with greater travel distances, smaller roads and challenging geographical features. Some countries have specific rural plans that seek to increase access to electric vehicles and charging infrastructure, public transport, and walking and cycling infrastructure, although consolidated data on this trend are lacking.

- Ireland launched a five-year rural mobility plan in 2022 that prioritises connectivity and is focused on public transport, specifically an increase in electric buses.[135]
- In 2023, Rwanda adopted a rural road programme to better connect rural populations to broader transport networks, including integrating trail bridges for pedestrians and cyclists to more easily cross rivers, thereby connecting more isolated communities to larger towns and cities to allow for better access to jobs, education and other services.[136] Also in 2023, Rwanda began exempting electric vehicles from import duties to make them more accessible for the general population, following earlier examples from Togo and Tunisia; it previously adopted a plan to convert the more than 100,000 motorbikes on its roads to e-bikes.[137]
- According to the United Kingdom's updated rural transport plan, between 2019 and 2023 the country invested roughly half of the allocated USD 9.05 billion (GBP 7.2 billion) to walking, cycling and public transport infrastructure, mainly for walking and cycling but also to re-open rail lines and stations, increase zero-emission buses, and develop specific zones to trial Mobility-as-a-Service (MaaS), micromobility and demand-responsive transport.[138] The other half of the funding went to private road vehicles, nearly all of it to local highway maintenance, with smaller amounts for expanding electric vehicle charging networks and developing automated vehicle technologies.[139]
- In 2024, Uzbekistan expanded its integrated rural development plan, which includes improving roads and transport infrastructure alongside other areas such as education and health care.[140]



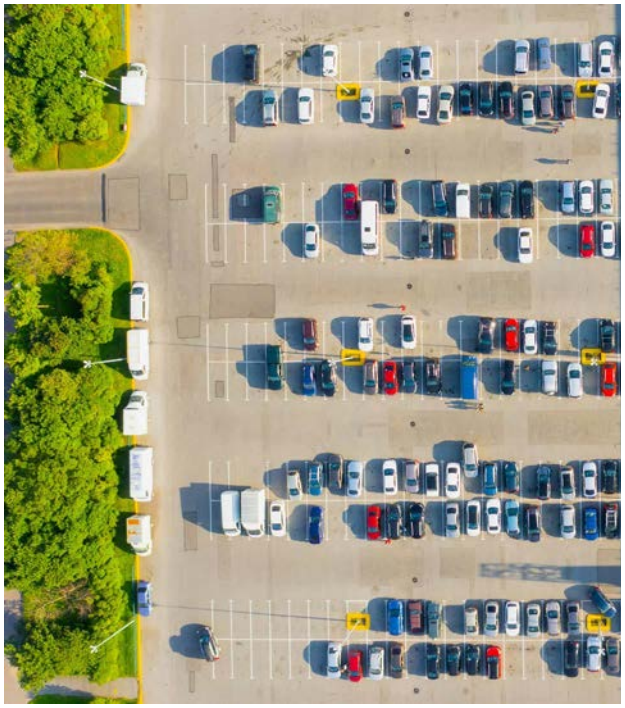
As part of public transport recovery measures since 2022, many cities in Asia, Europe and North America have explored free or reduced fare programmes to make services more accessible to everyone, particularly the vulnerable. However, the financial sustainability of public transport systems depends on a balance between operational costs and revenue generation. (See 4.5 Public Transport.)

- Mumbai (India) was among the cities with the cheapest monthly public transport passes in 2023, at USD 15.[141] In 2019, Delhi became the first Indian city to initiate fare-free bus transport for women of all ages and social classes.[142] By 2025, many Indian states were offering free bus fares for women, and a 2023 study showed that the money saved was spent mainly on family welfare needs.[143] Almost all Indian states offer public transport discounts to disadvantaged groups and those with disabilities.[144]
- By early 2024, 106 cities in Brazil were offering universal zero-cost public transport fares, up from less than 20 a decade earlier (in 2023 alone, 36 Brazilian cities adopted the policy).[145] The policy has increased in popularity and has increasingly been supported by political leaders.[146]
- As of 2024, at least 10 cities globally were offering free public transport for all, including Mariehamm (Finland) since 2000, Samokov (Bulgaria) since 2008, Dewsbury (United Kingdom) since 2009, Avesta (Sweden) and Chambly (Canada) since 2012, Tallinn (Estonia) since 2013, Aubagne and Dunkirk (France) since 2018, Luxembourg since 2020 and Valletta (Malta) since 2022.[147]
- In 2024, Mexico adopted the National Public Collective Urban Transport Policy (PNTPCU), with a commitment to cleaner transport alternatives that reduce environmental impact, decrease car dependence, and improve accessibility, sustainability, safety and governance.[148] The goal is to enhance public transport infrastructure and services, reduce inequality and combat climate change while fostering strategic planning for long-term urban mobility improvements.[149]

While these local efforts are important, more-transformative transport demand management actions – such as adjusting work schedules and promoting telecommuting – often fall outside local jurisdictions and are thus under-represented in city-level plans.

A handful of transport plans – such as in Scotland and some US states – have emphasised strategies to reduce vehicle travel as part of more people-centred, integrated approaches to satisfy mobility needs and improve quality of life.[150]

Since 2022, some European cities have revised their parking policies to adjust for the increased use of larger vehicles (mainly sport utility vehicles, or SUVs), which have been shown to take up more public space, produce more emissions and be more lethal in crashes.[151] French cities have been at the forefront of these "auto obesity" laws, with strong public support for reclaiming space for people by



imposing higher parking charges for larger vehicles. A growing number of cities in developing countries, such as Bogotá (Colombia) and Santiago (Chile), have implemented paid parking policies, and the World Bank has provided training on parking planning and management and guidance for increasing public transport.[152] Parking price reform can have positive impacts on the use of public transport.[153]

- Among French cities, Bordeaux in 2025 adopted a 30% higher parking rate for larger vehicles, with an exemption for professional vehicles, while Lyon in 2024 adopted a similar policy, with rates for large vehicles 1.5 to 3 times higher than for smaller vehicles, with exceptions for professional vehicles and for lower-income or multi-child households.[154]
- In a 2024 poll, 61% of residents in Paris (France) supported higher parking charges for vehicles that are large, heavy, or more polluting, with 56% of residents viewing SUVs negatively (mainly because they take up too much public space).[155]
- Paris charges large vehicles higher parking fees of USD 18.75 (EUR 18) per hour in the city and USD 12.50 (EUR 12) in the outskirts – compared with USD 6.25 (EUR 6) and USD 4.17 (EUR 4), respectively, for smaller vehicles.[156] The rates apply only to visitors, as local residents and professional vehicles are exempt.[157]
- In the 2024 poll, 68% of Paris residents supported strengthening the city's low-emission zone regulations to include vehicle weight, and 67% supported requiring manufacturers to increase the share of smaller vehicles on offer.[158]
- In 2023, Dublin (Ireland) was considering a parking policy with higher fees for larger vehicles, while also removing all free on-street parking in the city centre; however, as of 2024 the city had only raised overall parking fees.[159]
- Germany has charged higher rates for large vehicles since 2022, with the Association of German Cities supporting wider application of the policy.[160]
- In the United Kingdom, parking policies for large vehicles are in place in Bath and some London boroughs; Cardiff and Bristol launched public consultations in 2024 for such policies, and a proposal was put forward in Oxford.[161]
- Similar parking proposals in Brussels (Belgium) were at a standstill as of late 2024 due to political transition, although the city was considering a full ban on SUVs within city limits.[162]
- Outside of Europe, San Francisco (United States) has since 2018 imposed a USD 4 per hour parking charge for larger vehicles (compared to USD 2 per hour for smaller vehicles).[163]

Increasing bicycle parking near public transport hubs and train stations can facilitate integrated travel. In 2019, Utrecht (Netherlands) expanded bicycle parking at its central train station by 12,500 parking spaces, for a total of 22,000 spaces, making it the largest such hub in the world.[164]

- The previous record for bike parking was 9,400 spaces, held by a station in Tokyo (Japan).[165]
- In 2024, Buenos Aires (Argentina) was ranked as the sixth best city in the world for cycling.[166] From 2009 to 2023, as the city built bike lanes and installed more bike parking, the share of bicycle trips grew from 0.4% to 7.0%.[167]

Several jurisdictions have taken actions to improve the road safety of pedestrians and cyclists in connection to the Vision Zero approach.[168] **The greatest improvements in road safety have been achieved in countries where the Safe System approach has been adopted.**[169] (See 4.3 Walking.)

- Sweden remains a global leader in road safety, with just 2.8 deaths per 100,000 inhabitants in 2020, while Oslo (Norway) and Helsinki (Finland) achieved zero pedestrian deaths in 2019.[170]
- Kenya's Road Safety Action Plan 2024-2028 includes a commitment to reduce road fatalities 50% by 2030, which is aligned with Sustainable Development Goal 3.6 on road safety and with the Second United Nation Decade of Action for Road Safety 2021-2030.[171]
- In 2025, Malaysia committed to Vision Zero, in connection with its Road Safety Plan 2022–2030.[172]
- The Global Ministerial Conference of Road Safety held in Morocco in February 2025, and the associated Marrakech Declaration, urged UN Member States and related actors

to accelerate and scale up efforts to implement the Global Plan and associated Global Road Safety Performance Targets.[173] (See 1.7 Driving Health and Wellbeing Forward: The Critical Link with Transport.)

Digitalisation efforts have the potential to greatly reduce transport emissions by increasing efficiency. The emission savings could be even larger when such services focus on collective and integrated transport.

- **Research in Amsterdam (Netherlands) in 2022 found that Mobility-as-a-Service (MaaS) offers potential emissions savings of 3-54%, depending on the attractiveness of these services to users.**[174]
- In Merida (Mexico), ridership grew and emissions per passenger fell 9% after the city implemented digital monitoring of bus operators to improve maintenance and scheduling, without adding any buses.[175]

During 2023-2025, several implementation and planning efforts around congestion pricing were in the spotlight; such efforts can have direct positive impacts on traffic, emissions and pollution levels.

- In January 2025, New York City became the first US city to implement a congestion pricing policy, with strong initial results, although the policy has faced political challenges by the federal government.[176]
- Seoul (Republic of Korea) rolled back part of its congestion charging scheme after 27 years, opting to instead exempt traffic in one direction starting in January 2024; this was despite findings that traffic rates increased more than 5% during an experimental phase in 2023 when the city did not collect the toll fee from southbound vehicles.[177]
- In early 2025, the Malaysian government announced that studies were under way to assess the feasibility and potential impacts on traffic and public transport use of implementing congestion charges in Kuala Lumpur, George Town and Johor Bahru; findings were expected by year's end.[178]
- The Ministry of Transport in Bangkok (Thailand) announced plans in 2024 to implement a USD 1.16-1.45 (THB 40-50) congestion charge for motorists entering the inner city, which it says could generate an estimated USD 290 million (THB 10 billion) annually to help subsidise a flat-fare policy for all electric rail lines in Greater Bangkok of USD 0.58 (THB 20).[179] Officials emphasised the need for improved public transport systems and other sustainable alternatives before full implementation.

Some cities have implemented low-emission zones (LEZs), ultra-low-emission zones (ULEZs), zero-emission[ii] zones (ZEZs) and low-traffic neighbourhoods to reduce emissions, congestion, and air and noise pollution in specific areas. The aim is often to mitigate congestion and poor air quality, although the zones also lead to reduced CO_2 emissions and improved health and equity, as urban air pollution often disproportionately impacts the most vulnerable.[180] LEZs have also become an important revenue source for cities. Low-traffic neighbourhoods, although less common, involve installing traffic filters and have been shown to reduce traffic volumes and nitrogen dioxide (NO_2) emissions (without displacing either to other areas), while also promoting social equity, local businesses, inclusion, safety, walking and cycling.[181]

- By 2025, implementation and expansion of the ULEZ in London (United Kingdom) in 2019 had resulted in CO_2 reductions equivalent to the removal of 3 million flights between London and New York City, as well as significant reductions in particulate matter ($PM_{2.5}$) and in NO_2 (by 27% city-wide and 54% in central London).[182] London's LEZ generated an estimated USD 1.26 billion (GBP 1 billion) between 2019 and 2024.[183]
- Elsewhere in Europe, low-emission zones in some cities have led to NO_2 reductions of around 20%.[184] Fewer reductions occurred in older zones – based on the Euro 4 and 5 emission standards for diesel vehicles – due mainly to the mismatch between the emissions for these vehicles in test conditions versus real-world use.[185]
- In 2025, Ahmedabad (India) began exploring implementation of an LEZ, which was projected to reduce pollutants up to 40%, following a model designed by the High Volume Transport Applied Research Programme.[186]
- New York City's congestion pricing policy is projected to decrease daily vehicle traffic more than 4% and CO_2 emissions more than 10% by 2045, alongside decreases in fine particulate matter, nitrogen oxides and carbon monoxide.[187]
- In 2024, the People's Council in Hanoi (Viet Nam) approved a resolution to implement pilot LEZs in Hoàn Kiếm and Ba Đình districts starting in 2025.[188] Within LEZ areas, Hanoi's strategy explicitly aims for public transport to account for 45-50% of passenger trips; all new and replacement buses must be electric or use green energy, with a target of a fully green bus fleet by 2030.[189]

While there is typically popular support for LEZs and similar strategies, implementation can be highly contested.[190] **To reduce resistance, some governments have introduced these policies incrementally and grown them progressively over time, either increasing the strictness or expanding the geographic coverage. More recently, some places, such as in France and Spain, have scaled back plans to strengthen LEZs in response to intensified political debate.**

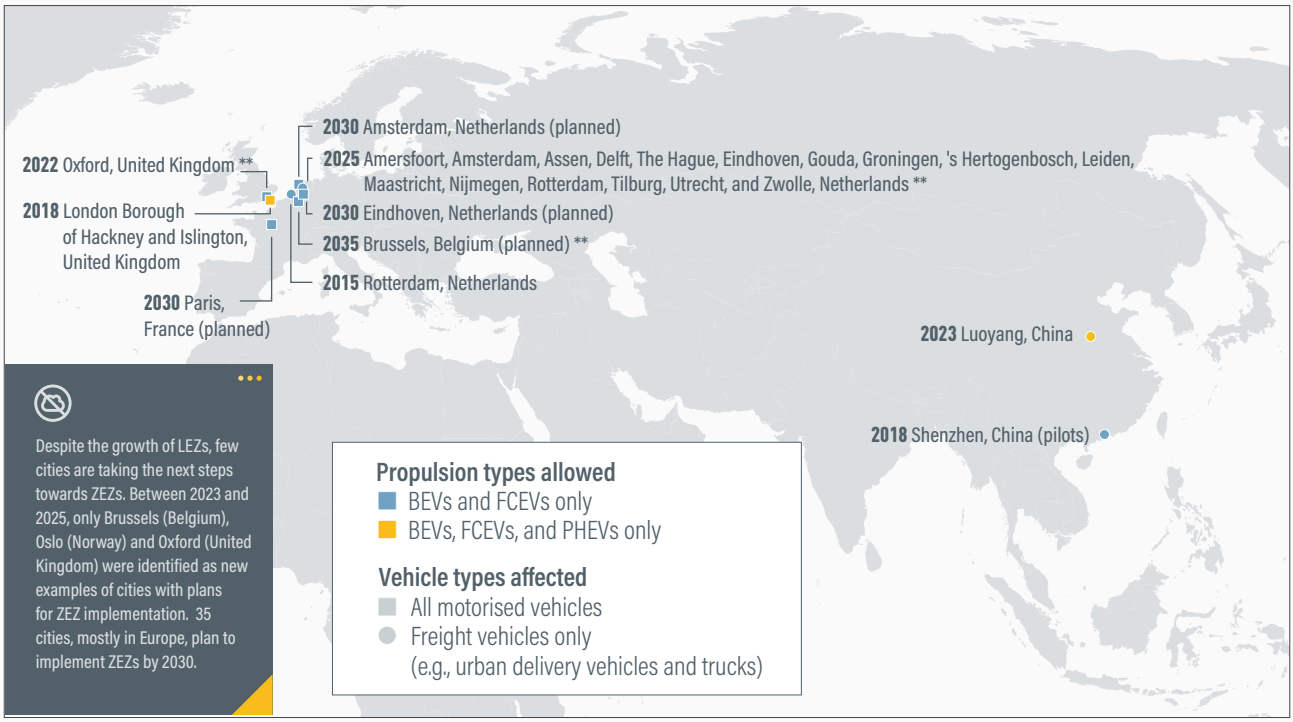
ii Limiting traffic to only vehicles that emit zero tailpipe emissions.

- **Overall, the number of LEZs in operation in Europe is estimated to have doubled between 2019 and 2025, from 228 to more than 500.**[191]
- Some of the newest LEZs include those in Palma (Spain) in 2025 and Dundee (Scotland) in 2024.[192]
- In May 2025, France's National Assembly – with support from right and far-right groups – voted to abolish low-emission zones.[193]
- By 2025, at least 27 European cities were expected to expand or strengthen their existing LEZs.[194]

Despite the growth of LEZs, few cities are taking the next steps towards ZEZs. Between 2023 and 2025, only Brussels (Belgium), Oslo (Norway) and Oxford (United Kingdom) were identified as new examples of cities with plans for ZEZ implementation (Figure 2)**.**[195] **35 cities, mostly in Europe, plan to implement ZEZs by 2030.**[196]

- Several dozen cities worldwide had implemented or planned to implement ZEZs or near-ZEZs by the early 2020s – or earlier, as in Shenzhen (China) in 2018.[197] They were mostly in Europe but also in China, India and the United States.[198]
- The ZEZ in Oslo (Norway) entered into force in 2023 – starting with a "Car-Free City Life" area where pedestrians and cyclists have priority over private cars – and aims to expand to other areas of the city by 2026.[199]
- The ZEZ in Oxford is supported by the city's SUMP, which also includes implementing low-traffic neighbourhoods and traffic filters, measures for walking, cycling and public transport, and sustainable freight policies.[200]
- Brussels' LEZ, introduced in 2018 and tightened in 2022, led to a halving in the number of diesel vehicles in the city between 2018 and 2022, as well as a 30% reduction in particulate matter emissions and 62% less black carbon.[201]

FIGURE 2. Implemented and planned zero-emission zones and variants as of April 2025



Source: See endnote 195 for this section.

* Note: Zero-emission zones (ZEZs) allow battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs) only; near-ZEZs also allow plug-in hybrid electric vehicles (PHEVs). Affected areas of zones range from a single street to an entire city or metropolitan area. The map includes cities that have committed in an offcial policy document or announcement to introduce a ZEZ or near-ZEZ, set a date of introduction/start date, indicated the vehicle types affected, and set binding requirements for access (such as minimum emissions standard certification). For ZEZs and near-ZEZs covering all motorized vehicles, the applicability to all vehicle types must be clearly stated in the offcial document.

** For cities in the Netherlands with an implemented ZEZ, a transitional phase for some types of freight vehicles exist until up to 2030 e.g., newer vans and trucks with high Euro emission standards. Oxford has a charge-based scheme which allows non-zero emission vehicles to enter when paying a charge. Brussels has not set a date for buses, coaches, and heavy goods vehicles.

By 2035, the LEZ will be upgraded to a ZEZ by banning all internal combustion engine vehicles except for heavy goods vehicles and coaches.[202]

- In London, the existing ULEZ was expanded in 2023 to include every London borough, but a plan to implement a ZEZ starting in 2025 was put on hold.[203]

Some cities have established specific zero-emission zones for freight transport (ZEZ-Fs) – ranging from urban delivery vans to medium- and heavy-duty trucks – to address the large contribution of freight transport to air pollution and greenhouse gas emissions.[204]

- By late 2024, at least 35 cities globally were planning to introduce ZEZ-Fs, most of them in the Netherlands, where a national law mandated such zones by 2025.[205]
- In 2025, ZEZ-Fs came into force in 14 Dutch cities, including Amsterdam, Rotterdam, Utrecht, and The Hague, with an additional 16 cities expected to follow suit.[206]

LEZ, ULEZ and ZEZ policies can be supported by targets for 100% electric vehicle sales and mandates for phasing out internal combustion engine vehicles. By the end of 2023, at least 74 countries and 26 states/provinces across all major continents had targets promoting electric vehicles, while 49 of these jurisdictions had a 100% electric vehicle sales target or a targeted ban on internal combustion engine vehicles.[207] In 2025, to further strengthen its LEZ policies, Norway announced plans to allow cities to ban fossil fuel-powered cars entirely from their ZEZs.[208] (See 5.2 Road Vehicle Electrification.)

Partnerships in action

- **Bridges for Prosperity** connects rural communities through proven infrastructure solutions, such as trail bridges. It advocates for rural mobility as a policy and investment priority and ensures a long-lasting impact by combining local capacity building, community ownership, evidence-based planning and long-term systems change. In 2024 alone, the organisation built 130 bridges across Bolivia, Eswatini, Ethiopia, Rwanda and Uganda, directly serving more than 1.4 million people.[209]
- **UN-Habitat** has developed guidelines for rural-urban connections for key stakeholders, including national and local governments; as of 2023, 11 developing countries had adopted the guidelines as part of their planning and 20 had strengthened urban-rural connections.[210]
- **Clear Air Asia's** mission is to improve air quality and foster healthier, more liveable cities across Asia, particularly through providing policy guidance, building capacity and making the case for action among stakeholders.[211]
- The **High Volume Transport (HVT) Applied Research Programme**, funded by UKAID through the UK Foreign, Commonwealth & Development Office, has undertaken many activities to support integrated transport planning, including an initiative through its Pan-African Capacity Building Programme to increase inclusivity, resilience, and walking and cycling in low- and middle-income countries in Africa.[212] The HVT programme released a guide on "quick wins" for low-carbon transport highlighting opportunities for low-income countries in Asia and Africa to increase resilience in transport while reducing emissions, increasing liveability, improving living conditions and supporting economic prosperity, as well as a planning framework for implementing LEZs in Indian cities.[213] It also produced a compendium of the 188 reports and documents from the over 100 projects that were funded.[214]
- **ICLEI–Local Governments for Sustainability** leads the global **EcoMobility** agenda, prioritising active and shared travel, as well as the **EcoLogistics** community, which focuses on advancing sustainable urban freight.[215] It has more than 100 participating cities accounting for a combined 239 million people, where 60% of the residents use active and shared modes and 75% of the cities report their greenhouse gas emissions.[216]

- The **Institute for Transportation and Development Policy** (**ITDP**) uses technical expertise, advocacy, and policy guidance to mitigate climate change impacts, improve air quality and support more sustainable and equitable cities.[217] Its focus is on high-quality public transport, safe and pleasant active travel infrastructure, transit-oriented development and people-centred inclusive policies.[218]
- Through the **MobiliseYourCity Partnership**, 19 SUMPs and 6 NUMPs had been completed as of 2023, of which 13 SUMPs and 4 NUMPs were linked to financing, directly contributing to mobilising more than USD 1.82 billion (EUR 1.75 billion) in secured funding (primarily through international loans) for public transport infrastructure, walking and cycling facilities, and urban space improvements.[219] The total identified investment needs through these plans exceed USD 28.75 billion (EUR 27.6 billion), highlighting their potential to scale climate-aligned mobility investments across cities and countries.[220] The partnership – implemented by AFD, GIZ, ADEME, Cerema, CODATU, the European Bank for Reconstruction and Development, KFW and the Wuppertal Institute – also has created a dedicated calculator to help cities quantify the emission reduction potential of proposed measures.[221]
- In 2023, in the lead-up to the UN Climate Change Conference in Dubai, United Arab Emirates (COP 28), a group of organisations launched a **call to double the share of energy-efficient and fossil-free forms of land transport by 2030, with the goal of fossil-free land transport by 2050.**[222] The call emphasises shifts towards public transport, walking, cycling, and rail freight, as well as electric vehicles and railways, while drastically scaling up the use of renewable and zero-emission energy sources.[223] While each country will adopt a nationally determined approach, the call to action outlines a series of universal enablers to meet this target. The call was issued by SLOCAT and REN21, jointly with the Institute for Sustainable Development and International Relations (IDDRI), ITDP, the International Union of Railways (UIC), the International Association of Public Transport (UITP) and the World Resources Institute, and is supported by over 60 multi-stakeholder signatories (including Chile and Colombia).
- Building on the call to action and other multi-stakeholder efforts, the **Climate Champions Team** launched the Avoid and Shift Breakthrough at the 2024 UN Climate Change Conference in Baku, Azerbaijan (COP 29).[224] The Breakthrough features the same doubling goal for land transport and seeks to strengthen transport targets that focus on "Avoid" and "Shift" measures in complementarity with other initiatives that favour "Improve" measures.[225]
- The **Transformative Urban Mobility Initiative** (**TUMI**) is a leading global implementation initiative on sustainable transport that aims to change mobility for the benefit of people and the environment. It is supported by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented through GIZ. In 2024, under TUMI's leadership, the Hamburg Charter for Inclusive and Just Mobility was officially launched at the inaugural Hamburg Sustainability Conference. The Charter emphasises the social dimension of the mobility transition, with central components being climate action, gender equity, safety and access. The Charter was signed by 23 cities and organisations, including Hamburg (Germany), Malmö (Sweden), Tirana (Albania) and the World Bank.[226]
- The **World Bank** published a guide for planning for transit-oriented development in emerging cities to rapidly transform urban areas into vibrant communities, stressing the importance of integrating land use regulations and transport planning.[227]
- In 2024, the **World Resources Institute** – working in 12 countries with partners in more than 50 – published a report demonstrating how public transport agencies worldwide can adjust their funding portfolios for operational costs, considering changes since the pandemic.[228]

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Walking



KEY FINDINGS

Demand, use and access

- Most of the world's population identifies as pedestrians, and nearly all transport trips made globally include a walking stage if not walked all the way. A 2022 survey of more than 45,000 people in 48 countries found that 94% of respondents identified themselves as pedestrians.
- In Africa, walking is the primary mode of transport, with more than three-quarters (78%) of people travelling on foot every day to access health care, education, shops, jobs and public transport as of 2022.
- In the European Union (EU), 61% of the population reported having walked for 10 minutes or more on at least four days in the previous week in 2022.
- In the United States, walking accounted for only 7% of all trips in 2022, while 87% of trips were made using private motorised transport.
- Walking has been undervalued due to its undercounting as a transport mode. Traditional surveys of modal shares capture only around one-quarter of the actual walking that takes place because they tend to underrepresent the walking done by public transport users and to overlook many short but essential trips made by young people, older adults, women and people with disabilities.
- Research on public transport in 12 cities across Australia, Austria, Germany, the Netherlands, Switzerland, and the United Kingdom found that, as of 2024, more than 90% of passengers walked to public transport, 50% of their total travel time was spent as a pedestrian, and 70% of their reported memories included the walking experience.
- In 2022, just half (52%) of the world's urban population lived within convenient access (walking distance) of public transport.
- Women make more frequent walking trips than men, due mainly to their caregiving tasks; yet because many of these trips are undercounted, planning and policies do not cater to women's needs.
- Promoting walking and cycling has been identified as a potential solution to boost physical activity levels and counter the persistent burden of inactivity. As of 2016, an estimated 81% of adolescents and 27.5% of adults globally were not meeting the recommended physical activity levels of 60 minutes or more daily for adolescents and 150 minutes or more weekly for adults.
- Studies have shown that walking for 30 minutes or cycling for 20 minutes regularly can reduce mortality risk by 10%.
- Walking for transport can play an important role in supporting active lifestyles. In a global study of 104 countries, walking and cycling for travel accounted for 36% of the total physical activity of adults who reported undertaking physical activity.



KEY FINDINGS

Sustainability and climate trends

- Traditional transport planning often overlooks women's mobility patterns, resulting in infrastructure that benefits motorised travel and does not serve women's needs or protect them. Inadequately lit pedestrian environments expose people (especially women) to an elevated risk of harassment and violence, while the absence of sidewalks and pedestrian crossings puts everyone (especially people with disabilities, children and older people) at higher risk from road crashes.
- Among the 17 UN Sustainable Development Goals, only one – SDG 16 on Peace, Justice and Strong Institutions – has an indicator that refers directly to walking (specifically, perceived safety while walking).
- In all regions, women feel less safe than men when walking alone at night where they live. For the period 2020-2022, this difference ranged between 9 percentage points in Sub-Saharan Africa and 18 percentage points in Northern Africa and Western Asia.
- Latin America and the Caribbean was the region where both women and men felt the least safe walking alone in their neighbourhood after dark (37-52% safe).
- The need for inclusive pedestrian environments that are gender responsive and accessible for all users is increasingly recognised.
- SDG Target 11.7 – on access to public space – could be adapted to provide more information about women's experiences when walking, to help improve these experiences and to enable women to exercise their right to the city.
- Road traffic deaths overall fell 5% between 2010 and 2021, but fatalities among pedestrians rose 3%. Road traffic crashes claimed an estimated 1.19 million lives worldwide in 2021, with pedestrians representing 21% of all fatalities.
- The highest shares of pedestrian fatalities among road traffic deaths in 2021 were in Africa (33%) and the Eastern Mediterranean (26%), whereas South-East Asia and the Americas had the lowest shares (17% each).
- In 2021, the annual economic cost to society from pedestrian road casualties exceeded an estimated USD 940 billion globally. Low- and middle-income countries accounted for 89% of the victims and 68% of the economic cost.
- Although Africa had only 3% of the world's registered vehicles in 2021, it suffered 20% of global road traffic deaths that year.
- As of May 2025, only 17% of assessed roads in 88 countries attained a three-star or better rating (out of five) for pedestrian safety, whereas nearly half (49%) of assessed roads met this standard for vehicle occupants.
- As of 2023, half of surveyed drivers across 48 countries reported exceeding the speed limit. Speeding was responsible for one-third of road crashes in high-income countries in 2017, and this share is likely to be even higher in low- and middle-income countries given the large proportions of deaths of pedestrians, cyclists and motorcyclists. Elevated speeds are also directly associated with increased greenhouse gas emissions and noise levels.
- Providing safe walking and cycling infrastructure is a quick, affordable and reliable way to reduce transport emissions by 20-50%. A modal shift study in Australia estimated that substituting just 1% of automobile travel with walking (or cycling) could result in a 2-4% reduction in motor vehicle emissions.

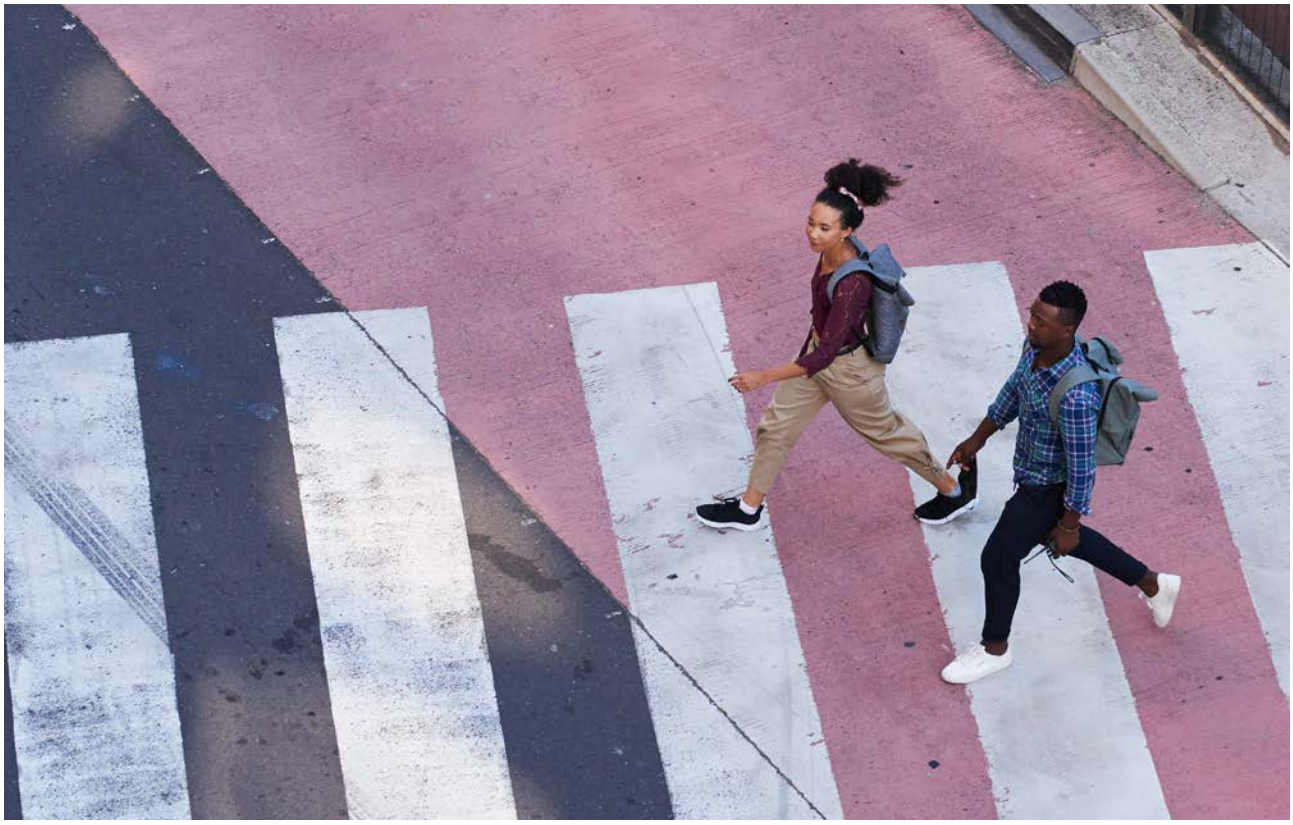


KEY FINDINGS



Policy and investment developments

- Despite their decarbonisation benefits, walking and cycling remain underrepresented in climate change policies and in countries' Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. Integrating walking into national policies and improving data collection are crucial steps towards enhancing public health, reducing environmental impact and achieving various SDG targets.
- In 2022, the WHO identified significant gaps in data collection and monitoring of walking and cycling, including a lack of global indicators and data on the provision of related infrastructure and networks.
- More than 100 countries worldwide have utilised the WHO's Global Physical Activity Questionnaire, which is designed to provide a more accurate measurement of walking and to help authorities assess the extent to which walking and cycling for travel occur on a typical day.
- As of 2018, fewer than half (73) of 174 countries analysed had national policies to promote or support walking and/or cycling (mostly high-income countries), and only 27 countries had sub-national policies.
- By contrast, 127 countries had national policies and funding for public transport as of 2018. While this investment in public transport is promising, it underscores the need to recognise that every public transport user is also a pedestrian.
- As of 2023, a total of 124 of the 197 member countries of the UN Framework Convention on Climate Change had integrated walking into a national policy and/or an NDC aimed at reducing greenhouse gas emissions. However, only 17% of these policies had a visible, dedicated budget, and less than 30% had an evaluation mechanism, revealing a significant gap between stated commitments and actionable delivery.
- As of 2023, 80 countries (41%) addressed walking in their national policies but not in their NDCs, and 13 countries (7%) integrated walking in their NDCs but not in national policies. These countries have an opportunity to reinforce policy coherence. There is a need for a common system to develop climate policies that address walking.
- Only 31 UNFCCC member countries (16%) as of 2023 had both a national policy and an NDC addressing walking.
- The most common objectives in national policies addressing walking as of 2023 were to increase physical activity (36%), to improve road safety (32%), and to mitigate climate change (28%), followed by aims to improve accessibility (23%) and comfort (14%).
- Most of the NDCs that mentioned walking and cycling as of 2023 aimed to increase the share of people using these modes; only 6% had a goal to increase physical activity, and less than 3% mentioned road safety and other objectives.
- As of August 2025, 29 countries had submitted new (third-generation) NDCs to the UNFCCC. The third-generation NDCs of nine countries – Brazil, Canada, Lesotho, Monaco, Nepal, Singapore, the United Arab Emirates, the United States and Uruguay – featured climate action in relation to walking (often subsumed under active transport) to mitigate greenhouse gas emissions in the transport sector.
- Regional plans for walking have also begun to emerge. The first Pan-European Master Plan on walking, released in 2024, has the potential to put walking at the forefront of mobility policies in 56 countries.
- Walking has often been overlooked in urban planning, although some countries and cities have integrated efforts to improve pedestrian infrastructure in their plans.
- In NDCs and other strategies, policy makers have increasingly adopted more systemic, multi-disciplinary approaches to walking that connect across departments; prioritise the safety, comfort and enjoyment of the pedestrian; and deliver immediate, measurable benefits (which can often be reported using existing datasets). However, datasets on walking continue to show gaps and limitations, which can be improved through additional local data collection.
- The greatest improvements in road safety have been achieved in countries where the Safe System approach has been adopted. This approach shifts the responsibility from road users to road designers and operators and puts people and safety at the heart of mobility systems through four core areas: safe roads, safe speeds, safe road users and safe vehicles.
- As of 2022, only 57 countries met the WHO's recommended speed limit for urban roads of 50 kilometres per hour, just 9 more countries than in 2018. Implementing reduced speeds for people to safely walk or cycle is an important measure to improve global road safety trends and promote active mobility.



Context, challenges and opportunities

Billions of people walk every day. Whether heading to work, school, shops, or public spaces, every journey begins and ends on foot. Yet despite walking's universality, pedestrians around the world face safety, security, and accessibility challenges, ranging from poor or non-existent walking infrastructure and street harassment to inadequate integration with public transport systems. These barriers not only endanger lives but also discourage walking, especially for the more vulnerable (children, women, older persons and persons with disabilities).

The lack of walkable environments reduces active commuting by foot or bicycle, increasing the reliance on motorised transport and exacerbating air pollution and greenhouse gas emissions.[1] Enhancing the walking conditions and experience for the people who travel by foot every day represents the quickest, most cost-effective, dependable and equitable way to keep people walking.

As the most accessible and equitable form of mobility, walking supports progress on multiple Sustainable Development Goals (SDGs). The impacts of walking are positive in many areas, including on emissions, congestion, road crashes, gender equity, accessibility, social justice, public transport ridership and public health. Walkability is associated with the reduction of non-communicable diseases and better health conditions.

Globally, 80% of all roads failed to meet minimum three-star (out of five) or better safety standards for pedestrians as of mid-2025, and in 2023 half of all drivers across 48 countries reported exceeding the speed limit.[2] The Safe System approach to road safety and the improvement of public transport systems with better walking (and cycling) access are all ways to improve walking conditions and support more walking. Often, the low-cost, high-return interventions that are needed represent good value for the money and can underpin a stronger return on investment for public transport systems.[3]

Although progress is being made, significant work remains to ensure that walking is fully embedded in both transport and climate policies. Across countries, gaps remain in the policy delivery system for Nationally Determined Contributions (NDCs) towards reducing greenhouse gas emissions under the Paris Agreement. As of 2023, only 16% (31) of the member countries of the United Nations Framework Convention on Climate Change (UNFCCC) had both a national policy and an NDC that addressed walking, 41% (80 countries) had only a national policy addressing walking, and 7% (13 countries) had only an NDC addressing walking.[4] There is an urgent need for a common system to develop climate policies that support and promote walking as well as the infrastructure that facilitates it.

Demand, use and access

Most of the world's population identifies as pedestrians, and nearly all transport trips made globally include a walking stage if not walked all the way.[5] **A 2022 survey of more than 45,000 people in 48 countries found that 94% of respondents identified themselves as pedestrians.**[6] Regionally, this share reached 94.9% in Europe (24 countries), 94.4% in Africa (12 countries), 93.8% in Asia and Oceania (9 countries) and 86% in the Americas (3 countries: Canada, Colombia and the United States).[7]

In Africa, walking is the primary mode of transport, with more than three-quarters (78%) of people travelling on foot every day to access health care, education, shops, jobs and public transport as of 2022.[8] On average, the region's population spent 56 minutes per day walking or cycling for transport in 2022, with women showing 29% higher rates of engagement in these forms of transport than men.[9]

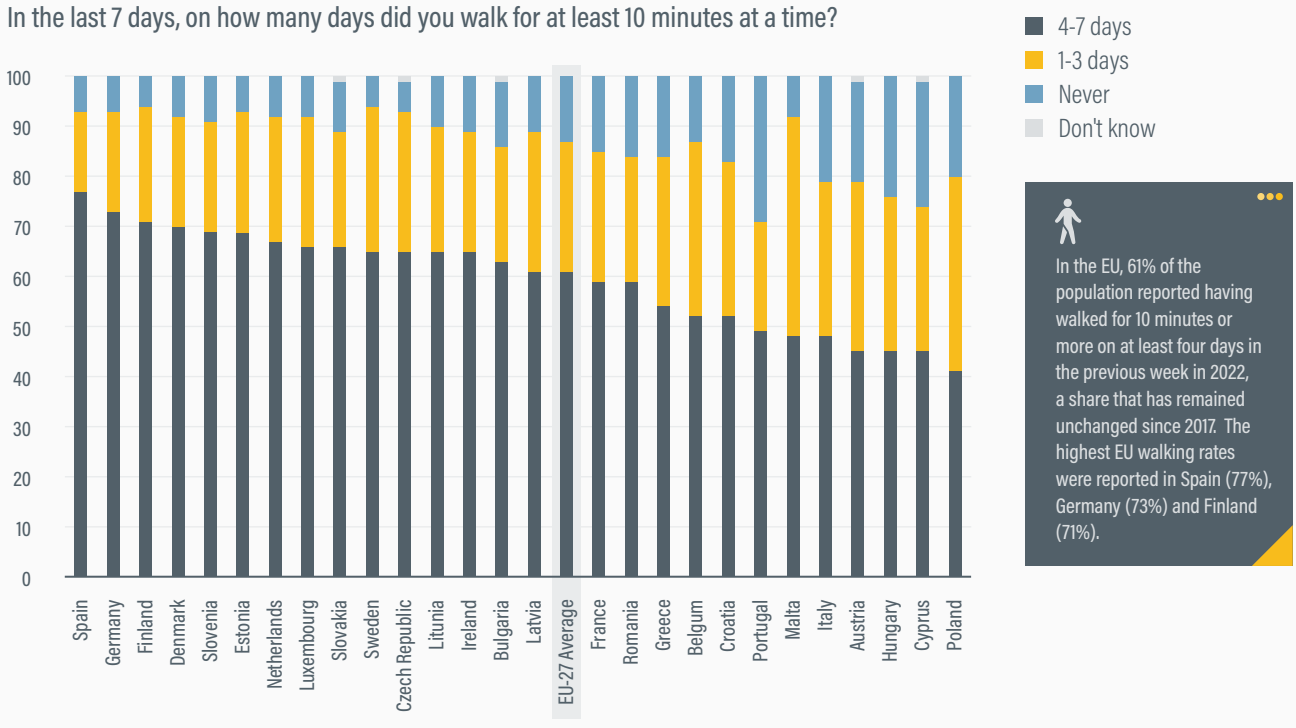
In the European Union (EU), 61% of the population reported having walked for 10 minutes or more on at least four days in the previous week in 2022 (Figure 1), a share that has remained unchanged since 2017.[10] The highest EU walking rates were reported in Spain (77%), Germany (73%) and Finland (71%).[11]

- In Germany, walking's share grew from 22% in 2017 to 26% in 2023.[12]
- EU respondents aged 15-24 walked the most (71%), a share that decreased with age.[13]
- Globally, the share of older adults walking in urban areas fell from 34% in 2012 to 28% in 2022, with much of this decline occurring in high-income and ageing countries.[14]

In the United States, walking accounted for only 7% of all trips in 2022, while 87% of trips were made using private motorised transport.[15] Although regional data for Latin America were unavailable, walking-only trips represented 38% of all weekly trips in Bogota (Colombia) and 23% in São Paulo (Brazil), as of 2021.[16] A study of 2,000 students in Rio de Janeiro (Brazil) found that nearly half (46.5%) of all children walked to school in 2023, with a higher share of girls (50%) walking to school than boys (43%).[17]

Walking has been undervalued due to its undercounting as a transport mode. Traditional surveys of modal shares capture only around one-quarter of the actual walking that takes place because they tend to underrepresent the walking done by public transport users and to overlook many short but essential trips made by young people, older adults, women and people with disabilities.[18] Most travel

FIGURE 1. Survey results on walking for at least 10 minutes at a time for EU countries, 2022



Source: See endnote 10 for this section.

surveys focus mainly on journey-to-work trips and record only the primary mode of transport, typically excluding journeys shorter than 500 metres.[19]

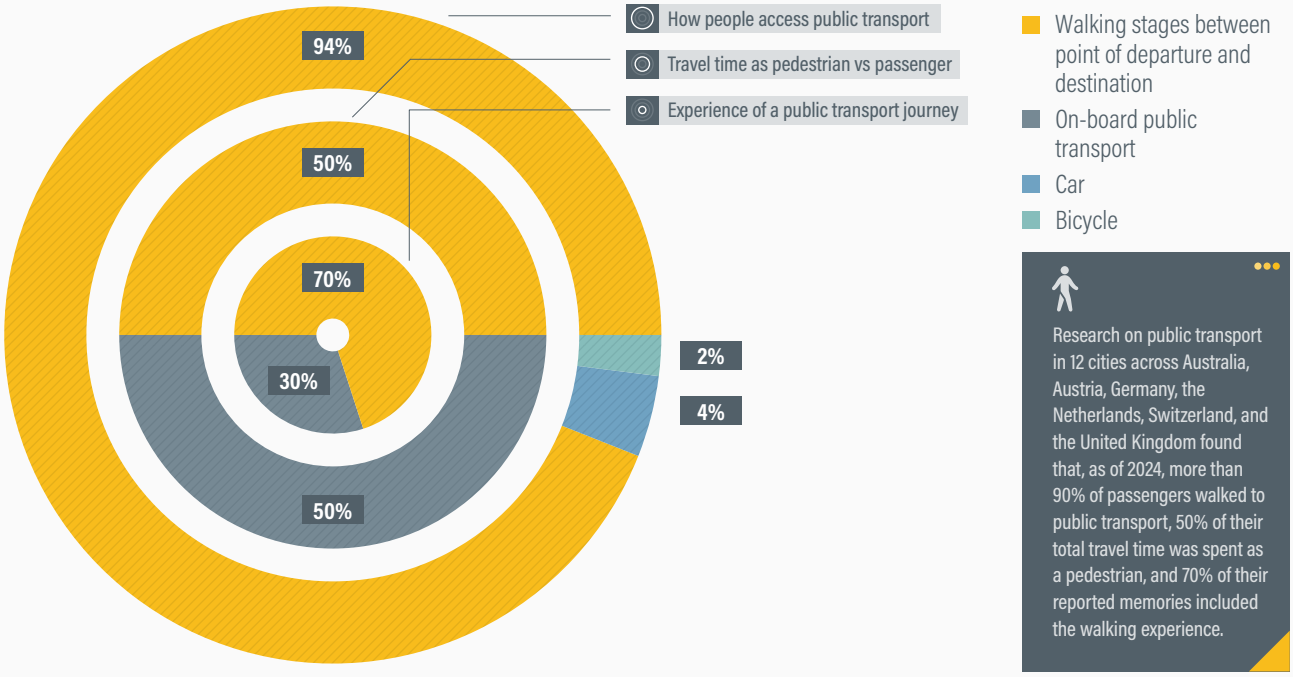
Research on public transport in 12 cities across Australia, Austria, Germany, the Netherlands, Switzerland, and the United Kingdom found that, as of 2024, more than 90% of passengers walked to public transport, 50% of their total travel time was spent as a pedestrian, and 70% of their reported memories included the walking experience (Figure 2).[20] Thus, any improvements to public transport will also require enhancements to the walking experience – which can ultimately support more walking. Realising these improvements necessitates greater acknowledgement of walking as a fundamental element of public transport journeys, as well as the inclusion of walking data in statistics on public transport trips.

In 2022, just half (52%) of the world's urban population lived within convenient access (walking distance) of public transport.[21] "Convenience of access" is defined in SDG 11.2, which aims for urban populations to live within reach of public transport.[22]

- The regions with the lowest shares of access to public transport in 2021 were Western Asia and Africa, where only a third (33%) of the population lived within walking distance of a public transport stop.[23]
- In a 2024 multi-day survey of the walking experiences of 503 people across five public transport hubs in Ulm (Germany), 53% of participants reported these trips as positive, although respondents requested safer crossings, more greenery and better footpaths.[24] By comparing people's positive and negative experiences, the city was able to gain clarity on the types of interventions needed and where to ensure a more seamless and integrated sustainable transport experience.[25]

Women make more frequent walking trips than men, due mainly to their caregiving tasks; yet because many of these trips are undercounted, planning and policies do not cater to women's needs.[26] In major cities, women have a 23% higher likelihood to walk than men, and a 25% higher likelihood to walk to work than men.[27]

FIGURE 2. Surveys related to the walking component of a public transport journey



Source: See endnote 20 for this section.



- A 2022 study of 19 cities across 13 countries found that in the 3 cities with the highest levels of walking – Accra (Ghana), Delhi (India) and Kisumu (Kenya) – 59% of women's trips were on foot, compared to 45% of men's trips.[28]
- In the main cities of Bihar state (eastern India), women accounted for 61% of all walking trips in 2020.[29]

Promoting walking and cycling has been identified as a potential solution to boost physical activity levels and counter the persistent burden of inactivity.[30] **As of 2016, an estimated 81% of adolescents and 27.5% of adults globally were not meeting the recommended physical activity levels of 60 minutes or more daily for adolescents and 150 minutes or more weekly for adults.**[31] In 2022, women were less active than men by 5 percentage points at a global level, and by more than 10 percentage points in 61 assessed countries.[32]

Studies have shown that walking for 30 minutes or cycling for 20 minutes regularly can reduce mortality risk by 10%.[33]

- An estimated 3-5 million premature deaths per year could be prevented if a greater proportion of the population were to engage in regular walking and cycling.[34]
- The World Health Organization's (WHO) global target is to reduce physical inactivity in adults and adolescents 15% by 2030.[35]

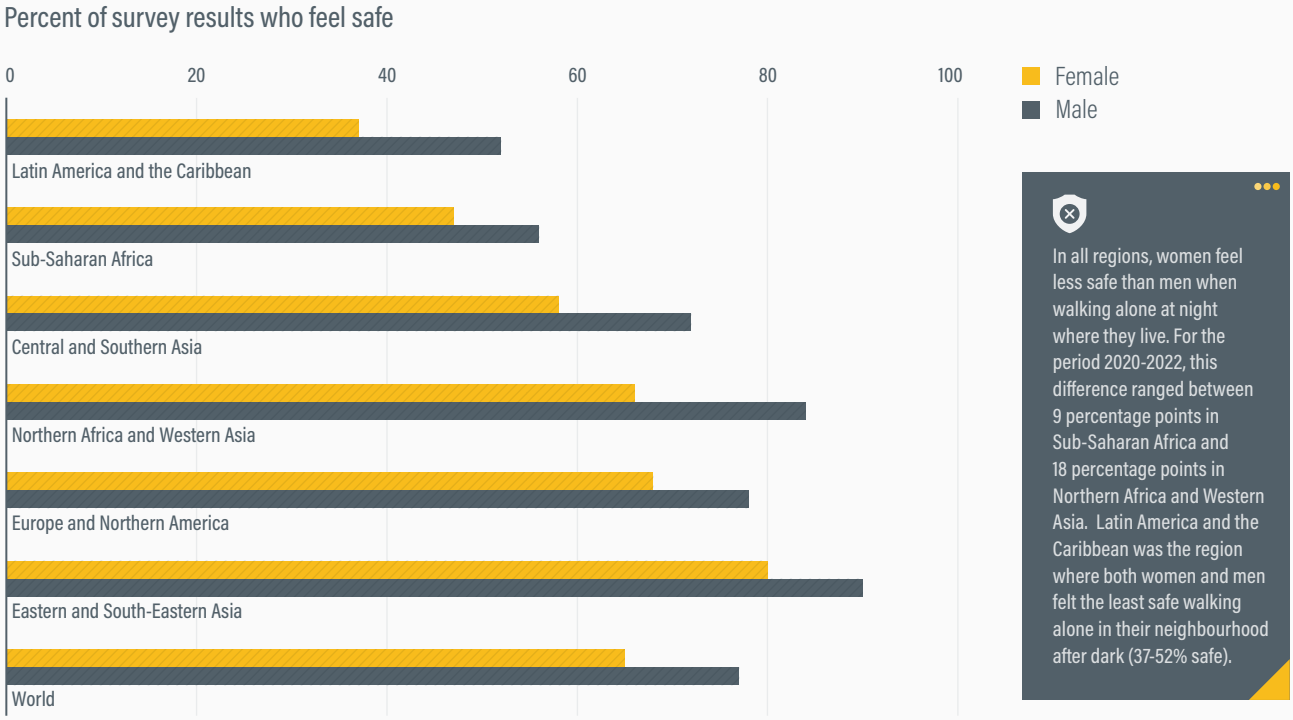
Walking for transport can play an important role in supporting active lifestyles. In a global study of 104 countries, walking and cycling for travel accounted for 36% of the total physical activity of adults who reported undertaking physical activity.[36] As of 2021, 19-25% of residents across five major Latin American cities were able to achieve the recommended physical activity levels through walking for transport alone.[37]

Sustainability and climate trends

Traditional transport planning often overlooks women's mobility patterns, resulting in infrastructure that benefits motorised travel and does not serve women's needs or protect them.[38] **Inadequately lit pedestrian environments expose people (especially women) to an elevated risk of harassment and violence, while the absence of sidewalks and pedestrian crossings puts everyone (especially people with disabilities, children and older people) at higher risk from road crashes.**[39]

Among the 17 UN Sustainable Development Goals, only one – SDG 16 on Peace, Justice and Strong Institutions – has an indicator that refers directly to walking (specifically, perceived safety while walking). Target 16.1 aims to reduce violence and related death rates, and Indicator 16.1.4 measures the share of people who feel safe walking alone in their neighbourhood after dark.[40] However, this indicator was

FIGURE 3. Share of people who feel safe walking alone at night where they live, by region and gender, 2020-2022



Source: See endnote 42 for this section.

not part of the 2024 SDG global progress report, despite 23 countries reporting it in 2022 and 15 in 2023.[41]

In all regions, women feel less safe than men when walking alone at night where they live. For the period 2020-2022, this difference ranged between 9 percentage points in Sub-Saharan Africa and 18 percentage points in Northern Africa and Western Asia (Figure 3)**.**[42] **Latin America and the Caribbean was the region where both women and men felt the least safe walking alone in their neighbourhood after dark (37-52% safe).**[43]

- People felt the most safe walking alone at night in Eastern and South-Eastern Asia (80-90% safe).[44]
- The discrepancies in perceived safety between women and men totalled 14 percentage points in Central and Southern Asia, 15 in Latin America and the Caribbean, and 18 in Northern Africa and Western Asia.[45]
- Only six countries have reported this indicator for women since 2022, limiting the availability of updated data.[46]

The need for inclusive pedestrian environments that are gender responsive and accessible for all users is increasingly recognised. Research shows that when gender is not part of the planning process, the solutions likely benefit men more than women.[47] Integrating a gender perspective into mobility systems involves understanding the daily travel patterns of women and their diverse needs, addressing gender-based violence to improve women's security and their perception of it, and incorporating women into the planning and policy processes.[48] People with mobility limitations need specific and careful interventions in the environment to enable them to independently access their communities.

SDG Target 11.7 – on access to public space – could be adapted to provide more information about women's experiences when walking, to help improve these experiences and to enable women to exercise their right to the city. Target 11.7 aims to "provide universal access to safe, inclusive, accessible and green public spaces, particularly for women, children, older persons and persons with disabilities, by 2030".[49] It includes an indicator (11.7.2) on the share of people who have been victims of non-sexual or sexual harassment in the previous 12 months (disaggregated by sex, age, disability status and place of occurrence).[50]

Road traffic deaths overall fell 5% between 2010 and 2021, but fatalities among pedestrians rose 3%.[51] **Road traffic crashes claimed an estimated 1.19 million lives worldwide in 2021, with pedestrians representing 21% of all fatalities.**[52] Young pedestrians are more at risk in low- and middle-income countries – where 92% of all road traffic fatalities occurred in 2021 – than in high-income countries.[53]

The highest shares of pedestrian fatalities among road traffic deaths in 2021 were in Africa (33%) and the Eastern Mediterranean (26%), whereas South-East Asia and the Americas had the lowest shares (17% each).[54] However, between 2018 and 2021 the share of pedestrian fatalities increased from 14% to 17% in South-East Asia, while declining in all other regions.[55]

- In the EU, where pedestrians are the most vulnerable urban road users, the number of road crash victims increased 4% in 2022.[56]
- One-third (33%) of all EU fatalities in urban areas in 2022 were people walking, and more than half (65%) of these deaths were from collisions involving private vehicles.[57]

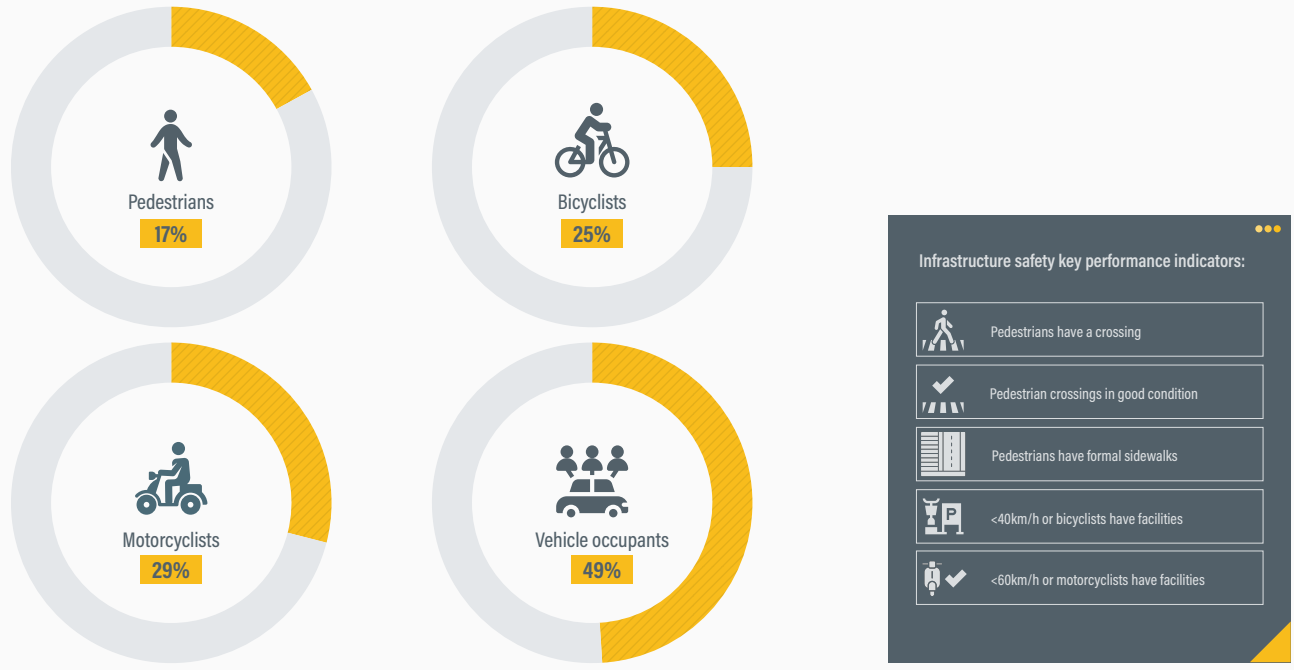
In 2021, the annual economic cost to society from pedestrian road casualties exceeded an estimated USD 940 billion globally.[58] **Low- and middle-income countries accounted for 89% of the victims and 68% of the economic cost.**[59] **Although Africa had only 3% of the world's registered vehicles in 2021, it suffered almost 20% of global road traffic deaths that year.**[60]

As of May 2025, only 17% of assessed roads in 88 countries attained a three-star or better rating (out of five) for pedestrian safety, whereas nearly half (49%) of assessed roads met this standard for vehicle occupants (Figure 4)**.**[61] This highlights the urgency of providing safe infrastructure for pedestrians.

- In urban areas, 34% of roads attained a three-star or better rating for pedestrians, compared to 65% for vehicles.[62]
- Of the assessed roads globally, only 7% had adequate sidewalks (17% in urban areas) and 8% had safe crossings (13% in urban areas).[63]

As of 2023, half of surveyed drivers across 48 countries reported exceeding the speed limit.[64] **Speeding was responsible for one-third of road crashes in high-income countries in 2017, and this share is likely to be even higher in low- and middle-income countries given the large proportions of deaths of pedestrians, cyclists and motorcyclists.**[65] **Elevated speeds are also directly associated with increased greenhouse gas emissions and noise levels.**[66] Consequently, implementing a speed management strategy can yield favourable outcomes in environmental quality and the creation of liveable communities.[67]

FIGURE 4. Assessed quality of the world's roads for safety, as of May 2025



Source: See endnote 61 for this section.



Providing safe walking and cycling infrastructure is a quick, affordable and reliable way to reduce transport emissions by 20-50%.[68]

- **A modal shift study in Australia estimated that substituting just 1% of automobile travel with walking (or cycling) could result in a 2-4% reduction in motor vehicle emissions.**[69]
- A UK study found that walking (or cycling) had the potential to replace 41-69% of short car trips and to save 5-10% of carbon dioxide (CO_2) emissions from car travel.[70]

Policy and investment developments

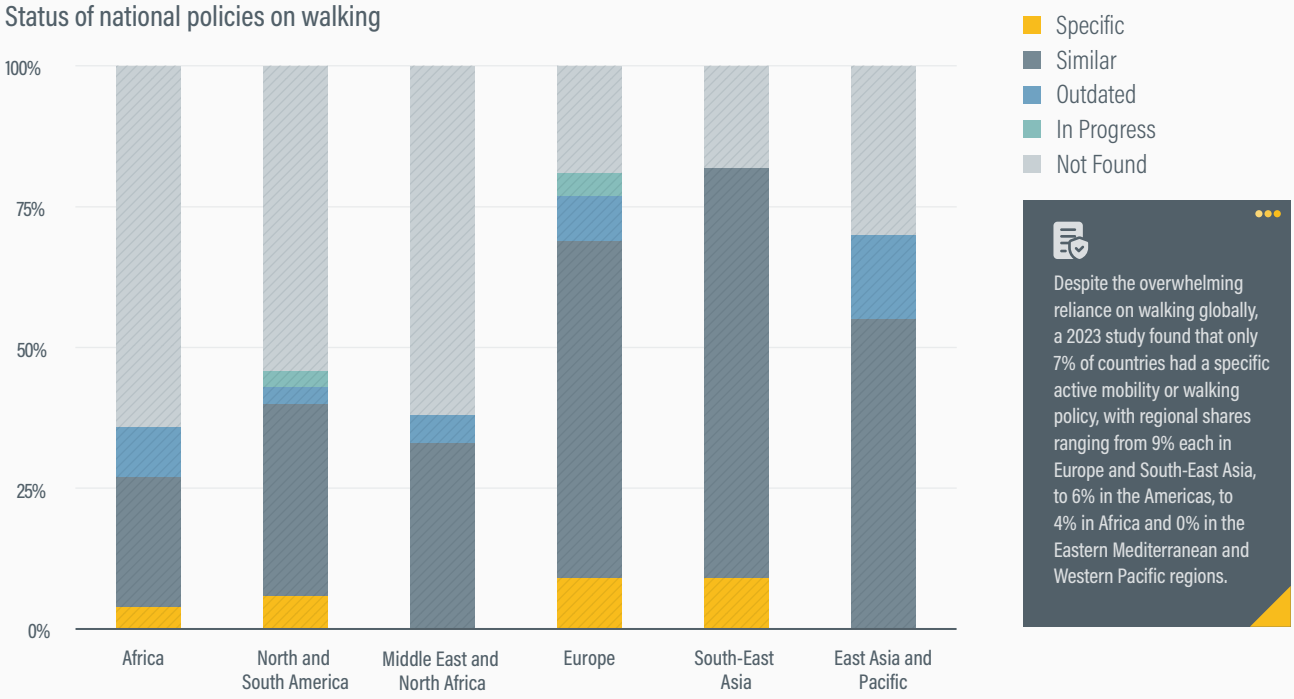
Despite their decarbonisation benefits, walking and cycling remain underrepresented in climate change policies and in countries' Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement.[71] **Integrating walking into national policies and improving data collection are crucial steps towards enhancing public health, reducing environmental impact and achieving various SDG targets.**

In 2022, the WHO identified significant gaps in data collection and monitoring of walking and cycling, including a lack of global indicators and data on the provision of related infrastructure and networks.[72] Understanding the number of minutes spent in active mobility can help in accurately ascertaining the health benefits from walking.

More than 100 countries worldwide have utilised the WHO's Global Physical Activity Questionnaire, which is designed to provide a more accurate measurement of walking and to help authorities assess the extent to which walking and cycling for travel occur on a typical day.[73] The survey offers a standardised, valid, reliable, relatively inexpensive and easily administered protocol that identifies transport-related physical activity. In some cases, respondents are equipped with accelerometers (activity watches), pedometers (step-counters) or global positioning system (GPS) units to validate their responses.

As of 2018, fewer than half (73) of 174 countries analysed had national policies to promote or support walking and/or cycling (mostly high-income countries), and only 27 countries had sub-national policies.[74] Despite the overwhelming reliance on walking globally, a 2023 study

FIGURE 5. Status of national policies on walking by region, 2023



Source: See endnote 75 for this section.

found that only 7% of countries had a specific active mobility or walking policy, with regional shares ranging from 9% each in Europe and South-East Asia, to 6% in the Americas, to 4% in Africa and 0% in the Eastern Mediterranean and Western Pacific regions (Figure 5).[75]

By contrast, 127 countries had national policies and funding for public transport as of 2018.[76] While this investment in public transport is promising, it underscores the need to recognise that every public transport user is also a pedestrian. Improved understanding of this experience could result in more effective investment strategies for public transport, such as the potential to enhance its efficacy and to greatly boost ridership, helping to optimise the financial return. A policy brief outlining the benefits of integrating walking and public transport has inspired several countries to collect data on the walkability of catchment areas around public transport stops to increase ridership and customer satisfaction.[77]

As of 2023, a total of 124 of the 197 member countries of the UN Framework Convention on Climate Change had integrated walking into a national policy and/or a NDC aimed at reducing greenhouse gas emissions.[78] However, only 17% of these policies had a visible, dedicated budget, and less than 30% had an evaluation mechanism, revealing a significant gap between stated commitments and actionable delivery.[79] Enhancing funding and evaluation mechanisms would help translate policies into measurable progress.

As of 2023, 80 countries (41%) addressed walking in their national policies but not in their NDCs, and 13 countries (7%) integrated walking in their NDCs but not in national policies.[80] These countries have an opportunity to reinforce policy coherence. There is a need for a common system to develop climate policies that address walking.

Only 31 UNFCCC member countries (16%) as of 2023 had both a national policy and an NDC addressing walking.[81] Many of these strategies have been published since the COVID-19 pandemic began in 2020. A total of 73 countries had yet to develop a national policy or NDC integrating walking.[82]

The most common objectives in national policies addressing walking as of 2023 were to increase physical activity (36%), to improve road safety (32%), and to mitigate climate change (28%), followed by aims to improve accessibility (23%) and comfort (14%).[83] The most common actions in policies were: providing infrastructure (35%),



developing campaigns (29%), integrating walking in public transport (28%) and land-use planning (28%), and building capacity (22%).[84]

Most of the NDCs that mentioned walking and cycling as of 2023 aimed to increase the share of people using these modes; only 6% had a goal to increase physical activity, and less than 3% mentioned road safety and other objectives.[85] In terms of actions, 13% of the NDCs mentioned the need to provide infrastructure, while fewer than 4% included actions such as campaigns, land-use planning, integration of public transport and capacity building for walking.[86]

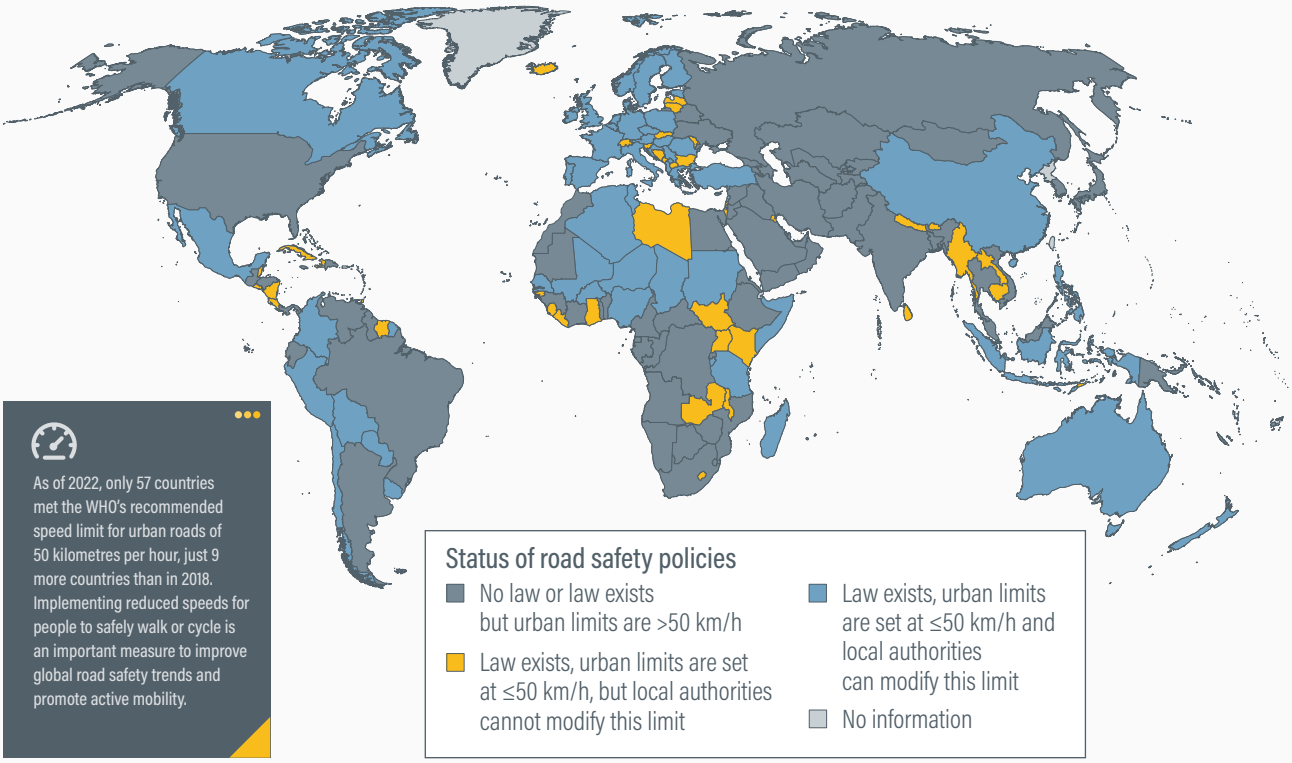
As of August 2025, 29 countries had submitted new (third-generation) NDCs to the UNFCCC (see Spotlight on Transport Ambition in NDCs 3.0).[87] **The third-generation NDCs of nine countries – Brazil, Canada, Lesotho, Monaco, Nepal, Singapore, the United Arab Emirates, the United States and Uruguay – featured climate action in relation to walking (often subsumed under active transport) to mitigate greenhouse gas emissions in the transport sector.**[88]

- Canada's third-generation NDC highlights the Canada Public Transit Fund, which starting in 2026, will provide an average of USD 2.1 billion (CAD 3 billion) per year to support active and public transport.[89]
- Nepal's new NDC commits to the development of an active mobility transport policy by 2030.[90]
- The third-generation NDC of the United Arab Emirates outlines plans by Abu Dhabi, Dubai, and other cities to pursue sustainable urban planning, with a focus on mixed land use and the development of walking and cycling infrastructure.[91]

Regional plans for walking have also begun to emerge. The first Pan-European Master Plan on walking, released in 2024, has the potential to put walking at the forefront of mobility policies in 56 countries.[92] The first Pan-African Action Plan for Active Mobility (PAAPAM) was also launched in 2024 and provides a framework to prioritise the needs of pedestrians and cyclists across the region (see section on Partnerships in action).[93]

Walking has often been overlooked in urban planning, although some countries and cities have integrated efforts to improve pedestrian infrastructure in their plans. In low- and middle-income countries, improved footpaths are a highly cost-effective means to mitigate greenhouse gas emissions and enhance public health and safety in cities.[94] Globally, work is under way to quantify the value of walking in transport appraisal methodologies, including for public transport, but much remains to be done.[95]

FIGURE 6. Status of speed laws by country, 2022



Source: See endnote 102 for this section.

- In Brazil, where walking accounted for 27% of trips and cycling for 3% as of 2024, 67 cities had committed to building more bike lanes, but only 23 cities reported plans to extend sidewalks.[96]
- In Chennai (India), more than 100 kilometres of sidewalks were built between 2013 and 2019, promoting a 9-29% shift to walking, avoiding an estimated 4,200-12,000 tonnes of CO_2 emissions annually, and improving the perception of road safety and personal security to 95%.[97]

In NDCs and other strategies, policy makers have increasingly adopted more systemic, multi-disciplinary approaches to walking that connect across departments; prioritise the safety, comfort and enjoyment of the pedestrian; and deliver immediate, measurable benefits (which can often be reported using existing datasets).[98] However, datasets on walking continue to show gaps and limitations, which can be improved through additional local data collection. The systemisation of knowledge into action and understanding of the impact is emerging, giving practitioners confidence and creating momentum for action.

The greatest improvements in road safety have been achieved in countries where the Safe System approach has been adopted.[99] This approach shifts the responsibility from road users to road designers and operators and puts people and safety at the heart of mobility systems through four core areas: safe roads, safe speeds, safe road users and safe vehicles.[100] Reducing pedestrian injuries and fatalities on roads leads to safer and healthier environments that can in turn increase the number of pedestrians and cyclists and reduce motorised travel and related emissions.[101]

As of 2022, only 57 countries met the WHO's recommended speed limit for urban roads of 50 kilometres per hour, just 9 more countries than in 2018 (Figure 6).[102] **Implementing reduced speeds for people to safely walk or cycle is an important measure to improve global road safety trends and promote active mobility.[103]** Further steps to reduce road crashes and improve safety include minimising the environmental impacts and implementing enforcement measures.[104]

Box 1. Useful tools to gain insights on walking

The WHO's **Health Economic Assessment Tool** (**HEAT**) for walking and cycling is designed to quantify the health and economic benefits of active mobility. By providing evidence-based estimates, HEAT supports informed decision making that promotes healthier, more sustainable and economically beneficial transport systems. HEAT calculates the effect that walking has on premature mortality considering physical activity levels, exposure to air pollution, the risk of road crashes and changes in carbon emissions resulting from shifts from motorised modes.

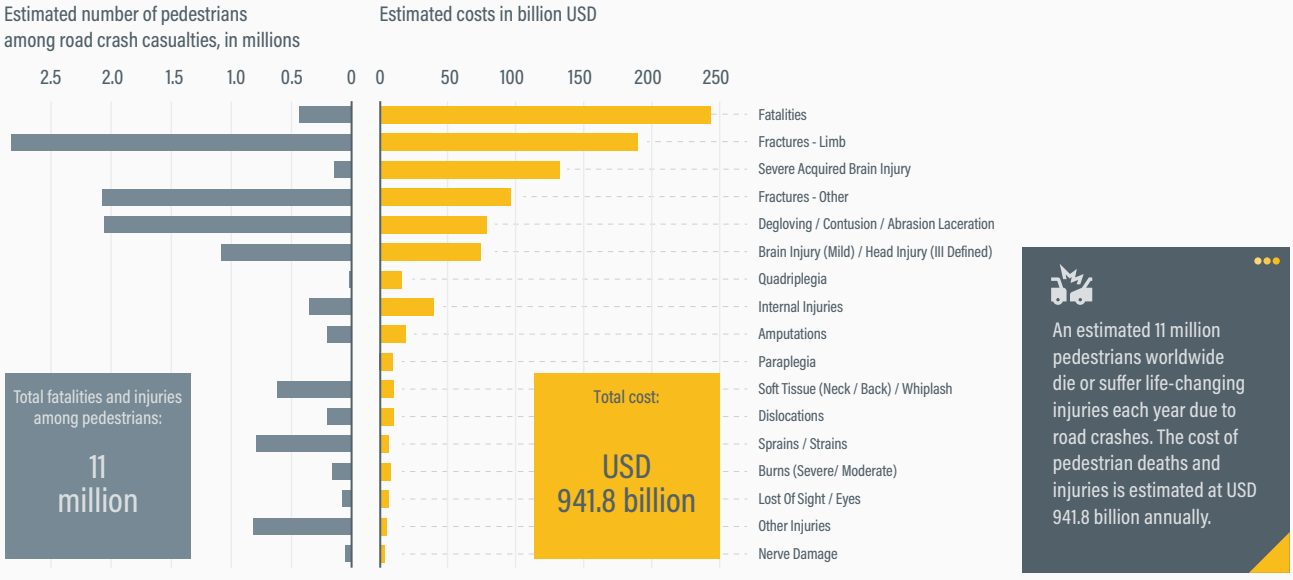
The **Star Rating for Schools** programme and associated **Youth Engagement App**, hosted by the International Road Assessment Programme (iRAP) and delivered by partners worldwide, provides a practical and objective tool to measure the risk of pedestrian journeys to school and inform speed changes and infrastructure upgrades to improve safety.

The iRAP **Safety Insights Explorer** provides insights on the scale of pedestrian casualties and the widespread lack of infrastructure investment (Figure 7).

- The **Walkability App** is a crowdsourcing tool designed to gather real-time insights into walking experiences across diverse communities, ages and abilities – helping communities and authorities understand walkable places and identify areas that need improvement based on people's perceptions. In Lisbon (Portugal), the app is being used to validate existing investments in public spaces, evaluate their success and inform future decision making. In 2024, more than 600 people were interviewed to gain insight into how public spaces influence people's experiences and on how best to ensure consideration of the needs and concerns of people with different abilities. The preliminary results found that children, older adults, women and people with reduced mobility had more negative experiences in public spaces because of specific needs and concerns. The final report aims to help the municipality prioritise interventions and assess their impact, so that future policies are effective for everyone.

Source: See endnote 105 for this section.

FIGURE 7. Estimated pedestrian road crash casualties and costs, 2021



Partnerships in action

Global, regional and national partnerships are essential for creating momentum around walking, enabling knowledge sharing, policy alignment and co-ordinated action across multiple scales. These collaborative efforts facilitate the exchange of best practices and create synergies that amplify action through broader networks. These partnerships are developing policy frameworks and toolkits, creating data collection tools, conducting research and putting walking at the centre of the conversation.

- The **Partnership for Active Travel and Health (PATH)** is a global coalition advocating for walking and cycling as essential solutions to address climate change, improve public health and advance social equity. More than 400 organisations worldwide are part of the PATH network, funded and led by FIA Foundation along with Walk21, the European Cyclists' Federation and the UN Environment Programme.[106] PATH calls on governments to make substantial commitments to active travel and publishes reports with data and actions to support the integration of walking into national policies and strengthen road safety.[107]
- PATH's **Active Travel NDC Template**, developed in 2024, assists national governments in integrating walking and cycling into their climate commitments, include their third-generation NDCs. In 2025, PATH planned to review these latest NDC submissions to evaluate if more countries have recognised the value of supporting and encouraging walking as a quick, affordable and reliable way to reduce transport emissions.[108] The template has a people-centred vision and can be used to steer transport, health, and environmental policies, where enabling walking and cycling is an ambition.[109]
- In February 2024, PATH co-ordinated the **Global Blind Spot** report to draw attention to the lack of policy commitment and investment for essential infrastructure, and the subsequent impact on people walking and cycling.[110] The report was launched at the **Global Ministerial on Road Safety**, where 25 countries made new commitments to road safety, including mentions to improve pedestrian safety by the Philippines, Tanzania and Thailand.[111]
- The **Pan-African Plan for Active Mobility** (PAAPAM), developed with more than 1,300 stakeholders across the region, presents a pathway of principles, goals and actions to place the needs of pedestrians and cyclists at the centre of transport planning for the coming decade.[112] The framework's three action areas are focused on advocating and creating places, policies and investment processes that promote walking and cycling in 54 countries.[113]
- The **Pan-European Master Plan on Walking**, embedded in the Vienna Declaration and adopted in 2024, sets a framework to prioritise walking by developing and implementing national walking policies and plans; integrating walking into other national policies, encouraging walking; improving safety and security; and providing and improving walking infrastructure.[114]
- A 2024 **policy brief on the importance of walking and public transport** provides recommendations to increase walking activity and public transport ridership by creating and promoting safe, accessible and comfortable walkable catchments to and from public transport stops and stations.[115] Further research in this area includes studies in Egypt with **Transport for Cairo** as well as European initiatives through **Active2Public Transport**, **Unleashing the Potential of Public Transport in Europe** and **Active Cities**.[116]
- In 2025, the WHO hosted the **8th UN Global Road Safety Week**, focused on the theme "Make walking and cycling safe".[117] The campaign emphasised concrete and specific interventions at the national and local levels to improve road safety for pedestrians and cyclists.[118]
- A **WHO toolkit** aims to promote safe walking and cycling at a policy level and is focused on integrating active mobility into all relevant policies, building safe infrastructure, setting and enforcing safe speed limits, promoting safe road use and using financial incentives to promote walking and cycling.[119]



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Cycling



KEY FINDINGS

Context, challenges and opportunities

- After a strong boom in bicycle sales during the COVID-19 pandemic in 2020 and 2021, sales stagnated in 2023. In 2022, the global bicycle fleet totalled some 1 billion units, including around 450 million in China and 100 million in the United States.
- E-bikes are the primary growth driver in the bicycle industry, representing 10% of global bicycle sales in 2021 and 30% of the European market in 2023. In 2022, Asia continued to lead the world's e-bike market, followed by Europe and North America. The e-bike market is projected to grow 10-15% annually by 2030.
- Shared bike systems – an impactful alternative to private motorised transport – have expanded greatly, setting new record highs in Europe and North America in 2024 and 2023 respectively. Technology improvements and easier access to services in recent years have helped spur growth.
- The rising demand for cycling for transport since 2020, in combination with the impacts of the COVID-19 pandemic, led to expansion of cycling infrastructure in many areas.



- Although a consistent global methodology is lacking for measuring cycling's share of overall trips, a 2024 analysis of 800 cities found that this share was highest in Asia and Europe.
- Cycling has increased dramatically in cities that have invested in cycling infrastructure. In 2023, New York City (United States) experienced all-time highs in cycling levels, with much of the growth linked to the increase in safe cycle infrastructure.
- The average cycling distance varies widely by country and city, reflecting differences in culture, infrastructure quality, demographics, urban form, topography and weather. As of 2021, most cycling trips globally were 5 kilometres or less, suggesting that cycling can be a reliable alternative for short journeys and can thus greatly reduce CO_2 emissions from urban transport. To achieve these benefits, integrated land use efforts and urban and transport planning should ensure that residents can access services within this distance, particularly in places with high urban sprawl.
- A substantial gender gap in cycling persists in cities across the world, although in some northern European countries (Denmark, Germany, the Netherlands), levels of cycling are generally balanced between women and men.
- Globally, the most important enabler of a high modal share for cycling continues to be the presence of good-quality paved roads and safe cycling infrastructure, particularly with features that separate cyclists from vehicle traffic.
- As of 2023, only 5% of the global population had access to a protected bike lane within 300 metres. Regional disparities were significant: whereas 27.6% of people in Europe had access to protected bike lanes, just 0.7% in Africa did.
- Cycling as a way to transport goods – known as cycle logistics – has continued to gain traction among bicycle manufacturers as well as owners of small and medium-sized businesses, entrepreneurs and gig workers. The cargo bike market was valued at USD 7.9 million in 2024, and big companies have increasingly caught on, often through the use of electric cargo bicycles.

KEY FINDINGS

Sustainability and climate trends

- Cycling brings numerous benefits for the economy and employment. The economic case for cycling has been demonstrated by studies showing an average benefit-cost ratio ranging from 2:1 to 19:1.
- The multi-modal combination of cycling and public transport is a powerful alternative to individual car use, boosting sustainable mobility as well as a range of benefits to society, the economy and environment in nearly any city, region and country.
- Economic appraisals based on broad sustainability criteria demonstrate that public transport, in combination with cycling and walking, offers a high return on investments. An inter-modal transport system based on these modes requires half the transport spending from governments and individuals compared to a car-centric system, even without accounting for the health and productivity benefits related to improved air quality and reduced traffic congestion.
- Studies have shown that people with e-bikes ride more frequently because the bikes are increasingly seen as genuine car replacers. Riding an e-bike, a person can cover longer distances than traditional pedal bikes with less effort, contributing to large reductions in traffic congestion, noise and air pollution, and transport emissions.
- Cyclists accounted for 5% of the 1.2 million people killed from road crashes in 2021, although these deaths vary widely by country income level. In countries with high motorisation levels but a lack of sufficient quality of cycling infrastructure, cyclists make up a higher share of road fatalities. In 2021, cyclists represented nearly 8% of road deaths in upper-middle-income countries, but only around 3% in low-income and lower-middle-income countries.
- Despite these trends, research indicates that the health benefits of cycling outweigh any kind of negative impacts related to cycling. A 2023 study found that increasing cycling activity 50% over current levels can result in a 12% net reduction in overall mortality. A study of urban populations aged 20 to 64 years in 17 countries globally found that a scenario of high bike use – where 100% of bike trips replace car trips – could prevent 205,424 premature deaths annually by 2050 (considering road traffic fatalities, air pollution and physical activity impacts).
- Due to their flexibility and low cost, bicycles have helped various cities and communities respond to sudden shocks and crises, from natural disasters to armed conflict.
- Cycling is the most energy-efficient mobility mode, using 27 times less energy per kilometre than a battery-electric car. People who cycle every day emit 84% fewer carbon emissions from their daily travel than those who do not. Even though the bulk of the greenhouse gas emissions from transport are caused by long-distance travel, regular bicycle use and substituting a car trip per day would reduce per capita CO_2 emissions 7% per year in the European context.



KEY FINDINGS

Policy and investment developments

- Cycling has gained growing recognition as a vital tool for climate action, including at the highest levels of global climate talks. From the annual United Nations Climate Change Conferences to national climate strategies, policy makers have highlighted cycling not just as a mode of transport, but as a low-cost, low-emission solution with wide-ranging benefits for health, equity and urban resilience.
- At the regional level, in 2024 the European Union adopted the European Declaration on Cycling, its highest-level political strategy to integrate cycling in transport systems at all levels of governance.
- As of 1 August 2025, only 8 (28%) of the 29 countries that had submitted third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement mentioned cycling among their greenhouse gas mitigation actions for transport (Brazil, Canada, Lesotho, Monaco, Nepal, Singapore, the United States and Uruguay). In general, NDCs have undervalued active travel.
- As of 2023, only 10 (5%) out of 197 countries assessed had both a national cycling policy and an NDC addressing cycling: Bangladesh, Bhutan, Chile, Colombia, Costa Rica, Ethiopia, Rwanda, Singapore, Uganda and Venezuela. Meanwhile, 17% of the assessed countries had a national cycling policy but their NDC did not include cycling, while the majority of countries (59%) had neither a national policy nor an NDC on cycling.
- Even so, national cycling strategies have been on the rise since 2023, with more countries adopting dedicated plans that prioritise active mobility, integrate cycling into transport and climate policies, and invest in safer, more connected infrastructure. Countries that have new or updated national cycling promotion strategies include Croatia, Germany, Japan, Lithuania and the Netherlands.
- Sub-national governments – including regions, provinces and cities – are also increasingly launching cycling strategies and infrastructure initiatives, often in co-ordination with or even outpacing national efforts.
- Greater recognition of the economic benefits of cycling has generally led to rising investment in cycling, as well as plans for increased investments in the sector.
- Cycling expenditure varies greatly by country, with higher values in areas with high levels of cycling.





Context, challenges and opportunities

Cycling's prominence as a transport mode has grown substantially in the past few years, boosted by the effects of the COVID-19 pandemic and by growing recognition of cycling's role in combating climate change, improving health and fostering economic growth.[1] Since the pandemic, countries have integrated temporary cycling infrastructure into long-term networks and adopted cycling strategies at the national, sub-national and international levels – amid a steadily expanding global bicycle market.

Although bicycle sales and exports flattened in 2022 and 2023, the popularity of electric bikes (e-bikes) continued to rise, especially in Global North cities, where they accounted for most of the growth in bicycle sales and use.[2] The global e-bike market is projected to expand 10-15% annually to 2030.[3] In 2022, Asia remained the e-bike market leader, home to more than 64% (30 million) of the 47 million e-bikes sold worldwide, followed by Europe (12 million) and North America (5 million).[4]

Global data on cycling activity remain fragmented, making it difficult to track trends across countries and cities. Cycling rates vary widely by region, with growth in many countries constrained by limited protected bike lanes, gaps in policy implementation, insufficient support for emerging uses such as urban freight delivery, and a lack of standardised methodologies for cost-benefit analysis of investments.[5] In cities that have invested in safe cycling infrastructure, growth has been exponential, with New York City reaching record cycling levels in 2023.[6] Globally, the strongest enabler of a high modal share for cycling is the presence of safe infrastructure that separates cyclists from motor traffic.[7] Yet as of 2023, only 5% of the global population had access to a protected bike lane within 300 metres; in Europe, 27.6% of people had such access, whereas only 0.7% in Africa did.[8]

Studies show that cycling can greatly cut carbon dioxide (CO_2) emissions, particularly for urban trips under five kilometres.[9] Investing in cycling networks is among the most cost-effective ways to reduce greenhouse gas emissions per dollar spent, outperforming even bus rapid transit and metro systems.[10] Cycling also delivers substantial health benefits and provides resilience during shocks such as natural disasters and armed conflict.[11] Overall, cycling's health benefits outweigh any associated risks.[12] Transport systems based on public transport, walking and cycling have been found to deliver higher returns on investment than car-centric models – requiring roughly half the spending, even before accounting for the gains from cleaner air, reduced congestion and improved productivity.[13]

Political attention to cycling has grown. In 2024, the European Union (EU) launched the European Declaration on Cycling, a high-level strategic plan to integrate cycling into transport systems at all levels of government.[14] Cycling – often paired with walking as "active mobility" – has also been featured in several national climate action plans, and efforts to develop national cycling strategies are under way in all world regions. However, progress towards mainstreaming cycling as a daily transport mode remains limited in low- and middle-income countries.

Demand, use and access

After a strong boom in bicycle sales during the COVID-19 pandemic in 2020 and 2021, sales stagnated in 2023.[15] The global bicycle fleet totalled some 1 billion units, including around 450 million in China and 100 million in the United States.[16]

- Asia-Pacific recorded very high levels of bicycle exports in 2020 and 2021; however, overall regional trade in bicycles (imports and exports) fell 12% between 2015 and 2023.[17]
- EU bicycle sales fell 5.5% in 2023; overall, they declined from all-time high of 19.7 million in 2021 to 18.8 million in 2022 and 17.7 million in 2023.[18]
- Bicycle production in the EU decreased 24% in 2023 to 9.7 million units; the greatest decline was in Romania, which produced 1 million fewer bicycles that year.[19]

E-bikes are the primary growth driver in the bicycle industry, representing 10% of global bicycle sales in 2021 and 30% of the European market in 2023.[20] In 2022, Asia continued to lead the world's e-bike market, followed by Europe and North America.[21] The e-bike market is projected to grow 10-15% annually by 2030.[22] E-bikes range in size and form from single-rider urban and racing bikes, to e-cargo bikes that can carry people and goods, to larger e-cargo cycles that can carry freight.

- In 2022, around 47 million e-bikes were sold worldwide, with China selling around 30 million units, Europe selling 12 million and North America selling 5 million.[23]
- China, the largest e-bike market, had a reported 350 million units nationwide in 2021, including more than 183 million units in urban areas.[24] After several Chinese cities banned motorcycle licensing in the early 2000s, many riders adopted lower-cost e-bikes that look like motorcycles but have less weight and power.[25]
- In 2023, for the first time, more e-bikes were sold in Germany than conventional bicycles.[26] E-bikes have outsold electric cars in Germany at a rate of 4 to 1, with 2.1 million units sold in 2024.[27]

Shared bike systems – an impactful way to encourage people to rely less on private motorised transport – have expanded greatly, setting new record highs in Europe and North America in 2024 and 2023.[28] Technology improvements and easier access to services in recent years have helped spur growth.

- In the United States, shared micromobility (bicycles and electric scooters) reached a new record high of 157 million rides in 2023, surpassing the 147 million rides recorded in 2019.[29]
- As of June 2024, the United States had more than 50 docked bike share systems with nearly 9,000 stations; major providers included Bluebikes (Boston), Capital Bikeshare (Washington, D.C.), Citi Bike (New York) and Divvy (Chicago).[30]
- In Europe, 640 million shared mobility trips were recorded in 2024; London and Paris accounted for a third of these trips.[31]
- China led the global bike sharing market in 2022 with companies such as Meituan Bike (formerly Mobike) contributing to a domestic market totalling USD 5.7 billion.[32] As of October 2020, dockless bike sharing systems in China had 287 million users and 19.45 million bikes.[33]
- Bike share systems in India and South-East Asia, particularly in Singapore and Malaysia, have expanded to a large number of stations and market share.[34]
- As of 2024, South America had more than 90 bike share systems in 11 countries, notably in Brazil, Chile and Colombia.[35]
- In Africa, small-scale or pilot bike share systems have been introduced in cities such as Cairo (Egypt), Kigali (Rwanda) and Marrakech (Morocco).[36]

The rising demand for cycling for transport since 2020, in combination with the impacts of the COVID-19 pandemic, led to expansion of cycling infrastructure in many areas.

- Between 2021 and 2025, 2,000 kilometres of protected and unprotected cycling lanes were built in the 34 cities globally that are part of the Cycling Cities campaign.[37]
- As of 2025, 37 European countries provided an estimated combined 467,000 kilometres of cycling infrastructure, of which 378,000 kilometres were physically separated from the main road.[38]

Although a consistent global methodology is lacking for measuring cycling's share of overall trips, a 2024 analysis of 800 cities found that this share was highest in Asia and Europe.[39] The study found that higher-income cities recorded fewer journeys by walking, bicycle or public transport.[40]

- In Asia, cycling had a modal share of 14.8% in 2024, with sub-regional shares of 16.6% in Eastern Asia, 16.5% in Southern Asia and 13% in Western Asia.[41] However, cycling is on the decline in Asian cities and a shift to motorcycles and cars has occurred, based on data from 2018 to 2023.[42]
- In Europe, cycling's modal share was 6.9% overall in 2024 but reached 11.2% in Western Europe.[43]
- In Germany, a 2023 survey found that cycling's modal share has held steady at 11% since 2017, although its share of total passenger-kilometres increased from 3% to 4% during this period.[44]

- Cycling accounted for an estimated 1.7% of all trips in Africa as of 2025; however, this low value is likely due to undercounting, and the lack of data prevents insights for every sub-region.[45]

Cycling has increased dramatically in cities that have invested in cycling infrastructure. In 2023, New York City (United States) experienced all-time highs in cycling levels, with much of the growth linked to the increase in safe cycle infrastructure.[46]

- Around 28% of New Yorkers (nearly 2 million people) cycled in 2023, with more than 762,000 people doing so regularly; on a typical day, more than 620,000 cycling trips occurred city-wide.[47] Daily cycling in New York grew 64% between 2013 and 2023, and 16% between 2018 and 2023.[48]
- In Paris (France), cycling's modal share surpassed that of car driving in 2024: 11.2% of trips in the city were made by bicycle, whereas only 4.3% of trips were made by car.[49]
- Cycling in Bogotá (Colombia) grew 44% between 2011 and 2015, 38% between 2015 and 2019, and 6-8% between 2020 and 2022.[50]

The average cycling distance varies widely by country and city, reflecting differences in culture, infrastructure quality, demographics, urban form, topography and weather.[51] **As of 2021, most cycling trips globally were 5 kilometres or less, suggesting that cycling can be a reliable alternative for short journeys and can thus greatly reduce CO_2 emissions from urban transport.**[52] **To achieve these benefits, integrated land use efforts and urban and transport planning should ensure that residents can access services within this distance, particularly in places with high urban sprawl.** (See SLOCAT's Transport, Climate and Sustainability Global Status Report - 3rd Edition for more on cycling distances.)

A substantial gender gap in cycling persists in cities across the world, although in some northern European countries (Denmark, Germany, the Netherlands), levels of cycling are generally balanced between women and men.[53] A 2019 study found that, at a country level, women's cycling levels are lower than men's across every age group.[54] (See SLOCAT's Transport, Climate and Sustainability Global Status Report - 3rd Edition for more on the gender gap in cycling.)

Globally, the most important enabler of a high modal share for cycling continues to be the presence of good-quality paved roads and safe cycling infrastructure, particularly with features that separate cyclists from vehicle traffic (Figure 1).[55] Other enablers include secure bicycle storage, economic incentives or factors, environmental and health benefits, and seeing other people ride bicycles. Street lighting also impacts cycling, with a cyclist likely to forego a trip if the access road is not well-lit. Other barriers to cycling include being too close to vehicle traffic, perceptions of poor physical fitness and negative perceptions of cyclist communities.[56]

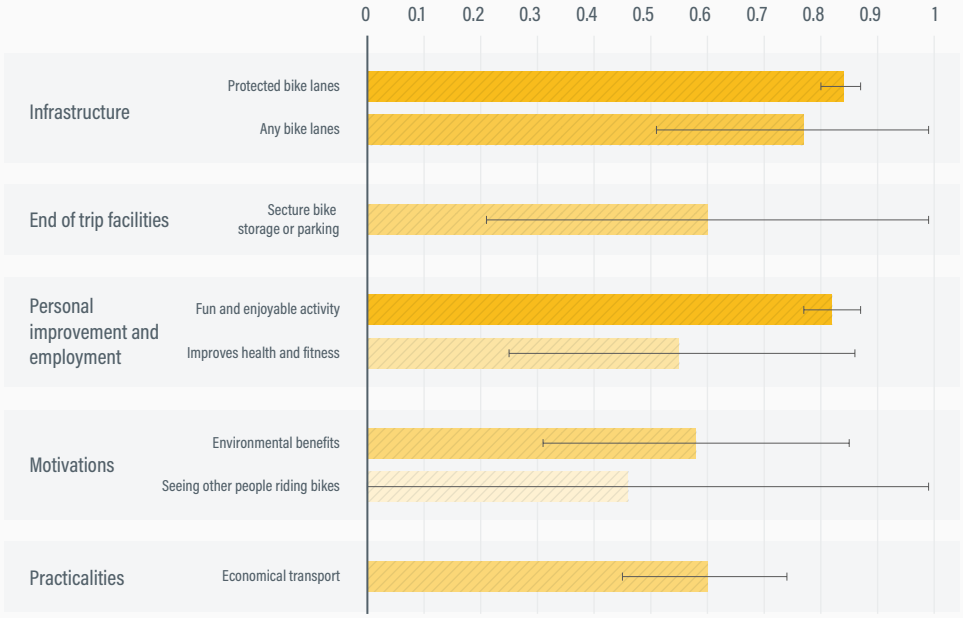
- In a 2022 online survey across 28 countries globally, 52% of respondents said cycling was too dangerous in their area; there was a moderate correlation between perceptions of safety and the share of people cycling for transport.[57]
- A 2025 survey in the United Kingdom found that more than half of women's cycling journeys were constrained by safety concerns.[58] In a UK study from 2023, half of women surveyed cited a fear of cycling at night due to poorly lit roads, isolated cycle routes, anti-social behaviour and fear of harassment from other road users.[59]

As of 2023, only 5% of the global population had access to a protected bike lane within 300 metres.[60] **Regional disparities were significant: whereas 27.6% of people in Europe had access to protected bike lanes, just 0.7% in Africa did** (Figure 2).[61]

Cycling as a way to transport goods - known as cycle logistics - has continued to gain traction among bicycle manufacturers as well as owners of small and medium-sized businesses, entrepreneurs and gig workers.[62] **The cargo bike market was valued at USD 7.9 million in 2024, and big companies have increasingly caught on, often through the use of electric cargo bicycles.**[63]

- Belgium's cycle logistics sector has grown significantly, with deliveries doubling in 2023 to 3.1 million parcels, although these still represented only 1.5% of the country's total parcel deliveries.[64] The Belgian cycle logistics sector reduced an estimated 3,078 tonnes of CO_2 emissions and saved up to USD 11.4 million (EUR 11 million) in congestion-related and societal costs that year.[65]
- The Ich entlaste Städte ("I relieve cities") project in Germany is conducting real-world cargo cycle testing with commercial and public sector users to reduce urban freight transport and service trips by internal combustion engine vehicles, and to alleviate congestion in cities.[66]
- In 2023, numbers of cargo cycles increased 73% in inner London and 63% city-wide; cargo bicycles were estimated to replace up to 17% of van kilometres in central London, improving air quality and road safety and removing 30,000 metric tonnes of carbon emissions annually.[67]

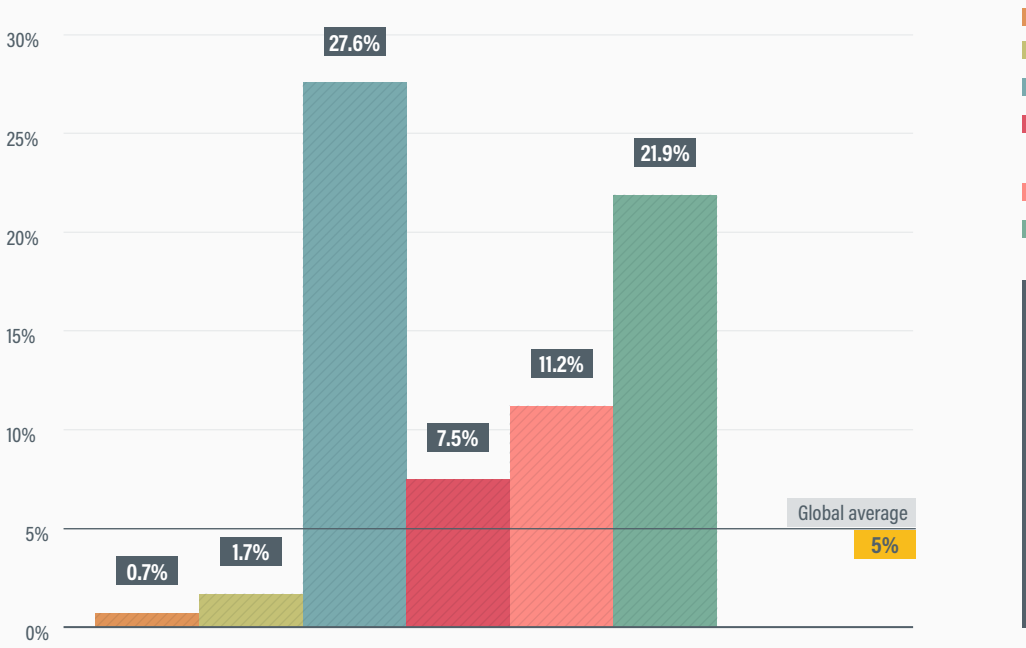
FIGURE 1. Enablers to cycling for transport, based on a 2022 study



Globally, the most important enabler for a high cycling mode share is still the good-quality of paved roads and the presence of safe cycling infrastructure, especially features that separate cyclists from car traffic.

Source: See endnote 56 for this section.

FIGURE 2. Share of population with access to protected bike lanes, by region, 2023



While access to protected cycling infrastructure is a key enabler of cycling for transport, as of 2023, only 5% of the global population had access to a protected bike lane within 300 metres. Regional disparities are significant: 27.6% of people in Europe and have access to protected bike lanes, compared with just 0.7% in Africa.

Source: See endnote 62 for this section.

Sustainability and climate trends

Cycling brings numerous benefits for the economy and employment.[68] The economic case for cycling has been demonstrated by studies showing an average benefit-cost ratio ranging from 2:1 to 19:1.[69] Major economic opportunities can be found in bicycle and parts manufacturing, bicycle retail (sales, repair and services), bicycle tourism and infrastructure development (including shared services).

- In Germany, the cycling industry directly employed 76,700 people in 2024; indirectly, up to 205,000 jobs in the country are linked to the cycling industry, sales and tourism.[70]
- In 2022, Belgium's cycling industry supported 17,434 jobs (up 147% compared to 2015) and generated total revenue of USD 984 million (EUR 951 million) – up 90% compared to 2015.[71]
- The cycling industry in the Netherlands employed 13,000 people across 3,350 companies in 2020; the total added value was USD 1.14 billion (EUR 1.1 billion), and the total export value was USD 2 billion (EUR 1.9 billion).[72]

The multi-modal combination of cycling and public transport is a powerful alternative to individual car use, boosting sustainable mobility as well as a range of benefits to society, the economy and environment in nearly any city, region and country.[73] Cycling, as an alternative to walking to reach public transport stations, helps improve the accessibility and flexibility of public transport by broadening its reach to a wider catchment area.[74] Cycling as an alternative to motor vehicles helps avoid the negative environmental impacts of cars, while freeing up funding for cycling infrastructure.

- Brest (France) has integrated shared bike systems into public services contracts, with a service level requirement similar to other means of transport. This enables users to engage in long-term bike rentals (up to 12 months), use shared bike systems, bring bikes on trams during off-peak hours and secure bike parking at station hubs.[75]
- After a survey found that people in Singapore wanted more seamless connections in their journeys, the country developed a "Walk-Cycle-Ride" strategy. Singapore's land transport authority is considering how to incorporate cycle networks into public transport infrastructure and planning.[76]
- Mexico City (Mexico) is integrating cycling with public transport by providing 10 free mass bicycle parking facilities (ranging from 80 to 408 spaces) in subway stations or modal transfer centres.[77]

Economic appraisals based on broad sustainability criteria demonstrate that public transport, in combination with cycling and walking, offers a high return on investments.[78]

An inter-modal transport system based on these modes requires half the transport spending from governments and individuals compared to a car-centric system, even without accounting for the health and productivity benefits related to improved air quality and reduced traffic congestion. (See Spotlight on Economic Appraisals.)

Studies have shown that people with e-bikes ride more frequently because the bikes are increasingly seen as genuine car replacers.[79] Riding an e-bike, a person can cover longer distances than traditional pedal bikes with less effort, contributing to large reductions in traffic congestion, noise and air pollution, and transport emissions.[80] E-bikes are normal bicycles in that they require human power, but they have an electric motor that assists with pedalling. The most widely used e-bikes have a motor of up to 250 watts, and the electric assist shuts off when the bike reaches a maximum speed of 25 kilometres per hour in Europe and 32 kilometres per hour in the United States.[81]

Cyclists accounted for 5% of the 1.2 million people killed from road crashes in 2021, although these deaths vary widely by country income level.[82] In countries with high motorisation levels but a lack of sufficient quality of cycling infrastructure, cyclists make up a higher share of road fatalities.[83]

- **In 2021, cyclists represented nearly 8% of road deaths in upper middle-income countries, but only around 3% in low-income and lower-middle income countries.[84]**
- Between 2010 and 2021, cyclist deaths rose 50% in Europe (accounting for 6% of fatalities) and 88% in the Western Pacific region, where cyclists represented up to 15% of road fatalities in 2021.[85]

Despite these trends, research indicates that the health benefits of cycling outweigh any kind of negative impacts related to cycling. A 2023 study found that increasing cycling activity 50% over current levels can result in a 12% net reduction in overall mortality.[86] A study of urban populations aged 20 to 64 years in 17 countries globally found that a scenario of high bike use – where 100% of bike trips replace car trips – could prevent 205,424 premature deaths annually by 2050 (considering road traffic fatalities, air pollution and physical activity impacts).[87] (See 1.7 Driving Health and Wellbeing Forward: The Critical Link with Transport.)

- A more conservative scenario – where only 8% of bike trips replace car trips – could prevent an estimated 18,589 premature deaths annually by 2050.[88]
- In all countries and scenarios, the mortality benefits from bike use (compared to car use) outweighed the mortality risks.[89]
- The biggest impact would be in India (where even in the

conservative scenario 6,957 premature deaths could be avoided), followed by China (4,127 avoidable premature deaths).[90]

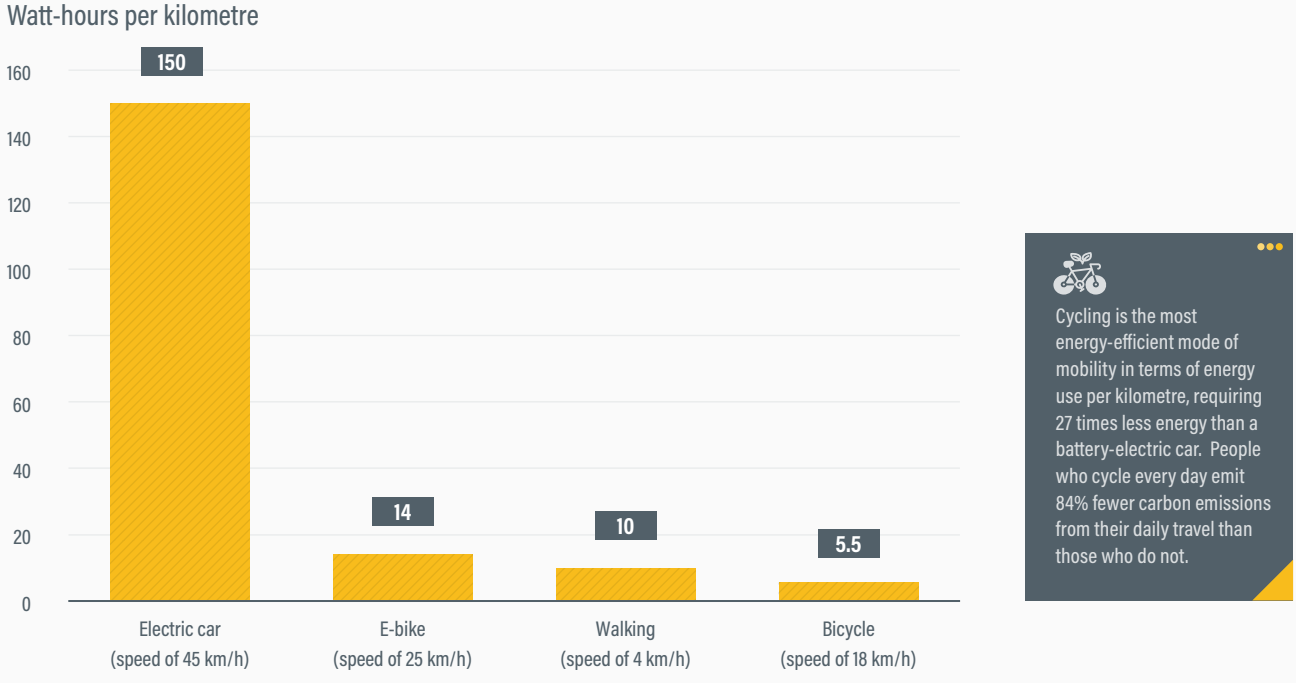
- In high bike-use scenarios, more than 1,000 premature deaths could be avoided in Austria, the United States and Indonesia.[91]

Due to their flexibility and low cost, bicycles have helped various cities and communities respond to sudden shocks and crises, from natural disasters to armed conflict. A 2024 study found that bicycles and other forms of micromobility have the potential to aid short-term response and longer-term recovery from natural disasters due to their flexibility, low cost and ability to navigate small spaces that cannot be reached by larger motor vehicles.[92]

- In Ukraine, bicycles have been an important emergency response resource during attacks and bombardments from the Russian Federation, and for delivering humanitarian relief. Between 2022 and 2024, the #BikesForUkraine campaign implemented by the local cycling association U-Cycle delivered nearly 3,000 bicycles to more than 85 communities, including to youth centres, volunteers, social workers, medical staff, local governments, internally displaced persons and children.[93] U-Cycle has also partnered with local governments to integrate bicycle planning and infrastructure into reconstruction efforts aimed at boosting resilience in Ukrainian communities.[94]
- Cycling helped Valencia (Spain) cope with catastrophic flooding after parts of eastern Spain were hit with torrential rain in October 2024, with some areas experiencing a year's worth of rainfall in just one day.[95] The floods killed more than 200 people and destroyed homes and critical mobility infrastructure, and bicycles emerged as a crucial solution for flexible commuting and for emergency workers and volunteers to distribute basic goods and food supplies.[96]

Cycling is the most energy-efficient mobility mode, using 27 times less energy per kilometre than a battery-electric car (Figure 3)**.**[97] **People who cycle every day emit 84% fewer carbon emissions from their daily travel than those who do not.**[98] **Even though the bulk of the greenhouse gas emissions from transport are caused by long-distance travel, regular bicycle use and substituting a car trip per day would reduce per capita CO_2 emissions 7% per year in the European context.**[99]

FIGURE 3. Energy efficiency of different modes of transport



Source: See endnote 99 for this section.

- In 2024, Germany's biggest cycling association, the Allgemeiner Deutscher Fahrrad-Club e.V., estimated that even in a moderate scenario (with some improvements in cycling infrastructure), 8-12 million tonnes of CO_2 could be saved annually by 2035 – or around 8-9% of Germany's total transport emissions.[100]
- A 2024 study found that a shared e-bike emits just 46 grams of CO_2 per passenger-kilometre, compared to 160 grams for an EU-based fossil-fuel car and 91 grams for an electric car.[101]
- A non-electric shared bike provides an even better benefit for the climate, emitting just 15 grams of CO_2 per passenger-kilometre, making it the most efficient form of shared vehicle.[102]
- In Sweden, e-bikes could replace up to 56.7% of car trips, leading to a possible 22.8% reduction in emissions.[103]
- Compared to individual public transport initiatives, projects that integrate public transport with cycling and walking solutions can greatly reduce emissions at a much lower cost per unit of CO_2.[104]

Policy and investment developments

Cycling has gained growing recognition as a vital tool for climate action, including at the highest levels of global climate talks. From the annual United Nations (UN) Climate Change Conferences to national climate strategies, policy makers have highlighted cycling not just as a mode of transport, but as a low-cost, low-emission solution with wide-ranging benefits for health, equity and urban resilience.

- At the 2021 UN Climate Change Conference (COP 26) in Scotland, a global transport declaration incorporated active travel (walking and cycling) for the first time ever at the COP level.[105] The last paragraph, added during the final negotiations thanks to persistent lobbying by non-governmental organisations, states: "*We recognise that alongside the shift to zero emissions vehicles, a sustainable future for road transport will require wider system transformation, including support for active travel, public and shared transport, as well as addressing the full value chain impacts from vehicle production, use and disposal.*"[106]
- The COP 29 meeting in Azerbaijan built on the progress made at COP 26 with the new "Transport Avoid & Shift 2030 Breakthrough" launched by the UN High-Level Champions.[107] The Breakthrough promotes the inclusion of walking and cycling and urges governments to: "Double the share of energy efficient and fossil-free forms of land transport for people and goods by 2030, by focusing on shifts to public transport, walking and cycling and rail freight, as well as electric vehicles and railways."[108] The effort was initiated in response to a call to action to double the share of energy efficient and fossil-free forms of land transport by 2030' launched by SLOCAT and REN21, in partnership with the Institute for Sustainable Development and International Relations (IDDRI), the Institute for Transportation and Development Policy (ITDP), the International Union of Railways (UIC), the International Association of Public Transport (UITP) and the World Resources Institute (WRI).[109]

At the regional level, in 2024 the EU adopted the European Declaration on Cycling, its highest-level political strategy to integrate cycling in transport systems at all levels of governance.[110] The Declaration commits EU, national and local resources to increase cycling infrastructure, allocate more financing to cycling projects and improve methodologies for collecting cycling data across the region. The adoption of the Declaration was a major breakthrough for pro-cycling advocates in the EU.[111]

- As a result of the European Declaration on Cycling, the EU created a network of National Cycling Contact Points comprising representatives of national transport ministries from nearly every EU Member State.[112] The purpose of this group is to share knowledge and catalyse implementation of the various commitments in the cycling declaration.
- Another direct result of the cycling declaration was an EU-funded study to define and assess cycling data throughout the EU, for example by quantifying the type and length of cycling infrastructure and producing better data on use. The study, to be finished by the end of 2025, is being implemented by a consortium of civil society, city networks and research organisations.[113]

As of 1 August 2025, only 8 (28%) of the 29 countries that had submitted third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement mentioned cycling among their greenhouse gas mitigation actions for transport (Brazil, Canada, Lesotho, Monaco, Nepal, Singapore, the United States and Uruguay).[114] **In general, NDCs have undervalued active travel.**[115] Among the eight submissions, only Lesotho, Nepal and Singapore included a specific target for cycling infrastructure and modal share.[116] (See Spotlight on Transport Ambition in NDCs 3.0.)

- In its third-generation NDC, Lesotho aims to build 30 kilometres of bicycle lanes by 2030.[117]
- Nepal outlines in its NDC the ambition to establish bike sharing services in three cities by 2030.[118]
- Singapore's third-generation NDC includes the Walk-Cycle-Ride (WCR) strategy for active mobility and prioritises public and shared transport as the primary modes of travel.



The NDC calls for expanding cycling infrastructure from 600 kilometres in 2025 to 1,300 kilometres by 2030; for all journeys to the nearest neighbourhood centre using WCR modes to take no more than 20 minutes by 2040; and for 9 out of 10 peak-period WCR journeys to take less than 45 minutes by 2040.[119]

- In 2024, the PATH (Partnership for Active Travel and Health) coalition developed an Active Travel NDC template as a step-by-step guide for national governments to be more ambitious and to strengthen commitments to walking and cycling within their NDCs.[120]

As of 2023, only 10 (5%) out of 197 countries assessed had both a national cycling policy and an NDC addressing cycling: Bangladesh, Bhutan, Chile, Colombia, Costa Rica, Ethiopia, Rwanda, Singapore, Uganda and Venezuela.[121] **Meanwhile, 17% of the assessed countries had a national cycling policy but their NDC did not include cycling, while the majority of countries (59%) had neither a national policy nor an NDC on cycling.**[122] Although fewer high-income countries have cycling in their NDCs, more higher-income countries have national cycling policies than do lower-income countries.

- Cycling-related objectives included in national policies and NDCs include increasing activity, road safety, accessibility, comfort and climate change mitigation through interventions such as infrastructure, campaigns, land-use planning, integration with public transport and capacity building.[123]
- Only 16% of the national polices and 2% of the NDCs that include cycling identify specific financial budgets for delivery, highlighting a crucial limitation for policy implementation.[124] Additionally, only 13% of national cycling policies indicate a time frame for policy implementation.[125]

Even so, national cycling strategies have been on the rise since 2023, with more countries adopting dedicated plans that prioritise active mobility, integrate cycling into transport and climate policies, and invest in safer, more connected infrastructure.[126] As of mid-2025, at least 25 European countries either have a national cycling strategy or a similar plan to promote active and sustainable mobility.[127]

- In 2024, Croatia adopted its first-ever cycling strategy, which envisions an increase in the use of bicycles for daily commuting and travel and an improvement in the safety of cyclists in traffic.[128]
- Colombia is advancing the development of its National Strategy for Active Mobility, which has a specific focus on gender and getting more women to choose active travel.[129]



- Germany's national cycling plan for 2021-2030 is one of the most complete in Europe, with objectives to create seamless cycling infrastructure, become a country of cycling commuters and cyclists, and put cycling at the heart of mobility systems.[130]
- In 2024, Lithuania adopted its first-ever national cycling strategy, setting out comprehensive goals to increase the modal share of cycling in the country by 2035.[131] It accompanied this with a new regulation for the planning and design of bicycle infrastructure that establishes national standards for high-quality cycling facilities.[132]
- In 2023, the Waka Kotahi New Zealand Transport Agency launched a Cycling Action Plan that envisions people of all ages and abilities, in major towns and cities, to be able to get to where they need to go using connected networks of safe, attractive cycleways and quiet streets within 10 years.[133]
- In 2023, Argentina published its first national guide for cycling infrastructure design as part of its National Plan for Sustainable Transport; the guide sets technical standards for safe, inclusive and connected infrastructure in urban areas.[134]
- Chile released an updated national cycling infrastructure manual in 2024 that incorporates equity and sustainability principles and is expected to inform sub-national policies and investment priorities.[135]
- In 2020, India launched the India Cycles4Change Challenge to inspire more than 100 cities to become cycling havens, which led to the piloting of cycling-friendly solutions on 400 kilometres of main roads and 3,500 kilometres of neighbourhood streets.[136] The 25 most successful cities are receiving support to further integrate cycling in their streets through new cycling plans.[137]
- Spain's Ministry of Transport allocated USD 4.9 million (EUR 4.7 million) to various municipalities to expand high-quality cycle infrastructure and bike parking facilities.[138]

Sub-national governments – including regions, provinces and cities – are also increasingly launching cycling strategies and infrastructure initiatives, often in co-ordination with or even outpacing national efforts.

- Abu Dhabi (United Arab Emirates) launched the Bike Abu Dhabi platform to encourage people to cycle to stay healthy and fit. Abu Dhabi provides 300 kilometres of dedicated cycle tracks, including a 20-kilometre urban cycle track that is fully separated from car and pedestrian traffic. The government plans to build cycling infrastructure to link with Dubai and connect all city hubs in an uninterrupted loop free of interference from other transport modes.[139]
- In 2018, Addis Ababa (Ethiopia) published a Non-Motorised Transport (NMT) Strategy that called for a 200-kilometre cycle network in 10 years.[140] Since 2022, efforts such as the Addis Ababa Cycle Network Plan 2023-2032 and the City Action Plan have led to rapid expansion



of the cycle network, including more than 60 kilometres of walkways and protected cycle tracks, with plans for another 76 kilometres of cycle tracks and 200 kilometres of walkways in the next phase.[141]

- Fayetteville (United States) published an update to its previous Active Transportation Plan, with a vision to "develop and promote an interconnected and universally accessible network of sidewalks, trails and on-street bicycle facilities that encourage citizens to use active/non-automotive modes of transport to safely and efficiently reach any destination."[142]
- Wollongong (Australia) developed a comprehensive 2030 cycling strategy with a 10-year vision to make cycling the preferred option for local transport.[143] The strategy includes commitments to build 50 kilometres of on-street cycling routes and 30 kilometres of off-street cycling routes through partnerships with state and federal partners; this would expand the city's cycle infrastructure from 130 kilometres to 215 kilometres.[144]
- Additional cities with sub-national cycling strategies include Chennai (India), Lagos (Nigeria), Nairobi (Kenya) and Seoul (Republic of Korea)[145]

Greater recognition of the economic benefits of cycling has generally led to rising investment in cycling, as well as plans for increased investments in the sector.

- Buenos Aires (Argentina) had a total of 300 kilometres of bike lanes and 5,000 bike parking spots as of 2022; between 2009 and 2023, the share of cycling trips in the city grew from 0.4% to 7.0%, to total 400,000 trips per day.[146]
- In 2024, British Columbia (Canada) agreed to invest an additional USD 35 million (CAD 50 million) in walking and cycling over three years, adding to the USD 70 million (CAD 100 million) allocated in 2023.[147] The new funds are aimed at closing gaps in the active transport network by building new bicycle lanes and enhancing the safety of people walking and cycling.[148]
- In 2023, Kenya's Transport Cabinet Secretary announced mandatory plans for all road construction in major cities to have a corridor that will accommodate non-motorised transport.[149]
- Among Pacific islands, Kiribati offers financial incentives for bicycles and e-bikes, and Tuvalu is exploring the possibility of introducing solar-powered e-bikes.[150]
- Rio de Janeiro (Brazil) changed its building code in 2019 to restrict off-street parking and to promote walking and cycling by removing parking minimums, among other measures.[151]
- The US Department of Transportation's strategic plan for fiscal year 2022-2026, released prior to the second Trump administration, aims to increase the share of trips by public transport, walking, and cycling 50% by 2026, compared to 2020 levels.[152]

Cycling expenditure varies greatly by country, with higher values in areas with high levels of cycling.

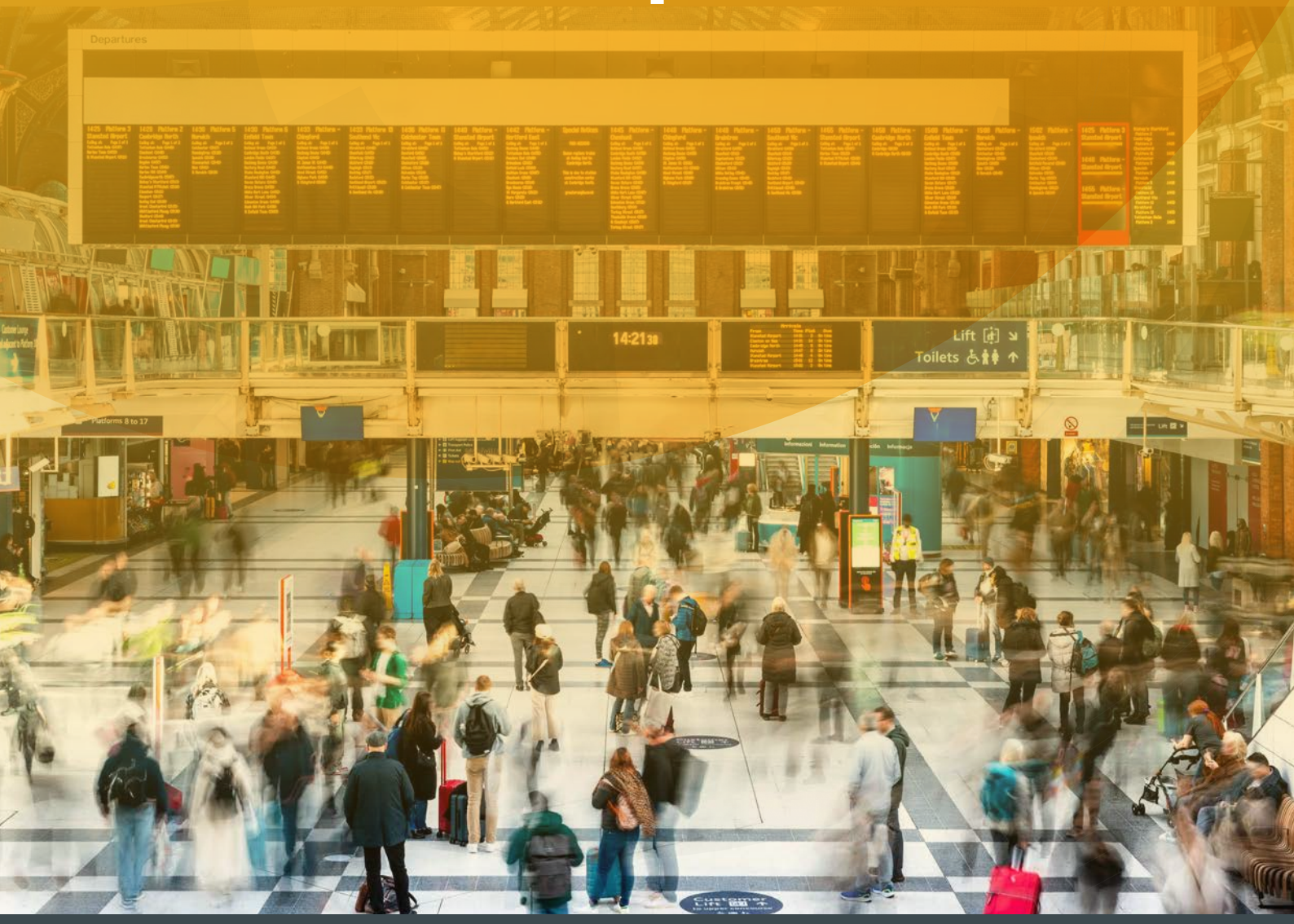
- In Europe, analysis of central government capital investments in cycling (which is in some cases grouped with walking) showed that in 2024, Ireland led with USD 74.5 (EUR 72) per capita, followed by Luxembourg with USD 54.9 (EUR 53) per capita, Flanders (Belgium) with USD 49.7 (EUR 48) per capita and Scotland with EUR 40 per capita.[153]
- Between 2016 and 2021, London (United Kingdom) spent USD 30 (GBP 24) per person annually on its Healthy Streets programme.[154]
- Germany has an annual spending target of USD 31 (EUR 30) per person in its National Cycling Plan 3.0.[155]

Partnerships in action

- In 2024, more than 370 non-profit organisations from 70 countries signed a joint open letter by the **Partnership for Active Travel and Health (PATH)** urging government and city leaders at the UN Climate Change Conference (COP 29) to invest more in walking and cycling to achieve climate goals and improve life quality.[156] PATH members include the FIA Foundation, the European Cyclists' Federation, Walk21, the UN Environment Programme, the Africa Network for Walking and Cycling, ITDP, BYCS, the Dutch Cycling Embassy, SLOCAT, the Transport Decarbonisation Alliance, Union Cycliste Internationale (UCI), the World Cycling Alliance and WRI.
- The **Bloomberg Initiative for Cycling Infrastructure**, a collaboration between Bloomberg Philanthropies and the Global Designing Cities Initiative, was launched in October 2022, targeting cities with more than 100,000 residents and receiving 275 applications from cities in 66 countries.[157] In 2023, the initiative announced the 10 selected cities, which were slated to receive between USD 400,000 and USD 1 million in funding and work with technical experts on project development, cycling facility design, data collection and resident engagement.[158]
- The **European Cyclists' Federation's (ECF) 2024 annual review** of national cycling strategies in 54 European countries provides good examples of national strategies and plans (and what makes good plans), while also demonstrating that many countries need to improve the process of implementing more cycling measures.[159]
- In 2021, **ITDP** launched **Cycling Cities**, a major global campaign that aims to influence 250 cities to design, adopt and implement more cycling-friendly plans by 2050. Since 2021, the campaign has reached 34 cohort cities and more than 50 partners at the local, national and international levels working to make streets safer and urban spaces more welcome for cyclists.[160] In 2024, the Cycling Cities cohort built 213 kilometres of protected bicycle lanes, for a total of more than 630 kilometres of protected and unprotected lanes.[161] They held more than 320 kilometres of bicycle training and learn-to-ride activities, and more than 1,000 car-free days or open streets events.[162]
- In 2023, **Union Cycliste Internationale (UCI)** launched a revised sustainability strategy – aligned with its Cycling Agenda 2030 – as part of its first ever Sustainability Report (2021-2023).[163] The strategy adheres to UCI's vision to "make cycling one of the world's most sustainable sports and promote the bicycle as a key transport mode in combating climate change, improving population health and building a more sustainable future for all".[164] This publication was followed by UCI's Bike City Pathway, a strategic guide supporting cities globally to develop sustainable and active mobility.[165] The guide offers a roadmap for city planners, policy makers, and cycling advocates to create bike-friendly environments, helping build healthier, safer and more resilient communities.
- These publication launches were closely linked to UCI's **Cycling for All Programme** and its objective to get more people to ride bicycles as a daily mode of transport. This includes the UCI Bike City label network (which in 2024 grew to 28 cities and regions in 15 countries on four continents), advocacy partnerships and resources developed to promote cycling at the international level, particularly in connection to the UN Sustainable Development Goals.[166]
- The **Ecologistics project, led by ICLEI-Local Governments for Sustainability** in collaboration with Despacio, the Smart Freight Centre and the Zaragoza Logistics Center, is critical in helping develop roadmaps for efficient and sustainable freight transport.[167] The project promotes low-emission transport of goods that prioritises public health and safety and people-centred urban development, to enable circular and regional economies and limit the growth of freight transport.[168] Principle 1 is the shift to alternative mode options, including electric bicycles.[169]
- In 2023, **SLOCAT and the Transformative Urban Mobility Initiative (TUMI), in collaboration with ECF, the International Institute for Sustainable Development, MobiliseYourCity, and Walk21**, released a policy paper on **evolving economic appraisals for land transport investments towards broader sustainability criteria.** The aim is to enable more accurate valuation of the financial and economic case for investing in integrated public transport, walking and cycling solutions.[170] The paper sets out four recommendations regarding the context or enabling environment needed to consistently apply economic appraisals based on broad sustainability criteria, and evolving the economic appraisal methods.[171]
- At the 2023 UN Climate Change Conference (COP 28), the **Alliance for Cycling and Walking Towards International Vitality and Empowerment (ACTIVE)** was unveiled by Belgium, Luxembourg and the Netherlands. The programme was spurred by a COP 27 Call for Action on Active Mobility and aims to train 10,000 mobility experts in the Global South over a decade, through a coalition of countries and organisations, to stimulate active mobility globally.[172]

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Public Transport



KEY FINDINGS

- Public transport presents one of the most powerful and cost-effective solutions available to tackle our pressing climate crisis and development challenges. The environmental benefits are substantial: buses and trains can slash greenhouse gas emissions by around two-thirds per passenger-kilometre when compared with private vehicle use.

- Beyond environmental impact, public transport serves as a vital catalyst for economic opportunity and social equity. Public transport can generate economic returns that are about five times greater than the initial investment made in it, making it one of the most cost-effective ways to improve urban accessibility and economic productivity, and reduce traffic and parking congestion problems. When properly implemented, these systems provide affordable access to essential activities and services such as employment, education, health care and urban amenities for diverse populations.

- The window for capitalising on post-pandemic mobility transitions is narrowing.

- Successful public transport uptake requires unified urban visions that integrate public transport with land-use planning, governance that discourages car dependency, sustained funding and bold political leadership. Transport agencies must quickly adapt service patterns to reflect changing community needs, focusing on improving service frequency, reliability and safety to attract riders.



Demand, use and access

- Public transport serves as the connective tissue to help people realise their capabilities, getting them to where they need to be and directly contributing to more liveable, healthy and economically viable communities. At its core, "access" is a matter of transport justice, distributive in nature and wrestling with the question of how fairly transport systems serve different population segments and areas.

- In 2022, convenient access to public transport services – as captured through Sustainable Development Goal (SDG) indicator 11.2.1 – ranged widely across regions, with the lowest access (0-40%) in Africa, South Asia, and Central America, and the highest access (80-100%) in western Europe, Australia and Canada.

- Average access to public transport can be misleading even for urban areas when socio-economic and individual factors – such as income, gender, disability status, race and ethnicity – create systematic barriers to public transport use. Public transport affordability is commonly measured by examining the cost of a monthly pass relative to household income.

- Safety concerns result in curtailed access, especially for vulnerable travellers such as women, children and people with disabilities who make trips during off-peak hours or in isolated areas. These challenges are compounded by distinct patterns of "trip chaining": women generally make shorter but more complex journeys as they balance employment, caregiving responsibilities and household duties. Traditional transit network services often poorly accommodate such linking of multiple destinations in a single trip.

- Improving travellers' comfort, safety and security is a key way to increase mobility and economic productivity, and reduce traffic problems. This includes redirecting funding from urban highway and parking expansion towards safer public transport services – including improved vehicles, stations, walkways and bikeways – as well as prioritising transit-oriented development that provides convenient access to frequent and affordable services for low-income families and those with special needs.

- Since the start of the COVID-19 pandemic in 2020, its effects have continued to impact public transport ridership globally, with an estimated loss of 75 billion riders between 2019 and 2023. Recovery patterns have varied widely by region, as large Asian and European cities experienced higher gains in ridership than cities in North and South America.

- As a cultural shift due to the COVID-19 pandemic, the role of remote work has played out differently around the world.

- Although multiple factors have contributed to globally reduced ridership levels – including lifestyle changes from remote work, reduced commuting and rising living

KEY FINDINGS



costs – service quality remains the primary driver of public transport use. Investing in quality and abundant local passenger transport is critical to increasing this use.

- The development of public transport infrastructure has continued globally, with varying levels of expansion across different modes. Around 1,300 kilometres of new metro lines opened worldwide in 2024, contributing to a more than tripling of the total metro length since 2000. Light rail, tramway and streetcar networks added 120 kilometres, and bus rapid transit expanded nearly 170 kilometres.
- China led in metro system developments, representing two-thirds of 2024 openings and 45% of 2023 additions.
- As cities in emerging economies continue to develop, metro systems have experienced relatively consistent growth in network length between 2011 and 2023. Between 2010 and 2023, 73 new urban agglomerations worldwide launched their first metro systems, with China accounting for nearly half of these openings.
- After two decades of rapid growth, implementation of bus rapid transit (BRT) and bus corridors has slowed in recent years. As of February 2025, BRT networks served 191 cities globally, carrying around 32 million passengers daily. Latin America led globally with the most daily passengers (19 million), the highest number of cities served (64) and the most extensive total corridor length (more than 2,000 kilometres).
- Some cities, especially in Latin America, have experienced challenges in the service quality of BRT as demand outpaces investments in capacity. These challenges reflect institutional and financial constraints rather than technical limitations of the bus systems themselves. With proper investment and management, BRT and bus systems, hold substantial potential – and eventual necessity – for sustainable urban mobility.
- Electric buses continued to grow in popularity, with 50,000 electric buses sold globally in 2023 and 70,000 in 2024 (30% annual growth). Electric bus sales represented around 6% of total bus sales in 2024 and expanded the worldwide e-bus fleet to around 730,000 units. China remained the global leader, but other Asian countries have taken a growing share of the market, and even Sub-Saharan Africa is experiencing new developments in electric bus deployment.
- China has remained the world leader in electric bus deployment, although its share of global sales fell from around 99% in 2017 to less than 70% in 2024, due to lower domestic demand and expanding sales elsewhere. The Chinese e-bus market has achieved maturation, with around 65% of its stock deployed before 2019, and at the end of 2022 the country withdrew subsidies for purchases of battery electric and plug-in hybrid electric buses. Chinese manufacturers including BYD and Yutong continue to dominate exports.
- Growing interest in electric buses has been driven by a decrease in their total cost of ownership – making them more competitive with conventional alternatives – although high upfront capital costs and supply chain constraints have affected adoption rates. Since 2022, electric bus manufacturers have faced multiple challenges related to market share and industry dynamics.

KEY FINDINGS

Sustainability and climate trends

- Public transport is widely recognised as a cost-effective strategy for decarbonising transport. Buses and rail contribute lower emissions than other passenger transport modes (such as cars and planes) on both a life cycle assessment (LCA) and a well-to-wheel (WTW) basis. Buses show median emission values of 43 grams of CO_2 per passenger-kilometre on a WTW basis and 48 grams of CO_2 per passenger-kilometre for LCA, whereas rail exhibits median emissions of around 29 grams for WTW and 33 grams for LCA.

- Battery electric buses emit 3-4 times fewer greenhouse gases than internal combustion engine buses, according to a 2024 study in Latin America. Electric and zero-emission buses also offer quieter, smoother rides and reduce local air pollution, providing benefits in marginalised communities historically impacted by vehicle emissions. The most substantial emission reductions can be achieved when electric buses are powered by renewable energy sources rather than fossil fuels.

- Privately owned vehicles are projected to dominate urban passenger transport globally by 2050. Improvements in vehicle efficiency and technological advances, as well as shifts towards low-carbon modes and improved land use planning, are expected to contribute to a 23% decrease in urban passenger transport emissions by 2050. An additional 8% reduction could be achieved by combining public transport systems with shared mobility options (such as cycling, walking and ridesharing), while simultaneously improving and integrating informal transport networks.



- One study estimates that achieving climate goals will require rapid transit systems in the world's 50 highest-emitting cities to expand and double in infrastructure between 2020 and 2030. More ambitious policy measures and investments will be needed.

- Public transport systems play an important role in improving air quality by reducing private vehicle dependency and its associated emissions, particularly through fleet renovation and the adaptation of new powertrain technologies.

- Public transport fleets can present environmental challenges depending on the fuel type, vehicle age and technology. Although heavy-duty vehicles such as buses and freight trucks represented less than 5% of vehicles on roads in 2019, they generated as much as two-thirds of urban air pollutants, including NO_x, black carbon, $PM_{2.5}$ and sulphur dioxide (SO_2), by mass. As such, public transport needs to be closely linked to transport planning, low/zero-emission zones and related activities.

- Farebox recovery ratios, defined as the share of operating costs covered by fare revenues, vary widely across public transport agencies globally. Asian agencies typically exhibit higher ratios than their North American and European counterparts. In 2022, nearly 90% of US public transport agencies recovered less than one-fifth of their operating costs through fare revenue, highlighting heavy dependence on local and federal government subsidies.

- Since the COVID-19 pandemic, operating costs for many public transport agencies have risen due to inflation, energy price rises, and wage growth, whereas fare revenues have tended to remain below pre-pandemic levels. European metropolitan areas illustrate these financial pressures.

- In addition to reducing greenhouse gas emissions, efforts towards climate adaptation and resilience have become equally vital in the public transport sector. Public transport is exposed to risks linked to biological, societal and meteorological/hydrological hazards.

KEY FINDINGS



Policy and investment trends

- Safe, convenient, reliable and affordable public transport is key to successful and thriving cities and communities. Public transport has strong links to the positive achievement of 14 of the 17 United Nations Sustainable Development Goals.
- During 2022-2024, several important policy shifts across public transport systems had notable effects at the national and international levels. Governments have applied a wide range of policy strategies, from outright bans on fossil fuels to generous tax incentives, with mixed but noticeable progress.
- Public transport in many countries is often cushioned by fuel tax exemptions and/or direct subsidies, but these supports become harder to sustain during price and political fluctuations, especially in countries already experiencing financial stress.
- A 2025 study of urban rail projects worldwide – including metros, subways and light rail systems – estimated the global weighted average cost at around USD 238 million per kilometre, based on 696 lines across 189 cities; however, construction costs vary dramatically across countries.
- Public transport agencies that have maintained revenue stability have adopted diversified funding models including real estate development, advertising and regional transport taxes. The COVID-19 pandemic prompted agencies worldwide to reconsider their revenue sources and fare policies, with some offering fare-free services.
- While fare-free transit has gained political attention and been extensively implemented in countries such as Brazil, an emerging consensus suggests that targeted policies – such as subsidies for specific populations (e.g., students, elderly, etc.) – may be more sustainable than blanket fare-free systems, since transport infrastructure requires funding regardless of fare structure. Ultimately, effective fare policies must balance access, sustainability and financial viability within broader integrated transport strategies.
- As of 1 August 2025, a total of 29 countries had submitted their third-generation Nationally Determined Contributions (NDCs) to the UN Framework Convention on Climate Change (UNFCCC); of these, 25 NDCs included content related to transport, but only 15 featured content (either as targets or actions) on public transport.
- Public transport actions in the third-generation NDCs were aimed at improving and expanding services and increasing access. However, the low number of NDCs submitted as of 1 August 2025 made it difficult to identify detailed trends and to compare actions to previous generations of NDCs.
- In the second generation of NDCs (submitted to the UNFCCC between 2020 and 2023), 67% of countries prioritised action with public transport. Identified gaps included a lack of ambitious targets, clear timelines for activities, and specifying ministries and budgets.
- Efforts to decarbonise public transport must be paired with strategies to adapt to and withstand potential climate-related hazards. Strengthening the synergy between mitigation and adaptation is essential to ensure that investments in low-carbon public transport remain effective amid intensifying climate stress and more frequent extreme weather events.



Context, challenges and opportunities

Public transport presents one of the most powerful and cost-effective solutions available to tackle our pressing climate crisis and development challenges. The environmental benefits are substantial: buses and trains can slash greenhouse gas emissions by around two-thirds per passenger-kilometre when compared with private vehicle use.[1] This has led the United Nations' (UN) recent climate action assessment to designate increased public transport ridership as not merely beneficial, but "essential" for meaningfully curbing climate change.[2]

Beyond environmental impact, public transport serves as a vital catalyst for economic opportunity and social equity. Public transport can generate economic returns that are about five times greater than the initial investment made in it, making it one of the most cost-effective ways to improve urban accessibility and economic productivity, and reduce traffic and parking congestion problems.[3] **When properly implemented, these systems provide affordable access to essential activities and services such as employment, education, health care and urban amenities for diverse populations.**

The safety and accessibility advantages are also compelling. Transit-oriented communities have much lower per capita traffic fatality rates than automobile-dependent areas, while public transport systems remain far safer and more affordable than personal car travel.[4] Safe and reliable public transport plays an important role for women, whose trip patterns are more complex than men's given the role that women play in the mobility of care.

Globally, public transport use varies based on differences in urban development approaches, infrastructure availability, pricing policies and cultural attitudes towards shared mobility. Even before the COVID-19 pandemic, North American cities demonstrated extreme car dependency with 92% of journeys by private vehicle and only 4.6% by public transport.[5] Car use in northern and southern European cities was 50-75%, while western Europe recorded 35-63% of trips by car with high rates of active transport (walking and cycling) (25-50%).[6] East Asian cities maintain balance with 46% public transport use and 19% by car.[7] Latin American cities tended to be split roughly equal between active mobility, public transport and cars.[8]

The window for capitalising on post-pandemic mobility transitions is narrowing, particularly in North America, which has one of the higher rates of remote work adoption.[9] In many regions, COVID-19 experiences led to a shift away from public transport towards walking and cycling and private vehicles.[10]

Successful public transport uptake requires unified urban visions that integrate public transport with land-use planning, governance that discourages car dependency,

sustained funding and bold political leadership. Transport agencies must quickly adapt service patterns to reflect changing community needs, focusing on improving service frequency, reliability and safety to attract riders.

Demand, use and access

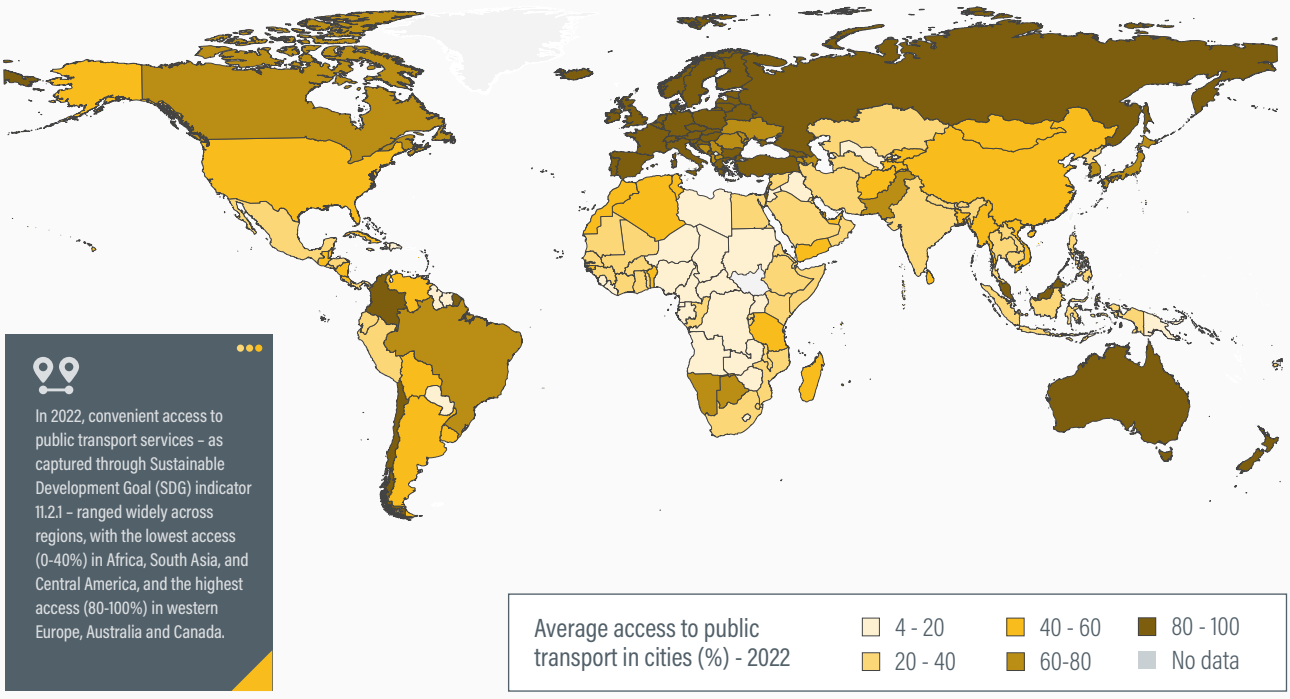
Public transport serves as the connective tissue to help people realise their capabilities, getting them to where they need to be and directly contributing to more liveable, healthy and economically viable communities. At its core, "access" is a matter of transport justice, distributive in nature and wrestling with the question of how fairly transport systems serve different population segments and areas.[11] Access is conceptually defined as "the potential for interaction" and has become a key indicator in urban and transport planning, as it captures the relationships among transport, land use and people.

In 2022, convenient access to public transport services – as captured through Sustainable Development Goal (SDG) indicator 11.2.1 – ranged widely across regions, with the lowest access (0-40%) in Africa, South Asia, and Central America, and the highest access (80-100%) in western Europe, Australia and Canada (Figure 1).[12]

Average access to public transport can be misleading even for urban areas when socio-economic and individual factors – such as income, gender, disability status, race and ethnicity – create systematic barriers to public transport use. Public transport affordability is commonly measured by examining the cost of a monthly pass relative to household income (Figure 2).[13] In lower- to middle-income groups, economic barriers may effectively render even nearby public transport services inaccessible.

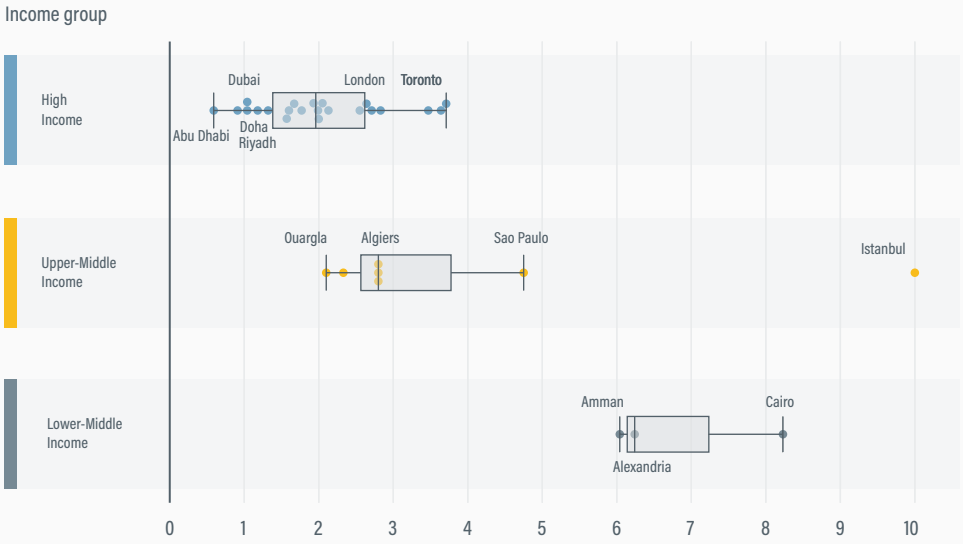
Safety concerns result in curtailed access, especially for vulnerable travellers such as women, children and people with disabilities who make trips during off-peak hours or in isolated areas. These challenges are compounded by distinct patterns of "trip chaining": women generally make shorter but more complex journeys as they balance employment, caregiving responsibilities and household duties.[14] **Traditional transit network services often poorly accommodate such linking of multiple destinations in**

FIGURE 1. Share of urban population with convenient access to public transport (population-weighted average), by country, 2022



Source: See endnote 12 for this section.

FIGURE 2. Ratio of monthly pass cost to average monthly income (%) in selected cities, 2025



Average access to public transport can be misleading even for urban areas when socio-economic and individual factors – such as income, gender, disability status, race and ethnicity – create systematic barriers to public transport use. Public transport affordability is commonly measured by examining the cost of a monthly pass relative to household income. In lower- to middle-income groups, economic barriers may effectively render even nearby public transport services inaccessible.

Source: See endnote 13 for this section.

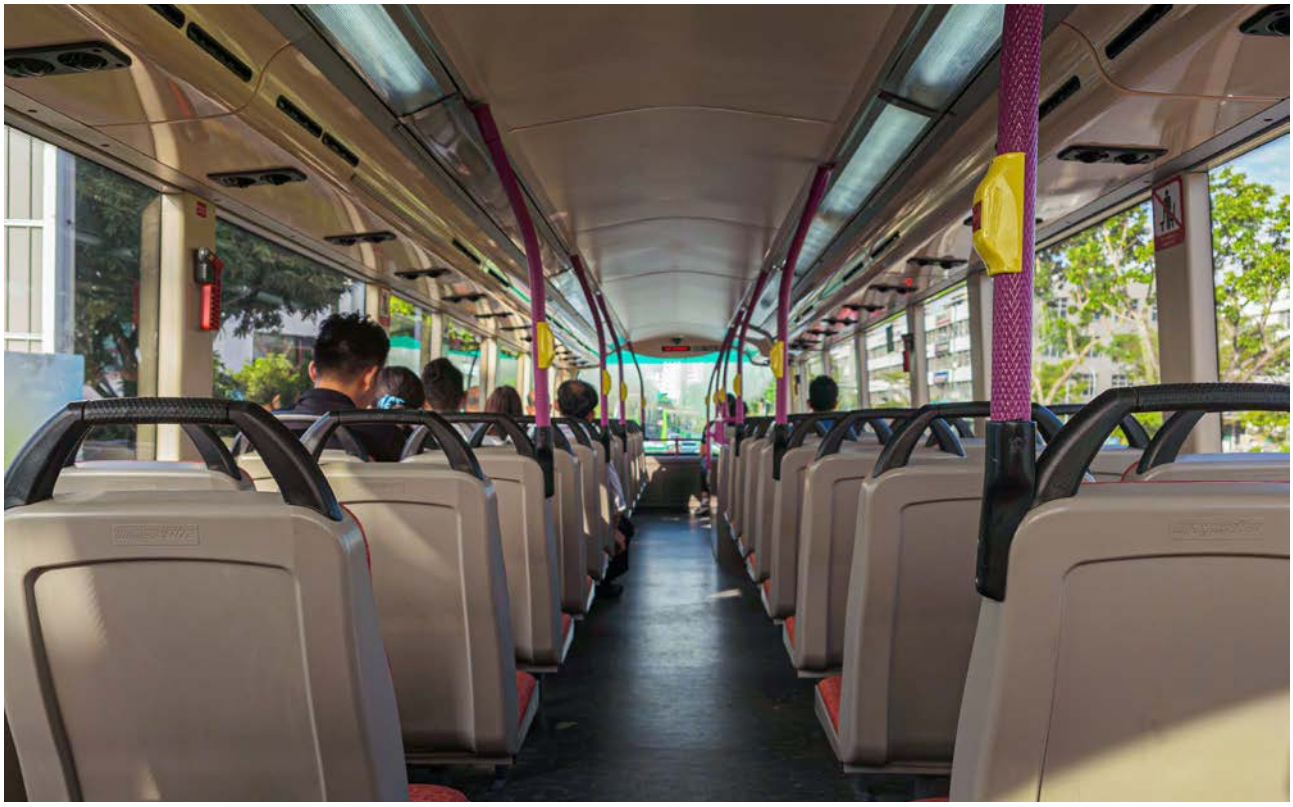
a single trip. Recent research highlights gender-based disparities in safety perceptions and mobility patterns associated with public transport worldwide. Factors such as inadequate lighting, desolate environments and intoxicated individuals greatly increase perceived risk. Lack of proper facilities such as safe passenger waiting areas contributes to security risks for women.[15]

- A 2022 study on public transport safety perceptions in 18 cities globally found high rates of sexual harassment victimisation, ranging from 70% in São Paulo (Brazil) and Lagos (Nigeria) to around 30% in Guangzhou (China) and Tokyo (Japan); female students consistently reported feeling less safe than male counterparts.[16]
- A study in Peshawar (Pakistan) in 2024 revealed that 66% of female users of bus rapid transit aged 18-30, and 52% of those aged 31-45, reported experiencing harassment at transport stations, with visual harassment being most prevalent.[17] Young women were particularly vulnerable: 54% of users under 18 and 56% of users aged 18-30 reported harassment on buses.[18]

Improving travellers' comfort, safety and security is a key way to increase mobility and economic productivity, and reduce traffic problems. This includes redirecting funding from urban highway and parking expansion towards safer public transport services – including improved vehicles, stations, walkways and bikeways – as well as prioritising transit-oriented development that provides convenient access to frequent and affordable services for low-income families and those with special needs.

Since the start of the COVID-19 pandemic in 2020, its effects have continued to impact public transport ridership globally, with an estimated loss of 75 billion riders between 2019 and 2023.[19] Recovery patterns have varied widely by region, as large Asian and European cities experienced higher gains in ridership than cities in North and South America.[20] Many smaller cities worldwide continue to struggle with reduced ridership and operating costs.

- In the United States, public transport ridership rebounded to 85% of pre-pandemic (2019) levels in the first quarter of 2025.[21] In 2024, US ridership grew by 491 million passenger trips (7%) to reach a total of 7.7 billion passenger trips.[22]
- Public transport ridership in Canada grew 8.8% in 2024 to around 1.6 billion passenger trips, or roughly 84% of the pre-pandemic (2019) volume.[23] Despite annual increases since 2021, operating revenue remained at USD 2.71 billion (CAD 3.9 billion) in 2024 – around 94% of 2019 levels – due to ridership shortfalls.[24]
- In Brazil, bus ridership had been in decline even before the pandemic-related disruption. Between 2013 and 2023, monthly passenger numbers fell by 176 million passengers (45%) to reach a total of 214 million passengers.[25]
- European public transport agencies recorded 10% growth in ridership in 2023, although most urban transport systems remained below 2019 levels.[26] In Valencia (Spain), ridership in 2023 was up 17% over 2019 levels, attributed in part to discounted fares.[27]
- China's urban rail systems have experienced strong recovery, reflecting rising post-pandemic demand as



well as network expansion. Annual passenger volumes nationwide surged 52% in 2023 (from 19.4 billion trips to 29.4 billion trips) and were up 9.5% in 2024 (to 32.2 billion trips).[28] In Shenzhen, passenger volumes grew 72.5% in 2023, rising from 1.6 billion trips to 2.7 billion trips.[29]

- Ridership on Singapore's public transport system rose from a pandemic low of 5.0 million passengers daily in 2020, to 7.2 million passengers in 2023 and 7.5 million passengers in 2024 (although still 3% below the 2019 peak of 7.7 million).[30] Urban rail services showed an especially strong recovery, with 2024 ridership of 3.41 million daily trips surpassing the 3.38 million recorded in 2019. [31]

As a cultural shift due to the COVID-19 pandemic, the role of remote work has played out differently around the world. In US cities, the ongoing debate over "return to office" has severely affected public transport systems, whereas elsewhere the recovery of public transport has been stronger despite remote work.

- The Bay Area Rapid Transit (BART) system in San Francisco (United States) carried only 46% of its pre-pandemic ridership as of October 2024.[32]
- Helsinki (Finland) has one of the highest work-from-home rates in Europe, yet it achieved 90% recovery of public transport ridership by summer 2024.[33]

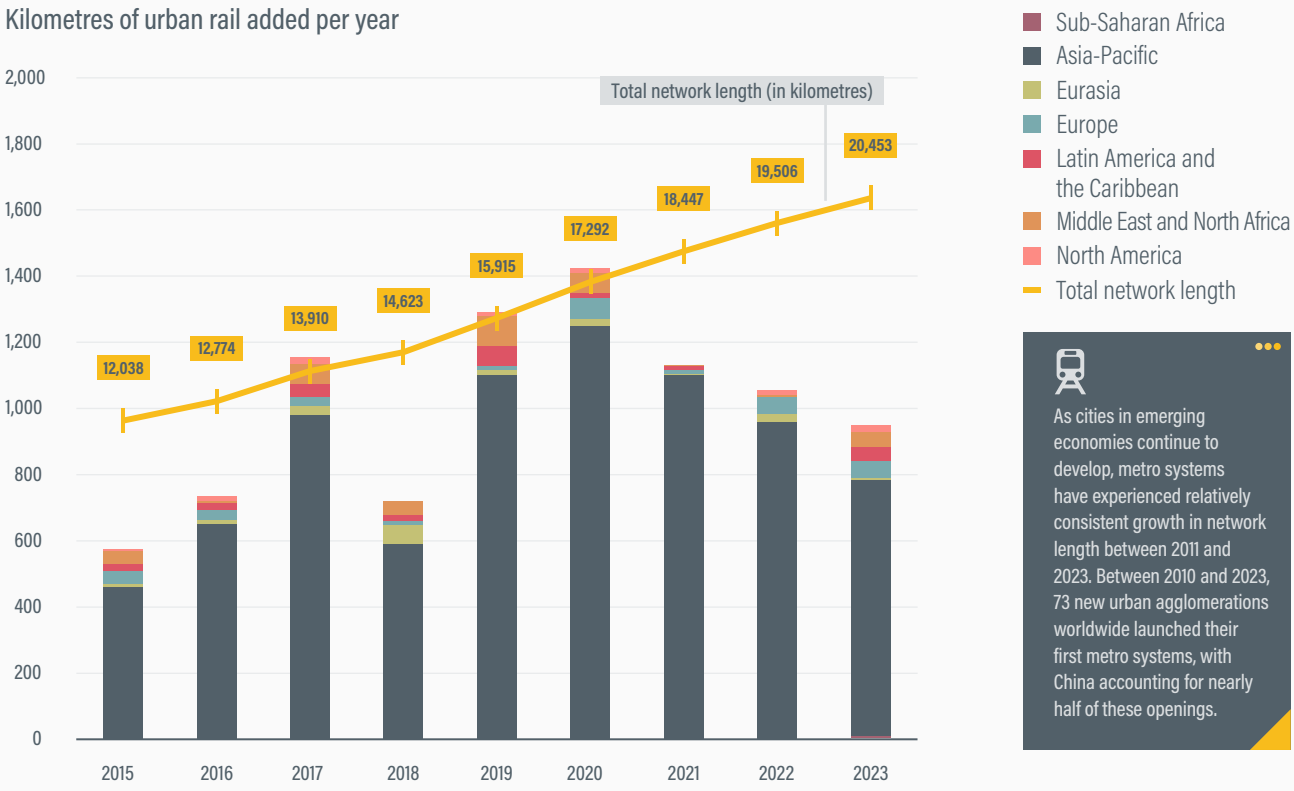
Although multiple factors have contributed to globally reduced ridership levels – including lifestyle changes from remote work, reduced commuting and rising living costs – service quality remains the primary driver of public transport use. Investing in quality and abundant local passenger transport is critical to increasing this use. Frequent, reliable service directly correlates with higher user satisfaction and increased ridership.[34]

The development of public transport infrastructure has continued globally, with varying levels of expansion across different modes. Around 1,300 kilometres of new metro lines opened worldwide in 2024, contributing to a more than tripling of the total metro length since 2000.[35] Light rail, tramway and streetcar networks added 120 kilometres, and bus rapid transit expanded nearly 170 kilometres.[36]

- Metro systems consistently dominate new developments: of the 1,760 kilometres of urban public transport added in 2023, metros accounted for 64% of the total route distance – well above the shares for commuter/regional rail (16%), light rail (10%) and bus rapid transit (6%).[37]
- **China led in metro system developments, representing two-thirds of 2024 openings and 45% of 2023 additions.**[38] This expansion has occurred mainly in major cities, including new loop lines in Guangzhou and Xi'an in 2024.[39]

As cities in emerging economies continue to develop, metro systems have experienced relatively consistent growth in network length between 2011 and 2023 (Figure 3).[40] **Between**

FIGURE 3. Metro network length by region, 2015-2023



Source: See endnote 40 for this section

2010 and 2023, 73 new urban agglomerations worldwide launched their first metro systems, with China accounting for nearly half of these openings.[41]

- A metro line was opened in at least one urban area in China every year between 2010 and 2022.[42]
- The Pearl River Delta region, a mega urban agglomeration that includes Guangzhou, Hong Kong, Shenzhen, and surrounding areas, had the most extensive metro service in the world in 2024, at 1,667 kilometres.[43]
- As of 2025, India's metro system spanned more than 1,000 kilometres across 23 cities, making it the world's third largest after China and the United States.[44] Delhi's ongoing metro expansion is expected to surpass New York's system in the coming years.[45]
- Viet Nam's first metro line began operations in Ho Chi Minh City in December 2024, 12 years after construction began in 2012.[46]
- In Quito (Ecuador), metro operations began in December 2023 with a 22-kilometre inaugural line and 15 stations; this fully electric transport system is projected to reduce carbon dioxide (CO_2) emissions by 67,000 to 84,000 tonnes annually.[47]
- Ahead of the 2024 Olympic Games, and to boost network capacity and connectivity, Paris (France) expanded Metro Line 14 by around 16 kilometres (adding eight new stations) and extended RER Line E by 8 kilometres (adding three new stations), alongside tramway upgrades.[48]
- After 38 years of planning, excavation, and delays, the driverless metro system in Greece's second largest city, Thessaloniki, opened in November 2024, featuring more than 300,000 archaeological artefacts discovered during construction and displayed throughout its 13 stations.[49]
- In the United States, three long-awaited rail projects finally opened in 2022 after decades of planning: Boston's Green Line extension, Los Angeles' Crenshaw Line, and Washington, D.C.'s Silver Line extension to Dulles Airport.[50]

After two decades of rapid growth, implementation of bus rapid transit (BRT) and bus corridors has slowed in recent years.[51] **As of February 2025, BRT networks served 191 cities globally, carrying around 32 million passengers daily.**[52] **Latin America led globally with the most daily passengers (19 million), the highest number of cities served (64) and the most extensive total corridor length (more than 2,000 kilometres).**[53] BRT systems offer dedicated lanes,

faster journey times and higher capacities than conventional bus-based transit. During their early expansion, BRT systems typically garnered strong community enthusiasm.[54]

- After ten years of development, TransBrasil in Rio de Janeiro (Brazil) opened in February 2024 as the city's fourth BRT corridor, featuring 20 stations along the Avenida Brasil; the system expects to serve up to 250,000 people daily by 2030 and to reduce peak-hour travel times up to 50%.[55]
- As of 2024, the extensive Karachi Breeze network in Pakistan included two operational lines (Green and Orange), two under construction (Red and Yellow), and two planned (Blue and Brown), totalling 112.9 kilometres with around 90 stations.[56] The Green Line became partially operational in late 2021 but remained incomplete as of mid-2025, while the Orange Line became fully operational in 2022.[57]
- Although metro expansion remains limited in the United States, BRT improvements in 2024 included the launch of Metro Rapid Route A in Madison (Wisconsin) – featuring articulated battery-powered buses and centre-running bus lanes – and the entry into service of the IndyGo Purple Line in Indiana, connecting downtown Indianapolis and Lawrence via 31 stations along a 24.5 kilometre corridor. [58]
- In Dar es Salaam (Tanzania), the BRT Phase 2 infrastructure has been completed, but operations were pending the arrival of clean natural gas buses by mid-2025.[59]

Some cities, especially in Latin America, have experienced challenges in the service quality of BRT as demand outpaces investments in capacity.[60] These challenges reflect institutional and financial constraints rather than technical limitations of the bus systems themselves. With proper investment and management, BRT and bus systems, hold substantial potential – and eventual necessity – for sustainable urban mobility.

Electric buses continued to grow in popularity, with 50,000 electric buses sold globally in 2023 and 70,000 in 2024 (30% annual growth).[61] Electric bus sales represented around 6% of total bus sales in 2024 and expanded the worldwide e-bus fleet to around 730,000 units.[62] China remained the global leader, but other Asian countries have taken a growing share of the market, and even Sub-Saharan Africa is experiencing new developments in electric bus deployment.

- In 2024, India and the Republic of Korea overtook the United States to become the second and third largest national electric bus markets by sales volume (after China), with more than 3,200 and 2,800 sales, respectively.[63]
- In India, electric bus registrations grew around 81% in 2024 (from 1,919 units to 3,616 units), although electric buses still represented only 4% of annual bus registrations.[64] Delhi, Gujarat, Karnataka and Maharashtra together accounted for more than three-quarters of the country's total electric bus registrations in 2023.[65]
- Electric bus sales in Europe, the world's second largest market, grew nearly 15% in 2024, bringing the region's sales share to more than 13%.[66]
- Battery electric bus registrations in Europe increased 53% in 2023 to reach 6,354 units across the European Union (EU-27) plus Iceland, Norway and Switzerland.[67] In 2024, zero-emission (battery electric and hydrogen) buses comprised nearly half (49%) of new city bus registrations in the region, up from 15% in 2020.[68]
- Madrid (Spain) established Europe's largest electric bus charging facility in 2024, with capacity to charge 118 buses simultaneously.[69]
- In Latin America and the Caribbean, electric bus sales rose from around 600 in 2020 to more than 2,000 in 2024.[70]
- Latin America's electric bus fleet grew 13% in 2024 to reach 6,055 vehicles, following average annual growth of 33.5% since 2017 (driven by battery electric bus adoption initially in Chile and Colombia, and later in Brazil and Mexico).[71]
- In late 2023, Mérida (Mexico) launched IE-Tram, the country's first all-electric BRT system, projected to serve more than 25,000 daily passengers.[72]
- Dakar (Senegal) launched Africa's first fully electric BRT system in December 2023.[73]
- In Kenya, private sector innovation has driven electric bus adoption through companies such as BasiGo, which had sold 35 buses to 11 co-operatives in Nairobi as of late 2024 and established the country's first dedicated electric bus assembly in partnership with Kenya Vehicle Manufacturers.[74] Working directly with co-operatives and *matatu* (minibus) owners, transit electrification presents an opportunity to catalyse broader reform in Kenya's informal transport sector. (See 4.6 Informal Transport.)

China has remained the world leader in electric bus deployment, although its share of global sales fell from around 99% in 2017 to less than 70% in 2024, due to lower domestic demand and expanding sales elsewhere.[75] The Chinese e-bus market has achieved maturation, with around 65% of its stock deployed before 2019, and at the end of 2022 the country withdrew subsidies for purchases of battery electric and plug-in hybrid electric buses.[76] Chinese manufacturers including BYD and Yutong continue to dominate exports: between 2017 and 2023, they supplied more than 85% of electric city buses in Latin America and expanded their share in the EU from 10% to 30% of total bus sales.[77]

Growing interest in electric buses has been driven by a decrease in their total cost of ownership – making

them more competitive with conventional alternatives – although high upfront capital costs and supply chain constraints have affected adoption rates.[78] **Since 2022, electric bus manufacturers have faced multiple challenges related to market share and industry dynamics**, including higher raw material costs following the Russian Federation's invasion of Ukraine, intensified price competition and industry consolidation pressures.[79] These pressures contributed to industry restructuring: for example, major US manufacturer Proterra filed for bankruptcy in August 2023.[80]

Box 1. Artificial intelligence, big data and public transport

Public transport authorities have long employed big data analytics for real-time predictions, schedule optimisation, maintenance forecasting and passenger flow analysis. Curation of transit data in the format of General Transit Feed Specification (GTFS) by organisations such as MobilityData and DigitalTransportforAfrica enables trip planning and accessibility analyses, among other applications. Many of these data-driven approaches now integrate with newer artificial intelligence (AI) capabilities, especially generative AI deploying Large Language Models, to create more responsive and interactive transit solutions globally.

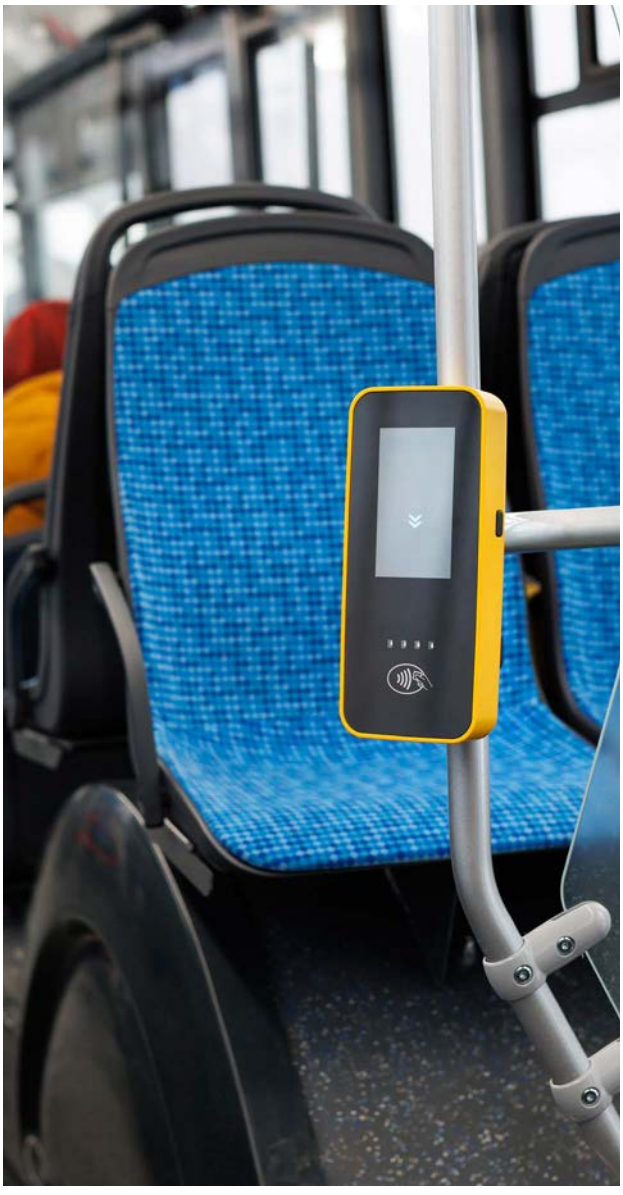
Modern AI systems help urban planners process multi-modal data sources; ingest structured data alongside videos, text, audio and visual inputs to enhance prediction accuracy; and improve customer interfaces.

- In 2025, Japan's JR East began deploying a generative AI system for signalling equipment failures across rail lines in the Shinkansen and Tokyo areas – the first of its kind in the country. The system automatically generates incident reports from radio communications, simplifies data input, and provides estimated causes and repair timelines, targeting up to 50% faster service restoration.
- Barcelona Metro (Spain) has deployed an AI ventilation control system that optimises air quality and thermal comfort in real-time. The system was initially implemented in 2020 to help limit the spread of COVID-19, and since 2022 it has balanced meteorological conditions, energy costs, and fan performance, achieving a 1.3 degrees Celsius temperature reduction, 25% energy savings, 21% improved fan efficiency and 11% increase in passenger satisfaction.
- Using Google's AI technology, the Chicago Transit Authority (United States) launched the chatbot "Chat with CTA" in 2024; it provides multilingual customer support in five languages, handling real-time updates, incident reporting and customer feedback on non-emergency topics such as cleanliness, maintenance and service disruptions.

Despite these potential advantages, serious challenges remain around the need for human oversight in safety-critical public transport operations. Privacy concerns have intensified as data collection on passenger tracking becomes more sophisticated. The lack of transparency behind AI's complex decision-making processes can create accountability challenges when the automated systems affect thousands or millions of daily passengers.

Additionally, the substantial energy requirements of AI systems present a sustainability paradox for public transport's decarbonisation goals. In 2022, data centres supporting AI consumed around 460 terawatts globally, with AI training clusters requiring seven to eight times more energy than typical computing workloads. For transit agencies promoting low-carbon mobility, these energy requirements must be carefully considered within sustainability frameworks.

Source: See endnote 81 for this section.



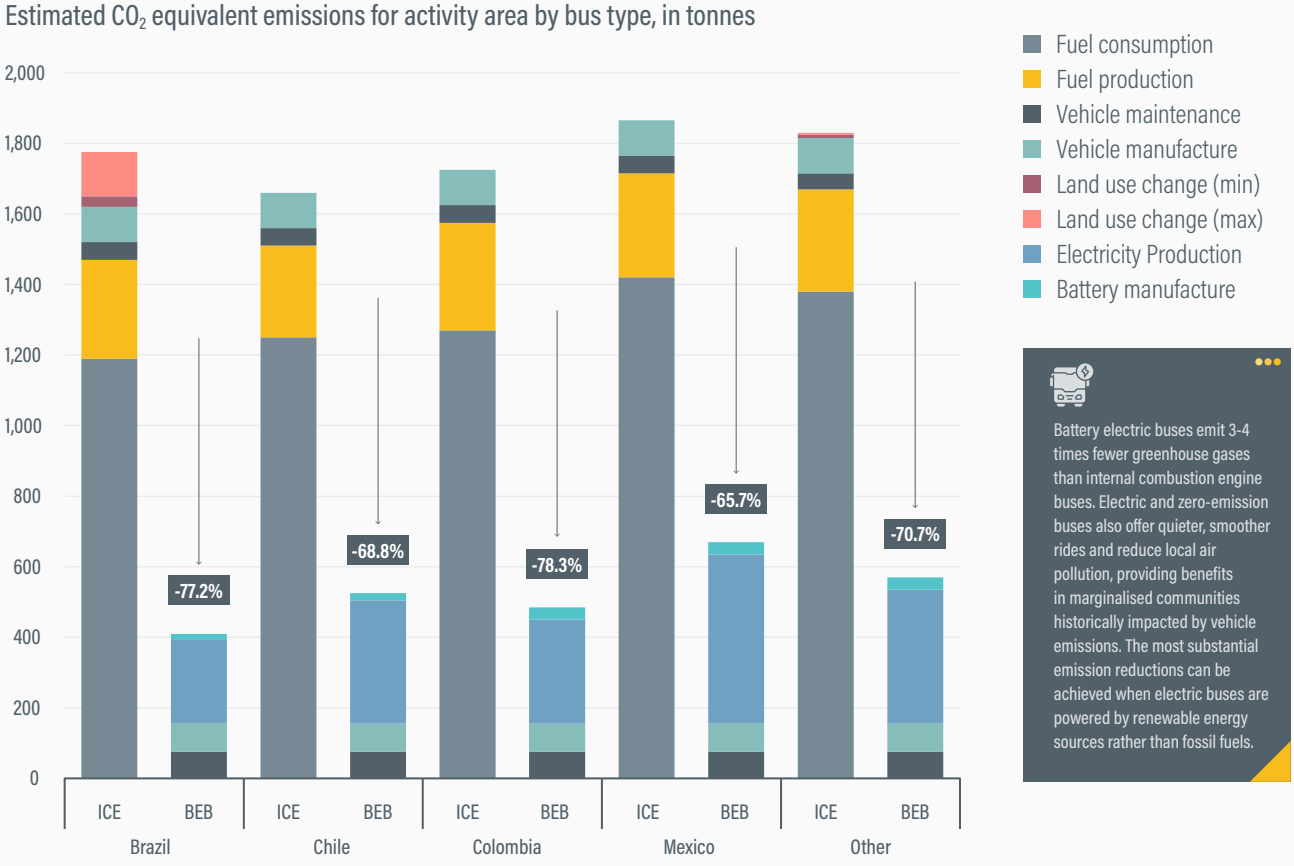
Sustainability and climate trends

Public transport is widely recognised as a cost-effective strategy for decarbonising transport. Buses and rail contribute lower emissions than other passenger transport modes (such as cars and planes) on both a life cycle assessment (LCA) and a well-to-wheel (WTW) basis. Buses show median emission values of 43 grams of CO_2 per passenger-kilometre on a WTW basis and 48 grams of CO_2 per passenger-kilometre for LCA, whereas rail exhibits median emissions of around 29 grams for WTW and 33 grams for LCA.[82] To reduce emissions, cities have introduced electric and zero-emission buses to their fleets.

Battery electric buses emit 3-4 times fewer greenhouse gases than internal combustion engine buses, according to a 2024 study in Latin America.[83] **Electric and zero-emission buses also offer quieter, smoother rides and reduce local air pollution, providing benefits in marginalised communities historically impacted by vehicle emissions.**[84] **The most substantial emission reductions can be achieved when electric buses are powered by renewable energy sources rather than fossil fuels.** For 12-15 metre buses in 2024, the life-cycle emissions for battery electric units compared to internal combustion engine units were 77.2% lower in Brazil and 78.3% lower in Colombia, but they were only 65.7% lower in Mexico, due to the different carbon intensities of the countries' respective electric grids (Figure 4).[85]

Privately owned vehicles are projected to dominate urban passenger transport globally by 2050.[86] **Improvements in vehicle efficiency and technological advances, as well as shifts towards low-carbon modes and improved land use planning, are expected to contribute to a 23% decrease in urban passenger transport emissions by 2050.**[87] **An additional 8% reduction could be achieved by combining public transport systems with shared mobility options (such as cycling, walking and ridesharing), while simultaneously improving and integrating informal transport networks.**[88]

FIGURE 4. Comparison of life-cycle emissions of 12-15 metre buses in Latin America, 2024



Note: ICEB = internal combustion engine buses; BEB = battery electric buses

Source: See endnote 85 for this section.

(See 4.6 Informal Transport.) However, even these combined measures remain insufficient to meet the emission reduction goals of the Paris Agreement.[89]

One study estimates that achieving climate goals will require rapid transit systems in the world's 50 highest-emitting cities to expand and double in infrastructure between 2020 and 2030.[90] More ambitious policy measures and investments will be needed.

Public transport systems play an important role in improving air quality by reducing private vehicle dependency and its associated emissions, particularly through fleet renovation and the adaptation of new powertrain technologies.

- Since 2017, Stockholm (Sweden) has successfully transitioned its public transport system to 100% renewable energy.[91] In February 2024, the city became the world's first capital city with bus services that are 100% fossil free; nearly two-thirds (64%) of Stockholm's buses are fuelled by biodiesel, resulting in CO_2 emission reductions of up to 90% when compared to conventional fuels.[92]
- In June 2022, Germany temporarily introduced a USD 9.3 (EUR 9) monthly ticket for regional and public transport, effectively reducing fares up to 90%; during the month, pollution levels nationwide fell an estimated 8%.[93]
- A 2024 study demonstrated that the Cablebus Line 1 in Mexico City (Mexico), inaugurated in July 2021, reduced nitrogen dioxide (NO_2) levels in areas near the cable car system by around 13%, helping to improve air quality in a city where the high-altitude mountain plateau creates pollution-trapping effects.[94]
- A 2025 modelling study on the impacts of medium- and heavy-duty electric vehicle policies in New York City found that complete electrification of these vehicles could save USD 2.4 billion in health costs by 2040, primarily from NO_2 reduction, while also preventing 248 premature deaths and 173 childhood asthma emergency department visits.[95] The greatest health benefits would occur in communities with the highest percentages of historically marginalised populations.[96]

Public transport fleets can present environmental challenges depending on the fuel type, vehicle age and technology. Although heavy-duty vehicles such as buses and freight trucks represented less than 5% of vehicles on roads in 2019, they generated as much as two-thirds of urban air pollutants, including NO_x, black carbon, $PM_{2.5}$ and sulphur dioxide (SO_2), by mass.[97] As such, public transport needs to be closely linked to transport planning, low/zero-emission zones and related activities. (See 4.2 Integrated Transport Planning.)

Farebox recovery ratios, defined as the share of operating costs covered by fare revenues, vary widely across public transport agencies globally. Asian agencies typically exhibit higher ratios than their North American and European counterparts.[98] In 2022, nearly 90% of US public transport agencies recovered less than one-fifth of their operating costs through fare revenue, highlighting heavy dependence on local and federal government subsidies.[99] To improve farebox recovery ratios, public transport agencies must improve service efficiencies (for example, with dedicated bus lanes and transit priority at intersections), and increase ridership and load factors by improving service quality and providing travel demand management (TDM) incentives for travellers to use public transport for more urban trips. Overall, the financial sustainability of these systems depends on the balance between operational costs and revenue generation.

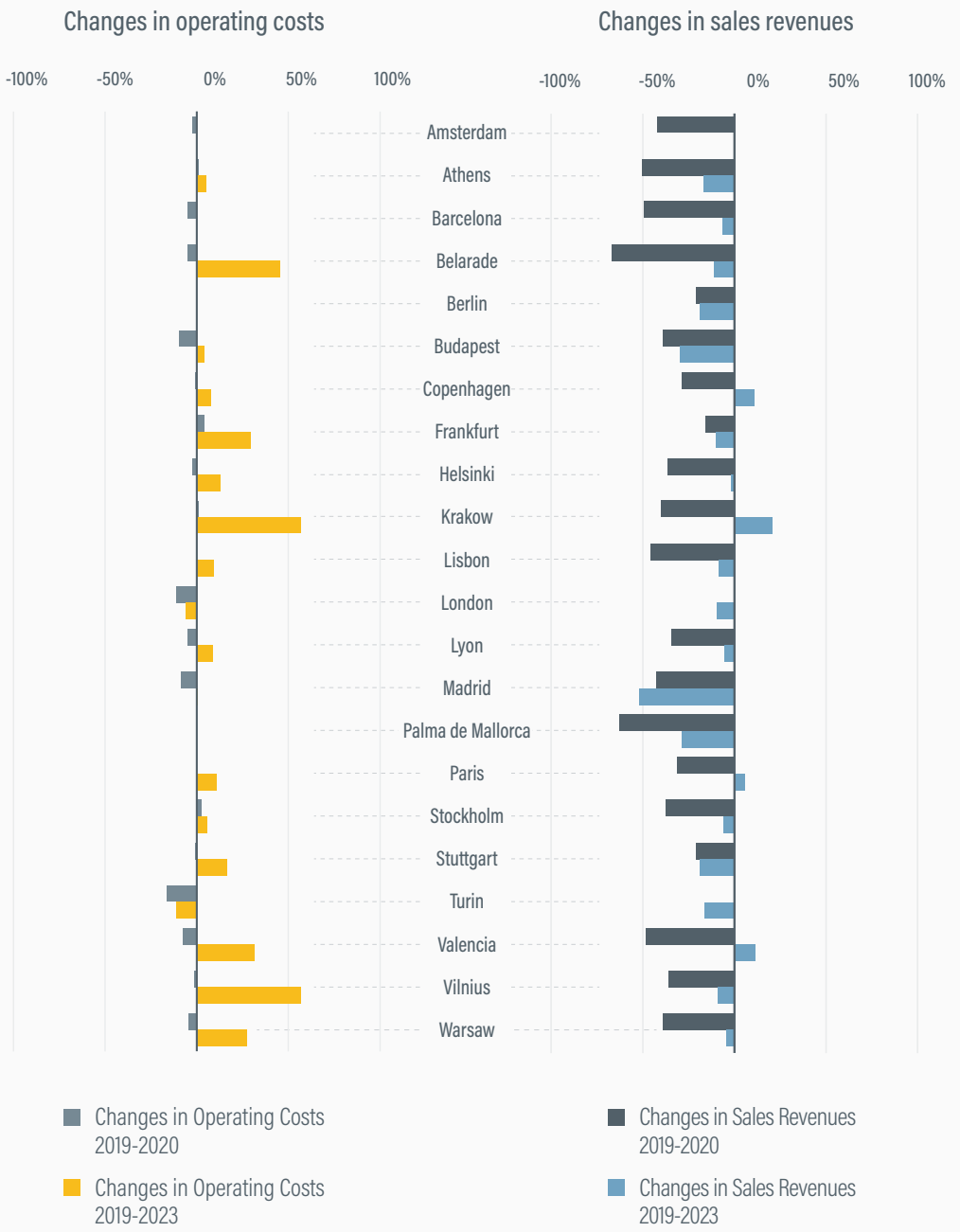
Since the COVID-19 pandemic, operating costs for many public transport agencies have risen due to inflation, energy price rises, and wage growth, whereas fare revenues have tended to remain below pre-pandemic levels. European metropolitan areas illustrate these financial pressures (Figure 5).[100]

- Cities in Europe that experienced modest changes in operating costs between 2019 and 2023 included Amsterdam (Netherlands; -2.4%), Athens (Greece; 5.1%) and Copenhagen (Denmark; 7.5%).[101]
- European cities that faced substantial increases in operating costs included Belgrade (Serbia; 45.5%), Frankfurt (Germany; 29.1%) and Krakow (Poland; 57.0%).[102]
- Between 2019 and 2023, revenue from transport sales grew in Rotterdam (Netherlands; 13.6%) but fell in Athens (Greece; -16.7%), Belgrade (Serbia; -11.0%) and Frankfurt (Germany; -18.1%).[103]

In addition to reducing greenhouse gas emissions, efforts towards climate adaptation and resilience have become equally vital in the public transport sector. Public transport is exposed to risks linked to biological, societal and meteorological/hydrological hazards. Service providers and users operate in environments increasingly strained by climate-related events, including heatwaves and flooding and their compounding and cascading effects. Adaptation is broadly defined as making adjustments to address and protect against expected or actual climate impacts, and is increasingly urgent as rising temperatures and extreme weather events pose growing threats to transport infrastructure.

- **Biological hazards:** The COVID-19 pandemic had profound consequences for the public transport sector, as countries grappled with physical distancing requirements that fundamentally conflict with the nature of mass transport operations. Studies have found that consistent

FIGURE 5. Transport operating costs and revenue recovery in European cities, 2019-2020 and 2019-2023



Since the COVID-19 pandemic, operating costs for many public transport agencies have risen due to inflation, energy price rises, and wage growth, whereas fare revenues have tended to remain below pre-pandemic levels. European metropolitan areas illustrate these financial pressures.

Source: See endnote 100 for this section.

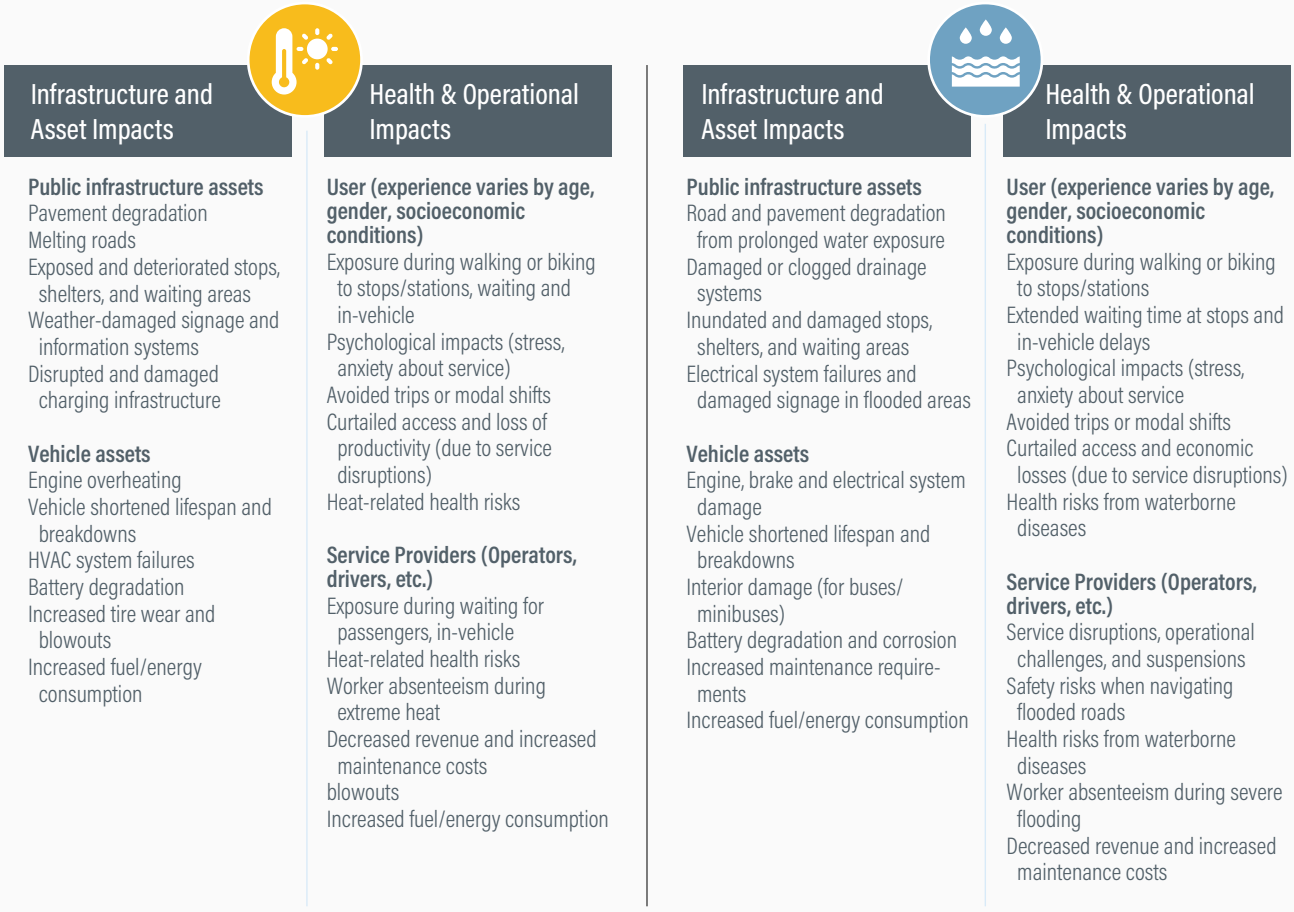
use of face masks in enclosed environments such as transport vehicles can greatly reduce transmission risks.[104] However, further research is required to determine how best to adapt to such hazards in the future. In addition to operational challenges and health concerns, the pandemic raised questions around public transport's underlying economic sustainability, equity access and long-term mobility goals.

- **Societal hazards:** The Russian Federation's invasion of Ukraine in 2022 illustrated how conflicts can disrupt public transport systems, not only in directly affected nations (in the Russian case due to sanctions) but also in surrounding regions. In Ukraine, Kyiv Metro suspended regular service early in the invasion, repurposing its tunnels as bomb shelters.[105] Across the EU, countries experienced changing mobility patterns in response to spiking fuel prices. A

study of 25 EU countries found that the 2022 energy crisis altered travel behaviours, with strong correlations between rising petrol and diesel prices and public transport use in Bulgaria, Denmark, Latvia, Poland and the Slovak Republic (with ridership in Bulgaria surpassing pre-pandemic levels).[106]

- **Meteorological and hydrological hazards:** Without major emission reductions, up to three-quarters of the global population could be exposed to lethal heat-humidity conditions by the end of the century, up from under one-third in 2000.[107] Urban flood risks are also expected to rise due to climate change and urbanisation, disrupting public transport operations.[108] In many cities, heat and flooding risks are compounded – sometimes occurring on the same day or triggering one another.[109] These hazards pose challenges for public transport authorities, operators, manufacturers and wider stakeholders, as they threaten infrastructure by damaging roads, tracks, and vehicles, often leading to service disruptions, delays and suspensions. The resulting impacts create ripple effects on mobility, access to essential services, public health, safety and economic productivity (particularly for users with limited transport alternatives) (Figure 6).[110]

FIGURE 6. Impacts of extreme heat (left) and flooding (right) on public transport users, service providers and physical assets



Source: See endnote 110 for this section.

Policy and investment trends

Safe, convenient, reliable and affordable public transport is key to successful and thriving cities and communities. Public transport has strong links to the positive achievement of 14 of the 17 United Nations Sustainable Development Goals.[111] They include:

- SDG 1 (No Poverty) – by providing access to education and economic opportunities;
- SDG 3 (Good Health and Well-being) – through better road safety, improved air quality, increased physical activity getting to and from fixed stations, and improved access to health centres;
- SDG 5 (Gender Equality) – by providing safe and independent mobility to empower women and girls to reach education and job opportunities;
- SDG 7 (Affordable and Clean Energy) – by creating demand for clean and sustainable electricity, through electrification efforts;
- SDG 8 (Decent Work and Economic Growth) – by creating jobs and connecting people to opportunities;
- SDG 9 (Industry, Innovation and Infrastructure) – by allowing optimisation of investments in resilient infrastructure; and
- SDG 11 (Sustainable Cities and Communities) – by expanding public transport, notably through target 11.2.[112]

During 2022-2024, several important policy shifts across public transport systems had notable effects at the national and international levels. Governments have applied a wide range of policy strategies, from outright bans on fossil fuels to generous tax incentives, with mixed but noticeable progress.

- In 2024, Ethiopia became the first country to completely ban imports of non-electric vehicles , aiming to reduce its annual petrol and diesel import bill of USD 7.6 billion.[113] The move builds on the country's 2022 imposition of a 200% customs duty on fossil fuel vehicles (versus just 15% on electric vehicles).[114]
- Egypt demonstrated its commitment to low-emission mobility by deploying 260 electric buses for the 2022 UN Climate Change Conference in Sharm El-Sheikh (COP 27).[115] Although a national strategy has been announced, a detailed five-year roadmap for petrol and electric bus adoption was still pending as of mid-2025.[116]
- In 2025, Morocco announced that it would invest USD 10.7 billion in public transport and high-speed rail to enhance connectivity and drive economic growth.[117]
- India concluded its nine-year FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) policy in March 2024, after providing subsidies totalling USD 1.37 billion (INR 11,500 crore) to support 1.6 million electric vehicles, including more than 5,100 e-buses.[118] The successor scheme, PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM e-DRIVE), was launched in September 2024 with an allocation of USD 1.29 billion (INR 10,900 crore) over two years.[119]
- Bus electrification in India is driven by the National Electric Bus Program, targeting 50,000 e-buses by 2027 in major cities, and by PM-eBus Sewa, a USD 6.9 billion (INR 57,613 crore) programme deploying 10,000 e-buses across 169 smaller cities.[120]
- In the United States, the 2021 Infrastructure Investment and Jobs Act authorised funding of up to USD 108 billion for public transport through 2026, including USD 5.6 billion for the Low or No Emission Vehicle Program.[121] As of 2024, the US Environmental Protection Agency's Clean School Bus Program had allocated nearly USD 2 billion to replace around 5,000 school buses with electric models.[122] The Inflation Reduction Act (IRA) of 2022 offers complementary tax credits for electric vehicle infrastructure, although both acts faced political headwinds in 2025. (See 3.5 North America Overview and 5.2 Road Vehicle Electrification.)
- The EU's Green Deal Industrial Plan, launched in 2023 as a response to the US IRA, addresses the growing global competition in clean technologies by backing net zero industries through subsidies and streamlined regulation, including simplified procedures and a more favourable investment environment.[123]
- The amended EU Regulation on Heavy-Duty Vehicle CO_2 Emissions, adopted in 2024, sets more ambitious binding targets for urban buses, calling for 90% of new city buses to be zero-emission by 2030, and 100% by 2035.[124]
- In Latin America, Uruguay created a Sustainable Mobility Trust Fund in November 2023 to incentivise electric bus adoption and replace diesel-focused subsidies.[125]
- In 2022, São Paulo (Brazil), with a bus fleet of more than 13,000 vehicles, banned new diesel bus procurement in line with its Climate Law.[126]
- Bogotá (Colombia) ended purchases of fossil-fuelled buses in early 2022.[127]

Public transport in many countries is often cushioned by fuel tax exemptions and/or direct subsidies, but these supports become harder to sustain during price and political fluctuations, especially in countries already experiencing financial stress. The impacts vary depending on countries' different policy priorities and responses when balancing mobility needs against broader fiscal constraints.

- Colombia began phasing out its Fuel Price Stabilization Fund (FEPC) in 2022 due to the fund's growing fiscal burden.[128] By early 2024, petrol subsidies had been mostly removed, and diesel subsidies were reduced by USD 0.18 (COP 800) per gallon.[129] The original plan called for reductions of COP 1,904 but was revised downward

after protests from freight truckers and public transport operators facing rising operational costs.[130]

- In Malaysia, diesel subsidy costs surged dramatically from USD 300 million (RM 1.4 billion) in 2019 to USD 3 billion (RM 14.3 billion) in 2023.[131] In June 2024, the government responded by raising diesel prices more than 50% and shifting from blanket subsidies to a targeted, tiered system.[132] For public transport, under the new fleet card programme Sistem Kawalan Diesel Subsidi (SKDS 1.0), operators pay a lower diesel rate of USD 0.42 (RM 1.88 per litre), while non-subsidised users pay the full USD 0.75 (RM 3.35) per litre.[133]
- The Philippines allocated USD 52.6 million (PHP 3 billion) for its 2024 transport fuel subsidy programme, of which USD 43 million (PHP 2.5 billion) was earmarked for direct fuel subsidies to public utility vehicle drivers, including those operating jeepneys, tricycles, ride-hailing services and delivery vehicles.[134] The subsidy programme aims to ease immediate fuel price pressures while supporting long-term development goals, especially in the context of the Public Utility Vehicle Modernization Program. However, ongoing transport strikes since 2023 have protested the programme, which mandates replacing the iconic traditional jeepneys with more expensive, eco-friendly models.[135]
- In May 2023, Nigeria's removal of fuel subsidies caused petrol prices in Abuja to triple, reaching USD 0.45 (NGN 700) per litre; transport fares doubled nationwide, and intra-city bus fares rose around 98%.[136] The abrupt policy shift led inflation to hit a 27-year high by December 2023, making basic goods unaffordable for many people.[137] In response to the economic strain and public backlash, the government partially reinstated fuel subsidies in early 2024, along with additional relief measures such as halving public transport fees and offering free train rides during the holiday season.[138]

A 2025 study of urban rail projects worldwide – including metros, subways and light rail systems – estimated the global weighted average cost at around USD 238 million per kilometre, based on 696 lines across 189 cities; however, construction costs vary dramatically across countries.[139]

- US urban rail projects exhibit exceptionally high costs, with the Second Avenue Subway Phase I in New York City reaching around USD 1.7 billion per kilometre (adjusted in 2023 dollars); this was driven by factors such as complex underground conditions, extensive consultant costs and stringent regulatory requirements (such as maintaining four traffic lanes during construction).[140]
- In Hong Kong, the Tung Chung Line Extension cost around USD 3.1 billion (HKD 24.2 billion) for just 2.5 kilometres, or roughly USD 1.2 billion per kilometre; this reflected the challenge of building in one of the world's most densely populated areas, requiring extensive community facility relocations and complex engineering in limited space.[141]
- Metro construction in Italy demonstrates cost effectiveness, averaging 57% below global benchmarks at around USD 120 million per kilometre; this results from procurement reforms implemented since the 1990s that prioritised transparency and competition, strong in-house public sector capacity for planning and design, and standardised designs that reduce engineering complexity.[142]

Public transport agencies that have maintained revenue stability have adopted diversified funding models including real estate development, advertising and regional transport taxes.[143] **The COVID-19 pandemic prompted agencies worldwide to reconsider their revenue sources and fare policies, with some offering fare-free services** (Table 1).[144] Advocates of fare-free transit argue that eliminating fares repositions public transport from a market commodity to a public good (thereby addressing social exclusion and inequality), whereas critics raise concerns about potential service quality deterioration due to funding shortages for operations and maintenance.[145] In the United States, many public transport systems that relied on COVID-19 relief funds later faced funding gaps as the temporary funding expired.

- New York City (United States) and Bangkok (Thailand) use congestion charging to fund public transport improvements, while London (United Kingdom) uses its ultra-low emission zone as a funding stream.[146]
- Queensland (Australia) trialled reducing its public transport fares to USD 0.31 cents (AUD 0.50) in August 2024 and then made the programme permanent in February 2025.[147] The number of public transport users was 18.3% higher than during the same six-month period (August to February) a year prior and 5% higher than pre-pandemic levels of 2019, and users had saved around USD 112 million (AUD 181 million) through the first six months of the programme.[148]
- Kansas City, the first major US city to implement fare-free public transport in 2020, had a projected USD 26 million funding gap as of 2025 and was considering transitioning to a USD 2 base fare while maintaining free access for seniors and people with disabilities.[149]

While fare-free transit has gained political attention and been extensively implemented in countries such as Brazil, an emerging consensus suggests that targeted policies – such as subsidies for specific populations (e.g., students, elderly, etc.) – may be more sustainable than blanket fare-free systems, since transport infrastructure requires funding regardless of fare structure. Ultimately, effective fare policies must balance access, sustainability and financial viability within broader integrated transport strategies.

TABLE 1. Selected fare-free transit systems and their funding mechanisms, as of January 2025

Transit agency and/or location	Date implemented (status if available)	Funding mechanism	Additional notes
Belgrade (Serbia)	January 2025	Not available	With a population of 1.7 million, Belgrade became the largest European city to implement fare-free public transport for all residents. Covers buses, trams and trolleybuses.
Brazil	Various	Not available	Number of cities with free public transport grew from 42 in 2020 to 136 as of September 2024. A 2024 study found that the fare-free policy resulted in a 4.3% emission reduction and a 3.8% increase in jobs, with the benefits outweighing the costs.
Chapel Hill Transit, Chapel Hill (United States)	2002 (active)	University partnership, municipal* funding, federal/ state subsidies	Celebrated 50th transit anniversary in 2024. Ridership grew from 3 million (2002) to 7 million (2019). Longest-running major fare-free system in the United States.
Corvallis Transit System, Corvallis (United States)	February 2011 (active)	Transit Operations Fee on utility bills (USD 3.89 per single-family household, as of February 2025)	Ridership increased 37.9% in first year of fare-free service. Utility fee provides stable funding that grows with costs. Experienced service reductions in 2022-2023 due to driver shortages.
Colorado Zero Fare Transit Program, Colorado (United States)	Summer 2023-2025 (active – ongoing seasonal)	State funding through Senate Bill 24-032	Statewide programme offering fare-free transit during July-August to reduce ground-level ozone. Includes multiple transit agencies across Colorado.
DASH, Alexandria, (United States)	September 2021 (active)	City subsidy (USD 1.7 million), VA Transit Ridership Incentive Program (TRIP) grant (USD 7.1 million through 2025)	Record ridership of 4.5 million boardings in FY2023. 54% of riders started using DASH after fare elimination. 62% of new riders cited free fares as reason for riding.[150]
Estonian County Buses, Estonia (rural areas)	2018 (partially active as of January 2024)	National and regional government funding	Free transit in rural counties was largely abolished in January 2024 but remains available for people under 19 and over 63.
Indian states of Delhi, Karnataka, Kerala, Punjab, Tamil Nadu and Telangana	2021	Not available	Free public transport for women. Women's use of public transport increased 60-99% in the six cities.
Intercity Transit, Olympia (United States)	January 2020 (active through at least 2028)	Sales tax increase approved by voters in November 2018	Initially a five-year "Zero-Fare" demonstration project. Extended its pilot due to the COVID-19 pandemic. Ridership increased 40% in the first two months before the pandemic.
Kharkiv (Ukraine)	2022	Not available	Introduced fare-free public transport to support residents during the ongoing conflict.
Luxembourg Public Transport, Luxembourg (nationwide)	February 29, 2020 (active)	National government funding	First country to make all public transit free nationwide, although first-class train service still requires payment. Limited modal shift impact but improves social equity.
Malta Public Transport, Malta (nationwide)	October 2022 (active)	National government funding	Second country (after Luxembourg) to implement nationwide fare-free transit. Available for residents only on most routes through personalised Tallinja Card system; excludes some express and on-demand services.
Spain	2022	Free passes, government subsidies; discounts were extended through June 2025, with plans to introduce a new subsidy model starting in July	Free commuter train passes (Cercanías and Rodalies) in metropolitan areas. Subsidised urban transport systems. The policy was introduced to combat inflation and rising living costs exacerbated by the economic effects of the Russian Federation's invasion of Ukraine.
Stavanger (Norway)	Not available	Not available	First Norwegian city to offer free public transport to its residents. Aim was to reduce the number of car trips by 70%.
TaM, Montpellier (France)	December 2023 (active)	Local taxes, using a redistributive policy to restore purchasing power while supporting environmental transition; mobility payments from companies with 11-plus employees	Largest French metropolis with fare-free transport. Eligible for 510,000 inhabitants across 31 municipalities; residents only. 33% ridership increase in first year.

Note: This table showcases various funding mechanisms in the public transport sector, using fare-free systems as a standardised comparison point. Affordable fares should be combined with service quality improvements to attract and retain users, creating a positive feedback loop that benefits the entire system.

* The term "municipal" may represent different governmental structures in different countries. In the United States, municipal typically refers to city or town government, whereas in other countries municipal authorities may have different powers, responsibilities and funding mechanisms.

Source: See endnote 144 for this section.

As of 1 August 2025, a total of 29 countries had submitted their third-generation Nationally Determined Contributions (NDCs) to the UN Framework Convention on Climate Change (UNFCCC); of these, 25 NDCs included content related to transport, but only 15 featured content (either as targets or actions) on public transport (Andorra, Botswana, Brazil, Canada, Kenya, Lesotho, Maldives, Moldova, Monaco, Nepal, Somalia, Singapore, the United Kingdom, the United States and Uruguay).[151] Belize, Botswana, Canada, Lesotho, Moldova, Monaco and Nepal outlined specific targets related to public transport, covering expansions, modal shifts as well funding targets.

- Botswana's new NDC commits to increasing the share of public transport in total transport use to 30% by 2030.[152]
- Canada aims to contribute USD 2.1 billion (CAD 3 billion) per year for public transport through the Canada Public Transit Fund from 2026 onwards.[153]
- Lesotho's NDC has a target to increase the share of public transport from around 10% in 2022 to 30% by 2030.[154]
- Moldova's NDC features a transition to hybrid vehicles for public transport by 2030, followed by 50% fleet electrification by 2040 and complete electrification by 2050.[155]
- Monaco's NDC commits to replace all public buses with electric vehicles by 2030.[156]
- The new NDC of Nepal targets effective public transport systems in all cities by 2035; an integrated electric bus, trolley and light-rail system of at least 50 kilometres by 2030 and 100 kilometres by 2035; and at least 50 cable-based transport services by 2030 and 150 by 2035.[157]

Public transport actions in the third-generation NDCs were aimed at improving and expanding services and increasing access. However, the low number of NDCs submitted as of 1 August 2025 made it difficult to identify detailed trends and to compare actions to previous generations of NDCs.

- Andorra highlights in its 2025 NDC that all public transport has been free since 2022.[158]
- Brazil aims in its NDC to reduce dependence on private transport by improving public transport.[159]
- Canada's NDC mentions ambitions in Vancouver to reduce vehicle emissions by promoting a shift to public transport; British Columbia plans to electrify public transport.[160]
- Kenya's NDC emphasises a comprehensive approach of promoting low-carbon, climate-resilient and efficient transport systems that are gender responsive and accessible to all, through electrification, modal shifts, urban mass rapid transport systems and overall greening of transport.[161]
- Singapore's NDC highlights the "Walk-Cycle-Ride" approach, including expanding its rail network from around 270 kilometres as of 2025 to 360 kilometres in the early 2030s, putting 8 in 10 households within a 10-minute walk from a train station.[162]
- The United Kingdom's NDC highlights a complete overhaul of public transport services and integrating transport networks to make the sustainable choice the most convenient choice.[163]
- The US NDC emphasises the need to invest in affordable, accessible, reliable public transport and rail to reduce emissions and to promote benefits for communities with environmental justice concerns.[164]
- Uruguay's NDC features the optimisation of public transport services through improved accessibility and affordability.[165]

In the second generation of NDCs (submitted to the UNFCCC between 2020 and 2023), 67% of countries prioritised action with public transport.[166] Identified gaps included a lack of ambitious targets, clear timelines for activities, and specifying ministries and budgets. High-income countries focused on clean vehicle technologies, whereas low- and middle-income countries focused on infrastructure and system improvements. However, in many cases the public transport-related policies or measures outlined in second-generation NDCs were vague in both terminology and intended on-the-ground impact.

Efforts to decarbonise public transport must be paired with strategies to adapt to and withstand potential climate-related hazards. Strengthening the synergy between mitigation and adaptation is essential to ensure that investments in low-carbon public transport remain effective amid intensifying climate stress and more frequent extreme weather events. Although the shift to electric buses can lower emissions, it introduces new vulnerabilities to power supply disruptions. Without adequate adaptation and the integration of transport and climate resilience, disruptions may erode public confidence and push users back towards more emission-intensive, privately owned vehicles, jeopardising climate goals.

- During China's 2022 heatwave and drought, hydropower outputs in Sichuan Province were halved, causing blackouts and temporary shutdowns of electric vehicle charging stations.[167]
- Ahmedabad (India) has advanced its Heat Action Plan by piloting cooling interventions such as high-pressure misting systems and shaded structures at bus stops to reduce heat exposure for commuters.[168]
- In Phoenix (United States), the Cool Corridors Program, launched in 2022, aims to create shaded routes by planting up to 200 trees per mile to provide safer, cooler walking environments for residents, including those accessing transit stops and services.[169]
- In Poland, the cities of Poznań, Siemiatycze and Warsaw

have installed "green bus stops" – nature-based solutions that have green roofs and vegetated retention-infiltration systems – which are designed to retain stormwater, reduce local flooding and mitigate urban heat.[170]

Partnerships in action

- Between 2021 and 2025, the **TUMI E-Bus Mission** spearheaded an ambitious initiative to build strong coalitions at the global and local levels, collaborating with 20 Deep Dive Cities and inspiring action in 100 additional cities.[171] Through roadmaps, technical support, and knowledge exchange, the Mission enabled cities to design e-bus fleets tailored to their contexts. By bringing together public and private sector partners, it created a lasting foundation for a global community committed to advancing cleaner, greener and more sustainable urban transport.[172]
- The World Resources Institute's (WRI) **Reimagining Public Transport** project helps cities in Brazil, China, India and Mexico improve public transport's mode share, quality, efficiency and prosperity. It also supports WRI's Mobility and Accessibility Program, the TUMI E-Bus Mission and global efforts such as the World Bank's Sustainable Mobility for All.[173]
- **Transforming Transportation**, organised by the World Bank and WRI's Ross Center for Sustainable Cities, is an annual gathering of high-level decision makers and cutting-edge thinkers focused on sustainable, equitable transport solutions for low- and middle-income countries.[174] The March 2026 event will feature a week-long programme, side events and partner meetings delivered in a dynamic hybrid format combining in-person networking, high-level sessions and virtual participation to engage its global community.[175]
- The **Access to Climate Finance for Transport** initiative, supported by the High Volume Transport programme of the UK Foreign, Commonwealth and Development Office, aims to assist low- and middle-income countries in obtaining climate finance for low-carbon transport solutions.[176] Between January and June 2024, WRI and partners engaged a broad range of stakeholders through five multi-stakeholder convenings, workshops and roundtables.[177]
- In 2024, the International Association of Public Transport (UITP) developed the **Public Transport National Determined Contributions Template**, a guidance document on how to integrate public transport targets in the new third-generation NDCs. Countries can use the template to explore options that reflect national priorities and address key implementation and financing needs. It consists of 4 key elements (and 14 key policies and actions): 1) Articulate a vision for the desired state of the future that puts public transport at the heart of urban transport climate action; 2) Accelerate transformations with ambitious targets in order to bring about change and accelerate ambition; 3) Detail the actions to reach the vision, targets and objectives that will help to bring about higher ambition and better urban mobility built on a backbone of public transport; 4) Elaborate indicators linked to the SDGs to monitor and verify progress against the actions so it accelerates change and delivers multiple sustainability benefits.
- The research project on **Inclusiveness, Accessibility, and Equity in Public Transport** was launched in March 2025 by UITP's Asia-Pacific Centre for Transport Excellence. The project aims to address the growing need for public transport systems that are inclusive, accessible and socially equitable, particularly for underserved and marginalised groups in growing Asia-Pacific cities.[178]
- Funded by Horizon Europe, the three-year **GOLIA** initiative (Governing, Optimising and Leveraging Innovations proActively) brings together 21 partners, including **UITP**, to rethink how mobility is planned, governed and delivered.[179] It focuses on three key areas – climate resilience, social inclusion and governance – to help cities build mobility systems that can withstand environmental, political and structural disruptions.[180]
- UITP's **Public Transport Benefits Toolbox** offers brochures, posters, visuals and other resources to help communicate the value of public transport to the public, policy makers and other stakeholders.[181]
- In April 2025, the International Union of Railways (UIC) and Southwest Jiaotong University hosted the **UIC World Congress on Railway Training** in Chengdu (China), gathering training directors, executives, human resource professionals and rail education institutions to promote best practices, showcase innovative research, address new training challenges and share knowledge across the industry.[182]
- UIC, through its Africa Programme, launched the **UIC Taskforce 'Women in Rail in Africa'** to develop recommendations, conclusions, and initiatives that enhance women's contribution to the rail sector in Africa – both as part of the workforce and as passengers.[183]

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Informal Transport



THIS CHAPTER IS SUPPORTED BY
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KEY FINDINGS

- Informal transport – also known as popular transport or paratransit – refers to a broad range of privately organised and operated transport services, mainly in the Global South. It can include motorcycle taxis, auto-rickshaws, minibus taxis, private automobiles and even boats. The level of informality of these services depends on the operational context, regulation, working conditions and level of involvement of public authorities in their planning and delivery.
- Because of the informal character of this sector, updated and consistent data are lacking on fundamental aspects such as the size and characteristics of vehicle fleets, the scale of operations and the number of workers. Such data are essential to better inform policies and investment that improve the service based on the local context.
- In recent years, interest, advocacy and knowledge sharing on informal transport have grown, and international organisations have increasingly funded and supported research, planning and policy in this area. In most cases, efforts have focused on large cities. However, there is an understanding that informal transport also plays a crucial role in peri-urban and rural areas, where other transport services may be unavailable or unreliable.
- Traditional modes of informal transport have steadily evolved towards motorised, digitalised and electric alternatives. In some settings, governments have integrated informal transport services into broader strategies for modern and sustainable urban mobility. In areas where political will or capacity may be limited, the private sector has helped drive modernisation.
- Recent policy initiatives have focused on fleet modernisation, regulation, data collection and sustainable transport planning. Yet challenges persist in data availability, financial sustainability, and regulatory co-ordination, limiting the informal transport sector's potential contributions to equitable and low-carbon urban transport solutions.
- Although informal transport could be a potential low-carbon solution with high passenger capacity, the sector's widespread inefficiencies and challenges related to quality, security and reliability must be addressed to prevent users from transitioning to more carbon-intensive private vehicle travel and to ensure truly inclusive and sustainable transport solutions.

Demand, use and access

- Global data on the size, operations and ridership of informal transport fleets remain sparse, inhibiting the ability to generate insights for better policy and planning.
- Data on informal transport for different cities in the Global South show that trips using these modes still represent a large share of passenger transport services, ranging from 11% to 95% of trips in different cities, with an average of 48% of trips.
- Informal transport using two- and three-wheelers is extremely common in cities across the Global South, particularly in Asia, and is often also the backbone of rural mobility. Auto-rickshaws, *tuk-tuks*, motorcycle taxis and bicycle taxis have become essential in providing connectivity and access to transport both in congested city centres and in areas outside or in the periphery of urban centres that may have limited public transport options.
- Globally, two- and three-wheelers remained the most electrified road transport segment in 2024, with more than 9% of the total fleet being electric. Although overall sales of two-wheelers fell in 2023, the electric two- and three-wheeler segment surged, thanks to innovative business models and policies such as India's FAME II scheme. Electric versions of informal transport such as *boda bodas*, auto-rickshaws, *ojeks*, *tuk-tuks* and others have appeared in many Global South cities.
- The transition to electric two- and three-wheelers is the most advanced in Asia, thanks to public incentives. In 2023, Asia held 53% of the global electric three-wheeler market and 52% of the electric two-wheeler market, with China alone holding 35% and 12%, respectively.
- A surge in the popularity of ride-hailing apps has sustained the demand for two- and three-wheelers (including electrified versions), with many informal transport operators incorporating these technologies into their daily operations.

KEY FINDINGS



- Minibus taxis play a prominent role in urban transit in different cities in Africa, underscoring their central place in urban mobility. In Gaborone (Botswana) and Maseru (Lesotho), they accounted for more than 70% of all trips as of 2021.
- Fewer data are available on other forms of informal transport, such as private (clandestine) taxis, pick-up trucks, and maritime and human-powered transport services. Pick-up trucks are frequently used as informal transport in rural areas, sometimes with seats or other adaptations in the back. Traditional boat ferries are common in many geographies, but their role in mobility has been less explored.
- In South-East Asia, traditional informal transport modes have evolved towards motorised and digitally integrated alternatives, due in part to interest from younger users. To actively promote modern and sustainable urban transport systems, some governments have explicitly banned traditional informal modes.
- Across Africa, informal transport continues to work in tandem with public transport to meet the region's growing urbanisation and mobility needs. Data and research on informal transport in Latin America are limited in comparison to Asia and Africa.
- Surveys reveal that in some of Latin America's biggest cities, informal transport may be more difficult to access than formalised public transport options, particularly in cities with well-developed mass transit networks or where regulations restrict informal operations. Although informal transport may not be as present in the city cores of large metropolitan areas, it plays a key role in connecting peri-urban areas and residents in informal settlements. In many contexts, informal buses still provide better access to transport services than other mass transport options such as trains or formal buses.
- A small but growing field of research has focused on informal transport in sub-regions such as Central America and the Caribbean, providing data on the roles of smaller vehicles and informal boat services in coastal secondary cities and rural areas.
- Although informal transport is usually explored in the context of the Global South, many high-income countries host small-scale, unregulated services. These services cater mainly to tourism but also operate in areas underserved by public transport, or disrupt the market by offering a cheaper transport option.

KEY FINDINGS

Sustainability and climate trends

- Informal transport is frequently valued as a catalyst for economic activity and local development, offering access factors such as door-to-door service, speed, cost and maneuverability in small or narrow streets found in the Global South.
- The informal transport sector intersects with many dimensions of sustainability and has the potential to generate numerous social, economic, and environmental benefits, contributing to at least 7 of the 17 United Nations Sustainable Development Goals (SDGs).
- Road safety remains a key challenge facing informal transport, with the lack of regulation and oversight contributing to a high risk of injuries and fatalities among users. On average, 22.5% of road traffic deaths globally in 2016 involved riders or passengers of two- and three-wheelers.
- Women are among the main users of informal transport but are the least represented in the sector's workforce, as they face challenges related to recruitment, retention and sexual harassment. Overall, there is an urgent need to improve working conditions in the informal transport sector.
- Smaller vehicles that make it possible to transport more people at the same time – such as auto-rickshaws and minibuses – are considered the most energy-efficient and least carbon-intensive modes of informal transport. A study in Cape Town (South Africa) found that motorcycle and minibus taxi services are still less energy intensive than petrol or hybrid-equivalent vehicles, which are more common than electric cars in cities in the Global South.
- Studies in different cities around the world indicate that, on average, the contribution of informal transport to overall transport emissions is 20%, although it can reach 40% in some cities. This contribution depends on characteristics such as the types and ages of vehicles, which can affect a vehicle's operational efficiency.
- Many of the vehicles used in informal transport are older, second-hand vehicles imported from other countries, raising significant safety, environmental and public health concerns. As of 2019, more than 80% of Africa's road vehicles failed to meet Euro 4 emission standards and often lacked valid roadworthiness. Older vehicles emit far more pollutants than newer models, especially when poorly maintained or fitted with low-quality components.
- In many African cities, where second-hand motorcycles dominate the informal transport fleet, emissions depend on the vehicle age and mileage, and drivers and users are among the most vulnerable to road crashes and injuries. In Kampala (Uganda) and Nairobi (Kenya), initiatives such as Lubyanza collect quarterly data on *boda bodas* that includes topics such as vehicle characteristics, road worthiness compliance, helmet use, reflective jacket use, and worker profiles and needs. Such insights can inform sustainability and climate action projects and help address challenges such as improving working conditions and compliance with road safety requirements.
- The electrification of informal transport has contributed to climate action, air quality and noise pollution goals while also improving services for users. Electric two- and three-wheelers accounted for around 60% of the avoided oil demand in the global road transport sector in 2023, driven by their rapid adoption and expansion in regions such as China, India and South-East Asia. However, many countries continue to face grid reliability issues that affect vehicle charging, and electricity is often sourced from highly polluting bagasse, coal and petroleum.



KEY FINDINGS

Policy and investment developments

- Recent policy developments in informal transport have focused on electrification, fleet modernisation, regulation and integrating the sector into data collection efforts and sustainable transport planning. Some governments have introduced digital registration and verification for drivers of informal transport vehicles; however, broader integration efforts are still evolving.
- As fleet electrification continues to expand, the push to electrify informal transport vehicles must be accompanied by strong planning and policy measures to ensure that systems are inclusive, sustainable and safe. Key challenges to electrification include data availability, access to affordable and appropriately scaled financing, the need for viable business models, and regulatory co-ordination, limiting the sector's potential contributions to equitable and low-carbon urban transport solutions.
- Despite the high prevalence of informal transport in the Global South, countries have only recently started to incorporate the sector into their Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. As of 2025, only Angola, Uganda and Somalia mentioned or included goals associated with informal transport in their NDCs.
- Vehicle scrappage and modernisation schemes have been implemented in various countries to replace ageing informal transport vehicles. Experiences in Africa, particularly in Dakar (Senegal), in the 2000s have generated insights and models for countries elsewhere to replicate.
- In addition to government action, a diversity of other stakeholders – including public-private partnerships and non-governmental organisations – have undertaken data collection and policy initiatives to improve and modernise informal transport services.
- Despite these advancements, significant gaps remain in formal recognition, integration and support for informal transport providers. To accelerate and support policy development in the field, international organisations have launched guiding documents and resources that provide recommendations and insights for policy makers to follow and integrate into their work.



Context, challenges and opportunities

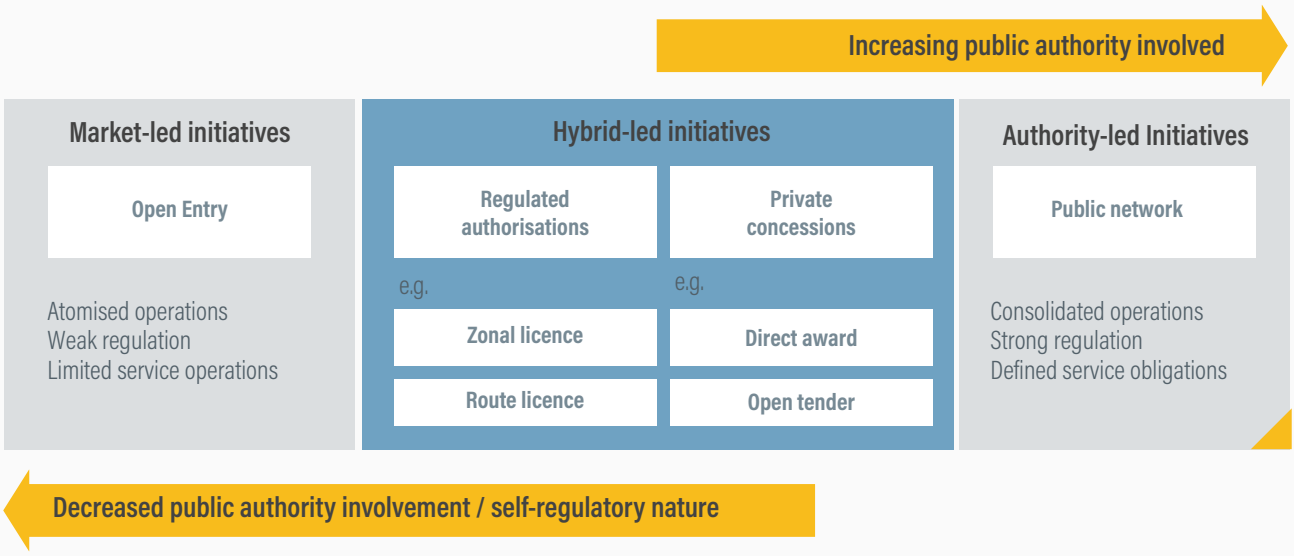
Informal transport – also known as popular transport or paratransit[i] – refers to a broad range of privately organised and operated transport services, mainly in the Global South. It can include motorcycle taxis, auto-rickshaws, minibus taxis, private automobiles and even boats. The level of informality of these services depends on the operational context, regulation, working conditions and level of involvement of public authorities in their planning and delivery (Figure 1).[1]

Because of the informal character of this sector, updated and consistent data are lacking on fundamental aspects such as the size and characteristics of vehicle fleets, the scale of operations and the number of workers. Such data are essential to better inform policies and investment that improve the service based on the local context. Data are also crucial for understanding the informal transport sector's contribution to greenhouse gas emissions and sustainability goals, both nationally and in pursuit of global ambitions such as the Paris Agreement and the Sustainable Development Goals (SDGs).

In recent years, interest, advocacy and knowledge sharing on informal transport have grown, and international organisations have increasingly funded and supported research, planning and policy in this area. In most cases, efforts have focused on large cities. However, there is an understanding that informal transport also plays a crucial role in peri-urban and rural areas, where other transport services may be unavailable or unreliable. The growing inclusion of the sector in the development of Sustainable Urban Development Plans and Sustainable Urban Mobility Plans has helped generate updated data on vehicle fleets and demand trends across different cities, while also enabling the interaction, investment and improvement of informal transport services.

Traditional modes of informal transport have steadily evolved towards motorised, digitalised and electric alternatives. In some settings, governments have integrated informal transport services into broader strategies for modern and sustainable urban mobility. In areas where political will or capacity may be limited, the private sector has helped drive modernisation – often in the form of super-apps, ride-hailing and e-mobility companies – covering gaps left by public policy. This increased private sector involvement has spurred innovations in business models, such as moving away from commission-based pricing[ii].[2]

FIGURE 1. Scale of informality of transport services according to their context



Source: See endnote 1 for this section

i Additional names for informal transport include: traditional, artisanal, provisional, illegal, unregulated, and clandestine transport, among others.
ii Commission-based pricing refers to the mechanism used by ride-hailing apps where a percentage is deducted from each fare to generate revenue.



Recent policy initiatives have focused on fleet modernisation, regulation, data collection and sustainable transport planning. Yet challenges persist in data availability, financial sustainability, and regulatory co-ordination, limiting the informal transport sector's potential contributions to equitable and low-carbon urban transport solutions. The sector also faces enormous challenges related to working conditions, police harassment, social security, and worker health and safety, in addition to discrimination and sexual harassment in the case of female workers.[3] Continued efforts are needed to incorporate informal transport into climate action through a just transition towards modern, sustainable, inclusive and integrated transport systems that ensure workers' wellbeing.

Although informal transport could be a potential low-carbon solution with high passenger capacity, the sector's widespread inefficiencies and challenges related to quality, security and reliability must be addressed to prevent users from transitioning to more carbon-intensive private vehicle travel and to ensure truly inclusive and sustainable transport solutions.

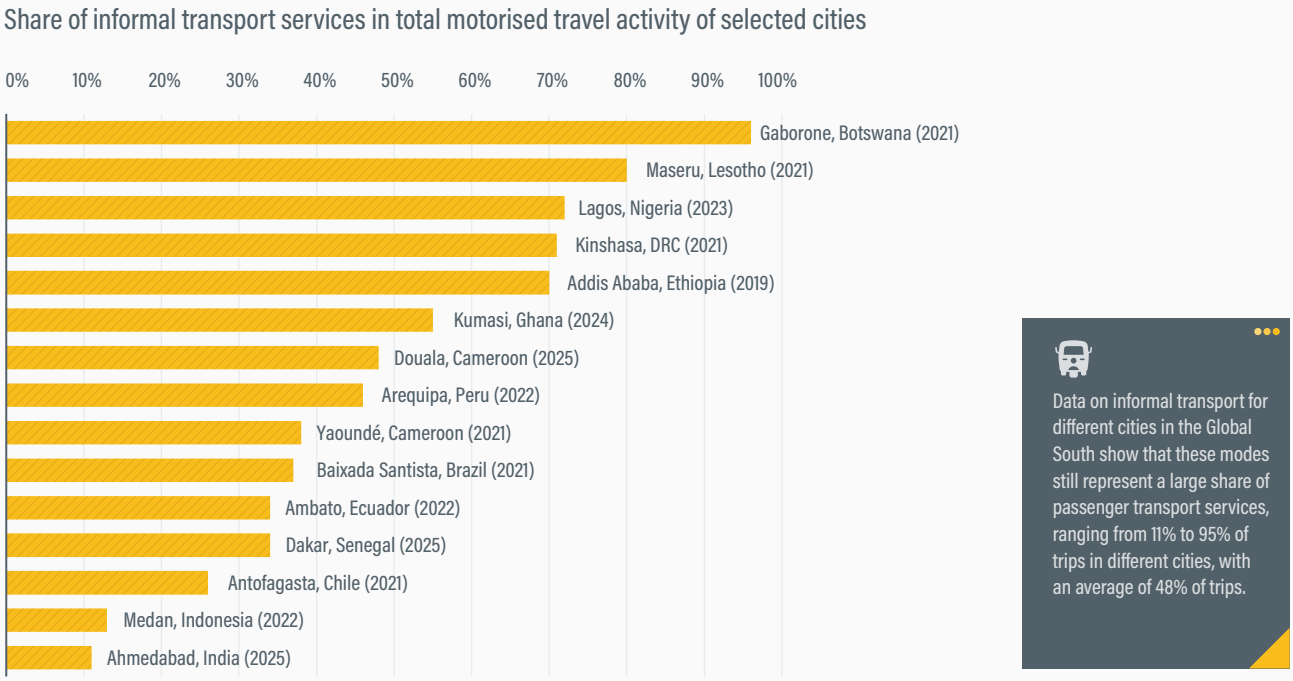
Demand, use and access

Global data on the size, operations and ridership of informal transport fleets remain sparse, inhibiting the ability to generate insights for better policy and planning. However, localised efforts in cities and countries – including the quarterly data insights from Lubyanza Research Group, the Atlas of Popular Transport, TUMI Data and the Partnership for Informal and Shared Mobility (PRISM) – have contributed to a more nuanced view of informal transport in different contexts.[4]

Data on informal transport for different cities in the Global South show that these modes still represent a large share of passenger transport services, ranging from 11% to 95% of trips in different cities, with an average of 48% of trips (Figure 2).[5] The share of informal transport has exceeded 70% in at least five African cities: Addis Ababa (Ethiopia), Gaborone (Botswana), Kinshasa (Democratic Republic of the Congo), Lagos (Nigeria) and Maseru (Lesotho).[6]

Given the loosely defined nature of informal transport, the methodology for calculating its share of trips can vary based on factors such as the type of vehicle or trip, the number of trips taken and the share of vehicle-kilometres travelled. Informal transport relies on many different vehicle types – often in response to the local context, markets, geography and climate – which may limit the standardisation of data collection.

FIGURE 2. Share of informal transport trips in selected cities and years



Data on informal transport for different cities in the Global South show that these modes still represent a large share of passenger transport services, ranging from 11% to 95% of trips in different cities, with an average of 48% of trips.

Source: See endnote 5 for this section.

MobiliseYourCity has prepared methodology guides and toolkits for integrating informal transport into calculations of greenhouse gas emissions.[7]

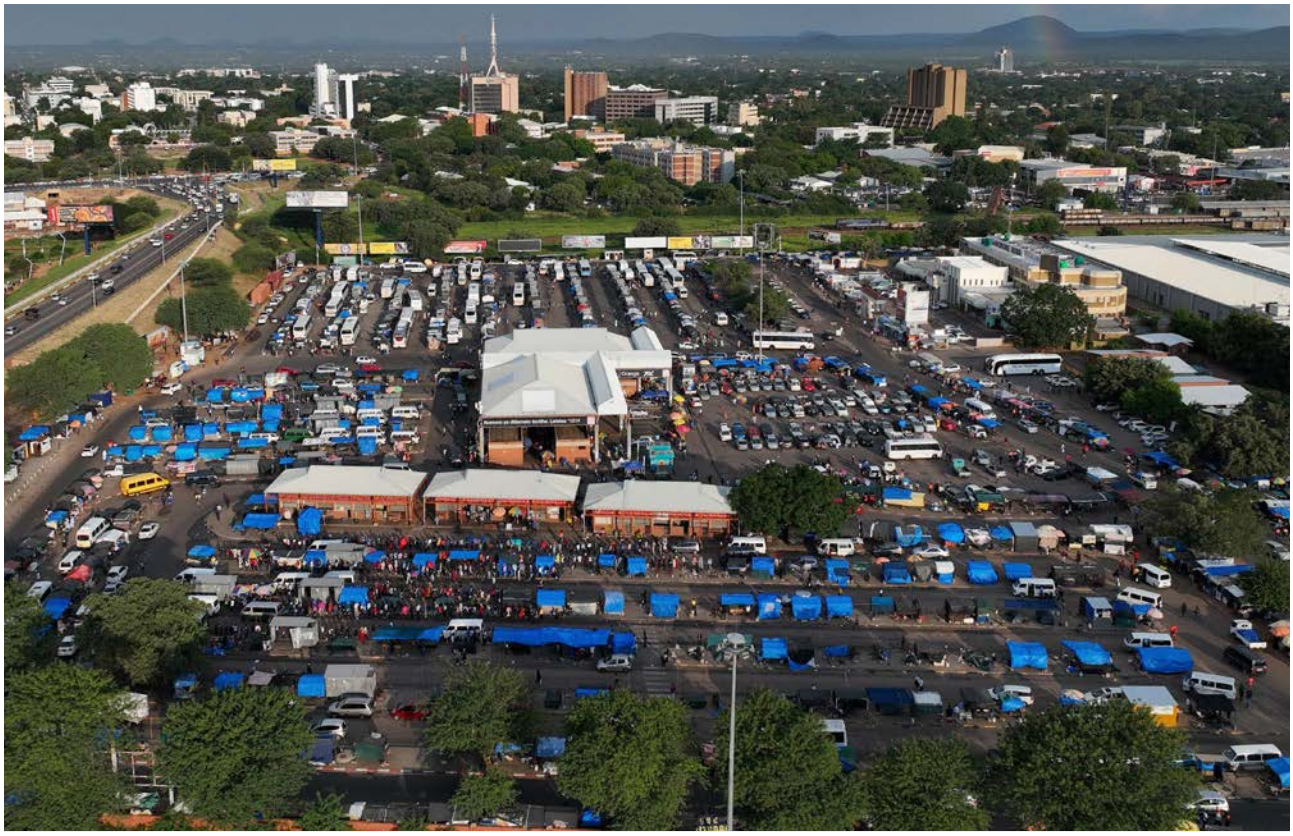
Informal transport using two- and three-wheelers is extremely common in cities across the Global South, particularly in Asia, and is often also the backbone of rural mobility.[8] Auto-rickshaws, *tuk-tuks*, motorcycle taxis and bicycle taxis have become essential in providing connectivity and access to transport both in congested city centres and in areas outside or in the periphery of urban centres that may have limited public transport options. Efforts have sought to improve the integration of two- and three-wheelers with mass transit, digitalise their operations, and improve personal and road safety.

- In China and India, two- and three-wheelers account for a large share of both general traffic and informal transport services.[9]
- In Thailand, motorcycle taxis and ride-hailing play an important role in connecting riders to mass public transport stations, and in India three-wheelers serve a similar demand.[10]
- In 2020, 28% of all trips in Amman (Jordan) were carried out on two- and three-wheelers.[11]

Globally, two- and three-wheelers remained the most electrified road transport segment in 2024, with more than 9% of the total fleet being electric.[12] Although overall sales of two-wheelers fell in 2023, the electric two- and three-wheeler segment surged, thanks to innovative business models and policies such as India's FAME II scheme.[13] Electric versions of informal transport such as *boda bodas*, auto-rickshaws, *ojeks*, *tuk-tuks* and others have appeared in many Global South cities.[14] However, precise data on the share of electric two- and three-wheelers used in informal transport are lacking.

- The social enterprise Greenwheels Africa, based in Nairobi (Kenya), manages a fleet of electric motorcycles (*bodas*) for on-demand passenger and cargo services, providing drivers with the vehicles, training and a fixed income.[15] Greenwheels carried more than 700,000 passengers in its first year of operation (2024), and in partnership with Uber it has expanded its fleet from 50 to over 500 bikes.[16]
- In Thailand, the electric *tuk-tuk* start-up MuvMi recorded more than 3 million trips between 2018 and 2023 and had plans to triple its fleet from 350 to 1,000 units in response to increased demand for rides.[17]

The transition to electric two- and three-wheelers is the most advanced in Asia, thanks to public incentives. In 2023,



Asia held 53% of the global electric three-wheeler market and 52% of the electric two-wheeler market, with China alone holding 35% and 12%, respectively.[18]

- As of 2021, India had surpassed China in the number of two- and three-wheelers with internal combustion engines (15.1 million units versus 15 million units), and a further 1.3 million electric two- and three-wheelers were sold in India and other parts of South Asia that year, helping to consolidate India's leadership in these vehicles by 2023.[19]
- Electric auto-rickshaws (e-autos) accounted for 6% of vehicle registrations in India in 2023, and the government has committed to 80% market penetration of electric three-wheelers by 2030, with various states setting their own targets and offering incentives to promote e-autos.[20]

A surge in the popularity of ride-hailing apps has sustained the demand for two- and three-wheelers (including electrified versions), with many informal transport operators incorporating these technologies into their daily operations.[21]

- The trend towards app integration has helped counter reports from 2018 indicating a possible slowdown of the motorcycle market across South-East Asia.[22]
- The Namma Yatri app, launched in India in 2022 by the Bengaluru Auto Rickshaw Drivers' Union, accumulated a total of 86 million trips, 621,000 drivers, and 11 million registered users as of 2025, generating more than USD 161 million.[23]
- Super-apps such as Gojek in Indonesia and Ola in India are establishing ambitious goals to electrify their two- and three-wheeler fleets, partnering with other private entities to manufacture electric two-wheelers, battery packs, and battery swap stations, and to offer them to drivers along with financing.[24]

Minibus taxis play a prominent role in urban transit in different cities in Africa, underscoring their central place in urban mobility.

- **In Gaborone (Botswana) and Maseru (Lesotho), minibus taxis accounted for more than 70% of all trips as of 2021.**[25]
- In South Africa, an estimated 80.2% of work trips in 2020 were taken using minibus taxis, far exceeding the shares by formal buses (16.6%) and trains (3.2%).[26]

Fewer data are available on other forms of informal transport, such as private (clandestine) taxis, pick-up trucks, and maritime and human-powered transport services. Pick-up trucks are frequently used as informal transport in rural areas, sometimes with seats or other adaptations in the back. Traditional boat ferries are common in many geographies, but their role in mobility has been less explored.

- In Thailand, *songthaews* (modified pick-up trucks with two rows of seats along the back) are convenient for both locals and tourists due to their affordability.[27]
- Pick-up truck services are common in both peri-urban and rural areas of Latin America, and similar services (known as *my loves*) are used in areas of Maputo (Mozambique) in Africa.[28]
- Across Central America, informal small boats known as *lanchas* or *pangas* provide key maritime transport options, with semi-regulated operators serving important routes across the Gulf of Fonseca (bordered by El Salvador, Honduras and Nicaragua) and the Caribbean coasts of Belize, Guatemala and Mexico.[29]

In South-East Asia, traditional informal transport modes have evolved towards motorised and digitally integrated alternatives, due in part to interest from younger users. To actively promote modern and sustainable urban transport systems, some governments have explicitly banned traditional informal modes. Bangkok (Thailand), Ho Chi Minh City (Viet Nam) and Jakarta (Indonesia) have all prohibited the operation of non-motorised bicycle rickshaws (*cyclo, becak*) and horse-drawn carriages (*delman*) in urban areas.[30]

Across Africa, informal transport continues to work in tandem with public transport to meet the region's growing urbanisation and mobility needs.

- Greater Cairo (Egypt) has a diverse multi-modal transport network, complementing its large metro and municipal bus system with informal transport systems that fulfilled 8.1 million trips per day in 2021.[31]
- In Nairobi (Kenya), some 20,000 *matatu* minibuses handled around 40% of daily trips as of 2020.[32]
- In greater Lagos (Nigeria), the estimated 75,000 minibuses on the road in 2021 captured 72% of all trips, more than 14 times the combined share of bus rapid transit and regulated bus services (5%).[33]
- Minibus taxis accounted for an estimated 80.2% of work trips in South Africa in 2020 (up from 67.2% in 2013 and 63% in 2003), whereas buses accounted for just 16.6% of work trips (down from 19.5% in 2013 and 22% in 2003).[34] A 2024 survey, using different methods and classifications, found that minibus taxis, sedan taxis and *bakkie* taxis accounted for 27.7% of work trips.[35]
- In 2025, clandestine taxis held 11.5% of the modal share in Dakar (Senegal), with fleet estimates ranging between 4,000 and more than 5,000.[36]
- A 2020 study of cities in mainland Africa with at least 100,000 residents found that the share of cities with motorcycle taxis was around 25% in Southern Africa but rose to 46% in East Africa, 69% in West Africa and 74% in Central Africa.[37]

Data and research on informal transport in Latin America are limited in comparison to Asia and Africa. Most information has focused on larger cities such as Bogotá (Colombia) and Mexico City (Mexico), where the development of mass transit systems has incentivised the collection of information on informal transport services. Such efforts reveal the importance of informal transport modes as crucial connectors, providing "last-mile" services as well as essential services to reach parts of the city that formal transit does not, forming a hybrid ecosystem that supplies mobility for millions.[38]

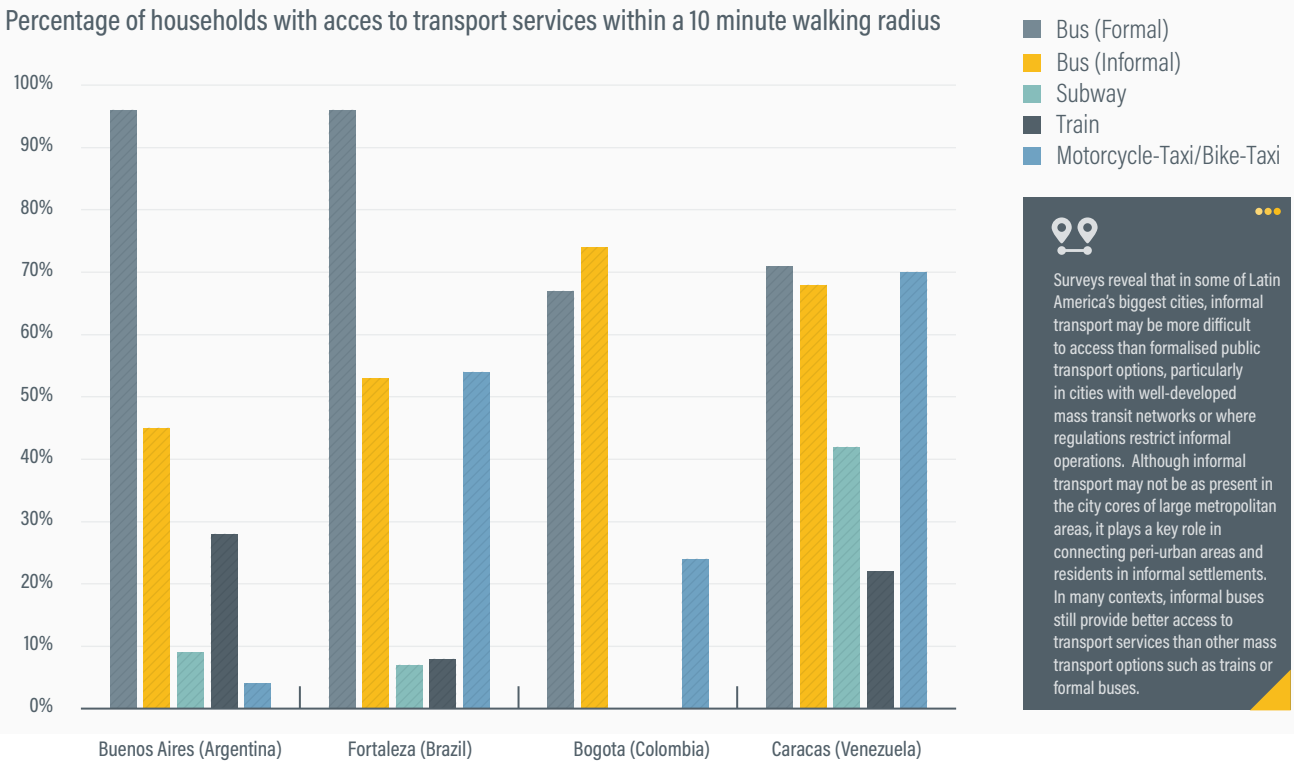
Surveys reveal that in some of Latin America's biggest cities, informal transport may be more difficult to access than formalised public transport options (Figure 3)**, particularly in cities with well-developed mass transit networks or where regulations restrict informal operations.**[39] **Although informal transport may not be as present in the city cores of large metropolitan areas, it plays a key role in connecting peri-urban areas and residents in informal settlements.**[40] **In many contexts, informal buses still provide better access to transport services than other mass transport options such as trains or formal buses.**

- Nearly two-thirds (65%) of Mexico City's more than 21 million inhabitants were served by small buses (*peseros*) as of 2020.[41] In 2024, an estimated 1,000 human-powered tricycles (*bicitaxis*) were operating in the city and its periphery, with 256 units registered to the downtown area.[42]
- A 2019 study found that, when informal modes were included, "absolute access" using public transport (measured as the number of people who can be reached within 30 minutes as a proxy for opportunities) increased 54% in the Mexico City Metropolitan Area and 35% in Bogotá (Colombia) (Figure 4).[43]

A small but growing field of research has focused on informal transport in sub-regions such as Central America and the Caribbean, providing data on the roles of smaller vehicles and informal boat services in coastal secondary cities and rural areas.

- A 2024 study found that three-wheelers had become the third most used mode of transport (after cars and bicycles) in the rural area of Puerto Viejo (Costa Rica).[44]
- As of 2024, a reported 30-50 *lanchas* (boats), each with an estimated capacity of 8-12 passengers, were operating daily in Puerto Los Coquitos on the mainland of El Salvador, connecting populations along the Gulf of Fonseca.[45] In 2022, more than 400 *lancha* passengers arrived daily to Puerto Los Coquitos from nearby islands and from Honduras and Nicaragua.[46]

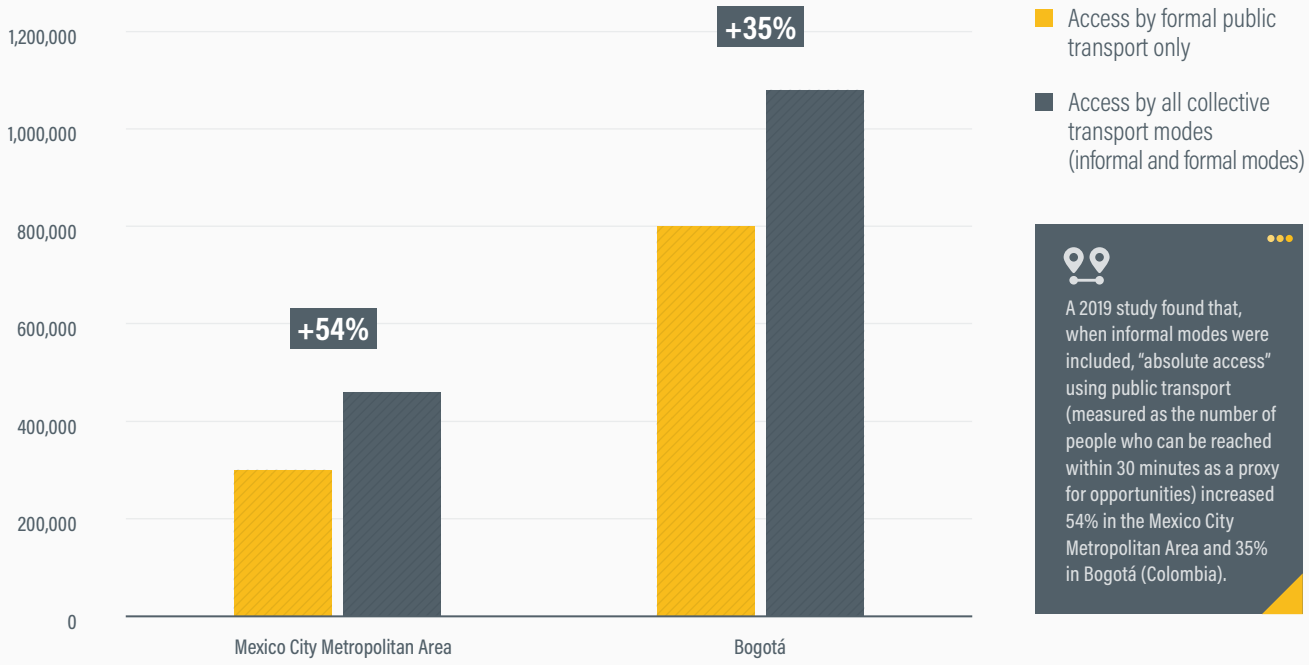
FIGURE 3. Share of households able to access transport modes within a 10-minute walk, in four Latin American cities, 2017



Surveys reveal that in some of Latin America's biggest cities, informal transport may be more difficult to access than formalised public transport options, particularly in cities with well-developed mass transit networks or where regulations restrict informal operations. Although informal transport may not be as present in the city cores of large metropolitan areas, it plays a key role in connecting peri-urban areas and residents in informal settlements. In many contexts, informal buses still provide better access to transport services than other mass transport options such as trains or formal buses.

Source: See endnote 39 for this section.

FIGURE 4. Absolute access using public transport and informal modes in Mexico City and Bogotá, 2019



A 2019 study found that, when informal modes were included, "absolute access" using public transport (measured as the number of people who can be reached within 30 minutes as a proxy for opportunities) increased 54% in the Mexico City Metropolitan Area and 35% in Bogotá (Colombia).

Source: See endnote 43 for this section.

- **Although informal transport is usually explored in the context of the Global South, many high-income countries host small-scale, unregulated services. These services cater mainly to tourism but also operate in areas underserved by public transport, or disrupt the market by offering a cheaper transport option.**
- London (United Kingdom) had an estimated 200 to 900 (during peak season) pedicabs, or bicycle rickshaws, operating around the city in 2023, mainly serving tourists.[47] The city has had some voluntary codes of practice for pedicab drivers, and since March 2024 new regulations have given the transport authority oversight over pedicabs, considered the city's last form of unregulated transport.[48]
- In New York City (United States), dollar vans – often unregulated and unregistered – fill gaps and serve minority communities that may be neglected by subways and buses.[49] Private initiatives such as the start-up Dollaride offer operators technology integrations, electrification solutions and financing.[50]

Sustainability and climate trends

Informal transport is frequently valued as a catalyst for economic activity and local development, offering access factors such as door-to-door service, speed, cost and maneuverability in small or narrow streets found in the Global South. Research continues to focus on the role of informal transport in addressing inequality and poverty issues by granting access to employment, educational opportunities and health care to people in marginalised communities.[51] However, literature on motorcycle taxis suggests that their social contributions are contested by issues related to road safety, insufficient operator training, lack of proper understanding of road rules, road conditions and sparse use of safety equipment.[52]

The informal transport sector intersects with many dimensions of sustainability and has the potential to generate numerous social, economic, and environmental benefits, contributing to at least 7 of the 17 United Nations Sustainable Development Goals (SDGs) (Box 1).[53]

Box 1. How climate action on informal transport can contribute to the Sustainable Development Goals

The Global NDC Template for Popular Transport suggests that effective climate action in the informal transport sector would contribute to the following seven SDGs:

SDG 3 (Good Health and Well-being) – by reducing pollution, improving air quality, road safety and health in cities.

SDG 5 (Gender Equality) – by making services and working environments more inclusive and safer for women.

SDG 7 (Affordable and Clean Energy) – by promoting the use of renewable energy and energy-efficient vehicles.

SDG 8 (Decent Work and Economic Growth) – by improving working conditions and supporting the formalisation and strengthening of small and medium-sized enterprises.

SDG 10 (Reduced Inequalities) – by improving access to transport services, reducing transport inequalities and improving livelihoods.

SDG 11 (Sustainable Cities and Communities) – by improving transport accessibility and the quality of existing services.

SDG 13 (Climate Action) – by decarbonising the most used motorised transport service in the world and avoiding private car use.

Source: See endnote 53 for this section.

Road safety remains a key challenge facing informal transport, with the lack of regulation and oversight contributing to a high risk of injuries and fatalities among users. On average, 22.5% of road traffic deaths globally in 2016 involved riders or passengers of two- and three-wheelers.[54] Head and neck injuries remain the leading causes of death and severe disability among motorcycle riders and passengers.[55]

- Helmet use remains low in many regions, despite its benefits in reducing the risk of fatal head injuries by up to 42% and the risk of head injuries by 69%.[56]
- A 2020 survey across 48 countries found that up to 47% of drivers and 71% of passengers did not wear protective helmets while riding two-wheelers.[57]

Women are among the main users of informal transport but are the least represented in the sector's workforce, as they face challenges related to recruitment, retention and sexual harassment. In high-traffic areas, two-wheelers can reduce women's travel time by navigating congestion and busy roads in a more agile way.[58] A key concern for many women that work (or attempt to work) in the informal transport sector is sexual harassment from vehicle owners, other transport workers, and passengers, as female workers express feeling forced to "put up with it" to keep their jobs.[59]

- In Cali (Colombia) and Quito (Ecuador), low-income women often resort to informal transport services because public transport routes and schedules do not adequately meet their needs.[60]
- In Sub-Saharan Africa, two-wheelers enhance women's mobility, contributing to greater time availability for



education, economic activities and leisure – ultimately fostering economic development and community welfare.[61]

- In the minibus sector of Nairobi (Kenya), women make up only 7% of the workforce and face challenges related to recruitment, retention and promotion; 58% of female workers in the sector report being victims of sexual harassment every day.[62]
- Women are heavily underrepresented in the transport workforce in Uganda, where *boda boda* riders, a group with an estimated 1.1 million workers, are more than 99% male.[63]

Overall, there is an urgent need to improve working conditions in the informal transport sector. According to the International Transport Workers Federation's 2025 Labour Impact Assessments, several pressing concerns must be addressed to improve working conditions in the sector.[64] These include:

- identifying and implementing alternatives to the target system (where workers must reach a daily income target to pay off their vehicle rental before receiving their earnings);
- establishing efforts to end gender discrimination, violence against women, and sexual harassment, both for users and workers of the informal transport sector;
- providing vocational training for workers in the sector, not just driver training for new bus services such as bus rapid transit or electric vehicles;
- co-ordinating policy and regulation between police, security services and transport authorities, to handle extortion and police harassment of informal transport workers and operators;
- improving sanitation, shelter, drainage, rest and catering areas, and other facilities to improve working conditions;
- providing mechanisms and incentives to enable access to affordable capital for electrification and recapitalisation of vehicles; and

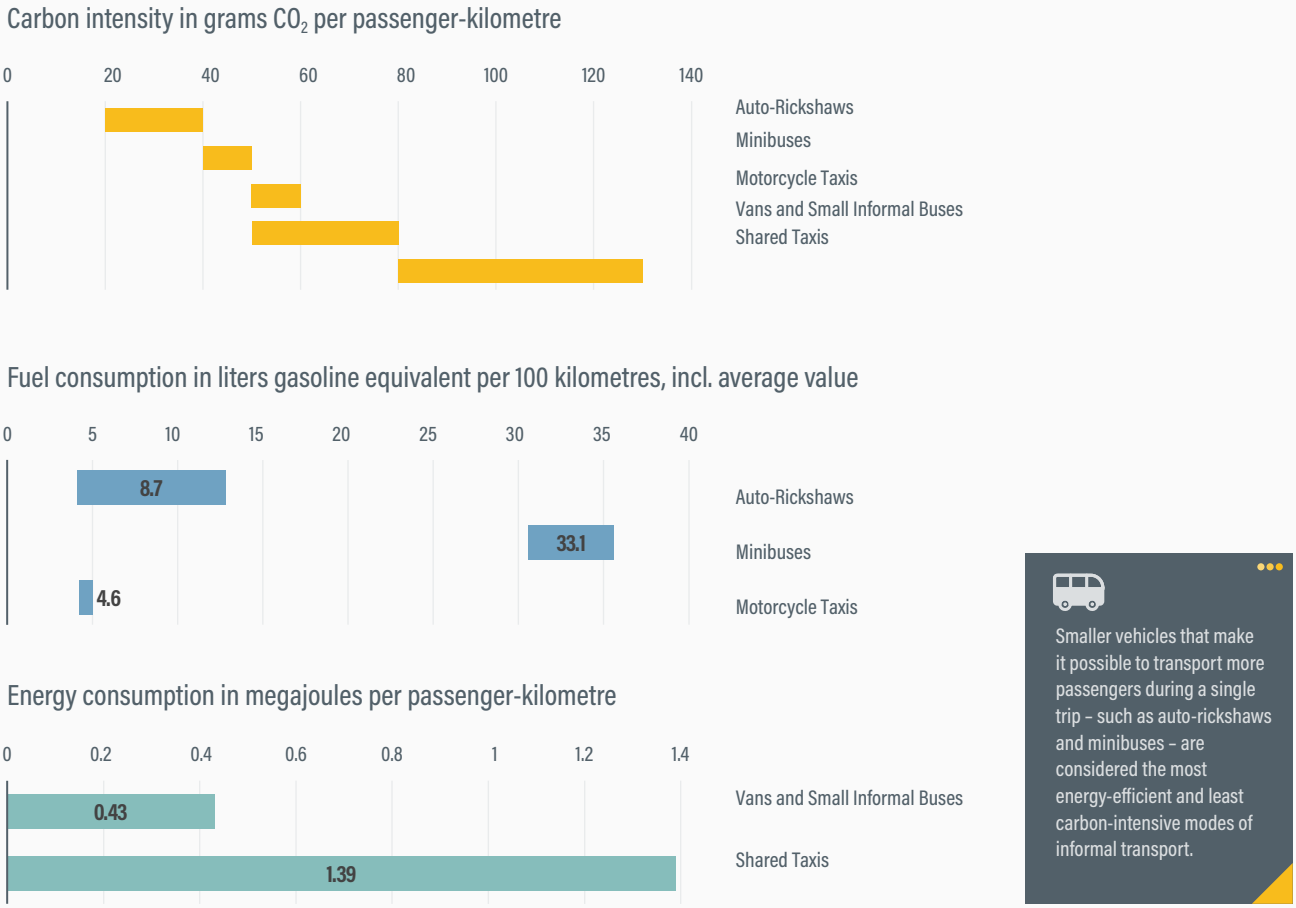
- developing state-supported social protection programmes or supporting workers' organisations to extend and improve provision of social protection services.

Smaller vehicles that make it possible to transport more passengers during a single trip – such as auto-rickshaws and minibuses – are considered the most energy-efficient and least carbon-intensive modes of informal transport (Figure 5).[65] **A study in Cape Town (South Africa) found that motorcycle and minibus taxi services are less energy intensive than petrol or hybrid-equivalent vehicles, which are more common than electric cars in cities in the Global South.**[66] However, data on greenhouse gas emissions from informal transport are limited, and few countries collect disaggregated data for the sector. Research, policy and investments in several areas are helping to decarbonise informal transport or at least better understand its decarbonisation potential.[67]

Studies in different cities around the world indicate that, on average, the contribution of informal transport to overall transport emissions is 20%, although it can reach 40% in some cities (Figure 6).[68] **This contribution depends on characteristics such as the types and ages of vehicles, which can affect a vehicle's operational efficiency.**

- In Ambato (Ecuador) and Dakar (Senegal), informal transport accounts for a similar share (34%) of total transport trips; however, the sector contributed only 10% of total transport emissions in Ambato (in 2022) but 28% in Dakar (in 2025).[69]
- In Ambato, informal transport consists mainly of minibuses and buses, with a total fleet size of 4,237 units and combined annual tank-to-wheel greenhouse gas emissions of 60.2 kilotonnes in 2022.[70]

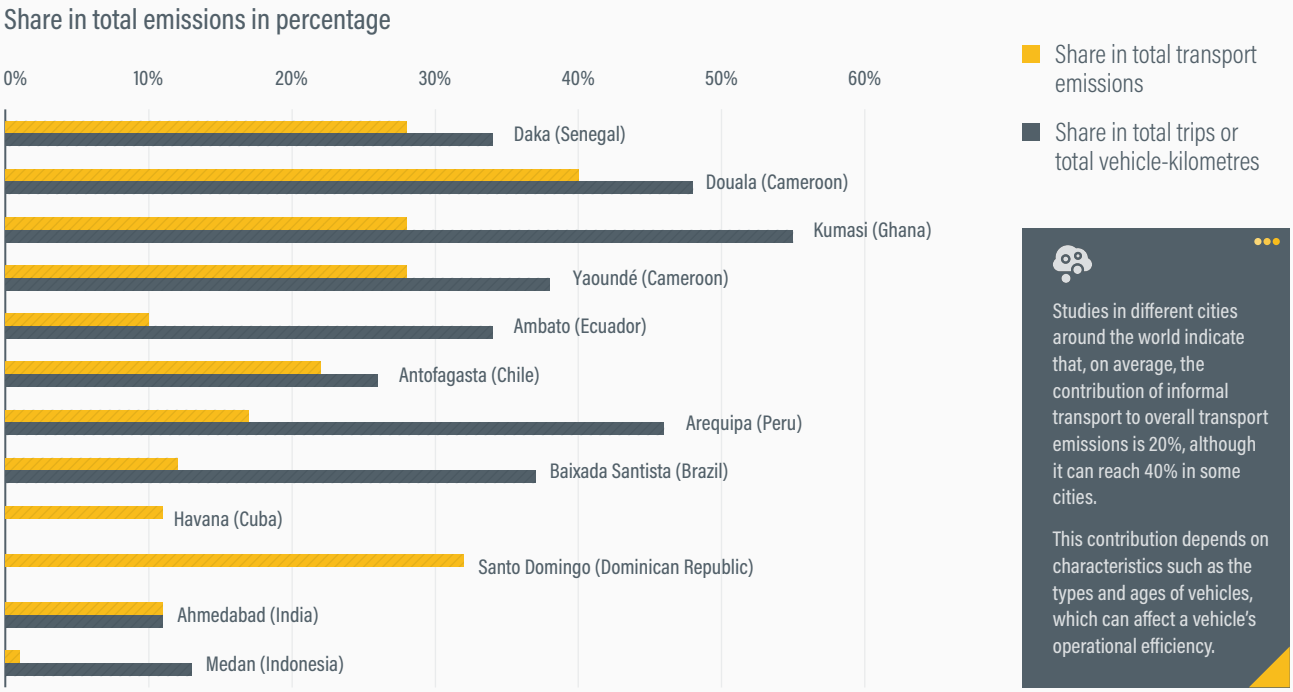
FIGURE 5. Typical carbon dioxide emission factors and energy efficiency for different informal transport modes



Smaller vehicles that make it possible to transport more passengers during a single trip – such as auto-rickshaws and minibuses – are considered the most energy-efficient and least carbon-intensive modes of informal transport.

Source: See endnote 65 for this section.

FIGURE 6. Informal transport's share of emissions in selected cities globally



Source: See endnote 68 for this section.

- In Dakar, *clandos* (clandestine or unregistered taxis) – generally older vehicles that can carry 4-6 passengers – are prominent, but they have among the highest emissions per vehicle per passenger.[71]
- In 2025, Dakar's *clandos* emitted 5.31 tonnes of CO_2 per vehicle per passenger, compared with 4.62 tonnes for *cars rapides* (minibuses) and 2.88 tonnes for *ndiaga ndiaye* (minibuses).[72]

Many of the vehicles used in informal transport are older, second-hand vehicles imported from other countries, raising significant safety, environmental and public health concerns. As of 2019, more than 80% of Africa's road vehicles failed to meet Euro 4 emission standards and often lacked valid roadworthiness.[73] Older vehicles emit far more pollutants than newer models, especially when poorly maintained or fitted with low-quality components. In some cases, exporters remove exhaust after-treatment systems to bypass emission controls or salvage valuable parts, further increasing emissions. In Kampala (Uganda), road transport contributed 60% of nitrogen dioxide and up to 24% of particulate matter ($PM_{2.5}$) in 2021.[74] Inspections of vehicles bound for Africa have also revealed severe safety risks, including prior accident damage, faulty brakes, non-operational lights, missing airbags and heavily worn tyres. (See Spotlight on Second-hand Vehicles.)

In many African cities, where second-hand motorcycles dominate the informal transport fleet, emissions depend on the vehicle age and mileage, and drivers and users are among the most vulnerable to road crashes and injuries. In Kampala (Uganda) and Nairobi (Kenya), initiatives such as Lubyanza collect quarterly data on *boda bodas* that includes topics such as vehicle characteristics, road worthiness compliance, helmet use, reflective jacket use, and worker profiles and needs (Figure 7)**.[75] Such insights can inform sustainability and climate action projects and help address challenges such as improving working conditions and compliance with road safety requirements.[76]**

The electrification of informal transport has contributed to climate action, air quality and noise pollution goals while also improving services for users. Electric two- and three-wheelers accounted for around 60% of the avoided oil demand in the global road transport sector in 2023, driven by their rapid adoption and expansion in regions such as China, India and South-East Asia.[77] However, many countries continue to face grid reliability issues that affect vehicle charging, and electricity is often sourced from highly polluting bagasse, coal and petroleum.[78]

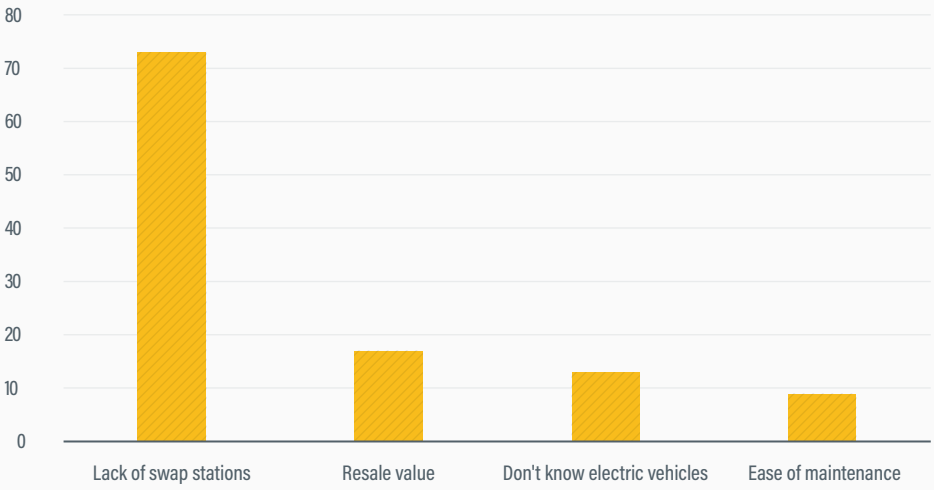
FIGURE 7. Insights on boda boda operations collected by Lubyanza Research Group during 2024

4% share their bike at least once a week

72% have never had a drivers license

40% of riders wearing reflector jackets

58% of bikes on the road are second-hand



In many African cities, where second-hand motorcycles dominate the informal transport fleet, emissions depend on the vehicle age and mileage, and drivers and users are among the most vulnerable to road crashes and injuries. In Kampala (Uganda) and Nairobi (Kenya), initiatives such as Lubyanza collect quarterly data on boda bodas that includes topics such as vehicle characteristics, road worthiness compliance, helmet use, reflective jacket use, and worker profiles and needs. Such insights can inform sustainability and climate action projects and help address challenges such as improving working conditions and compliance with road safety requirements

Source: See endnote 75 for this section.

Since it was launched in 2022, the BasiGo project in East Africa has expanded its electric bus fleet to 100 units in Kenya and Rwanda, avoiding an estimated 250 tonnes of CO_2 emissions each month.[79]

- Research found that, if electrified, only around 15% of Kenya's *matatus* (informal buses) would be able to complete their routes on a single charge; these vehicles, which cover an average of 150 kilometres per day, would require roughly five charging events daily.[80]

Although informal transport could be a potential low-carbon solution with high passenger capacity, these services have widespread inefficiencies and face challenges related to quality, security and reliability.[81] Efforts to improve the integration, safety and efficiency of informal transport vehicles (even those fuelled by petrol) are essential to ensure truly inclusive and sustainable transport solutions and to prevent users from transitioning to more carbon-intensive private vehicle travel, which can result in increased emissions, pollution, congestion and energy consumption.[82]

Policy and investment developments

Recent policy developments in informal transport have focused on electrification, fleet modernisation, regulation and integrating the sector into data collection efforts and sustainable transport planning. Some governments have introduced digital registration and verification for drivers of informal transport vehicles; however, broader integration efforts are still evolving. For example, regulation has emerged in different African cities.

- In 2024, the Philippines introduced digital registration and verification for informal transport drivers in its Bill 10424 (Motorcycles-for-Hire Act).[83]
- South Africa's National Land Transport Act, amended in 2023, requires the registration of taxi associations and outlines conditions for issuing fixed-route operating licences, while only recently permitting the electronic hailing of public transport.[84]

As fleet electrification continues to expand, the push to electrify informal transport vehicles must be accompanied by strong planning and policy measures to ensure that systems are inclusive, sustainable and safe. Key challenges to electrification include data availability, access to affordable and appropriately scaled financing, the need for viable business models, and regulatory co-ordination, limiting the sector's potential contributions to equitable and low-carbon urban transport solutions.

- Chulalongkorn University in Bangkok (Thailand) has developed research on the challenges and needs for electrifying motorcycle taxis based on differences in ownership and business models.[85]
- In Rwanda, to tackle rising electricity demand due to electrification, WRI China has explored ways that Chinese companies and other foreign investors can partner with battery swap station operators and moto drivers to create and expand access to solar-powered swap stations.[86]
- Kenya's BasiGo project has successfully implemented pay-as-you-go leasing models to support the financing and electrification of *matatus*, and it continues to expand to other African countries.[87]

Despite the high prevalence of informal transport in the Global South, countries have only recently started to incorporate the sector into their Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. As of 2025, only Angola, Uganda and Somalia mentioned or included goals associated with informal transport in their NDCs.[88]

- In its 2022 NDC, Angola recognises the contribution of *candongueiros* (minibus taxis) to local emissions but does not suggest actions to address this.[89]
- In its third-generation NDC, Somalia includes a goal to promote electric and energy-efficient vehicles, specifically *tuk-tuks*.[90]
- Uganda, in its 2022 NDC, proposes the electrification of *boda bodas* as an emission mitigation measure.[91]

Overall, informal transport is increasingly recognised as an essential service that is meeting people's mobility demands and improving access to transport services. There is also growing understanding that, with adequate support, the sector can address other environmental and social concerns. For example, the sector has been considered in discussions around the UN Decade of Sustainable Transport and in efforts to increase the attention to informal transport goals in the third generation of NDCs.

Vehicle scrappage and modernisation schemes have been implemented in various countries to replace ageing informal transport vehicles. Experiences in Africa, particularly in Dakar (Senegal), in the 2000s have generated insights and models for countries elsewhere to replicate.[92]

- Santo Domingo (Dominican Republic) has scrapped *concho* taxis and minibuses, substituting them with newer vehicles, in an effort to reform and modernise its vehicle fleet.[93]
- Mexico City (Mexico) has committed to scrap around 6,000 units between 2020 and 2023.[94] These efforts have been part of a larger reform to professionalise and modernise the city's informal transport sector.
- In 2023, Mexico City's transport agency SEMOVI launched the second iteration of its bus scrappage programme for vehicles older than 10 years operating in the Xochimilco corridor. The programme envisions replacing 236 ageing *combis* (minibuses), covering 16 million kilometres per year, with 142 higher-capacity diesel buses covering 7.8 million kilometres per year, with the aim of reducing CO_2 emissions by 2,898 tonnes (around 31%) annually.[95]
- As of mid-2024, Mexico City had replaced 97 diesel microbuses in the Aztecas transport corridor with 28 electric trolleybuses, resulting in an estimated 74% reduction in CO_2 emissions.[96]
- By 2025, South Africa's Taxi Recapitalization programme – responsible for scrapping ageing and unroadworthy minibus taxis – had met 63% of its goal, with 135,894 vehicles scrapped.[97] Although the scrapping component ended in 2018, the programme continues to introduce modern vehicles with added safety features such as seatbelts, speed governors and driver-operated doors.[98]

In addition to government action, a diversity of other stakeholders – including public-private partnerships and non-governmental organisations – have undertaken data collection and policy initiatives to improve and modernise informal transport services (Table 1)**.**

TABLE 1. Examples of data collection and policy initiatives contributing to cleaner, more sustainable and just informal transport services

Area	Measures / Strategies	Examples
Data and information	• Collect and organise comprehensive transport policy, data and documentation. • Identify key data needed to measure or estimate the status of the informal transport sector. • Build a database with digitised and catalogued indicators of sustainable passenger transport. • Map indicators of inclusive and sustainable passenger transport options.	• In March 2021, the Asian Development Bank launched the **Asian Transport Observatory (ATO)** as an open data resource to strengthen transport knowledge in the region. The ATO has collected and analysed data, policy information, and documentation, including on informal transport modes, for different countries in the region.[99] • The Massachusetts Institute of Technology (MIT), through its **Atlas of Popular Transport**, has gathered and corrected data on informal transport for 16 cities around the world.[100] • MobiliseYourCity has supported nine cities, with more in process, in developing **Sustainable Urban Mobility Plans** that collect data and integrate informal transport into a city's wider mobility planning.[101]
Regulatory recognition and integration	• Recognise the function and value of informal transport systems. • Introduce regulations for informal transport modes based on safety and quality of service standards. • Establish registration processes for informal transport drivers. • Define authorities responsible for regulating the sector. • Establish regulatory oversight for fares, surcharges and other fees. • Introduce liability for digital platforms and operators for any deaths, injuries or damage.	• In July 2024, the Philippine legislature approved **House Bill 10424**, which introduced regulations for motorcycles-for-hire, mandated vehicle registration and speed limits, and limited the number and operations of motorcycles.[102] • The **City of Douala (Cameroon)** began digital registration of moto-taxi drivers in July 2024, creating a database of verified drivers with the aim of enhancing order.[103] • In **Mexico City**, after negotiations with bike taxi associations, a new vehicle standard was approved; all associations that comply with the standard receive licences and recognition under the city's integrated transport system.[104]
Business development	• Respond to feedback and concerns of different rider demographics. • Empower drivers to make decisions on pricing and fares. • Align union interests with operators. • Empower drivers and reduce prices by limiting commissions. • Monitor rider demand for modes and services. • Build out informal transport networks based on ridership demands. • Build operators' capacities to become formal businesses that can be recognised or hired by governments.	• In Bengaluru (India), to address the concerns of female riders (in many locations its main users), Uber introduced **UberMoto Women: Women-only rides**, an on-demand two-wheeler ride service with female-only drivers.[105] • Uber shifted its **business model for auto-rickshaws in India** from a per-trip commission to a daily fee, and drivers were empowered to set their own driving rates per ride, as opposed to previously pre-set fares.[106] • **Mexico City** has introduced training for minibus operators to become transport companies and to be able to access funding for new vehicle fleets. • The **Namma Yatri app**, launched in 2022 by India's rickshaw drivers' union, directly connects riders to drivers and removes commissions by avoiding digital intermediaries.[107]
Fleet improvement and electrification	• Lay out goals for manufacturing and adoption of electric informal modes. • Diversify manufacturing across various modes. • Prioritise affordability and access.	• **India's FAME II policy** aims to provide backing for 500,000 electric three-wheelers. Under this policy, the RAAHI Project (2022) in Amritsar works to transition the city's three-wheeler informal transport system to electric vehicles.[108] • In **Mexico City**, minibus operators received bonuses to transition their vehicles to electric models, and some have begun operating new less-polluting buses that have cameras, GPS and integrated payment.[109]
Operations	• Offer safe driver training and improve labour conditions. • Consolidate driver recruitment and management. • Formalise existing rural informal transport and provide training to drivers. • Provide open public transport data. • Support mapping and digitalisation of transport routes and improved data on operations. • Bridge multiple data sources within a single app.	• The municipal government of **Peten (Guatemala)** trained 39 drivers and operators of *tuk-tuk* services in Paxcamán, San Miguel and the central area of Santa Elena.[110] • General Santos City (Philippines) modernised its public transit using the **SafeTravelPH app**, aimed at engaging the government, transport industry providers and passengers in information sharing.[111] • The **Namma Yatri app**, which offers direct-to-driver ride-hailing In Indian cities such as Bengaluru, Chennai, and Delhi, provides open data access to live and historical data points such as ride totals and driver earnings.[112]

Despite these advancements, significant gaps remain in formal recognition, integration and support for informal transport providers. To accelerate and support policy development in the field, international organisations have launched guiding documents and resources that provide recommendations and insights for policy makers to follow and integrate into their work (Table 2)**.**[113]

TABLE 2. Guiding documents and resources to accelerate progress towards development, climate, safety and equity goals in the informal transport sector

Area	Document	Description
Informal transport and the climate and sustainability agendas	Connecting Informal Transport to the Climate Agenda (World Resources Institute – WRI; Volvo Research and Educational Foundations – VREF)	Offers recommendations and case studies on how to quantify emissions from informal transport, improve services to reduce or prevent private vehicle trips, and electrify minibuses and two- and three-wheelers.
	Missing Mobilities: The Popular Transport Gap in Climate Adaptation (WRI; PRISM)	Analyses existing knowledge and research on informal transport and climate adaptation, noting that the sector remains a missing element in climate resilience, adaptation, and action plans, generating a barrier to enhancing the transport sector's climate resilience in a holistic and equitable way. Provides recommendations and insights on how to improve resilience and adaptation planning through the inclusion of informal transport.
	Popular Transport of Goods in Africa (Global Network for Popular Transportation – GNPT)	Represents a first step towards recognising the role of small and medium-sized operators not just in transporting passengers, but also in distributing goods in Africa. Offers recommendations on how to improve infrastructure, data, and livelihoods, and to reduce emissions in the informal transport sector.
	Global NDC Template for Popular Transport (GNPT; Transport for Cairo; with support from the Transformative Urban Mobility Initiative – TUMI)	Provides guidance and recommendations for including informal transport in NDCs. Insights from the NDC template are also included in the International Transport Forum's (ITF) *Guide to Integrating Transport into Nationally Determined Contributions*.
	Life-Cycle Assessment of Passenger Transport: An Indian Case Study (ITF)	Demonstrates the use of life-cycle assessment for a holistic evaluation of electrification policy and the nuances of infrastructure in India, showing how electrification of three-wheelers would lead to lower emissions even in high-carbon electricity grid cases like India. Given the prevalence of high-carbon grids in the Global South, this framework could be used to present more robust emission estimations by considering upstream energy and emission impacts.
	2&3W Explainers on: Economics; Equity & Inclusion; Road Safety; Electrification (GNPT; Uber)	A series that explores the role of two- and three-wheelers in the mobility of Global South cities, providing policy recommendations on topics such as personal and road safety, economics, electrification, and equity and inclusion.

Understanding and integrated planning of informal transport	Paratransit Toolkit (MobiliseYourCity)	Includes guidelines, tools, training materials and case studies on how to better understand, assess, contract and decarbonise the informal transport sector.
	Description, Roles, and Functions of Paratransit A Business Model Toolkit for the Paratransit Sector The Value of Data for the Paratransit Sector (International Association of Public Transport – UITP)	A series of policy briefs that covers various aspects of informal transport, providing examples and case studies from different cities, descriptions of business models, and discussion on the importance of data collection in the sector.
	Incorporating Informal Transport in Mobility Planning (ITF)	Provides recommendations for including the sector in mobility planning processes, engaging with service providers, investing in institutional capacity building, and identifying comprehensive measures, beyond regulation, to address informal transport's negative externalities.
	A Tactical Planning Framework to Integrate Paratransit with Formal Public Transport Systems (Indian Institute of Technology)	Presents an integration strategy using a two-step optimisation process that co-ordinates network assignment and service frequencies. Applied to Visakhapatnam, India, the framework shows that joint planning and frequency optimisation of both modes can reduce total travel time and emissions 50-60% compared to conventional, separate planning approaches.
	Informal Transport Transformation Toolkit (MobiliseYourCity)	An outcome of the 2nd Africa Sustainable Urban Mobility Course in 2020, the toolkit was developed as a strategic long-term reform approach, with expert reviews and recommendations for its adoption.
Informal transport labour market and capacity building	Labour Impact Assessments as Tools to Improve Workers' Conditions (ITF; VREF)	Includes recommendations on: participatory research methods; defining what an informal transport worker is; building partnerships with local academic institutions; how to carry out dialogue and negotiation between trade unions and transport authorities; and building participation by trade unions and workers' associations representing informal transport workers.
	Building Capacity on Informal Public Transport in African Cities: Government Officials' Experiences (VREF; CODATU)	Shares how capacity building initiatives can help government officials and institutions more effectively address informal public transport challenges. Drawing on interviews with 10 officials, the study highlights gaps and opportunities in capacity building, including the need for training, better data procedures, and cross-sector collaboration to improve policy making in informal transport.

Source: See endnote 113 for this section.

Partnerships in action

- The **United Nations Environment Programme** has supported the electrification of two- and three-wheelers in nine African countries (Burundi, Ethiopia, Kenya, Madagascar, Rwanda, Sierra Leone, Tanzania, Togo and Uganda), with programmes for other modes of informal transport in more countries.[114]
- **SolutionsPlus** has co-developed innovative and integrated electric mobility solutions for urban passengers – including for informal transport vehicles – in Dar es Salaam (Tanzania), Kathmandu and Lalitpur (Nepal) and Pasig (Philippines).[115] The project seeks to diversify the sector's workforce to make it more inclusive and resilient.
- A collaborative team – involving ACDC Dynamics, GoMetro, HSW, MiX by Powerfleet and Stellenbosch University – launched **South Africa's first electric minibus taxi pilot project** in 2022 to accelerate the adoption of sustainable transport amid rising fuel costs and environmental concerns.[116] The project is testing various electric minibus models under local conditions and engaging taxi operators and policy makers to identify practical uses and infrastructure needs. By providing critical data and promoting regulatory discussions, the initiative aims to facilitate a broader transition to green mobility solutions in the minibus taxi industry.
- The **Partnership for Research in Informal and Shared Mobility,** initiated and funded by VREF, is collecting data and insights on informal and shared mobility around the world, documenting it, and taking it to international policy spaces to support data and science-based decision making on sustainable transport. The project – led by Columbia University in partnership with WRI and GNPT – has living labs in eight cities: Accra (Ghana), Bangkok (Thailand), Beijing (China), Bogotá (Colombia), Cape Town (South Africa), Kumasi (Ghana), Mumbai (India) and San José (Costa Rica).[117]
- **Paratransit/Popular Transport Day** is a one-day event dedicated to exchanging the latest knowledge, research and practice emerging from the informal transport sector.[118] The event is co-organised by the Africa Transport Policy Program (SSATP), the Center for Sustainable Urban Development, Climate Champions, Digital Transport for Africa, the International Transport Workers' Federation (ITF), PRISM, the Shared-Use Mobility Center (SUMC), Transport for Cairo, VREF, the World Bank and WRI's Ross Center for Sustainable Cities.[119]
- The **Leapfrogging Partnership**, part of the global Drive Electric Campaign, aims to accelerate the transition to electric vehicles in emerging economies, including vehicles used in informal transport.[120]
- The event **Emergent + Empowered: Mobilizing Global Popular Transportation Networks for Equity, Health, and Climate**, held in the Rockefeller Foundation's Bellagio Leadership Center in 2024, aimed to develop a common vision for the informal transport sector and commitments for implementation and engagement with other stakeholders to achieve the shared vision. It gathered 20 attendees – including transport workers and labor organisers, representatives from multilateral development banks, climate funders, global transport and climate organisations, and research institutions – to develop four Strategic Pathways to empower and transform informal transport, including: Climate Action, Sustainability, and Just Transition; Finance and Investment; Policy and Advocacy; and Research, Data, and Evidence. The event was co-ordinated by GNPT, SUMC, the Center for Sustainable Urban Development (Columbia Climate School), PRISM and VREF.

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Rail



KEY FINDINGS

Demand, use and access

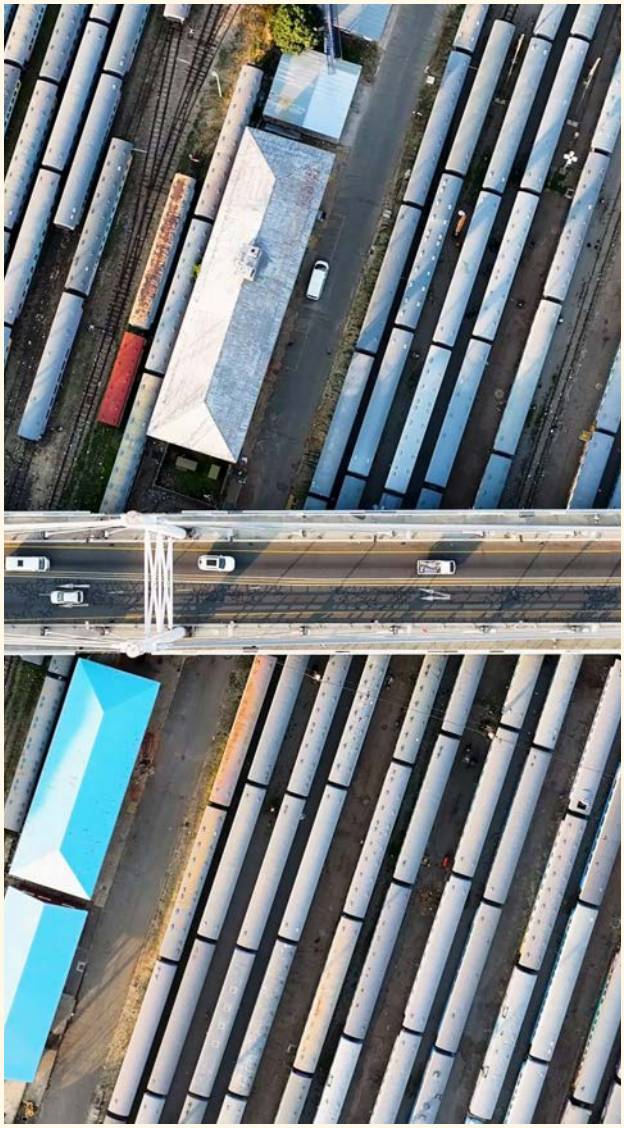
- Global passenger rail demand showed signs of recovery following the disruption caused by the COVID-19 pandemic in 2020 and 2021. Demand reached an estimated 2,470 billion passenger-kilometres in 2022, up 15.8% from the total of 2,132 billion passenger-kilometres in 2021 but still well below the peak of around 4,120 billion passenger-kilometres in 2019. In 2022, rail accounted for around 11.6% of global passenger transport (in passenger-kilometres).
- Trends in passenger rail have been uneven across regions. In 2022, passenger rail activity experienced the slowest growth in Africa (7.6%) and in the Asia-Pacific region and Oceania (8.7%). Europe's passenger rail traffic grew more than 50% in 2022, nearing 2019 levels.
- Unlike passenger rail, the rail freight sector has proven largely resistant to global shocks, with rail freight activity rising 2.9% in 2022 to reach 11,892 billion tonne-kilometres. This growth was driven mainly by increases in the Asia-Pacific region (particularly in China, India, Kazakhstan and Australia), which together with Oceania accounted for 45% of all rail freight activity in 2022, followed by North and South America (27%). In 2025, rail represented 11% of global freight activity.
- High-speed rail infrastructure rose 14% between 2020 and 2023 to reach a total length of 64,698 kilometres globally. This expansion occurred particularly in middle-income countries, such as China and Türkiye. China's high-speed rail length far outstrips all other countries, with 45,390 kilometres in operation in 2023.
- As of 2023, more than 16,000 kilometres of high-speed rail was under construction globally, including major projects in Asia, the Middle East and North Africa, and North America.
- Global high-speed rail activity totalled 678 billion passenger-kilometres in 2022, still well below the all-time high of 1,054 billion passenger-kilometres in 2019. Despite the continued growth in infrastructure, high-speed rail activity remained at 2015/16 levels as of 2022, as the COVID-19 pandemic had triggered a nearly 40% decline (in 2020).



KEY FINDINGS

Sustainability and climate trends

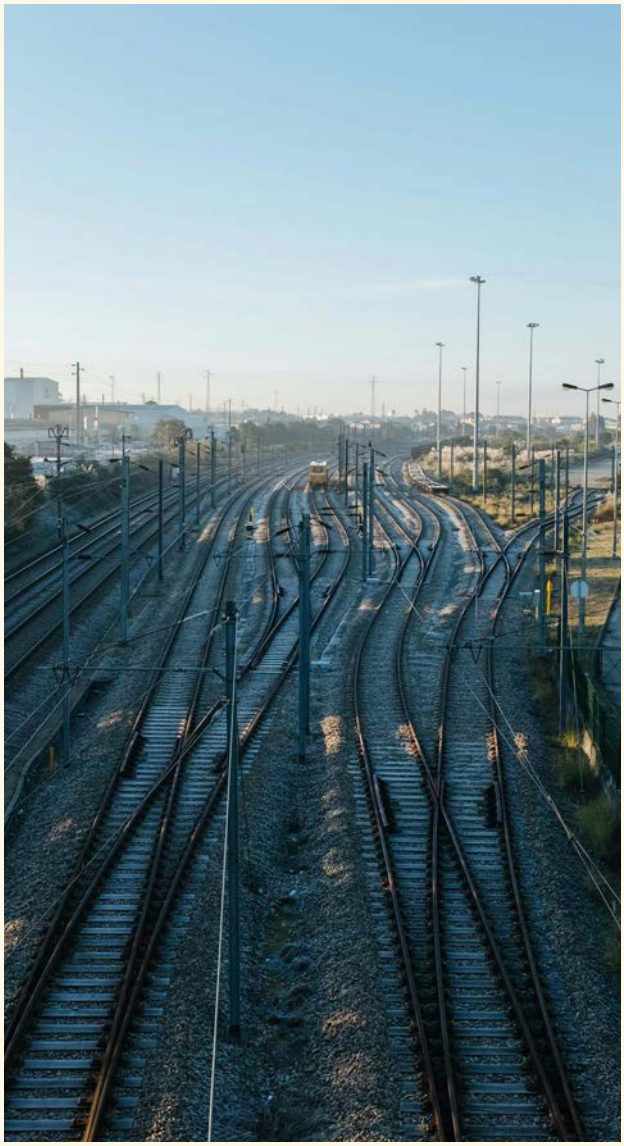
- Rail transport delivers significant socio-economic dividends, which are often overlooked in terms of the economic value that they generate. Rail's contribution to the national GDP ranges from 0.5% in the European Union in 2012, 0.7% in the United States in 2023, 0.8% in Australia in 2016 (even up to 1.6% in direct and indirect contributions) and 1.5% in India (even 3 to 4% through direct and indirect contributions).
- Rail can enhance social equity by providing accessible, affordable and sustainable mobility options – and therefore access to essential services, employment, and education, particularly for marginalised groups. Women are more likely than men to rely on public transport (especially rail and buses) due to differences in travel patterns and access to private vehicles. Rail transport contributes to improved air quality and reduced congestion, supporting better public health outcomes.
- Although rail transport can play a role in promoting gender equity in the transport workforce, women have remained under-represented in the rail workforce and in the wider transport sector.
- Rail transport remains the most energy-efficient mode of freight transport and collective passenger travel, thanks to its high energy efficiency and low greenhouse gas emissions per passenger- and tonne-kilometres.
- In 2023, rail passenger and freight transport accounted for 1.2% of global transport greenhouse gas emissions. Models estimate that freight contributed the major share (around 79%) of rail's greenhouse gas emissions in 2023.
- Passenger rail transport emitted 22.35 grams of CO_2 equivalent per passenger-kilometre (well-to-wheel) in 2023, reinforcing rail's role as the least carbon-intensive mode of motorised land transport.
- The carbon intensity of rail has continued to improve, declining 55.9% for passenger rail and 58.7% for freight rail between 2005 and 2023 (location-based). These gains place the sector ahead of its decarbonisation pathway for 2030, as rail operators reduce emissions through electrification, fuel switching and efficiency improvements.
- As of 2022, around one-third of all railways worldwide had been electrified, mainly in India, Japan and China. In 2023, 45% of global rail energy use came from electricity, with Europe nearing 60%.
- Rail consumed 2% of the total energy in the transport sector in 2022. It had the highest share of renewable energy use among motorised transport modes in 2022, at 16.1%, with rising integration of solar, wind and hydrogen systems into railway operations.
- Rail infrastructure is increasingly exposed to climate risks such as heatwaves, floods, storms and coastal erosion. Although vulnerabilities vary by region, the scale of the impacts has become more evident.



KEY FINDINGS

Policy and investment developments

- Governments have increasingly recognised rail's potential in decarbonisation strategies and national economic recovery plans. During 2023 and 2024, countries launched various plans to revive national economies through the upgrading and development of rail lines.
- Several African and Asian countries have implemented groundbreaking developments on rail since 2023 with the aim of connecting people and goods.
- Rail-related policy efforts have sought to promote inclusive and accessible services, improved customer experience, gender-responsive infrastructure, inclusive recruitment and safe working environments.
- As of 1 August 2025, only 8 (27%) of the 29 third-generation Nationally Determined Contributions (NDCs) submitted to the United Nations Framework Convention on Climate Change mentioned rail transport (Botswana, Brazil, Canada, Moldova, Nepal, the United Kingdom, the United States and Uruguay); only 3 NDCs (Botswana, Moldova and Nepal) had specific targets focused on rail transport.
- In 2022, rail represented about 26% of the total global investment in transport infrastructure from G20 countries.
- The share of public spending for road infrastructure remains much higher than for rail in most regions, risking the under-utilisation of rail's potential for climate mitigation.
- Significant investment and priority spending are needed in rail infrastructure for climate adaptation in the coming decades.
- Digitalisation and standardisation have emerged as critical enablers for emission reduction in the rail sector. Advanced train control, eco-driving systems and harmonised signalling help reduce energy consumption, increase network capacity and lower operating costs. Supported by real-time data and advisory systems, these techniques have delivered energy savings of 7-25% on various rail services across Europe and Asia, contributing to the sector's ongoing efforts to reduce operational emissions.
- To further progress in the rail sector, policies and regulations should incorporate an Avoid-Shift-Improve[i] prioritisation framework, with a focus on modal shift measures, an area where significant untapped potential remains.



i The Avoid-Shift-Improve framework has been central to sustainable, low carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.



Context, challenges and opportunities

Rail transport is an important contributor to economic development, enabling the efficient movement of goods and people over long distances at scale. Rail facilitates domestic and international trade, reduces travel and freight costs, and improves access to markets for both rural and urban communities. By enhancing supply chain reliability and lowering logistics costs, rail systems increase business competitiveness and support regional economic integration.

Rail investments tend to have strong multiplier effects, especially in low- and middle-income countries where improved connectivity can unlock economic potential in underserved regions.[1] The passenger rail transport sector was strongly impacted by the COVID-19 pandemic in 2020 and 2021. As of 2022, rail passenger demand was still well below pre-COVID-19 levels.[2] Rail freight transport proved to be more resistant and increased between 2019 and 2022, particularly in Asia-Pacific.[3]

As greenhouse gas emissions continue to rise, rail offers a compelling solution for decarbonising the transport sector. Rail has one of the lowest carbon intensities among motorised inland transport modes and is well suited for medium- and long-distance passenger and freight movement.[4] In 2022, the global average well-to-wheel greenhouse gas intensity of rail was 22.3 grams of carbon dioxide (CO_2) equivalent per passenger.[5] As rail's overall emission performance continues to improve, the CO_2 intensity of rail freight fell 50.6% (market-based) and 58.7% (location-based) between 2005 and 2023, putting the sector well ahead of the expected trajectory for achieving net zero emissions by 2050.[6]

Electrification and energy efficiency remain the backbone of the strategy to decarbonise rail transport. The fastest growth in rail electrification has occurred in the Asia-Pacific region, with Indian Railways reaching more than 98% electrification on the broad gauge network in 2025.[7] Renewable electricity and alternative energy sources play a growing role in the rail sector's transition. With more than 16% of rail's energy sourced from renewables as of 2022 – the highest share among transport modes – the sector is increasingly integrating grid-supplied solar, wind and hydropower into its operations.[8] Hydrogen remains at a pilot scale on selected routes.

Investment in rail infrastructure has grown in several regions but remains a shrinking share of the total infrastructure spending for inland transport, particularly when compared to road transport. A key challenge to rail investment in low-income and lower-middle-income countries is securing sufficient and affordable financing. With limited tax revenues and high debt burdens, these countries are rarely able to fully self-finance rail projects, and private investment alone is often insufficient. International financial institutions and export credit agencies are crucial sources of development funding, yet most of their support has historically favoured road infrastructure.[9]

Despite challenges, rail remains a robust and weather-resilient transport mode, provided there is adequate investment in maintenance and that climate adaptation measures are in place.

Realising the full emission mitigation potential of rail transport requires integrated policy frameworks, targeted investment, and supportive behavioural and economic incentives to deliver a significant modal shift to rail. Rail companies continue to invest in strategies focused on improving energy efficiency, electrifying operations, integrating renewable and alternative energy sources, and deploying digital technologies.

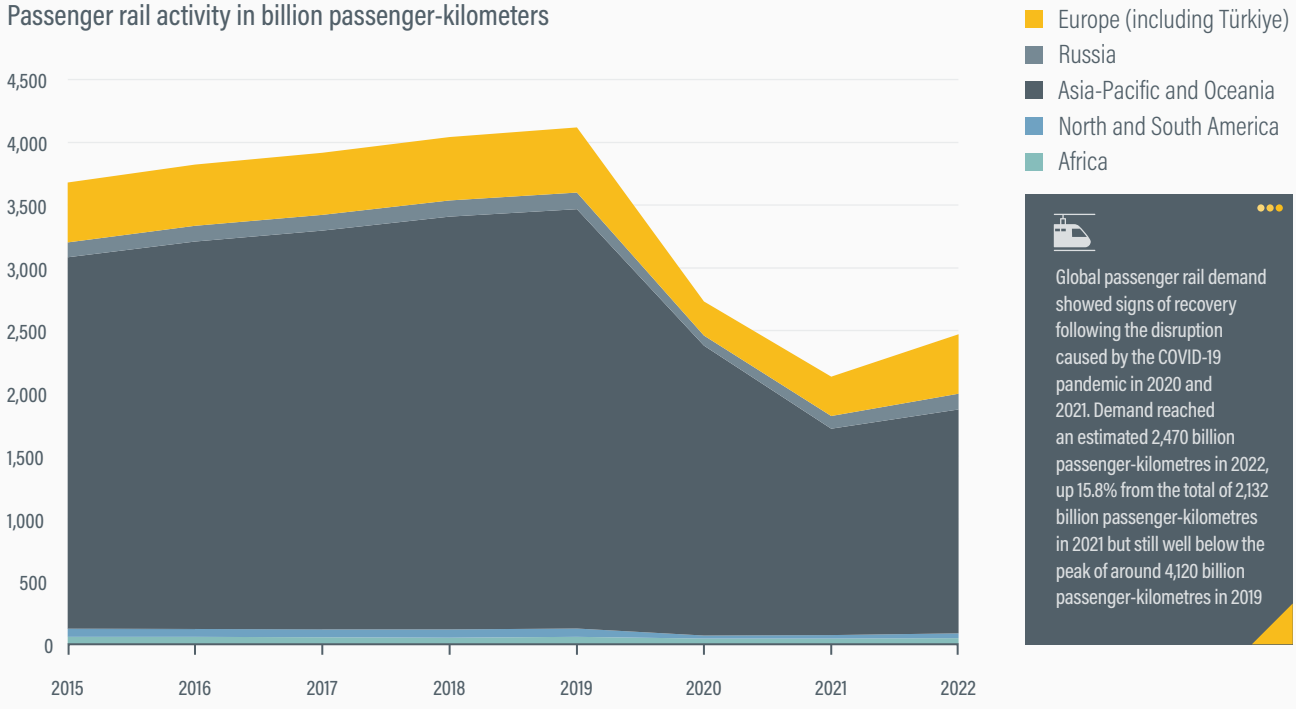
Demand, use and access

Global passenger rail demand showed signs of recovery following the disruption caused by the COVID-19 pandemic in 2020 and 2021. Demand reached an estimated 2,470 billion passenger-kilometres in 2022, up 15.8% from the total of 2,132 billion passenger-kilometres in 2021 but still well below the peak of around 4,120 billion passenger-kilometres in 2019 (Figure 1).[10] **In 2022, rail accounted for around 11.6% of global passenger transport (in passenger-kilometres).**[11] Estimates suggest that overall passenger transport activity – especially by road – recovered more quickly than rail transport from pandemic-related lows in 2020 and may have captured some of the demand from the rail sector.[12]

Trends in passenger rail have been uneven across regions. In 2022, passenger rail activity experienced the slowest growth in Africa (7.6%) and in the Asia-Pacific region and Oceania (8.7%).[13] **Europe's passenger rail traffic grew more than 50% in 2022, nearing 2019 levels.**[14]

- Brazil's subway, urban train, light rail and "people mover" systems carried 2.48 billion passengers in 2022, up 6% from the previous year.[15] Operating with 97.6% regularity and 98.6% reliability, these mostly electric urban rail systems provide clean transport and support sustainable city development, delivering an estimated USD 5.2 (BRL 32 billion) in social, economic and quality-of-life benefits.[16]
- Germany's rail passenger transport volume fell to 57.5 billion passenger-kilometres in 2021 but rebounded sharply in 2022 and 2023 to reach 101.4 billion passenger-kilometres (a 76.3% increase).[17]
- People in Japan undertake more rail travel than in any other country.[18] As of early 2024, passenger numbers were around 90% of pre-pandemic levels, with international tourism rebounding only gradually and domestic commuter traffic shifting in response to remote work trends.[19]

FIGURE 1. Passenger rail activity by region, 2015 to 2022



Source: See endnote 10 for this section.



- In Slovenia, rail passenger numbers increased more than 20% in 2022 to exceed pre-pandemic (2019) levels, and rose further in 2023.[20] National rail operator Slovenia Railways attributes this to new trains and attractive fares, among other factors.[21]
- In Spain, government subsidies led to a 33% increase in public transport ridership between 2022 and 2024.[22] Medium-distance rail services averaged 4.5 million trips per month in 2024, up 63.5% from 2019 and 82% from 2022.[23]

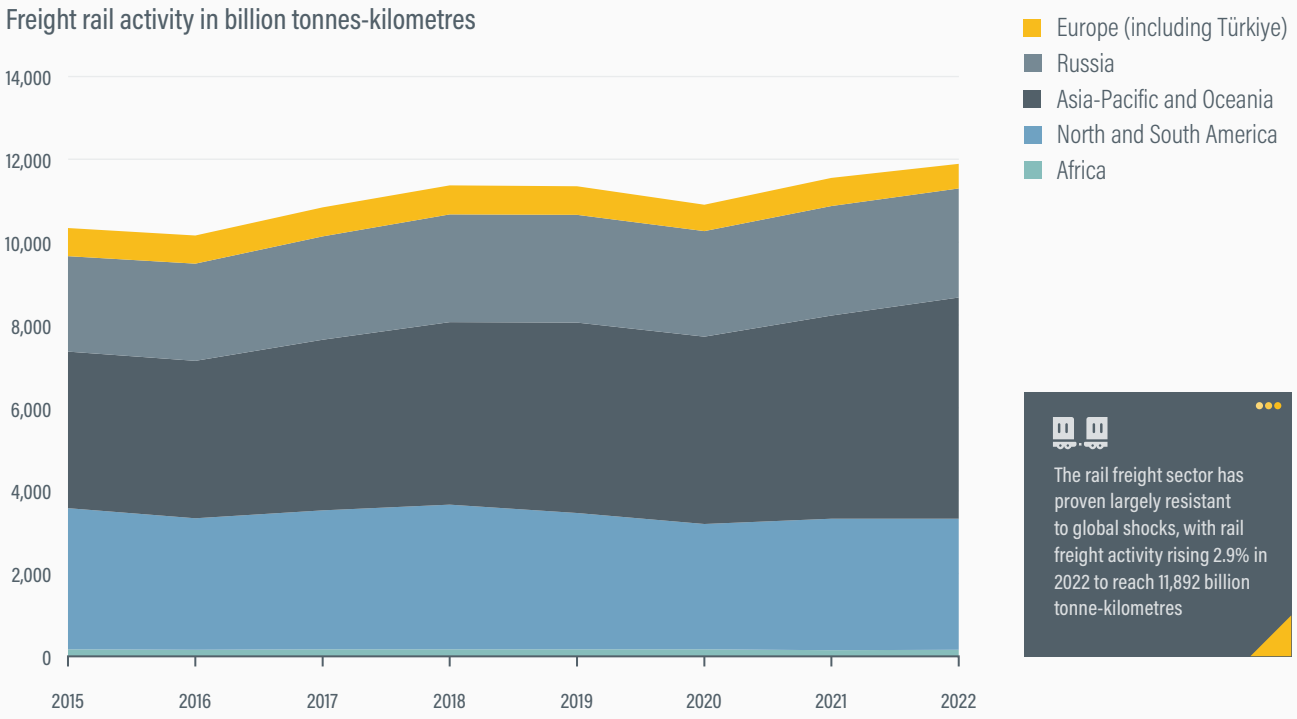
Unlike passenger rail, the rail freight sector has proven largely resistant to global shocks, with rail freight activity rising 2.9% in 2022 to reach 11,892 billion tonne-kilometres (Figure 2)**.**[24] **This growth was driven mainly by increases in the Asia-Pacific region (particularly in China, India, Kazakhstan and Australia), which together with Oceania accounted for 45% of all rail freight activity in 2022, followed by North and South America (27%).**[25] **According to 2025 estimates, rail represented 11% of global freight activity.**[26] The COVID-19 pandemic had only minor impacts on rail freight activities, with the sector's activity in 2021 (11,552 billion tonne-kilometres) already surpassing its 2019 level (11,346 billion tonne-kilometres).[27]

However, the growth in road freight transport outpaced rail freight.[28] **This is attributed to the faster growth of goods transport by road, particularly in China and India.**[29] **In 2023, rail freight experienced a slowdown (notably in Europe), although it continued to play an important role in many countries globally** (Figure 3)**.**[30]

- Rail freight volumes fell in North America in 2023 and 2024 due to economic headwinds, inventory adjustments in major sectors and service disruptions.[31] The Association of American Railroads reported a 3.1% year-to-year decline in US rail carloads in 2024.[32]
- In the European Union (EU-27), rail freight volumes fell 4.9% in 2023 to reach 378 billion tonne-kilometres, the lowest level since 2015 (excluding the pandemic year 2020).[33]
- The Middle Corridor has emerged as a key alternative for rail freight movement between Asia and Europe. Container volumes on the route rose 89% in 2023 and 70% in 2024, as Kazakhstan and other countries have boosted investments and capacity to shift traffic away from the Northern Corridor (via the Russian Federation).[34]

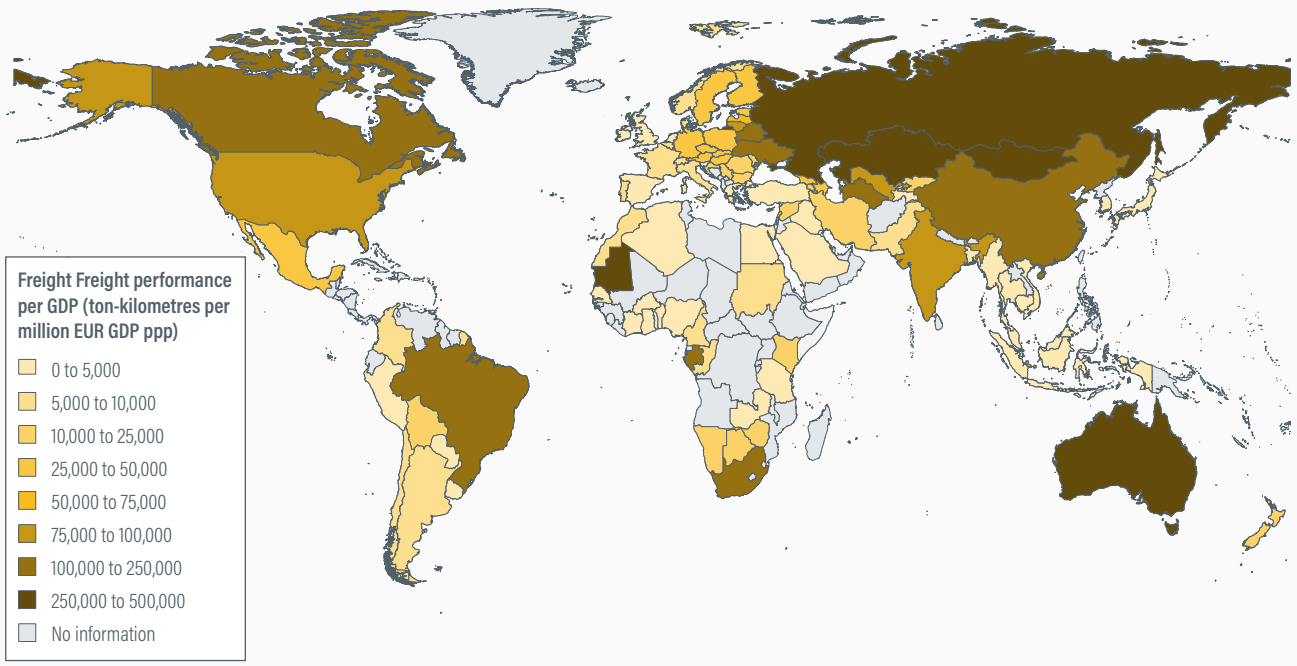
High-speed rail infrastructure rose 14% between 2020 and 2023 to reach a total length of 64,698 kilometres globally.[35] **This expansion occurred particularly in middle-income countries, such as China and Türkiye.**[36] **China's high-speed rail length far outstrips all other countries, with 45,390 kilometres in operation in 2023.**[37] **As of 2023,**

FIGURE 2. Freight rail activity by region, 2015-2022



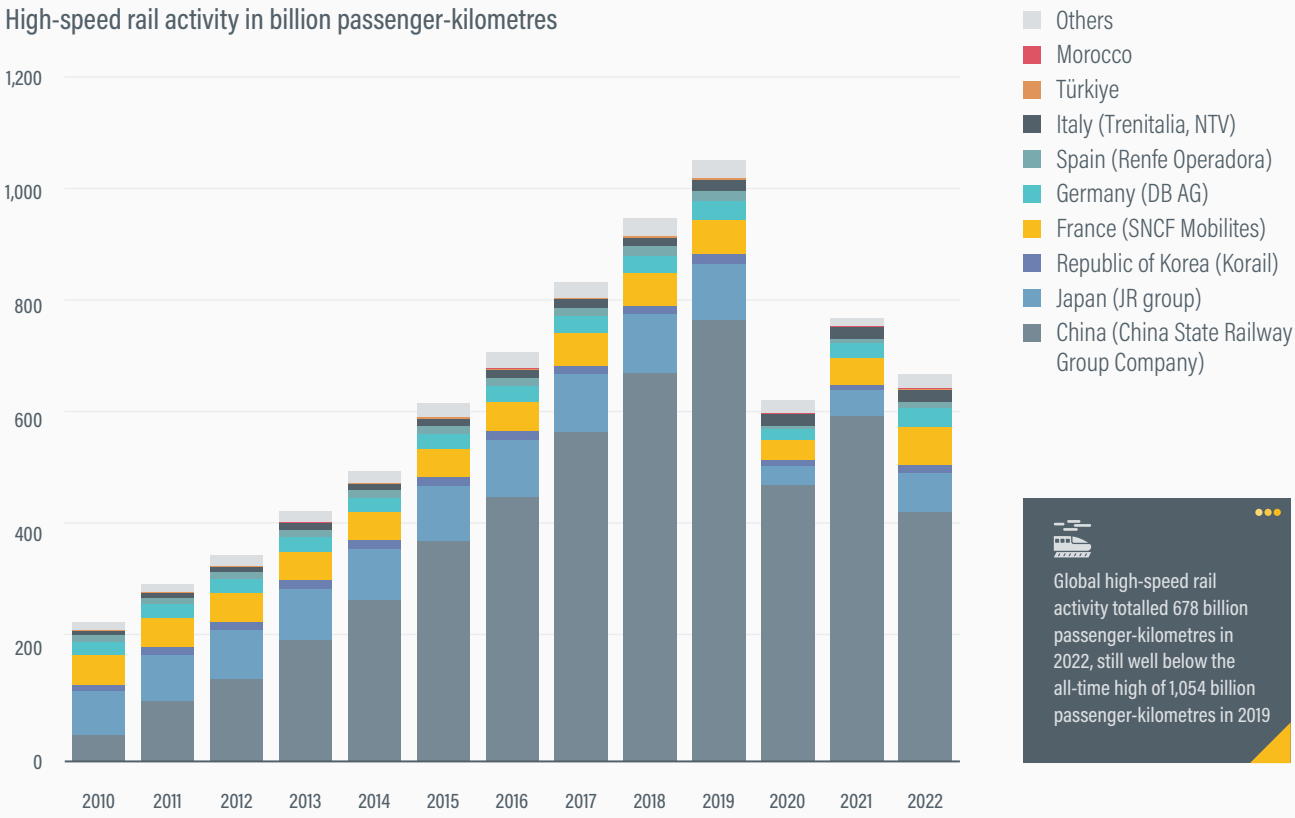
Source: See endnote 24 for this section.

FIGURE 3. Tonnes of rail freight carried per unit of gross domestic product, by country, 2023



Source: See endnote 30 for this section.

FIGURE 4. High-speed rail activity by country, 2010-2022



Source: See endnote 44 for this section.

more than 16,000 kilometres of high-speed rail was under construction globally, including major projects in Asia, the Middle East and North Africa, and North America.[38]

- Egypt's 2,000-kilometre high-speed rail network, initiated in 2018 and under active construction since 2021, aims to connect key cities along the Red Sea and Mediterranean Sea, reducing travel times and easing road congestion.[39] The project is expected to create more than 15,000 jobs and to reduce carbon emissions by shifting passengers from private vehicles to rail.[40]
- Indian Railways has launched and expanded Vande Bharat Express semi-high-speed trains between major cities, offering faster, energy-efficient alternatives to short-haul flights and road trips. The trains are produced in India and present significant updates and more comfort to users. The government announced plans to have 4,500 Vande Bharat trains running by 2047.[41]
- Indonesia's Jakarta-to-Bandung High-Speed Railway, opened in 2023, reduces the travel time between these cities from more than 3 hours to only 40 minutes, at 350 kilometres per hour.[42] With 31,000-plus daily seats and 5.8 million passengers served in its first year, the line has boosted the region's GDP by USD 5.62 billion (2019-2023) and saves USD 208 million in fuel costs annually. It alleviates congestion and spurs urban development along its 142-kilometre route.[43]

Global high-speed rail activity totalled 678 billion passenger-kilometres in 2022, still well below the all-time high of 1,054 billion passenger-kilometres in 2019 (Figure 4).[44] **Despite the continued growth in infrastructure, high-speed rail activity remained at 2015/16 levels as of 2022, as the COVID-19 pandemic had triggered a nearly 40% decline (in 2020).**[45] The low activity level in 2022 may reflect a lack of reporting by some high-speed rail companies.

Sustainability and climate trends

Rail transport delivers significant socio-economic dividends, which are often overlooked in terms of the economic value that they generate. Rail's contribution to the national GDP ranges from 0.5% in the European Union in 2012, 0.7% in the United States in 2023, 0.8% in Australia in 2016 (even up to 1.6% in direct and indirect contributions) to 1.5% in India (even 3 to 4% through direct and indirect contributions).[46]

- Indian Railways contributed around 3-4% of the country's GDP in 2024 through direct and indirect contributions, such as trade and employment. The rail sector was also one of India's largest employers, with a direct workforce of 1.2 million people and more people working through contractors, vendors, logistics and suppliers.[47]
- In 2023, the US rail transport sector contributed around USD 50 billion to the country's GDP (roughly 0.7% of total GDP).[48]

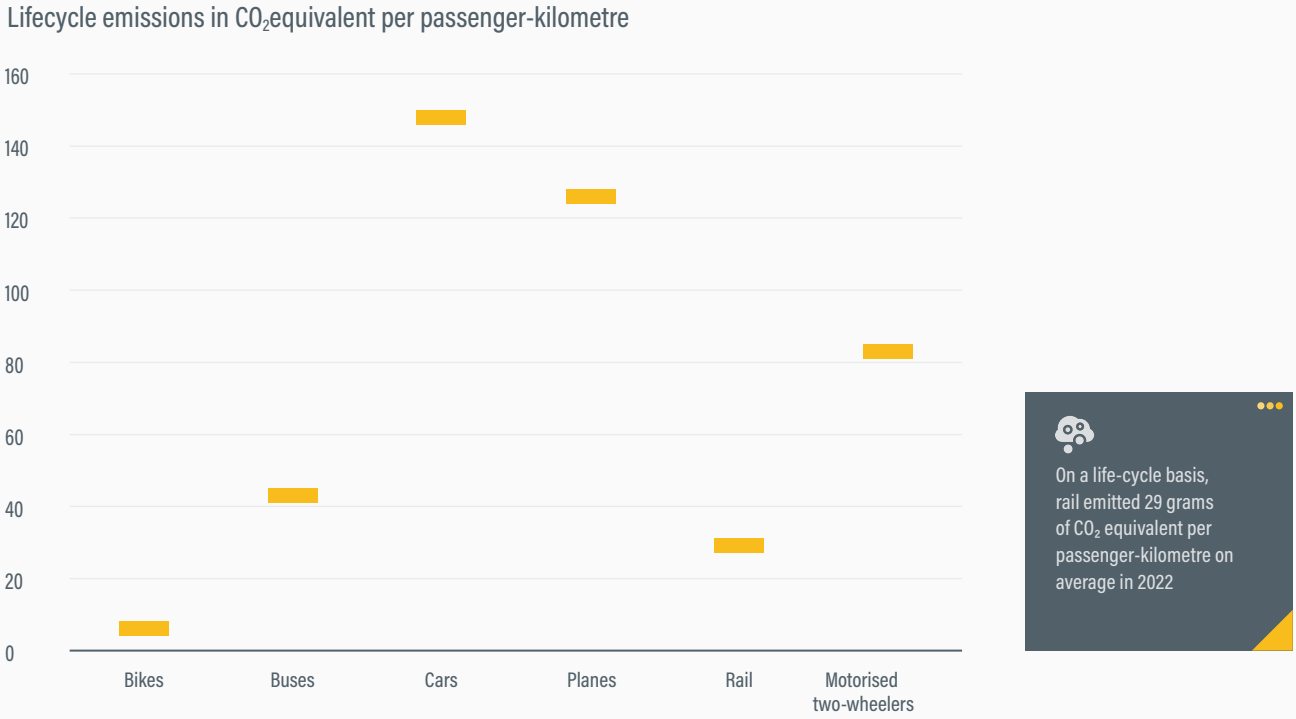
Rail can enhance social equity by providing accessible, affordable and sustainable mobility options – and therefore access to essential services, employment, and education, particularly for marginalised groups. Women are more likely than men to rely on public transport (especially rail and buses) due to differences in travel patterns and access to private vehicles (See 1.2 Advancing the Right to Mobility for Sustainable and Inclusive Societies)**.**[49] **Rail transport contributes to improved air quality and reduced congestion, supporting better public health outcomes** (See 1.7 Driving Health and Wellbeing Forward: The Critical Link with Transport)**.**[50]

- As of 2023, the UK community rail movement engaged around 125,000 people annually in various activities, delivering USD 161.5 million (GBP 129 million) in social value from just over USD 9 million (GBP 7.2 million) in funding.[51] This represents a social return on investment of nearly USD 22.5 (GBP 18) for every USD 1.25 (GBP 1) spent.[52]
- The second phase of the Tanzania Intermodal and Rail Development Project, approved in 2024, relies on USD 200 million in financing to improve safety and efficiency along the Dar es Salaam-to-Isaka railway segment.[53] The project benefits nearly 900,000 people directly and an estimated 3.5 million indirectly, roughly 5% of Tanzania's population.[54] This includes railway users, residents along the line, businesses involved in trade, and communities along the Kinywasungwe catchment area.
- In Kenya, the Standard Gauge Railway (SGR) infrastructure project has enhanced trade between Nairobi and the coastal city of Mombasa, contributing to job creation (30,000 temporary construction jobs and 5,000 permanent jobs) and reducing transport costs for goods around 40-60% compared to roads.[55]

Although rail transport can play a role in promoting gender equity in the transport workforce, women have remained under-represented in the rail workforce and in the wider transport sector. In 2023, women made up 15.6% of the global transport and storage workforce.[56] In Europe, women represented an estimated 21% of the rail workforce in 2020.[57] Although comprehensive data for other regions are lacking, the available evidence suggests that shares are likely even lower. Because gender-disaggregated data remain a challenge in many regions, a global picture of women's participation in the rail workforce is not clear.



FIGURE 5. Life-cycle greenhouse gas emissions intensity of motorised passenger transport modes, 2022



Source: See endnote 62 for this section

Rail transport remains the most energy-efficient mode of freight transport and collective passenger travel, thanks to its high energy efficiency and low greenhouse gas emissions per passenger- and tonne-kilometres.[58] **In 2023, rail passenger and freight transport accounted for 1.2% of global transport greenhouse gas emissions.**[59] **Models estimate that freight contributed the major share (around 79%) of rail's greenhouse gas emissions in 2023.**[60]

Passenger rail transport emitted 22.35 grams of CO_2 equivalent per passenger-kilometre (well-to-wheel) in 2023, reinforcing rail's role as the least carbon-intensive mode of motorised land transport.[61] On a life-cycle basis, rail emitted 29 grams of CO_2 equivalent per passenger-kilometre on average in 2022 (Figure 5).[62] By comparison, small- and medium-sized cars emit around 148 grams of CO_2 equivalent per passenger-kilometre globally, while a regulated European truck emits an estimated 52.0 grams of CO_2 per tonne-kilometre.[63]

The carbon intensity of rail has continued to improve, declining 55.9% for passenger rail and 58.7% for freight rail between 2005 and 2023 (location-based).[64] **These gains place the sector ahead of its decarbonisation pathway for 2030, as rail operators reduce emissions through electrification, fuel switching and efficiency improvements.** Despite the demonstrated potential of a modal shift to rail in reducing emissions, rail's modal share has stagnated or even declined in many regions.

- In the EU, total CO_2-equivalent emissions from railway operations fell 57% (location-based) and 58% (market-based) between 2005 and 2023, far surpassing the region's target of a 30% reduction by 2030.[65]
- DP World's Modal Shift Programme increased the share of freight moved by rail from the UK's Port of Southampton from 21% to 30% between September 2023 and August 2024.[66] This shift removed 6,400 tonnes of CO_2 equivalent emissions in its first six months, helping to reduce road congestion and support the United Kingdom's 2050 targets for rail freight.[67]

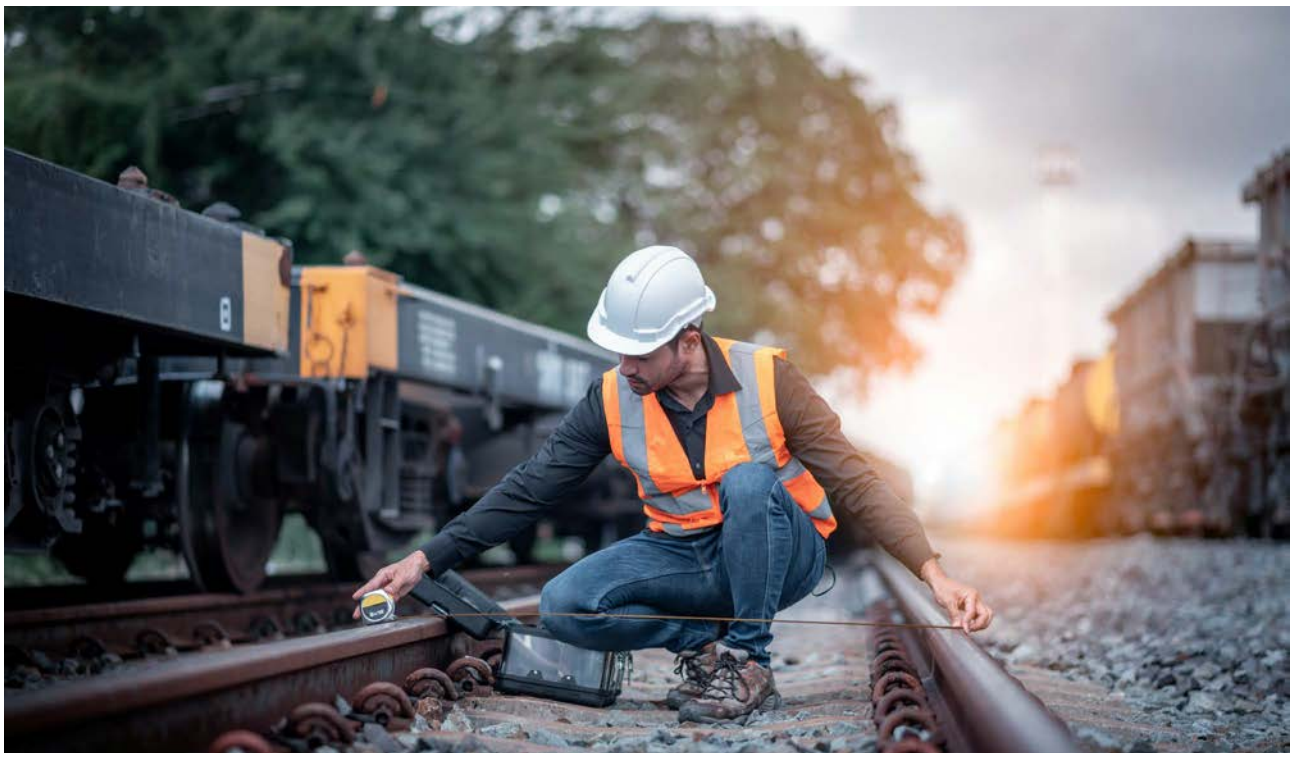
As of 2022, around one-third of all railways worldwide had been electrified, mainly in India, Japan and China.[68] **In 2023, 45% of global rail energy use came from electricity, with Europe nearing 60%.**[69] These trends are reinforced by rolling stock upgrades, route electrification, and modal shift strategies that favour energy- and space-efficient rail operations.

- Among the member countries of the International Transport Forum, Armenia, Georgia, and Switzerland achieved 100% rail electrification in 2022, with Türkiye following in 2023.[70]
- As of 2022, 56.9% (202,100 kilometres of railway lines) of the EU rail network was electrified.[71]
- In 2023, Austria's national rail company ÖBB ordered up to 120 battery-electric units from Stadler, with an initial 16 trains set to replace their diesel units on partially electrified routes starting in 2028.[72] This shift is expected to save up to 1.7 million litres of diesel annually, avoiding around 4,250 tonnes of CO_2 emissions.[73]
- In India, which has rapidly advanced its rail electrification programme, 93.8% of the broad-gauge rail network was electrified as of March 2024, covering more than 60,000 kilometres. As of February 2025, 98% of the Indian Railways' (IR) Broad Gauge (BG) network has been electrified .[74] This progress supports Indian Railways' goal of becoming a net zero carbon emitter by 2030, with full electrification expected in the near future.[75]
- In 2024, Türkiye secured USD 660 million in financing from the World Bank to electrify a 660-kilometre section of the Eastern rail corridor from Divriği to Kars.[76] The project replaces diesel trains with electric traction and integrates the line into the low-carbon Middle Corridor. Full implementation of the project, expected by 2030, will result in the avoidance of an estimated 72,332 tonnes of carbon annually, with this figure rising to 245,835 tonnes by 2060.[77]

Rail consumed 2% of the total energy in the transport sector in 2022.[78] It had the highest share of renewable energy use among motorised transport modes in 2022, at 16.1%, with rising integration of solar, wind and hydrogen systems into railway operations.[79]

- In 2024, Etihad Rail in the United Arab Emirates (UAE) partnered with Emerge (a Masdar–EDF joint venture) to install a 600 kilowatt-peak solar photovoltaic system with 2.56 megawatt-hours of battery storage at its Ghuweifat freight terminal.[80]
- These efforts are aligned with the UAE's Net Zero by 2050 Strategy, whereby the railway network contributes to reducing CO_2 emissions in the country's road transport sector 21% annually by 2050.[81]

Rail infrastructure is increasingly exposed to climate risks such as heatwaves, floods, storms and coastal erosion. Although vulnerabilities vary by region, the scale of the impacts has become more evident. Climate-related events can affect critical rail components such as tracks, signalling, and power systems, leading to delays and service disruptions; impacting the quality of goods transported and the welfare of railway workers; and, in rare cases, posing safety risks such as derailments. Northern areas experience wetter winters and face high risks of landslides, track flooding and bridge collapse. Southern regions experience extreme heat and desertification, with wildfires disrupting operations, tracks buckling, and overhead wiring sagging. Coastal lines are impacted by storm surges and erosion.



- In Pakistan, devastating floods in 2022 caused widespread damage to the rail system – including the destruction of tracks, bridges and stations – contributing to estimated infrastructure losses of USD 2.5 billion across the transport sector alone, with rail being among the hardest hit sub-sectors.[82]
- In Viet Nam, national climate planning documents estimate that the disruption of railway lines due to climate hazards could lead to economic losses of USD 2.3-2.6 million per day, highlighting the critical role of resilience planning in rail infrastructure.[83]

Despite these challenges, rail systems are inherently more robust and less weather-sensitive than many other transport modes, in part because of their centrally controlled operations.

Policy and investment developments

Governments have increasingly recognised rail's potential in decarbonisation strategies and national economic recovery plans. During 2023 and 2024, countries launched various plans to revive national economies through the upgrading and development of rail lines.

- Chile's 30/30 Plan aims to connect towns within 30 kilometres or 30 minutes of regional capitals, with the purpose of expanding new urban areas that have better access to public transport.[84] The first rail service from Temuco to Pitrufquen (29.6 kilometres) under this project became accessible to the public in June 2023, benefitting around 330,000 people in 3 municipalities.[85]
- The EU's Trans-European Transport Network (TEN-T) policy has driven investment in rail electrification across priority corridors. The TEN-T Core Network targets full electrification and deployment of the European Rail Traffic Management System (ERTMS) by 2030, with the aim of reducing emissions, enhancing inter-operability, and shifting freight and passenger traffic from road to rail.[86] A focus on key cross-border sections – such as Spain/France, Germany/Austria and Italy/Slovenia – will help accelerate the decarbonisation and integration of the single European railway area.[87]
- South Africa has integrated rail rehabilitation and greening into its Climate Change Response Strategy and Just Energy Transition Investment Plan, aiming to shift freight from road to rail and to reduce the overall emission intensity of the transport sector.[88]
- In 2021, the United Kingdom included rail decarbonisation as a central pillar of its Transport Decarbonisation Plan, setting a target to remove all diesel-only trains from the network by 2040 and enabling emission reductions through improved network planning and fleet renewals.[89]

Several African and Asian countries have implemented groundbreaking developments on rail since 2023 with the aim of connecting people and goods.

- A newly initiated railway project will connect Guinea's four regions to the global trade network, helping the country export nearly 120 million tonnes of iron ore by the end of 2025.[90]
- In 2023, Indonesia inaugurated its first high-speed railway, a USD 7.3 billion project that is backed by China under its Belt and Road Initiative.[91]
- Iraq unveiled its ambition in 2023 for a USD 17 billion road and rail project to link Asia and Europe.[92]

Rail-related policy efforts have sought to promote inclusive and accessible services, improved customer experience, gender-responsive infrastructure, inclusive recruitment and safe working environments.

- The Women in Rail autonomous agreement – the first EU-level sectoral agreement on gender equality – is aimed at increasing women's participation in the rail workforce through measures such as recruitment targets, equal pay, career development and workplace protections. The agreement was signed in 2021 by the Community of European Railway and Infrastructure Companies (CER) and the European Transport Workers' Federation (ETF).[93]
- In Belgium, the SNCB Accessibility App was launched in 2023 to facilitate the booking of assistance for passengers with reduced mobility. Future improvements include integration with station staff tools for greater flexibility during incidents (such as traffic interruptions), adding accessibility details about rolling stock and infrastructure and doubling the number of accessible stations between 2022 and 2032.[94]
- In 2023, Italy's national rail company FS Group, in partnership with the organisation Right To Be, launched a campaign against sexual harassment in public places, providing tools on how to behave in the event of harassment. FS also rolled out a training programme for staff.[95]
- Nakuru County (Kenya) developed a Public Transport Code of Conduct with Flone Initiative to set minimum professional standards for transit operators, emphasising gender and disability inclusion, sexual harassment prevention and environmental sustainability [96]
- In 2022, Santiago (Chile) launched the "Stand Up" campaign against sexual harassment in transit, encouraging both victims and bystanders to report and safely intervene, creating a safer and more inclusive passenger environment.[97]
- In the Republic of Korea, KORAIL's Smart Air Quality System has been integrated into rail stations, seamlessly integrating cutting-edge fine dust monitors, high-tech air



purifiers and interactive display devices for measurement. Passengers receive real-time updates on fine dust levels, increasing their awareness and enabling them to trust the underground's air quality and to use the railway safely.[98]

As of 1 August 2025, only 8 (27%) of the 29 third-generation Nationally Determined Contributions (NDCs) submitted to the United Nations Framework Convention on Climate Change mentioned rail transport (Botswana, Brazil, Canada, Moldova, Nepal, the United Kingdom, the United States and Uruguay); only 3 NDCs (Botswana, Moldova and Nepal) had specific targets focused on rail transport.[99]

- Botswana's NDC features the target of a 30% shift to rail but does not clarify whether the focus is on passenger or freight transport.[100]
- Moldova's third-generation NDC commits to electrifying 30% of the rail network by 2040 and shifting freight from road to rail (30% by 2030 and 60% by 2050).[101]
- Nepal's NDC targets developing an electrified rail network of 200 kilometres by 2030 and 300 kilometres by 2035 for freight as well as passenger transport.[102] Nepal also aims to implement light rail systems for urban public transport.[103]

Very few of the second-generation NDCs submitted between 2019 and 2024 featured adaptation efforts for railways; however, two of the third-generation NDCs (Botswana and Brazil) mentioned railways as among the sectors to boost adaptation.

- Botswana's third-generation NDC highlights flood control efforts to prevent flooding of railways.[104]
- Brazil's NDC refers to the AdaptaBrasil platform to disseminate knowledge and decision making regarding climate adaptation for railways (as well as for port and road infrastructure).[105]

In 2022, rail represented about 26% of the total global investment in transport infrastructure from G20 countries.[106] Rail investments tend to have strong multiplier effects, especially in low- and middle-income countries where improved connectivity can unlock economic potential in underserved regions.[107]

- In North America, rail's share of investment in inland transport infrastructure fell from 12% in 2020 to 8% in 2022.[108]
- In the EU-27, rail infrastructure investment accounted for 44% of total transport infrastructure spending in 2022, up from 38% in 2008.[109]
- Brazil's Interurban Train North Axis (TIC) project, a public-private partnership that aims to connect São Paulo to Campinas, is expected to attract more than USD 2 billion (BRL 12.7 billion) in private investments, generating social

and economic benefits estimated at USD 0.5 billion (BRL 3.18 billion).[110] The service is projected to serve around 65,000 daily passengers on the São Paulo-Campinas express route by 2055, with local services anticipating around 650,000 daily users.[111]

The share of public spending for road infrastructure remained four times higher than for rail in most regions in 2022, risking the under-utilisation of rail's potential for climate mitigation.[112]

- Between 1995 and 2018, European countries have spent around USD 1.56 trillion (EUR 1.5 trillion) on road infrastructure and only USD 962.5 billion (EUR 930 billion) on rail.[113]
- Between 1995 and 2020, the total length of European railways fell 6.5% (losing 13,700 kilometres), whereas motorway lengths increased 60% (gaining more than 30,000 kilometres).[114]
- Denmark, France, Italy and Slovenia all increased their rail investments between 1995 and 2018 – rising more than 20 percentage points – although this was still far below the investment in road transport.[115]
- In the Asia-Pacific region, Australia, Japan and the Republic of Korea have all increased their rail investments, but the share of road investments still remains far higher than for rail.[116]

Significant investment and priority spending are needed in rail infrastructure for climate adaptation in the coming decades. With the necessary maintenance and climate adaptation measures – such as reinforcing infrastructure, emergency procedures, upgrading drainage and relocating vulnerable lines – rail can continue to reliably serve people and goods.

- In Buenos Aires (Argentina), the Belgrano Sur Passenger Railway Line, a USD 675 million World Bank-financed modernisation project, is focused on climate-resilient infrastructure, including structural and hydrological upgrades to bridges and viaducts, renovated drainage systems, new hydraulic and pumping systems with back-up generators, rainwater conduits and efficient lighting.[117]
- In the EU, an estimated USD 28.4 billion (EUR 27.4 billion) (in 2023 terms) in investment will be needed by 2040 under the TEN-T to adapt railway infrastructure to climate-exacerbated risks, based on projected mid-century warming conditions and related hazards such as heatwaves, floods, droughts and wildfires.[118]
- In the United States, nature-based solutions have been employed to address shoreline erosion and flooding threats at Lamberts Point Marine Terminal in Norfolk, Virginia.[119] Norfolk Southern railway partnered with the Elizabeth River Project to construct a living shoreline using 2,300 cubic yards of sand, 24,000 marsh plantings, 2,000 cubic yards of stone, and 90 cubic yards of oysters, providing climate-resilient protection for rail infrastructure while enhancing local biodiversity.[120]

Digitalisation and standardisation have emerged as critical enablers for emission reduction in the rail sector. Advanced train control, eco-driving systems and harmonised signalling help reduce energy consumption, increase network capacity and lower operating costs. Supported by real-time data and advisory systems, these techniques have delivered energy savings of 7-25% on various rail services across Europe and Asia, contributing to the sector's ongoing efforts to reduce operational emissions.[121] Standardised systems such as the European Train Control System (ETCS) and digital twins for asset management further support sustainable operations. Eco-driving – training and guiding rail drivers to optimise acceleration, cruising and braking for energy efficiency – has become a well-established practice.

- In Switzerland, adaptive control (ADL), also called the "green wave", provides train engine drivers with driving recommendations, enabling them to avoid unplanned stops in a more resource-saving manner. Trains run more smoothly, consume less energy and are highly energy efficient. Thanks to ADL, the Swiss national rail operator SBB saved 72 gigawatt-hours of power per year as of 2025, equal to the annual household energy use in the city of Fribourg, with around 38,000 inhabitants.[122]
- In the Netherlands, ProRail and NS (the Dutch infrastructure manager and main rail operator) have implemented the Smart communications for Efficient Rail Activities (SFERA) standard, bringing immediate benefits in punctuality and communication between operators. When trains are exactly on schedule, drivers save more energy by not having to catch up to the timetable.[123]

To further progress in the rail sector, policies and regulations should incorporate an Avoid-Shift-Improve[i] prioritisation framework, with a focus on modal shift measures, an area where significant untapped potential remains.

i The Avoid-Shift-Improve framework has been central to sustainable, low carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

Partnerships in action

The **International Union of Railways' (UIC) Rail Sustainability Index** collects information on the contributions that railways make to the United Nations Sustainable Development Goals, providing benchmarking and publishing results annually.[124] UIC members have also established common framework methodologies that focus on climate impact analysis, vulnerability, risk, and criticality assessment for two areas: Heavy Rains and High Temperature.[125] The UIC Multimodal Working Group launched its 30 January webinar with 60 participants, presenting its three Passenger Services Group, (PSG)-managed workstreams—Air+Rail, Door-to-Door, and NGRS—continuing projects since 2019.[126]

The **International Council on Clean Transportation's (ICCT) Off-road and Freight Decarbonization Symposium** in 2025 attracted national and city government authorities from China, the United States and Europe.[127] The ICCT published a technical brief in 2024 on *Zero-emission locomotive technologies: pathways for U.S. rail decarbonization* and a policy brief in 2025 titled *Introduction to the low-carbon freight aspects of China's opinions on accelerating the construction of an open and unified transportation market*.[128]

In 2025, Alstom continued to advance smart and sustainable mobility worldwide, delivering the first stainless-steel train for São Paulo's Line 6-Orange, modernising Romania's Bucharest-Giurgiu railway with electrification and ERTMS Level 2 signalling, and upgrading Lyon Metro Line D with 26 new automatic rubber-tyred trains and system renovations, enhancing capacity, reliability and passenger experience across these key projects.[129]



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This section covers trends in motorised individual road transport and topics of road vehicle activity, vehicle sales, autonomous road vehicles, congestion and road safety. Road-based public transport is covered in *4.5 Public Transport*, and informal collective transport services are covered in *4.6 Informal Transport*.

Road Transport



KEY FINDINGS

- Road transport is a crucial part of transport and mobility systems globally, yet persistent challenges remain in terms of sustainability, resilience, access and safety. Increasing resilience and access to roads is critical to development, connectivity, equity and economic growth.
- Road transport is the largest contributor to greenhouse gas emissions of all transport sub-sectors – contributing nearly three-quarters (74%) of total transport emissions in 2023. Thus, policies aimed at reducing these emissions are essential to achieve decarbonisation goals and meet climate targets.
- Automobiles and motorised two- and three-wheelers are often the largest source of air and noise pollution in cities, with significant impacts on people's health and well-being as well as on the environment. An estimated 99% of the global population is exposed to particulate matter ($PM_{2.5}$) levels above the safe guidelines of the World Health Organization (WHO), with low- and middle-income countries experiencing the worst exposure.
- High demand for motorised road transport can lead to declining road safety, with a greater likelihood of road crashes and fatalities. In 2021, an estimated 1.2 million people died in road traffic crashes globally, and 50 million people were left injured, with most fatalities occurring among vulnerable road users such as pedestrians, cyclists and motorcyclists.
- Low- and middle-income countries bear the brunt of these impacts, accounting for 93% of road deaths, with Africa seeing the highest rate of 18.8 fatalities per 100,000 people, above the global average of 15 fatalities per 100,000 people.
- With 85% of the world's lower-income population living in rural areas, governments have increasingly recognised the importance of improving rural transport and creating rural-urban connections to narrow the development gap.
- Fossil fuels continued to account for around 95.4% of the energy used in road transport in 2023 – a share that has barely changed *in the past five decades* – and vehicle-centric models persist. A fundamental shift is necessary to transform this long-engrained approach to road transport.
- Alongside policies to advance zero-emission vehicle use, fuel efficiency standards, and renewable energy, governments at all levels need to prioritise policy and behaviour change measures that encourage shifts towards rail and inland waterways for freight transport and towards walking, cycling, informal (shared) and public transport for passenger transport – while reducing the need for total vehicle travel.



KEY FINDINGS



Demand, use and access

- emand for both passenger and freight road transport has increased in recent years, characterised by shifts in mode share to more road vehicles, changes in patterns of vehicle-kilometres travelled, mainstreaming of electric vehicles (EVs), and increasing interest in artificial intelligence (AI) and autonomous vehicles.
- Global demand for passenger transport grew 10% between 2019 and 2025 (modelled values), reaching 68.3 trillion passenger-kilometres in 2025. Road transport alone accounted for an estimated two-thirds (67%) of passenger mobility globally in 2025, although this share varies highly by location and to some degree urban density.
- In 2022, the absolute number of cars grew to a global average of 219 four-wheeled vehicles per 1,000 people, with much higher averages in North America (805), Europe (588) and Oceania (587). In many low- and middle-income countries, most of the vehicle growth has been in two- and three-wheelers, which tend to outnumber cars in these locations.
- Despite advances in road infrastructure and connections, more than 1 billion people globally did not have access to all-weather roads as of 2019, particularly in low- and middle-income countries and in rural places. Only 38% of the global rural population had access to all-weather roads as of 2019.
- Global freight activity grew an estimated 8% between 2020 and 2025 (modelled values), surpassing 171 trillion tonne-kilometres in 2025. Around 10% of total freight activity in 2025 was transported by road, below the shares for maritime transport (74%) and rail (11%). However, one estimate found that road transport accounted for 22% of total freight activity in 2019.
- Emerging countries, particularly in Asia, continued to see increases in freight activity, although most of Asia's freight transport growth was in maritime shipping.
- Road vehicles regained their popularity as production and sales soared to pre-pandemic levels. Sales of all vehicles approached 93 million in 2023 – surpassing 2019 levels (92 million) – after falling sharply to 80 million in 2020 and growing only slightly to 82-83 million during 2021-2022.
- Electric car sales (including plug-in hybrid electric vehicles) reached a sales share of 22% in 2024, totalling a record 17.5 million units. However, growth was slower than in previous years due to stagnating sales in Europe, as government support was reduced or eliminated in some markets and EU-level carbon dioxide (CO_2) targets were not strengthened.
- Larger vehicles such as sport-utility vehicles (SUVs) and pick-up trucks continued to rise in popularity (both conventional and electric models), due to their status appeal in many markets, potential comfort enhancements, and greater marketing efforts by manufacturers due to the larger profit margins.
- In 2023, SUVs surpassed a 50% market share in advanced economies for the first time and accounted for 48% of car sales globally, posing a growing challenge for public space, road safety and emissions. Global SUV revenues were projected to reach USD 1 trillion by 2025.
- Global demand for two- and three-wheelers has continued to increase. Models with internal combustion engines (ICE) remain dominant in most markets, although electric models have gained ground, especially in Asia. Asia has led in two-wheeler growth, with annual sales of ICE models projected to grow 1.6% in 2024 to reach 57 million and then fall to around 56 million by 2028.
- Despite the increase in electrification, global transport energy demand grew more than 21% between 2010 and 2023, with most of this growth being met by fossil fuels. Oil products supplied around 90% of the energy demand for transport in 2023. Road transport alone accounted for 75% of transport energy consumption and 48% of global oil demand that year.
- However, while global oil demand for transport continued to grow annually to 2023, growth in oil demand for road transport continued to decline (with no growth in 2024), due mainly to changes in the Chinese market.
- Integration of AI in passenger cars continued to advance, with the global market reaching USD 41 billion in 2024 and projected to grow nearly three-fold to USD 114.5 billion by 2029.

KEY FINDINGS



Sustainability and climate trends

- As access to convenient public transport and rail has faltered – and as ridership has struggled to recover from pre-pandemic levels in many locations – this has resulted in rising private car and motorcycle use, increased congestion, and worsening pollution and greenhouse gas emissions.
- The persistence of the car-centric paradigm has led to more vehicles on the road, as well as to increasing vehicle size and decreasing vehicle occupancy, which have in turn offset any gains in fuel efficiency.
- Achieving net zero greenhouse gas emissions globally by 2050 will require large emission reductions in the transport sector as a whole and particularly from passenger vehicles and heavy trucks. To reach global net zero goals, CO_2 emission intensity must be reduced more than 94% for trucks and 98% for cars compared to 2020 levels, according to the International Energy Agency's (IEA) Net Zero scenario.
- The road transport sector accounted for 74% of transport greenhouse gas emissions in 2023 and remained far from being on track to a net zero scenario, with constant annual emissions growth of 1.8% to 2% for most years between 2010 and 2023. Road transport emissions neared their pre-pandemic (2019) levels already in 2022 and surpassed them in 2023, reaching 6.2 gigatonnes of CO_2 equivalent.
- Transport emissions from road freight have outpaced those from road passengers, as emissions from road freight grew 23% and from road passengers 16% from 2010 to 2023. This suggests that policies pursuing efficiency improvements and electrification have had a stronger impact for passenger vehicles than freight vehicles. CO_2 emissions from road passenger transport reached 3.75 gigatonnes in 2023, while emissions from road freight reached nearly 2.46 gigatonnes.
- As larger passenger vehicle sizes have gained popularity, their rising energy consumption has posed a growing risk to decarbonisation, leading the IEA to recommend that the auto industry decrease vehicle size. SUVs alone were responsible for more than one-quarter of the total growth in oil consumption globally during 2022-2023.
- Road transport emissions are extremely unequally distributed among countries, with high-income countries contributing the bulk of emissions. The countries with the highest levels of per capita road transport CO_2 equivalent emissions in 2023 were Luxembourg (6.4 tonnes), Qatar (5.1 tonnes), Saudi Arabia (4.4 tonnes), the United States (4.2 tonnes) and the United Arab Emirates (4 tonnes).
- Emission standards have helped limit emissions to some extent where they have been implemented, but much of the world remains uncovered by such standards.
- Decarbonising the power grid is critical for achieving transport decarbonisation, with the aim of supplying cleaner energy for both EV charging and battery production.
- Road safety, health and climate change are interrelated and can influence each other in various ways, with the most direct and severe impacts occurring from road crashes and air pollution.
- Factors contributing to the slow decline in road deaths and injuries include increased road congestion, higher speeds, driver distraction and fatigue from longer commute times.
- Efforts to improve the resilience of road infrastructure have lagged, even as economic losses from infrastructure damage due to climate-related events grew an estimated seven-fold between the 1970s and 2010, to USD 1.6 trillion.
- Traffic congestion returned to pre-pandemic levels already by 2021, and most cities have experienced worsening congestion since 2022.
- Autonomous vehicles have the potential to decrease transport emissions if they are shared and regulated; however, increases in vehicle size and distances travelled could lead to higher emission growth, although these impacts are uncertain.

KEY FINDINGS

Policy and investment developments

- Successful strategies to reduce road transport emissions and create healthier, more sustainable urban and rural areas include a mix of the Avoid-Shift-Improve (A-S-I) framework for both passenger and freight transport.
- Among "Avoid" and "Shift" policies, a few jurisdictions have adopted targets to reduce vehicle travel, particularly at the sub-national level.
- Building roads and establishing urban-rural connections can support economic development; however, if these are not pursued with a sustainable, resilient vision, they can lead to unsustainable auto-centric, sprawling development.
- Investment in inland transport infrastructure (road, rail and inland waterways) has been decreasing in some countries, although several continue to invest heavily in road transport.
- Policies have been adopted at various levels to address road safety, particularly aimed at speed management and sometimes linked to improving the sustainability of transport systems. Research has shown that lowering average speed limits by just 5% can result in a 20% reduction in road deaths.
- Between 2023 and 2025, an increasing number of jurisdictions adopted targets for reducing average vehicle emissions, as well as scrappage policies that help governments accelerate fleet renewal, reduce emissions and encourage the adoption of cleaner, more efficient vehicles.
- In some places, rules for vehicle emission reductions include flexibilities around compliance that hinder their effectiveness, while in other cases emission rules have been weakened or removed altogether.
- EV adoption has been the most common measure for reducing emissions in the road transport sector, since EVs produce far fewer emissions than traditional petrol vehicles but allow for continuation of the auto-centric model. In addition, several governments have adopted targets for full or partial ICE vehicle bans or EV targets, although typically these are only for vehicle sales rather than the overall stock.
- As EV uptake increases, governments have taken steps to support the deployment of charging infrastructure and battery swap stations. However, they may need to develop new taxation approaches to replace the losses in income from fuel taxes on ICE vehicles.
- By 2023, the number of countries with support measures for EVs surpassed those with biofuel blending mandates, which until then had been the most common policy for decarbonising road transport.
- The deployment of EVs will not address concerns such as traffic congestion, urban sprawl and the amount of public space devoted to vehicles. In some places, increases in parking fees in recent years have been correlated with higher use of walking, cycling and public transport.
- For freight transport, low-carbon options include the adoption of fuel-efficient technologies and alternative fuels, carbon pricing mechanisms, promotion of multi-modality, cargo consolidation centres, last-mile sustainable urban logistics and autonomous deliveries. Although policy progress has been slower for freight than passenger vehicles, some advances towards reducing emissions occurred in recent years.





Photo: Dennis Schroeder / NREL

Context, challenges and opportunities

Road transport is a crucial part of transport and mobility systems globally, yet persistent challenges remain in terms of sustainability, resilience, access and safety. Adaptation of road transport infrastructure to climate change continues to receive a small share of global climate finance, while the impacts of natural hazards on transport systems have increasingly large costs. Climate-related impacts have disproportionate effects on low- and middle-income countries, where inadequate roads often already restrict the movement of people and goods.

Increasing resilience and access to roads is critical to development, connectivity, equity and economic growth. Road transport remains the dominant mode for freight movement globally, highlighting the vulnerabilities for trade and commerce with increasing climate change impacts, extreme weather and geopolitical events.[1]

Road transport is the largest contributor to greenhouse gas emissions of all transport sub-sectors – contributing nearly three-quarters (74%) of total transport emissions in 2023.[2] Thus, policies aimed at reducing these emissions are essential to achieve decarbonisation goals and meet climate targets. To achieve an economy with net zero greenhouse gas emissions, road transport must also be net zero. Although some progress has been made through policy adoption and technological advancement, the pace and scale of global emission reductions remain insufficient to meet current net zero targets.[3]

Automobiles and motorised two- and three-wheelers are often the largest source of air and noise pollution in cities, with significant impacts on people's health and well-being as well as on the environment.[4] An estimated 99% of the global population is exposed to particulate matter ($PM_{2.5}$) levels above the safe guidelines of the World Health Organization (WHO), with low- and middle-income countries experiencing the worst exposure.[5] Resulting health costs have continued to rise, as mounting evidence has linked road transport emissions to long-term conditions including asthma, heart disease, dementia and stroke.[6] Auto-centric economies also support sedentary lifestyles, contributing to increased frequency of diabetes, chronic kidney disease and chronic obstructive pulmonary disease.[7]

High demand for motorised road transport can lead to declining road safety, with a greater likelihood of road crashes and fatalities.[8] In 2021, an estimated 1.19 million people died in road traffic crashes globally, and 50 million people were left injured, with most fatalities occurring among vulnerable road users such as pedestrians, cyclists and motorcyclists.[9] Road traffic crashes are the eighth leading cause of death worldwide and the primary cause of death for

young people aged 5-29.[10]

Low- and middle-income countries bear the brunt of these impacts, accounting for 93% of road deaths, with Africa seeing the highest rate of 18.8 fatalities per 100,000 people, above the global average of 15 fatalities per 100,000 people.[11] Annual road deaths globally fell 2% on average during 2010-2019, but this was still well below the 50% reduction target set under the United Nations Decade of Action for Road Safety.[12] The need to accelerate action has resulted in a shift in strategy between the first and second Decades of Action for Road Safety.[13]

With 85% of the world's lower-income population living in rural areas, governments have increasingly recognised the importance of improving rural transport and creating rural-urban connections to narrow the development gap.[14] Efforts to make roads more resilient to climate change also have continued, particularly in rural areas, with growing support from climate finance, although far below necessary levels.

Fossil fuels continued to account for around 95.4% of the energy used in road transport in 2023 – a share that has barely changed *in the past five decades* – and vehicle-centric models persist.[15] **A fundamental shift is necessary to transform this long-engrained approach to road transport.** Resistance to change remains a barrier in most places, even though examples reveal how sectoral transformation can occur, as well as the resulting benefits to climate, air quality, health, congestion relief, etc.

Alongside policies to advance zero-emission vehicle use, fuel efficiency standards, and renewable energy, governments at all levels need to prioritise policy and behaviour change measures that encourage shifts towards rail and inland waterways for freight transport and towards walking, cycling, informal (shared) and public transport for passenger transport – while reducing the need for total vehicle travel.[16] Some governments have begun taking strong actions to encourage such advancements, and co-ordination has improved through international frameworks. However, efforts remain insufficient in scale and pace and are far from what is needed to reach climate, sustainability and health goals.

Demand, use and access

Demand for both passenger and freight road transport has increased in recent years, characterised by shifts in mode share to more road vehicles, changes in patterns of vehicle-kilometres travelled, mainstreaming of electric vehicles (EVs), and increasing interest in artificial intelligence (AI)[i] **and autonomous vehicles.** Factors driving these trends include population growth, urbanisation, economic development, and concerns about air pollution and climate change. However, some locations – such as Paris (France) – have supported shifting away from motorised vehicles towards more people-centred planning, due to factors such as inflation, fuel prices, congestion, and the prioritisation of healthier and more sustainable cities.[17] Similarly, shifts from road to rail or inland waterways are being encouraged in some places. (See 4.2 Integrated Transport Planning.)

Global demand for passenger transport grew 10% between 2019 and 2025 (modelled values), reaching 68.3 trillion passenger-kilometres in 2025.[18] **Road transport alone accounted for an estimated two-thirds (67%) of passenger mobility globally in 2025, although this share varies highly by location and to some degree urban density.**[19] In many major cities (mostly in high-income countries), car ownership per capita has declined due to effective and convenient public transport services, and some cities ramped up their support for walking and cycling following the outbreak of the COVID-19 pandemic.[20]

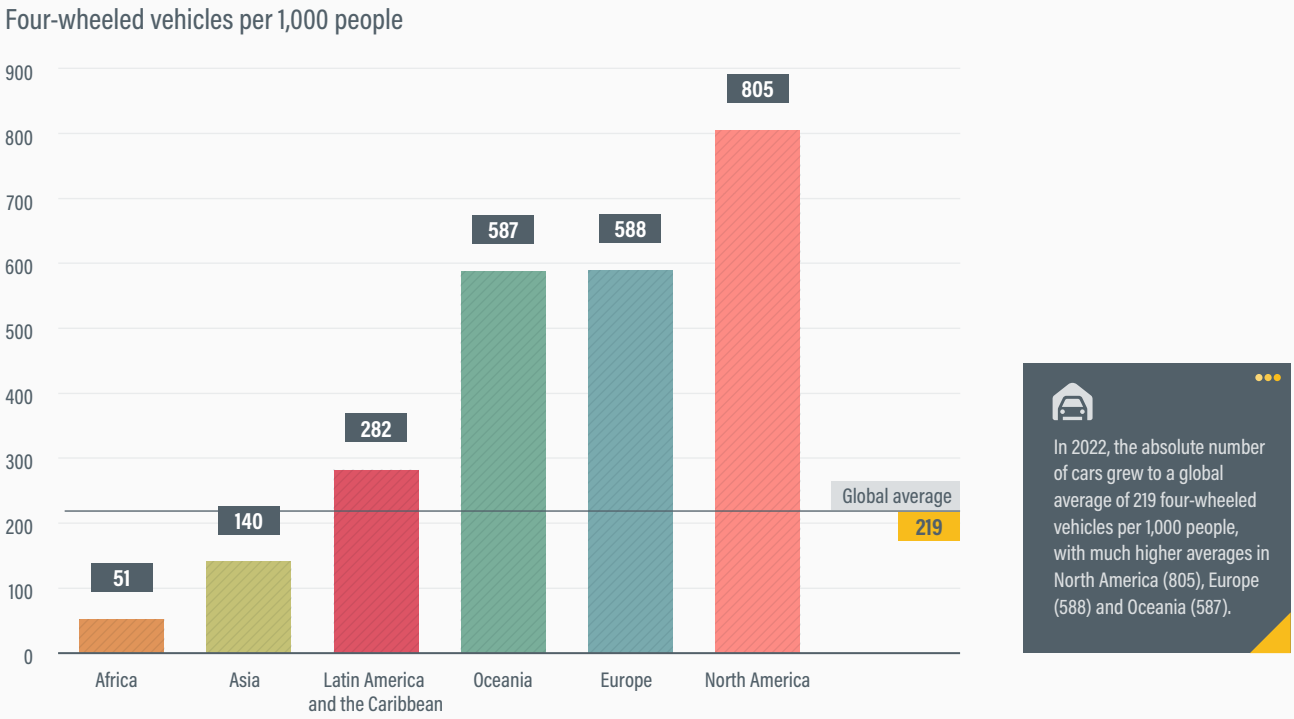
- Total passenger-kilometres travelled in private cars rose more than 10% between 2019 and 2024 in many countries, including North Macedonia (+29%), Slovenia (+25%), Hungary (17%) and Azerbaijan (+12%).[21]
- Countries where private car use decreased during this period included Finland (-9%), Italy and the Netherlands (both -8%) and Croatia (-5%).[22]

In 2022, the absolute number of cars grew to a global average of 219 four-wheeled vehicles per 1,000 people, with much higher averages in North America (805), Europe (588) and Oceania (587) (Figure 1)**.**[23] **In many low- and middle-income countries, most of the vehicle growth has been in two- and three-wheelers, which tend to outnumber cars in these locations.** However, the lack of available data makes it difficult to track global or regional trends for motorised two- and three-wheelers.

- In Africa, the motorisation rate was 51 four-wheeled vehicles per 1,000 people in 2022, well below the global average but climbing rapidly (up 34% since 2017).[24] More than three-quarters of the region's 72 million vehicles were concentrated in just 10 countries in 2022.[25]
- In South Africa, vehicle purchases among people under age 35 fell 8% annually between 2012 and 2022; however,

i AI integration refers to the incorporation of AI technologies into vehicle systems to improve driving functionality, safety, efficiency, and user experience. It includes features such as Advanced Driver Assistance Systems, autonomous driving capabilities, in-vehicle voice assistance, and predictive maintenance and diagnostics.

FIGURE 1. Vehicle ownership rates by region in 2022



Source: See endnote 23 for this section.

the desire for vehicles remains strong, and overall finance applications for cars increased from around 722,000 in 2021 to around 826,000 in 2023.[26]

- A third of Asian countries exceeded the global average motorisation rate in 2022, with a regional average of 140 four-wheeled vehicles per 1,000 people – up from 123 vehicles during 2016-2020.[27]
- In Europe, the motorisation rate was nearly three times the global average in 2022, at 589 four-wheeled vehicles per 1,000 people – up from 554 vehicles during 2016-2020.[28]
- Latin America and the Caribbean had a motorisation rate of 282 four-wheeled vehicles per 1,000 people in 2022, with nearly half of the region's countries exceeding the global rate.[29] In Brazil, the share of households with a car increased from 74% in 2019 to 79% in 2023.[30]
- The United States reached an all-time-high motorisation level in 2022 with 805 four-wheeled vehicles per 1,000 people – 4 times the global average and 15 times higher than in Africa.[31]
- In Oceania, the motorisation rate increased from 544 four-wheeled vehicles during 2016-2020 to 587 vehicles per 1,000 people in 2022.[32]

Despite advances in road infrastructure and connections, more than 1 billion people globally did not have access to all-weather roads as of 2019, particularly in low- and middle-income countries and in rural places.[33] **Only 38% of the global rural population had access to all-weather roads as of 2019.**[34] The lack of all-weather roads limits people's access to basic services and economic opportunities, while many existing roads face rapid deterioration due to poor maintenance, underfunding and inefficient execution.

- The share of the rural population with access to all-weather roads totalled 42.2% in small island developing states (2019), 40.8% in Asia (2020), 35.4% in Latin America and the Caribbean (2020) and just 31.3% in Africa (2020). (See Module 3 Regional Overviews and Spotlight on Small Island Developing States.)
- In Africa, where road transport accounted for 90% of passenger travel and 80% of freight transport in 2014, only around half of all roads had been paved as of that year.[35] (See 3.1 Africa Regional Overview.)

Global freight activity grew an estimated 8% between 2020 and 2025 (modelled values), surpassing 171 trillion tonne-kilometres in 2025.[36] **Around 10% of total freight activity in 2025 was transported by road, below the shares for maritime transport (74%) and rail (11%).**[37] **However, one estimate found that road transport accounted for 22% of total freight activity in 2019.**[38] (See 4.1 Freight Transport and Logistics.) Global trade volumes fell 1.2% in 2023, although the modal split and trends varied widely by location.[39]

- Road freight transport dominates in the European Union (EU-27), representing 53.8% of total freight transport activity in 2022, followed by intra-EU maritime transport at 28%.[40] Road freight in the EU-27 decreased 2.8% in 2023 and rail freight fell 6.6% (reflecting an ongoing decline in rail's share since 1995).[41]
- In the United States, road transport accounted for the largest share of freight activity (40.6%), followed by rail (28.6%) and pipelines (19.9%) in 2022.[42] In 2023, US road freight increased 6.6% while rail freight fell 2.6%.[43]

Emerging countries, particularly in Asia, continued to see increases in freight activity, although most of Asia's freight transport growth was in maritime shipping.[44] China continued to dominate shipping in the Asia-Pacific region but has also invested heavily in expanding road infrastructure.[45] Among countries in the Organization for Economic Co-operation and Development (OECD), road freight grew sharply above pre-pandemic levels in the Czech Republic (up 66% between 2019 and 2023), Bulgaria (+61%), and Slovenia (+32%), whereas it fell in Azerbaijan (-30.5%), the Slovak Republic (-22%) and Estonia (-13%).[46]

- In China, following a government stimulus package, the number of zero-emission medium- and heavy-duty trucks and buses spiked in 2024 to total more than 230,000 units sold, attaining a market share of around 80%.[47]
- Road freight accounted for more than one-quarter of India's oil import expenses in 2024 and was projected to grow four-fold in India by 2050, highlighting the economic potential of shifting to zero-emission trucks.[48]

Road vehicles regained their popularity as production and sales soared to pre-pandemic levels. Sales of all vehicles approached 93 million in 2023 – surpassing 2019 levels (92 million) – after falling sharply to 80 million in 2020 and growing only slightly to 82-83 million during 2021-2022.[49] The top five countries for car sales in 2023 were China, the United States, India, Japan, and Germany, indicating that advanced economies (rather than low- and middle-income countries) continue to further growth in vehicle emissions and pollution.[50]

- Global sales of passenger cars exceeded pre-pandemic (2019) levels in 2023, reaching 75.3 million, and totalled an estimated 77 million in 2024.[51] This was up more than 20% from a low of 63.8 million sales in 2020, during the height of the pandemic.[52]
- Car sales were impacted in 2020 and 2021 by slower global economic growth and the Russian Federation's invasion of Ukraine – which resulted in an automotive semiconductor shortage – and in 2022, sales numbers were low due to ongoing supply chain disruptions.[53]
- In China, car sales fell sharply in 2021-2022 due to the pandemic, shortages, and fears of economic recession, but by end-2023 the market had largely bounced back, with sales 21% higher than in 2021.[54]
- In 2024, China continued to be the largest market for car sales, with more than 31.4 million units sold.[55]

Electric car sales (including plug-in hybrid electric vehicles) reached a sales share of 22% in 2024, totalling a record 17.5 million units.[56] **However, growth was slower than in previous years due to stagnating sales in Europe, as government support was reduced or eliminated in some markets and EU-level carbon dioxide (CO_2) targets were not strengthened.**[57] Electric cars have advanced towards mainstream market status in an increasing number of countries.[58] (See 5.2 Road Vehicle Electrification for more information and regional trends on EVs.)

Larger vehicles such as sport-utility vehicles (SUVs) and pick-up trucks continued to rise in popularity (both conventional and electric models), due to their status appeal in many markets, potential comfort enhancements, and greater marketing efforts by manufacturers due to the larger profit margins.[59] **In 2023, SUVs surpassed a 50% market share in advanced economies for the first time and accounted for 48% of car sales globally, posing a growing challenge for public space, road safety and emissions.**[60] **Global SUV revenues were projected to reach USD 1 trillion by 2025.**[61] In some places, interest has risen in compact SUVs, which are seen as more practical than larger vehicles, especially in cities.[62] Policies aimed at discouraging larger vehicles directly impact road safety, as pedestrians are 200% more likely to be killed by SUVs than smaller vehicles – and 90% more likely to be injured by them.[63]

- SUVs weigh up to 300 kilograms more than an average medium-sized car, take up 0.3 square metres more space, emit 20% more CO_2, and increase the demand for basic metals and critical minerals needed for battery production in electric models (see section on Sustainability and Climate Trends).[64]
- In the US market, SUV growth is due largely to cultural factors and to low fuel prices supported by substantial government subsidies, as well as tax breaks for larger vehicles.[65]
- China has seen consistent growth in its SUV market since 2020.[66]

Global demand for two- and three-wheelers has continued to increase. Models with internal combustion engines (ICE) remain dominant in most markets, although electric models have gained ground, especially in Asia. Asia has led in two-wheeler growth, with annual sales of ICE models projected to grow 1.6% in 2024 to reach 57 million and then fall to around 56 million by 2028.[67] Although manufacturers continue to launch ICE models, several leading players have

invested heavily in electric models.[68] The electric two-wheeler market was expected to reach USD 128.6 billion in 2025 and USD 181.4 billion by 2029.[69]

- In China alone, more than 4.7 million electric two-wheelers were sold in 2024, while India's sales exceeded 2 million units that year.[70]
- For electric three-wheelers, India surpassed China in 2023 to become the global market leader with 580,000 units sold, while China reached 320,000.[71]

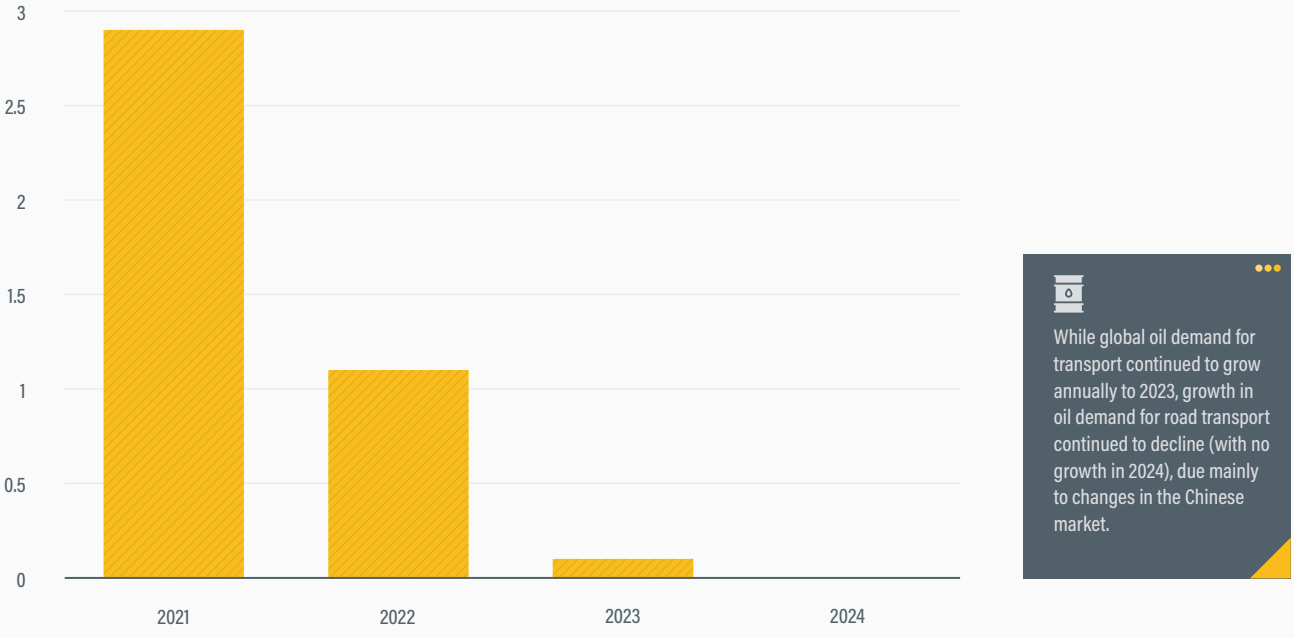
Despite the increase in electrification, global transport energy demand grew more than 21% between 2010 and 2023, with most of this growth being met by fossil fuels.[72] **Oil products supplied around 90% of the energy demand for transport in 2023.**[73] **Road transport alone accounted for 75% of transport energy consumption and 48% of global oil demand that year.**[74] (See 5.1 Transport Energy Sources.)

However, while global oil demand for transport continued to grow annually to 2023, growth in oil demand for road transport continued to decline (with no growth in 2024) (Figure 2), due mainly to changes in the Chinese market.[75] Oil use in the transport sector remained virtually unchanged in 2024 compared to 2019 levels, a trend attributed to increases in EVs, high-speed rail, efficiency improvements and teleworking.[76]

Integration of AI in passenger cars continued to advance, with the global market reaching USD 41 billion in 2024 and projected to grow nearly three-fold to USD 114.5 billion by 2029.[77] The sales share of connected vehicles in the global market increased from 93% in 2022 to 98% by 2025.[78] AI in freight and logistics has become indispensable for tasks such as route planning and forecasting of logistics planning.[79]

- The number of fully autonomous vehicles on the world's roads is expected to nearly double from 16,960 units in 2022 to 33,570 in 2025.[80]
- Level 1 (driver assistance) and Level 2 (partial) automation have become nearly ubiquitous in vehicles, increasing from a 92% market share in 2021-2022 to 97% in 2024-2025; meanwhile, Level 3 automation (performing most driving tasks but still requiring human intervention) remained in early stages.[81]

FIGURE 2. Growth in oil demand for road transport, 2021-2024



Source: See endnote 75 for this section.

Sustainability and climate trends

As access to convenient public transport and rail has faltered – and as ridership has struggled to recover from pre-pandemic levels in many locations – this has resulted in rising private car and motorcycle use, increased congestion, and worsening pollution and greenhouse gas emissions. In 2023, fossil fuels continued to account for 95.4% of the total energy demand in transport – a share that has barely changed in the past 50 years even as biofuels, EVs, fuel efficiency and renewable power have increased.[82]

The persistence of the auto-centric paradigm has led to more vehicles on the road, as well as to increasing vehicle size and decreasing vehicle occupancy, which have in turn offset any gains in fuel efficiency.[83] These trends have resulted in increased air (and noise) pollution, greenhouse gas emissions, congestion and road crashes.[84] Urban sprawl and longer supply chains have worsened the problem. Still, vehicle electrification displaced 1.3 million barrels of oil per day in 2024 – equal to around half of the Republic of Korea's oil consumption – and EV progress was considered "on track" to meet 2030 climate targets.[85]

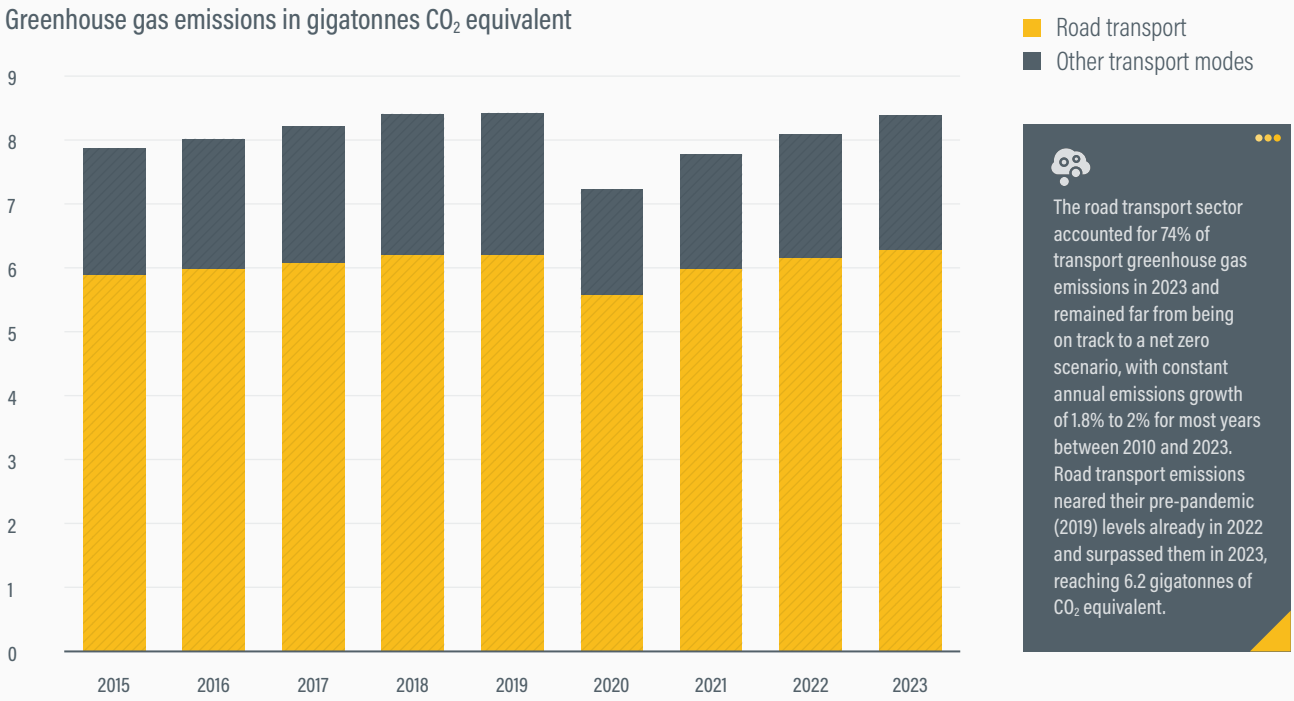
Achieving net zero greenhouse gas emissions globally by 2050 will require large emission reductions in the transport sector as a whole and particularly from passenger vehicles and heavy trucks. To reach global net zero goals, CO_2 emission intensity must be reduced more than 94% for trucks and 98% for cars compared to 2020 levels, according to the International Energy Agency's (IEA) Net Zero scenario.[86] Achieving the necessary reductions from road transport is essential for mitigating climate change but will require a concerted effort from governments, businesses and individuals.

The road transport sector accounted for 74% of transport greenhouse gas emissions in 2023 and remained far from being on track to a net zero scenario, with constant annual emissions growth of 1.8% to 2% for most years between 2010 and 2023.[87] **Road transport emissions neared their pre-pandemic (2019) levels already in 2022 and surpassed them in 2023, reaching 6.2 gigatonnes of CO_2 equivalent** (Figure 3).[88] Emissions from road transport continued to grow over the past decade despite the growth in EVs, renewable energy and regulations for cleaner vehicles.[89]

Transport emissions from road freight have outpaced those from road passengers, as emissions from road freight grew 23% and from road passengers 16% from 2010 to 2023.[90] **This suggests that policies pursuing efficiency improvements and electrification have had a stronger impact for passenger vehicles than freight vehicles.**



FIGURE 3. Greenhouse gas emissions from road transport compared to other modes, 2015-2023



Source: See endnote 88 for this section.

CO_2 emissions from road passenger transport reached 3.75 gigatonnes in 2023, while emissions from road freight reached nearly 2.46 gigatonnes.[91]

The CO_2 emission intensity of vehicles depends on factors such as the type of fuel used, vehicle size and weight, and level of fuel efficiency. Smaller, more fuel-efficient vehicles typically have lower emissions intensity than larger, less-efficient vehicles.[92] EVs bring significant emission benefits compared to ICE vehicles when considering the entire life cycle of the vehicle (from well to wheel), which accounts for resource consumption and emissions that occur during vehicle and infrastructure production in addition to operation. Measured this way, hybrid and electric vehicles can reduce emissions significantly – by around one-quarter for plug-in hybrids to more than three-quarters for battery electric vehicles powered by renewable electricity.[93] (See 5.2 Road Vehicle Electrification.)

As larger passenger vehicle sizes have gained popularity, their rising energy consumption has posed a growing risk to decarbonisation, leading the IEA to recommend that the auto industry decrease vehicle size.[94] Larger vehicles take up an increasing amount of public and private space, consume far more fuel, and contribute around 20% greater emissions than small- and medium-sized vehicles – cancelling out the energy efficiency and emission improvements made in the global passenger vehicle fleet over the past few decades.[95] Larger vehicles have become particularly popular in the United States for passenger transport, creating an ever-increasing carbon footprint. Light-duty trucks (weighing up to 8,500 pounds or 3,856 kilograms) have been the most popular passenger transport vehicle in most US states for some years and were responsible for the highest share of transport emissions in the country in 2022 (37%).[96]

SUVs alone were responsible for more than one-quarter of the total growth in oil consumption globally during 2022-2023, rising by more than 600,000 barrels per day (the equivalent of about one-quarter of Germany's oil consumption) – an increase of 20% from 2021-2022.[97] If the global SUV stock were a country, its 2023 emissions would make it the fifth largest emitter of CO_2, above the total annual emissions of Japan.[98]

Road transport emissions are extremely unequally distributed among countries, with high-income countries contributing the bulk of emissions. The countries with the highest levels of per capita road transport CO_2 equivalent emissions in 2023 were Luxembourg (6.4 tonnes), Qatar (5.1 tonnes), Saudi Arabia (4.4 tonnes), the United States (4.2 tonnes) and the United Arab Emirates (4 tonnes) (Figure 4)**.**[99] Despite vehicle emission standards in some of these

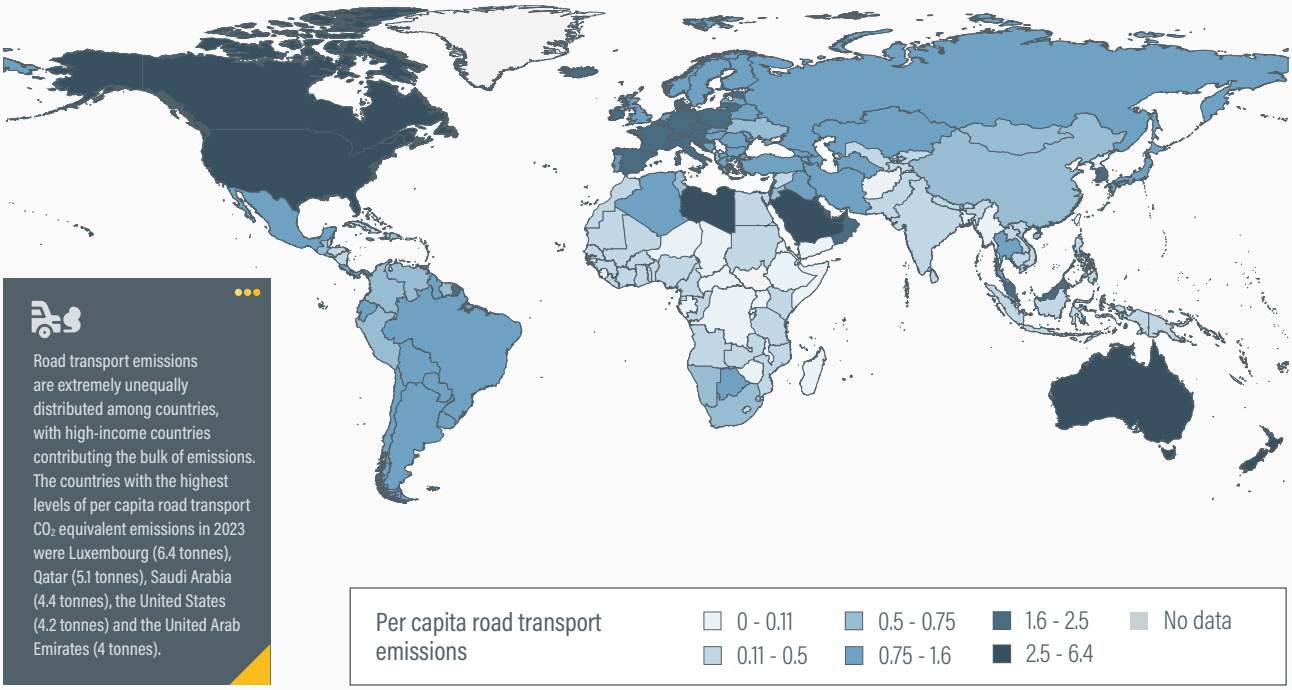
regions, their high motorisation levels and high kilometres-travelled in motorised vehicles lead to high per capita emission levels.

- The United States continued to contribute the highest transport emissions globally in absolute terms (1.74 gigatonnes of CO_2 equivalent) while also having one of the largest per capita values (4.2 tonnes) in 2023.[100]
- In Europe, where policies tend to require increasingly strict emission standards for road transport, the average CO_2 emissions of new cars sold continued to fall from 131 grams per kilometre (g/km) in 2020 and 115 g/km in 2021 to 107 g/km by 2023.[101]
- However, Europe as a whole recorded per capita transport greenhouse gas emissions of 1.66 tonnes of CO_2 equivalent in 2022, above the global average of 0.89 tonnes and the third highest among regions (after North America and Oceania).[102]
- In Australia, the emission intensity for new cars sold in 2023 averaged 150 g/km, similar to levels in Canada and the United States.[103] For all vehicles on the road in Australia in January 2024, the emission intensity was 193.7 g/km, virtually unchanged compared to new vehicles sold a decade earlier.[104]
- Australia had relatively high per capita transport emissions of 3.1 tonnes of CO_2 equivalent in 2023.[105]

Emission standards have helped limit emissions to some extent where they have been implemented, but much of the world remains uncovered by such standards. In many low- and middle-income countries, continued importation of vehicles through the second-hand market has resulted in a fleet with older vehicles that are more polluting and less safe than newer models.[106] (See Spotlight on Second-hand vehicles.)

- In 2019-2020 (latest data available), 85% of vehicles in Africa were used imports from Europe, the United States and Japan – often failing safety and emission standards in their home countries.[107] Overall, 80% of vehicles in Africa fell below Euro 4 emission standards.[108]
- In Asia, vehicle emission standards and fuel quality improvements have cut some pollutants by 2% annually between 2000 and 2022, while registrations of vehicles with emission standards at Euro 4 or above rose from 9% in 2010 to 89% in 2023.[109]
- The EU's CO_2 emission standards called for the end of ICE car sales starting in 2035 and for the near-complete phase-out of diesel heavy-duty vehicles by 2040.[110]

FIGURE 4. Per capita greenhouse gas emissions from road transport by country, 2023



Source: See endnote 99 for this section.

However, timelines have since been extended at both the EU and national levels due to fierce global competition, international tariff disputes, factory closures and job losses – potentially derailing emission reduction efforts.[111] European automakers have sought further concessions or even a complete moratorium of the ICE phase-out.[112]

- The average energy efficiency of new light-duty vehicles sold in Australia and New Zealand in 2021 trailed other high-income countries and regions such as the EU, Japan and the United States.[113] Both countries have targets to reduce emissions from new light-duty vehicles to 58–59 grams of CO_2 per kilometre by 2029.[114]

Decarbonising the power grid is critical for achieving transport decarbonisation, with the aim of supplying cleaner energy for both EV charging and battery production.[115] The electricity mix can have a substantial impact on EV emissions, with countries that have high shares of renewable or nuclear energy experiencing much lower emissions from EVs than from ICE vehicles.[116] High motorisation growth rates can contribute to lock-in of unsustainable development, whereas a transition to EVs alongside support for walking, cycling and public transport could take advantage of the transport-energy decarbonisation nexus.[117] (See 5.1 Transport Energy Sources.)

- In some regions, using an EV can reduce the average emissions per 100 kilometres by more than 90% compared to using an ICE vehicle, due to a cleaner electricity mix – such as in Switzerland (100% reduction), Norway (97%), France and Sweden (both 93%).[118]
- As of 2022, Latin America's power mix was an estimated 60% renewable electricity, with Costa Rica and Paraguay reaching shares of nearly 100% renewables; at the same time, region has one of the world's highest motorisation rates.[119]
- In countries where the electricity mix is dominated by fossil fuels, using an EV compared to an ICE vehicle can increase the average emissions per 100 kilometres, such as in Kosovo (95% increase), Poland (57%), Cyprus (39%) and Serbia (26%).[120]
- The carbon intensity of the power grid varies greatly by region, with Latin America and the Caribbean the lowest at 272.4 grams of CO_2 equivalent per kilowatt-hour in 2023, followed by North America (279 grams), Europe (283.9 grams), Africa (430 grams), Oceania (478.9 grams) and Asia (559.5 grams).[121] (See Module 3 Regional Overviews.)

Road safety, health and climate change are interrelated and can influence each other in various ways, with the most direct and severe impacts occurring from road crashes and air pollution (*Box 1 and Figure 5*)**.**[122] Speed management in particular has a direct impact on emissions and energy efficiency, as higher speeds increase the risk of traffic crashes and fatalities, and also result in higher fuel consumption, emissions and air pollution.[123] Effective speed management can reduce congestion and air pollution, leading to shorter travel times and fewer emissions from idling and stop-and-go traffic (in addition to decreasing road deaths, injuries and crashes).[124] Many countries have seen a trend towards 30 kilometre-per-hour speed limit zones in city centres and residential areas, as well as greater use of road speed limiters and speed cameras.[125] (See 1.7 Driving Health and Wellbeing Forward: The Critical Link with Transport.)



Box 1. Facts and figures on the human toll of road transport by region, with a focus on road safety and air pollution

Africa

The region has low motorisation compared to the rest of the world yet has the world's deadliest roads.

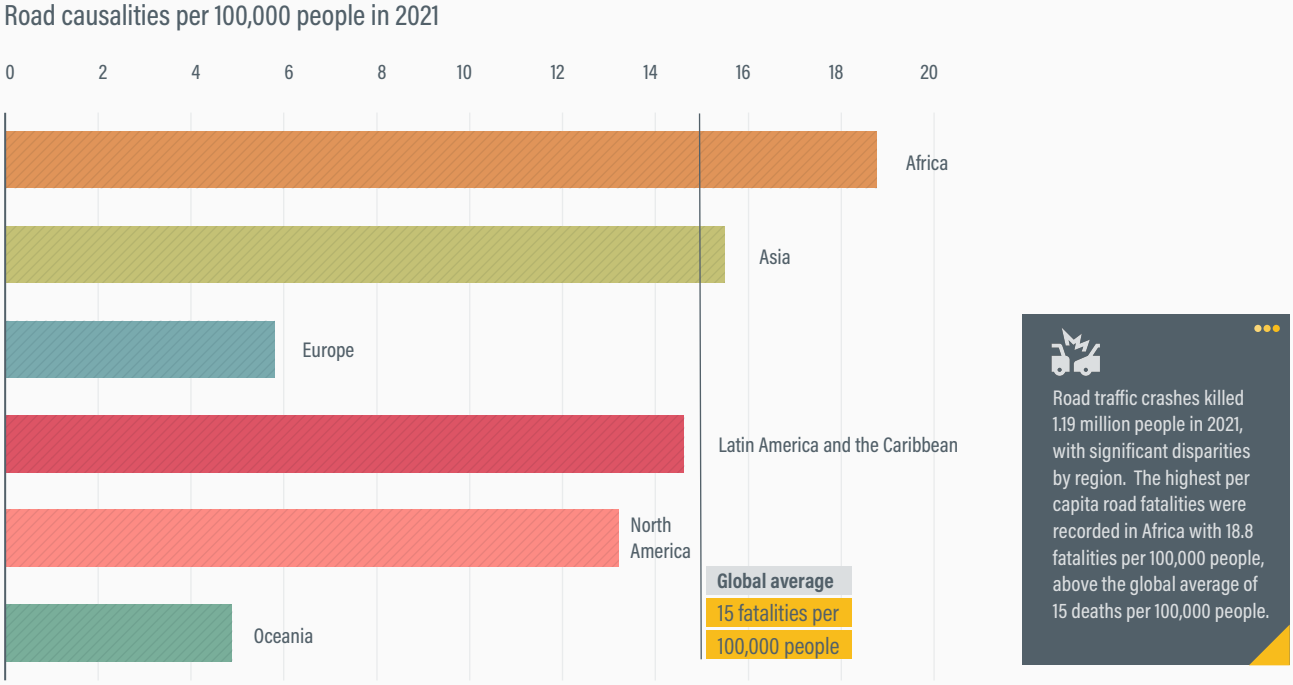
- In 2021, Africa averaged 18.8 road fatalities per 100,000 people – the highest rate globally, above the global average of 15 deaths (Figure 5).
- Over 50% of road fatalities involve vulnerable users: pedestrians, cyclists and motorcyclists.
- Several countries (e.g., Cameroon, Kenya, Morocco) are addressing road safety through policy reforms and innovative, context-specific initiatives.
- Transport caused 3.2% of air pollution and 1.01 premature deaths per 100,000 people in 2019, below the global averages of 6% and 2.3 deaths. (See 3.1 Africa Regional Overview.)

Asia

With half of the world's road deaths, road safety remains a public health challenge, while deadly air pollution from transport persists despite some progress.

- Road deaths averaged 15.5 per 100,000 people, above the global average of 15 deaths in 2021.
- Asia suffered more than half of the world's road deaths in 2021, with 35% being motorised two-wheeler users, and 22% pedestrians.
- Several countries (e.g., Laos, Nepal, the Philippines) are advancing road safety through multi-year action plans.
- 8% of air pollution comes from transport, leading to 3.2 premature deaths per 100,000 people in 2019, above the global averages of 6% and 2.3 deaths.
- Nearly all people in East and South-East Asia faced air pollution levels above the World Health Organization's (WHO) safe air standards in 2024.
- Vehicle emission standards and fuel quality improvements cut some pollutants 2% annually during 2000-2022.
- Vehicle registrations with Euro 4 or above emission standards rose from 9% in 2010 to 89% in 2023. (See 3.2 Asia Regional Overview.)

FIGURE 5. Road casualities per 100,000 people by region and compared to the global average



Europe

Despite declines, most countries are not on track to meet the region's road safety target, while harmful transport noise and pollution challenges continue to pose major health risks.

- The region has the lowest road traffic fatalities globally, at 5.8 deaths per 100,000 people, well below the global average of 15 deaths in 2021. Yet road fatalities were the leading cause of death for 5-29 year-olds in 2023. One person dies every seven minutes, and more than 62,000 people were killed on the roads every year as of 2021.
- Despite a 3% decrease in road fatalities in 2024, most EU countries are off-track to meet the region's goal of halving road fatalities by 2030.
- Transport accounted for 9% of air pollution and an estimated 4.1 premature deaths per 100,000 people in 2019, above the global averages of 6% and 2.3 deaths.
- More than 100 million Europeans were exposed to harmful transport-related noise, mainly from road traffic, in 2022, despite EU policies and regulations on motor vehicle and aircraft noise.
- Over 20% of the population lives in road traffic noise levels that exceed EU limits for harm to health and well-being; this rises to above 30% when considering stricter WHO thresholds (2024). (See 3.3 Europe Regional Overview.)

Latin America and the Caribbean

Road safety challenges persist, with pedestrians and cyclists bearing the brunt.

- The region's road traffic deaths averaged 14.6 per 100,000 people, near the global average (15); average deaths ranged from 5.1 in Trinidad and Tobago to 31.3 in Haiti in 2021.
- Pedestrians and cyclists accounted for nearly half of all road deaths in some countries in 2021.
- Only 7.8% of cities in the region met WHO air quality guidelines in 2024.
- Excessive exposure to particulate matter caused by transport contributed to nearly 180,000 premature deaths in 2019 – or nearly 6.1% of total deaths, similar to the global average (6%). (See 3.4 Latin America and the Caribbean Regional Overview.)

North America

Transport pollution remains more than double the global average, and road safety lags, with US roads among the least safe of high-income countries.

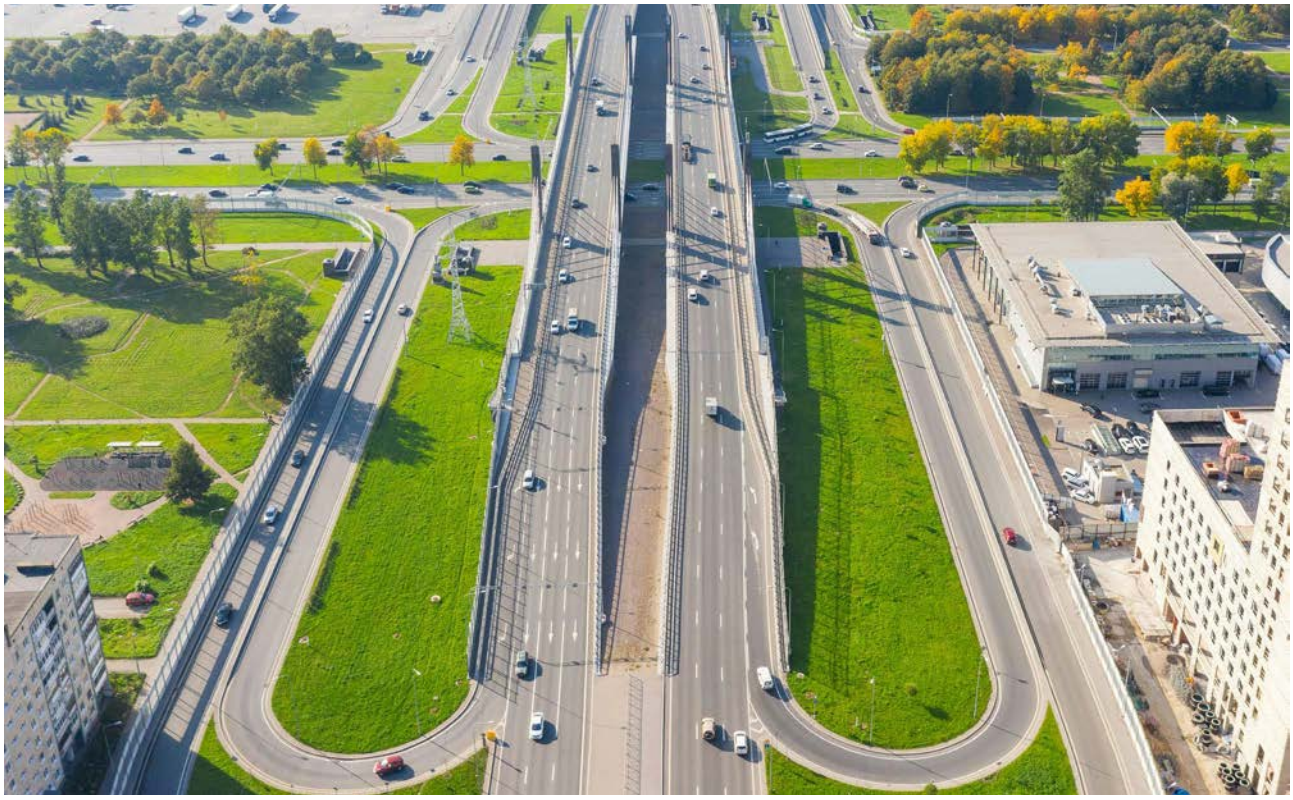
- Transport accounted for 12.6% of the region's air pollution in 2019, compared with a global average of 6%.
- In the United States, transport contributed 15% of air pollutant emissions, resulting in 2.29 premature deaths per 100,000 people, consistent with the global average of 2.3.
- In Canada, transport contributed 9.8% of air pollution, resulting in 1.01 premature deaths per 100,000, half the global average.
- North America recorded 13.2 road casualties per 100,000 people in 2021, slightly below the global average of 15 road deaths.
- Road traffic fatalities and injuries cost 1.9% of Canada's gross domestic product (GDP) and 5% of the US GDP in 2021.
- Less than 40% of roads assessed in the region meet the recommended three-star safety standards for pedestrians and cyclists, compared to 60% for motorcyclists and more than 80% for vehicle occupants.
- The United States had among the worst road safety records in 2021 among high-income countries, ranking just behind Saudi Arabia, the Bahamas and Guyana.
- In 2021, 42,939 people died in US road crashes, with around 20% of the deaths being pedestrians or cyclists; pedestrian fatalities in the country reached a record high. (See 3.5 North America Regional Overview.)

Oceania

Road deaths and transport-related air pollution are well below the world average.

- The region's transport sector contributed 2% of air pollutant emissions and 0.3 premature deaths per 100,000 people in 2019, compared to global averages of 6% and 2.3 deaths.
- Road casualties in Oceania were three times less than the global average in 2021, with 4.9 deaths per 100,000 people compared to 15 globally. (See 3.6 Oceania Regional Overview.)

Source: See endnote 122 for this section.



Factors contributing to the slow decline in road deaths and injuries include increased road congestion, higher speeds, driver distraction and fatigue from longer commute times.[126] Globally, road deaths increased 4.5% between 2020 and 2023, although they remained 5.5% below the pre-pandemic levels of 2019.[127] Most countries have maintained lower road fatality numbers, although road deaths increased 10% or more in 2023 compared to pre-pandemic levels in many places, such as Ireland (+23%), Switzerland (+22%), Türkiye (+16%), Armenia (+13%), the United States (+11%) and Estonia (+10%).[128]

Efforts to improve the resilience of road infrastructure have lagged, even as economic losses from infrastructure damage due to climate-related events grew an estimated seven-fold between the 1970s and 2010, to USD 1.6 trillion.[129] Multilateral development banks committed USD 24.7 billion for adaptation and resilience projects in 2023, and the World Bank delivered USD 10.3 billion in 2024.[130] To overcome the persistent finance gap, an estimated annual investment of USD 6.9 trillion in sustainable infrastructure will be necessary by 2030.[131]

Traffic congestion returned to pre-pandemic levels already by 2021, and most cities have experienced worsening congestion since 2022.[132] Increased transport demand can lead to greater congestion and delays and associated economic and health costs, especially when density is close to capacity.[133] One estimate found that 55% of urban areas experienced greater congestion in 2024 than in 2023, whereas just 28% of cities had a reduction in delays.[134] (See 1.7 Driving Health and Wellbeing Forward: The Critical Link with Transport.)

- In 2024, Istanbul topped the list of cities worldwide with the most hours lost due to congestion (105 hours per driver per year), followed by New York City and Chicago (102 hours each) and London (101 hours).[135]
- The losses due to congestion come at a significant cost to economic productivity, with delays in Germany and the United States averaging 43 hours lost per driver per year – around *a full work week* – and 61 hours in the United Kingdom.[136]
- Congestion in Kampala (Uganda) cost the city USD 1.5 million per day in 2020, or 4.2% of its GDP.[137]

Autonomous vehicles have the potential to decrease transport emissions if they are shared and regulated; however, increases in vehicle size and distances travelled could lead to higher emission growth, although these impacts are uncertain.[138] If autonomous vehicles are used mainly for ride hailing, carpooling, or public transport, they could help reduce the number of single-occupancy vehicles on the road and the overall vehicle-kilometres travelled. If they are privately owned and encourage sprawling development, they are likely to increase total vehicle-kilometres travelled and worsen congestion.[139]

Policy and investment developments

Successful strategies to reduce road transport emissions and create healthier, more sustainable urban and rural areas include a mix of the Avoid-Shift-Improve (A-S-I)[ii] framework for both passenger and freight transport.[140] A 2023 study on ambitious but feasible emission mitigation strategies for road transport by 2050 shows that "Avoid" and "Shift" measures would contribute as much as 18% of greenhouse gas reductions, keeping the allocated carbon budget for road transport within 1.7 degrees Celsius of global warming by 2050 (Figure 6).[141]

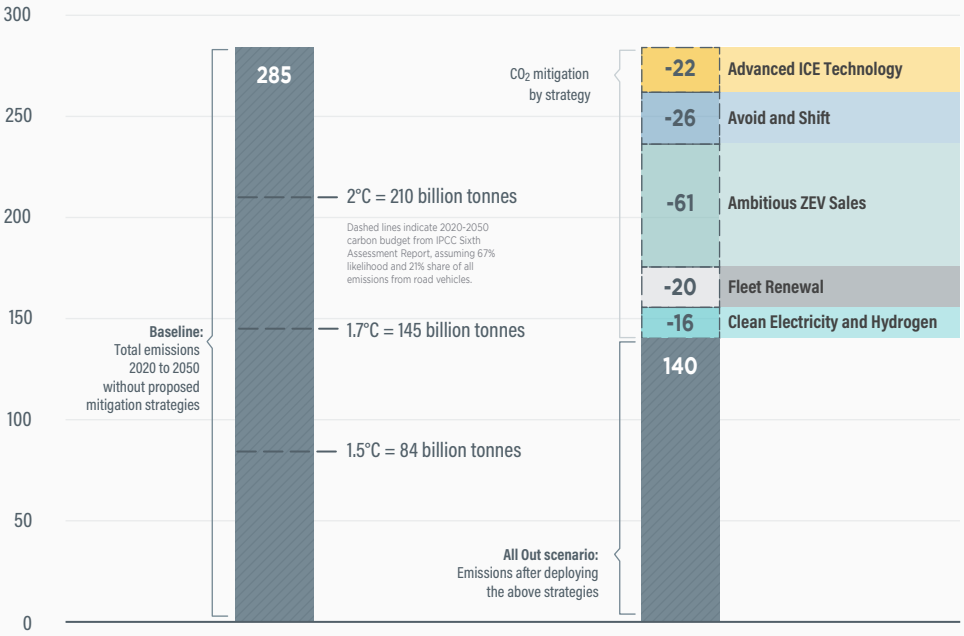
- "Avoid" measures are most important and meant to come first, followed by "Shift" and then "Improve". This prioritisation is due to not only climate benefits but also health, economic and social benefits.[142]
- The most successful "Improve" strategies combine carbon or fuel taxes with incentives for zero-emission vehicles, but prioritising measures that incentivise walking, cycling and public transport for passenger transport ("Avoid" and "Shift" measures) can maximise emission reductions and many other benefits; for freight, this means prioritising water-, rail-, and electrified road-based freight and solutions such as cargo bikes for last-mile deliveries.[143]
- Alongside "Improve" measures, support for renewable energy is crucial for decarbonising the energy supply for motorised vehicles.
- Applying the A-S-I framework can help with more holistic, sustainable planning and investment to support a shift from the auto-centric model towards more liveable environments.[144]

Among "Avoid" and "Shift" policies, a few jurisdictions have adopted targets to reduce vehicle travel, particularly at the sub-national level.

- A 2024 executive order in the US state of Maryland strengthened a target to reduce vehicle miles travelled 20% by 2050 as part of its climate strategy, including measures such as infrastructure improvements and land-

FIGURE 6. Mitigation potential of feasible emission reduction strategies for road transport

Cumulative well-to-wheel CO_2 transportation emissions (billion tonnes) projected from 2020 to 2050



Successful strategies to reduce road transport emissions and create healthier, more sustainable urban and rural areas include a mix of the Avoid-Shift-Improve framework for both passenger and freight transport. "Avoid" and "Shift" measures would contribute as much as 18% of greenhouse gas reductions, keeping the allocated carbon budget for road transport within 1.7 degrees Celsius of global warming by 2050.

Source: See endnote 141 for this section.

ii The Avoid-Shift-Improve framework has been central to sustainable, low-carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

use changes to improve alternatives to driving.[145]
- Similar regulations were adopted in 2022 in the US states of California (reducing vehicle miles travelled 25% by 2030) and Colorado (reducing vehicle miles travelled 6-9% by 2030).[146]
- In 2024, Glasgow (United Kingdom) set a target to reduce vehicle kilometres travelled 30% by 2030, while the national target in Scotland aims to reduce them 20% by 2030.[147]

Building roads and establishing urban-rural connections can support economic development; however, if these are not pursued with a sustainable, resilient vision, they can lead to unsustainable auto-centric, sprawling development.[148] Paradoxically, where road networks already exist, building more roads and widening existing roads leads to increased traffic.[149] Recognising these challenges, countries across all income levels have begun shifting their approaches and implementing rural transport programmes.

- Wales (United Kingdom) passed a new transport strategy in 2021 that subsequently guided the revision of the region's transport appraisal guidance in 2024.[150] These efforts resulted in new approaches that prioritised an accessible, sustainable and efficient transport system while discouraging large-scale road infrastructure projects.[151]
- As of 2023, 11 low- and middle-income countries had adopted UN-Habitat guidelines for strengthening urban-rural planning, and 20 had strengthened urban-rural connections.[152]

Investment in inland transport infrastructure (road, rail and inland waterways) has been decreasing in some countries, although several continue to invest heavily in road transport.[153] High-income countries in particular have had low ratios of transport infrastructure investment relative to GDP and stable investment levels – a sign of mature transport systems.[154]

- At least four countries allocated more than 2% of their GDP to transport infrastructure (nearly all of it to road infrastructure) in 2023, including Azerbaijan, China, North Macedonia and Serbia.[155]
- Among high-income countries, Hungary and Norway had the highest ratios of transport infrastructure investment to GDP in 2022 (1.8% and 1.4%, respectively) as well as the highest growth in transport investment compared to one decade earlier.[156]
- Azerbaijan, Bulgaria, Georgia and Serbia had high ratios of transport infrastructure investment to GDP due to their critical location for connectivity and trade between Central Asia and Eastern Europe; overall, China had the highest transport infrastructure investment as a share of GDP in 2022.[157]

Policies have been adopted at various levels to address road safety, particularly aimed at speed management and sometimes linked to improving the sustainability of transport systems. Research has shown that lowering average speed limits by just 5% can result in a 20% reduction in road deaths.[158] In 2023, the WHO released guidelines for reducing speeding globally to decrease road injuries and deaths.[159]

- Sub-national governments that have enacted recent speed management plans include the cities of Durango (United States) and Meaford (Canada) in 2024, and the US state of Nevada in 2022.[160]
- In 2024, Lima (Peru) launched a comprehensive urban mobility programme that included several measures aimed at reducing speeds and improving safety.[161]
- Kumasi (Ghana) launched a speed management plan in 2024 with concrete measures to strengthen road safety efforts.[162]

Between 2023 and 2025, an increasing number of jurisdictions adopted targets for reducing average vehicle emissions, as well as scrappage policies that help governments accelerate fleet renewal, reduce emissions and encourage the adoption of cleaner, more efficient vehicles. A few countries had vehicle scrappage policies that incentivised trading in an older polluting vehicle for a newer, cleaner model.

- In early 2025, Brazil implemented the first phase of emission standards with substantial limit reductions for vehicles, increasing in stringency to 2032.[163]
- Morocco adopted the Euro 6 emission standard starting in January 2023, and Thailand adopted the Euro 5 emission standard starting in January 2024.[164]
- The EU planned to impose stricter standards on auto manufacturers in 2025, with carmakers expected to close their gap in compliance with the targets during the year; most were close to meeting the targets by the first half of 2024, while some (such as Volvo Cars) had already achieved it.[165]
- US targets for reducing the average CO_2 emissions of new passenger cars contributed to a consistent decline in emissions between 2000 and 2023, with a 2035 target of 0 grams per kilometre.[166] However, manufacturers had no pressure to further reduce emissions following a significant reduction in 2021, so reductions in subsequent years occurred at a slower pace.[167]
- India enacted a scrappage policy at the national level that mandates fitness tests for older vehicles and offers incentives for scrapping unfit ones, aiming to reduce air pollution and promote safer, cleaner vehicles.[168]
- France and Romania also had scrappage policies at the national level, while at the city level, the 14 German cities

with the poorest air quality had a government-backed trade-in incentive.[169]

In some places, rules for vehicle emission reductions include flexibilities around compliance that hinder their effectiveness, while in other cases emission rules have been weakened or removed altogether.

- In 2025, the European Commission launched a new Industrial Action Plan for the automotive sector that outlines a strategy to accelerate the uptake of zero-emission vehicles in corporate fleets; however, the plan also includes increased flexibility on compliance with the emission target.[170]
- Mexico enacted a CO_2 emission standard for light-duty vehicles in 2024, but the standard's compliance flexibilities show it will be insufficient to reach the country's Nationally Determined Contribution (NDC) and 2030 decarbonisation goals.[171]
- In the United States, the new administration in 2025 reversed steps towards the decarbonisation of road transport adopted in previous administrations, including removing vehicle emission rules that would have required manufacturers to offer an increasing number of EVs.[172]

EV adoption has been the most common measure for reducing emissions in the road transport sector, since EVs produce far fewer emissions than traditional petrol vehicles but allow for continuation of the auto-centric model.[173] **In addition, several governments have adopted targets for full or partial ICE vehicle bans or EV targets, although typically these are only for vehicle sales rather than the overall stock.** During 2022-2023, total investments of USD 275 billion in EVs and USD 195 billion in batteries were announced globally, boosting confidence in the electrification of road transport across markets.[174] In the United States, the new administration withdrew a previous target for 50% EVs in new vehicle sales by 2030.[175] (See 5.1 Transport Energy Sources and 5.2 Road Vehicle Electrification.)

As EV uptake increases, governments have taken steps to support the deployment of charging infrastructure and battery swap stations. However, they may need to develop new taxation approaches to replace the losses in income from fuel taxes on ICE vehicles. The UK government estimates that much of the USD 46 billion (GBP 37 billion) in fuel and vehicle excise duties collected in 2020 would be lost as the fleet transitions to EVs (which did not face similar taxes in order to encourage uptake).[176] (See 5.2 Road Vehicle Electrification.)

By 2023, the number of countries with support measures for EVs surpassed those with biofuel blending mandates, which until then had been the most common policy for decarbonising road transport.[177] A total of 60 countries had biofuel blending mandates by the end of 2023, up from 56 countries in 2022 (but still below the 65 countries in 2021).[178] Ten countries introduced new or revised mandates in 2023, with most trends towards increasing the mandated blending shares, although these are not always enforced.[179] (See 5.1 Transport Energy Sources.)

The deployment of EVs will not address concerns such as traffic congestion, urban sprawl and the amount of public space devoted to vehicles.[180] **In some places, increases in parking fees in recent years have been correlated with higher use of walking, cycling and public transport.**[181] Parking occupies a great deal of public space, sometimes far outnumbering the actual vehicle fleet.[182] A growing number of European cities (especially in France) have implemented higher parking fees to counter the trend towards SUVs and other larger vehicles ("auto obesity").[183] (See 4.2 Integrated Transport Planning.)

For freight transport, low-carbon options include the adoption of fuel-efficient technologies and alternative fuels, carbon pricing mechanisms, promotion of multi-modality, cargo consolidation centres, last-mile sustainable urban logistics and autonomous deliveries.[184] **Although policy progress has been slower for freight than passenger vehicles, some advances towards reducing emissions occurred in recent years.** A comprehensive and integrated approach to decarbonising freight transport could provide significant environmental and social benefits, but policies targeting heavy-duty vehicles have lagged behind those for light-duty vehicles.

- As of 2025, just five countries – Canada, China, India, Japan and the United States – had national fuel economy standards for heavy-duty vehicles, and no additional countries have adopted such standards since 2017.[185]
- In 2024, the EU approved a 90% CO_2 emission reduction target for new heavy-duty vehicles by 2040.[186]
- Jurisdictions that adopted targets for zero-emission heavy-duty vehicles included Ireland (targeting 35% of registrations by 2030) and the US state of California (targeting 100% of sales by 2042).[187]
- In 2023, the United States adopted tax credits for zero-emission commercial and heavy-duty vehicles, but the future of the policy was unclear due to the change in administration in 2025.[188]
- New York City (United States) transitioned its entire heavy-duty vehicle fleet to 100% renewable diesel in 2024.[189]

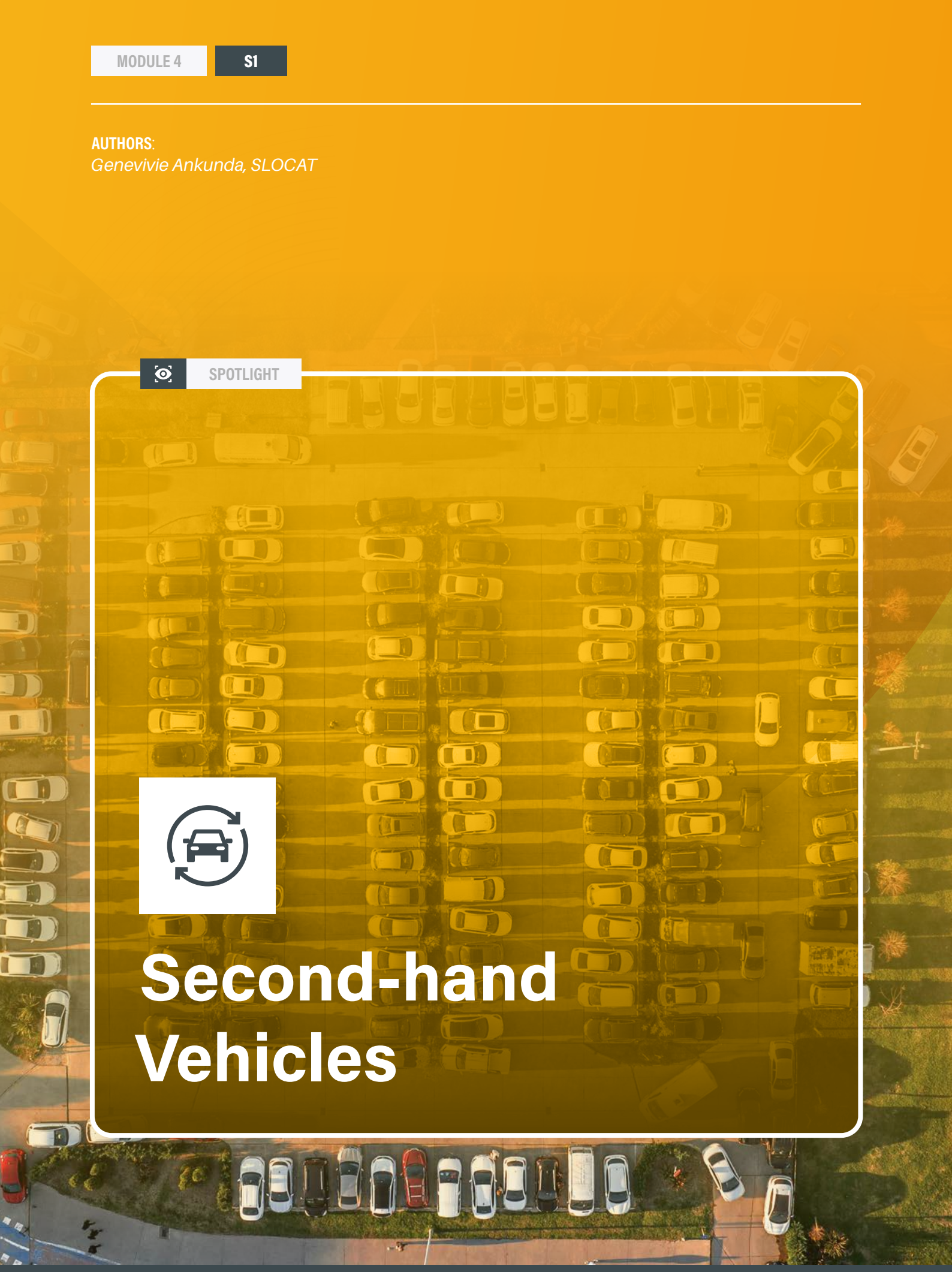
Partnerships in action

- The organisation **Bridges to Prosperity** is dedicated to rural infrastructure development, connecting rural communities through trail bridges and complementary infrastructure to increase resilience and to unlock access to health care, education and markets.[190]
- The Asian Development Bank's **Green Roads Tool Kit**, published in 2024, provides a collection of good practices for development and management of roads including concerns for sustainability, resilience and inclusivity.[191]
- In 2023, **ICLEI–Local Governments for Sustainability** set up an "ecologistics community" to encourage sustainable urban freight in cities globally, including the development of indicators to serve as a guide for local governments.[192]
- The **International Road Assessment Programme (iRAP)** published new guidance in 2024 for safe and inclusive road design aimed at road engineers and infrastructure designers in the Kyrgyz Republic, Tajikistan and Uzbekistan.[193]
- The **International Transport Forum (ITF)** produced a policy report in 2023 on taxation during the transition to electric vehicles and options for reforming vehicle and road-use taxes.[194]
- The **Road Asset Management Committee** of the International Road Federation (IRF) brings together a network of practitioners to share knowledge and develop improved practices for better management of road assets globally.[195]
- **UN-Habitat** launched a small funding call in 2024 for initiatives to enhance road safety in Africa and Mediterranean cities.[196]
- The **UN Road Safety Fund** supported Senegal in 2025 through its Ten-Step Plan for Safer Road Infrastructure following successful implementation in Tanzania in 2023.[197]
- In 2023, the **World Road Association (PIARC)** published a report on case studies of rural roads for development in Africa to raise awareness and offer solutions for improving rural development and road infrastructure, highlighting the importance of roads for accessibility and mobility.[198]
- The **ZEFES project**, launched by the International Road Transport Union (IRU) in 2023, aims to demonstrate real-world applications of battery electric vehicles and fuel cell electric vehicles in Europe for long-haul freight transport.[199]



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SPOTLIGHT



Second-hand Vehicles

KEY FINDINGS

- Globally, the primary method of acquiring an internal combustion engine (ICE) vehicle has been through the acquisition of a second-hand vehicle, such that the used car market has become larger than the new car market in some countries.
- Second-hand vehicles play a dual, contradictory role in transport sustainability. On one hand, the second-hand market allows improved access to mobility by providing lower-cost vehicle options, and enables the extension of vehicle lifespans. On the other hand, the export of high-emission vehicles, many of which are not roadworthy, has major safety implications for users, as well as negative environmental impacts for importing countries.
- Trade in used electric vehicles presents opportunities for faster, more affordable transfer of cleaner technologies (including electric vehicles) to low-income countries and to low-income households in high- and middle-income countries.
- Optimising the second-hand vehicle market requires strengthening regulations to avoid the import and export of unsafe vehicles that are near the end of life; ensuring battery longevity in used electric vehicles; and addressing the environmental cost of older, less efficient ICE vehicles and the disposal of end-of-life vehicles and components.

Demand, use and access

- The global used vehicle market has expanded steadily in recent years, driven by factors such as economic shifts, changing consumer preferences and advancements in technology.
- An estimated 23 million used light-duty vehicles were exported to the Global South from the four major exporting countries between 2015 and 2022. Of these, 34.5% were from Japan, 31.1% from the European Union (EU), 23.9% from the United States and 10.5% from the Republic of Korea.
- Although the EU, the United States and the Republic of Korea led exports of used light-duty vehicles as of 2022, exports from China have risen exponentially and in the next ten years are projected to exceed the combined exports from all countries in the Organisation for Economic Co-operation and Development (OECD).
- The largest exporters of used heavy-duty vehicles have been Japan, the EU, and the Republic of Korea, which exported 2.4 million units between 2015 and 2022, comprising 90% trucks and 10% buses.
- Half of all used light-duty vehicle exports went to low-income (18%) and lower-middle income countries (32%) between 2015 and 2018; meanwhile, most used heavy-duty vehicles (60%) have been traded in high-income or upper-middle income countries.
- Africa was the largest importer of second-hand light-duty vehicles between 2015 and 2022, receiving around 7.5 million units (33%). African countries represented 6 of the top 10 importing countries of used light-duty vehicles from the EU during that period. The next highest importing regions were Eastern Europe, the Caucasus, and Central Asia (around 5.4 million units, or 24%), Asia-Pacific (3.7 million units, 16%), the Middle East (3.3 million units, 15%) and Latin America and the Caribbean (2.8 million units, 12%).



KEY FINDINGS

- Although Africa was the leading importer of used vehicles, the region received only 1% of the used battery electric vehicles exported between 2015 and 2022 (1,431 units), signalling limited opportunities for clean transport technology transfer and trickle-down electrification. The largest importer of battery electric vehicles in this period was the region of Eastern Europe, the Caucasus and Central Asia.
- Imported used vehicles accounted for more than 60% of the vehicles added to Africa's fleet annually as of 2020. In 2018, 85% of the region's vehicle fleet was used imports. African countries also have the highest median age of used vehicle imports, at more than 15 years, compared to less than 3 years in Norway.
- Two- and three-wheelers are an increasingly popular component of Africa's second-hand vehicle fleets. Although specific data are not available, the growing share of used two- and three-wheelers in some countries' fleets calls for closer monitoring, data collection and reporting to prevent harmful environmental and safety effects.
- Factors driving the growing used vehicle market globally include supply constraints, technological and price shifts, changing vehicle preferences, environmental policies, and price disparities between new and used vehicles.



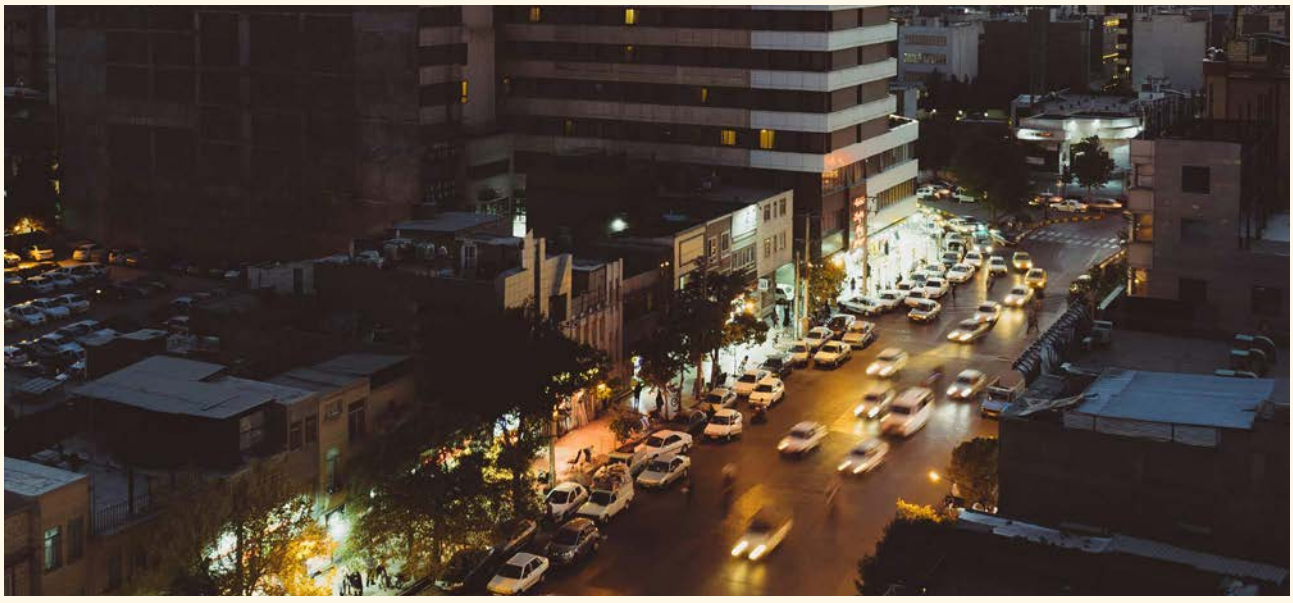
Sustainability and climate trends

- The poor quality of used vehicles exported to emerging markets raises environmental, safety, and public health concerns and contributes to overall emissions from road transport.
- In 2020, light-duty and heavy-duty vehicles together emitted more than 5,000 million tonnes of CO_2, accounting for more than 70% of total transport emissions.
- Older vehicles produce significantly more air pollutant emissions than new vehicles, particularly if they lack good maintenance and high-quality components. As of 2019, more than 80% of Africa's road vehicles fell below the Euro 4 vehicle emission standards, while also lacking valid roadworthiness.
- In addition to higher pollution rates, inspections of vehicles being exported to Africa found numerous vehicles to be unsafe, having been involved in accidents or with severe structural damage.
- In 2021, an estimated 1.19 million people were killed in road traffic crashes globally; such crashes were the leading cause of death for young people aged 5-29 and the 12th leading cause of death among all age groups as of 2021. The vast majority (90%) of the deaths in 2021 were in low- and middle-income countries, even though these countries accounted for only 54% of the global vehicle fleet that year.
- Although the used vehicle trade supports resource efficiency in automobile production, the importing countries carry the burden of dismantling and responsibly disposing of used vehicles when they reach their end of life, to avoid environmental damage. Externalising this responsibility to low-skilled informal waste workers, usually with limited or no protective equipment, exposes the workers to personal and occupational health and safety problems.
- Although second-hand vehicles are cheaper and have reduced foreign exchange requirements for importing countries, a growing dependence on used car imports has hindered the development of domestic auto manufacturing industries in many places.
- As high-income economies switch to electric vehicles, growing numbers of low-demand used ICE vehicles are being exported to emerging economies; this will likely undermine importers' efforts to shift to electric vehicles.
- The supply and pricing of second-hand vehicles has evolved in some regions. In the United States, the price of "lightly used vehicles" hit record highs in 2025, in part because the shortage of semiconductor chips during the COVID-19 pandemic affected the supply of then-new (later used) vehicles. This trend is expected to continue, given the potential effects of expanding tariffs on vehicle supply chains.
- The used vehicle market provides employment opportunities for large numbers of people in the sales and after-sales sectors in both exporting and importing countries, although data on the latter are limited.

KEY FINDINGS

Policy and investment developments

- In 2023, the EU – as a leading exporter of used vehicles – proposed stricter export requirements through its regulation on end-of-life vehicles, covering all aspects of a vehicle from design, to market placement, to treatment during disposal.
- The Safer and Cleaner Used Vehicles for Africa project, launched in 2022, aims to improve road safety and reduce pollution by promoting the import of safer and more environmentally friendly used vehicles into Africa.
- In 2020, the Economic Community of West African States (ECOWAS) adopted a used vehicles policy for the region, setting age limits of 10 years for heavy-duty vehicles and 5 years for light-duty vehicles, as well as a minimum Euro IV emission standard for all imported vehicles. The policy has a 10-year implementation period to 2030. In 2022, the East African Community similarly adopted the Euro IV standard for new and used heavy-duty and light-duty vehicles as well as in-use emission limits.
- However, wider regional harmonisation of policies and standards is critical for enforcement of these policies, especially in light of the African Continental Free Trade Area (AfCFTA). As of 2021, 55% of African countries did not regulate imports of used heavy-duty vehicles and/or lacked a comprehensive set of regulations.
- Harmonisation of policies for heavy-duty and light-duty vehicles is critical to maximise the environmental gains from restricting imports of high-polluting vehicles.
- Several importing and exporting countries of second-hand vehicles have included regulations and measures related to these vehicles in their national policies, including in Nationally Determined Contributions (NDCs) towards reducing greenhouse gas emissions under the Paris Agreement. These measures include restricting or banning used vehicle imports (based on age, mileage or emission standards), fiscal instruments, inspection licensing and certification, and selective technology bans.
- At the national level, several countries have put in place import bans or penalties on second-hand vehicles, based on either age or mileage. Apart from the complete import bans by Egypt and South Africa, age restrictions are the most prevalent in Africa.
- Subsidies for second-hand electric vehicles can bring equity benefits and complement subsidies for new electric vehicles, and are essential for optimal policy outcomes in the transition to net zero greenhouse gas emissions.
- Innovations in battery life-cycle management are critical for used electric vehicles.



Context, challenges and opportunities

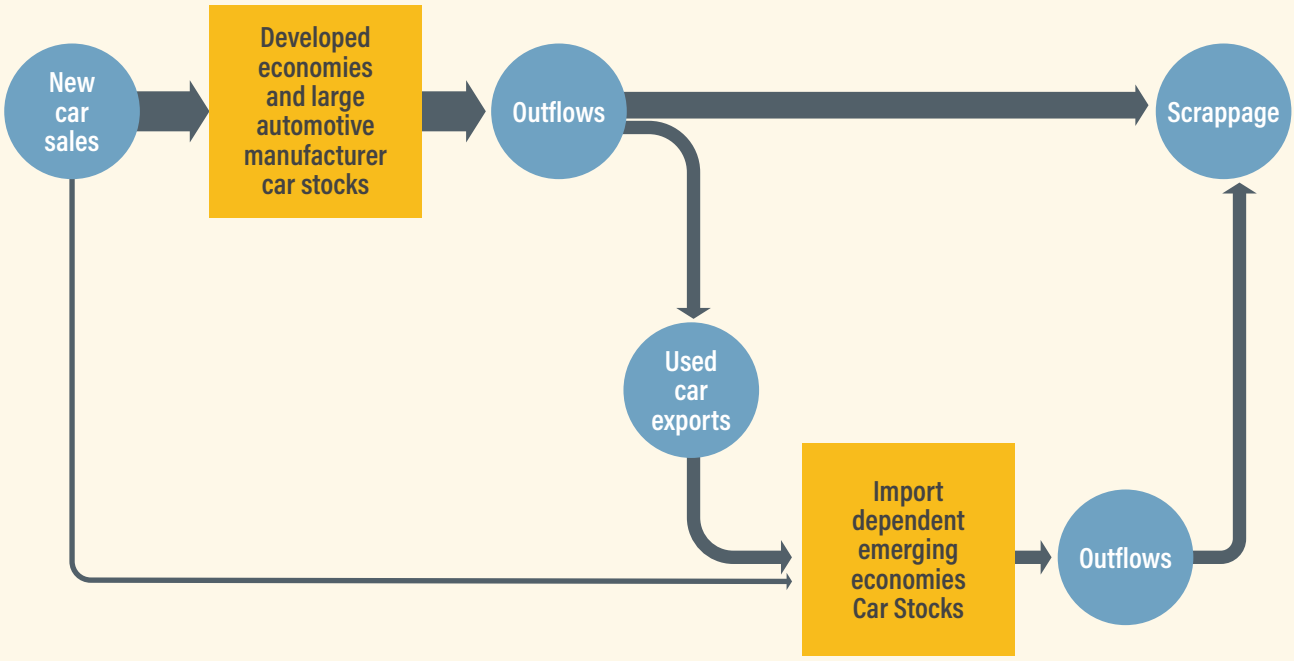
Second-hand vehicles, also known as used or previously owned (pre-owned) vehicles, are vehicles that have been registered by at least one previous owner and are resold or traded after their initial purchase from a manufacturer or dealership. Individuals acquire second-hand vehicles in various ways, including buying them domestically from previous owners or vehicle resellers and purchasing vehicle imports from other countries or regions (Figure 1).[1]

Globally, the primary method of acquiring an internal combustion engine (ICE) vehicle has been through the acquisition of a second-hand vehicle, such that the used car market has become larger than the new car market in some countries.[2] According to the latest data available, 23 million used light-duty vehicles were traded between 2015 and 2022, and 2.9 million used heavy-duty vehicles were traded between 2015 and 2020.[3] In the United States, around 62% of low-income households acquire vehicles by buying used, while in the European Union (EU) the share is 80% overall (90% in low- and middle-income groups).[4] Although many low- and middle-income countries rely on imports of used buses and trucks, a high share of used heavy-duty vehicles is traded in high-income and upper-middle-income countries.[5]

Second-hand vehicles play a dual, contradictory role in transport sustainability. On one hand, the second-hand market allows improved access to mobility by providing lower-cost vehicle options, and enables the extension of vehicle lifespans. This helps to reduce or slow the production of new vehicles and batteries, the associated carbon dioxide (CO_2) emissions, and the 112 million tonnes of materials required to produce 80 million vehicles annually (as of 2024).[6]

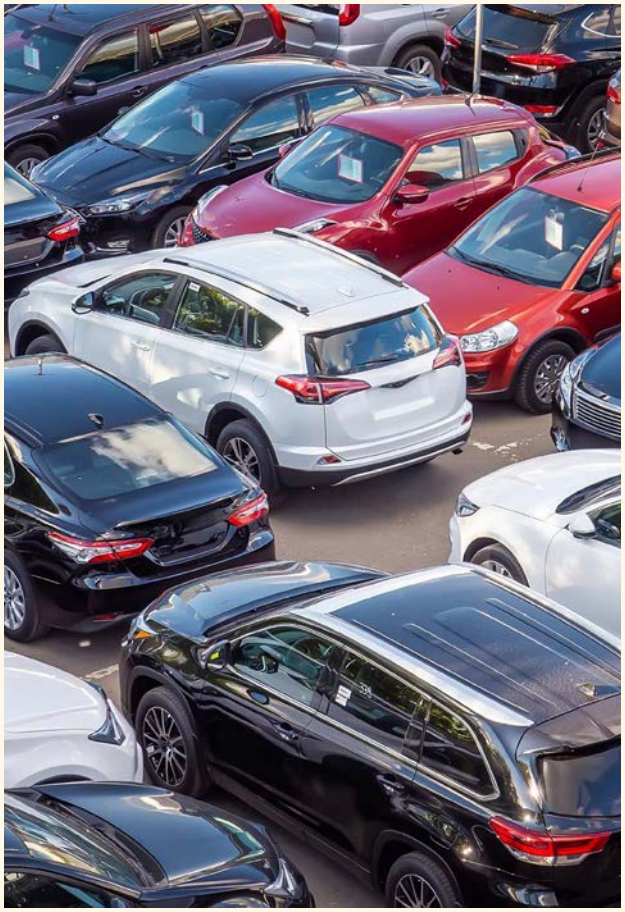
On the other hand, the export of high-emission vehicles, many of which are not roadworthy, has major safety implications for users, as well as negative environmental impacts for importing countries. These impacts, coupled with the implications of the overall growth in private vehicle ownership for climate and sustainability, likely tips the scale against the benefits accrued. In the freight sector, these negative effects are amplified by the nature of the vehicles, their emissions and the market dynamics: for most trucks, the owner-operators struggle to make a living and thus rely on old, poorly maintained, unsafe vehicles.

FIGURE 1. Schematic flowchart of global vehicle flows



Note: The thickness of the arrows qualitatively depicts the volume of the vehicle flows. Used vehicle exports/imports within a region are not shown.

Source: See endnote 1 for this section.



Demand, use and access

The global used vehicle market has expanded steadily in recent years, driven by factors such as economic shifts, changing consumer preferences and advancements in technology. The size of the used car market is projected to increase from USD 1.90 trillion in 2024 to USD 2.70 trillion by 2030.[11]

- Between 2008 and 2021, the quantity of cars imported into the United States increased more than 10-fold, from 8,100 units to 81,000 units.[12] US car exports, meanwhile, declined during this period, rising from 950,000 in 2008 to a peak of 980,000 units in 2017, then falling to 933,000 units in 2023.[13]
- Car exports from the United Kingdom have grown sharply from around 19,000 units in 2000 to 780,000 units in 2022.[14]
- In Japan, car exports increased from 840,000 units in 2010 to 1.3 million units in 2022.[15]

An estimated 23 million used light-duty vehicles were exported to the Global South from the four major exporting countries between 2015 and 2022.[16] Of these, 34.5% were from Japan, 31.1% from the EU, 23.9% from the United States and 10.5% from the Republic of Korea.[17] However, the volume of used vehicles exports could be even higher, given that these data are sometimes underreported.[18]

- In 2022, these four high-income countries exported 3.1 million used light-duty vehicles, representing a 29% increase from 2.4 million in 2015 and a rebound to levels prior to the COVID-19 pandemic.[19]
- The EU was the highest exporter of used light-duty vehicles in 2021 and 2022, overtaking Japan, which was the leading exporter from 2015 until 2020.[20]

Although the EU, the United States and the Republic of Korea led exports of used light-duty vehicles as of 2022, exports from China have risen exponentially and in the next ten years are projected to exceed the combined exports from all countries in the Organisation for Economic Co-operation and Development (OECD).[21] Further analysis is required to assess the impact of this trend – coupled with the growth in "zero-mileage used cars" registrations in China – on the global used vehicle market.[22]

The largest exporters of used heavy-duty vehicles have been Japan, the EU, and the Republic of Korea, which exported 2.4 million units between 2015 and 2022, comprising 90% trucks and 10% buses[i].[23]

Trade in used electric vehicles presents opportunities for faster, more affordable transfer of cleaner technologies (including electric vehicles) to low-income countries and to low-income households in high- and middle-income countries. In the EU, in a case example where vehicle leasing companies electrify their fleets earlier, an estimated 18 million more households (in addition to the projected 33 million households) will have access to cheaper, second-hand battery electric vehicles by 2035.[7] Overall, second-hand vehicle exports from high-income countries and leading exporters are likely to rise with the increasing uptake of electric vehicles and the declining popularity of conventional ICE vehicles.[8]

Optimising the second-hand vehicle market requires strengthening regulations to avoid the import and export of unsafe vehicles that are near the end of life; ensuring battery longevity in used electric vehicles; and addressing the environmental cost of older, less efficient ICE vehicles and the disposal of end-of-life vehicles and components.[9] Innovations in battery life-cycle management are critical for used electric vehicles.[10]

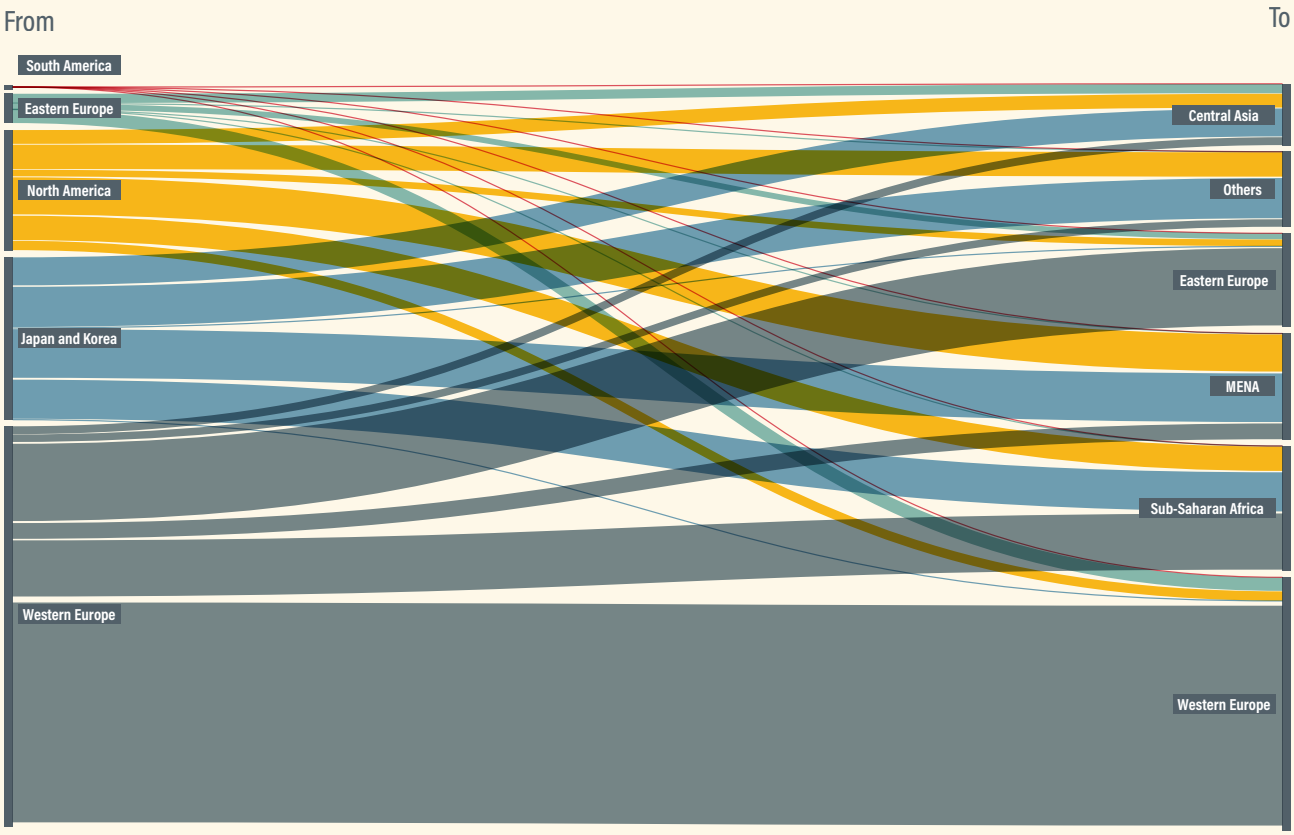
i These data are based on a first and recent (2024) attempt by the United Nations Environment Programme (UNEP) to quantify the volume of used heavy-duty vehicle trade, which is not yet subject to regular updates similar to those available for light-duty vehicles.

- In 2015, 2.9 million used heavy-duty vehicles were sold globally, almost as many as the 3.4 million new units manufactured and sold that year.[24]
- Between 2015 and 2020, Japan was the largest exporter of used heavy-duty vehicles, at around 1.3 million units (67,000 used buses and 1.2 million used trucks).[25]
- During this same period, the EU exported close to 1 million used heavy-duty vehicles (75,000 used buses and 898,000 used trucks), and the Republic of Korea exported 134,000 (106,000 buses and 28,000 trucks).[26]
- Another 1 million used heavy-duty vehicles were traded domestically within the EU between 2015 and 2020.[27]
- Of the three largest exporters, the Republic of Korea exported the largest number of used buses during this period, accounting for 40% of the total.[28]

Half of all used light-duty vehicle exports went to low-income (18%) and lower-middle income countries (32%) between 2015 and 2018; meanwhile, most used heavy-duty vehicles (60%) have been traded in high-income or upper-middle income countries.[29] Between 2015 and 2020, one-third of the world's used heavy-duty vehicles went to the EU, 20% were exported to Africa, and 20% went to Asia-Pacific, with the rest exported to other regions.[30] (Note that some recorded recipient countries are not the final destination for used vehicle imports, as some countries act as transit countries or re-export them elsewhere.)

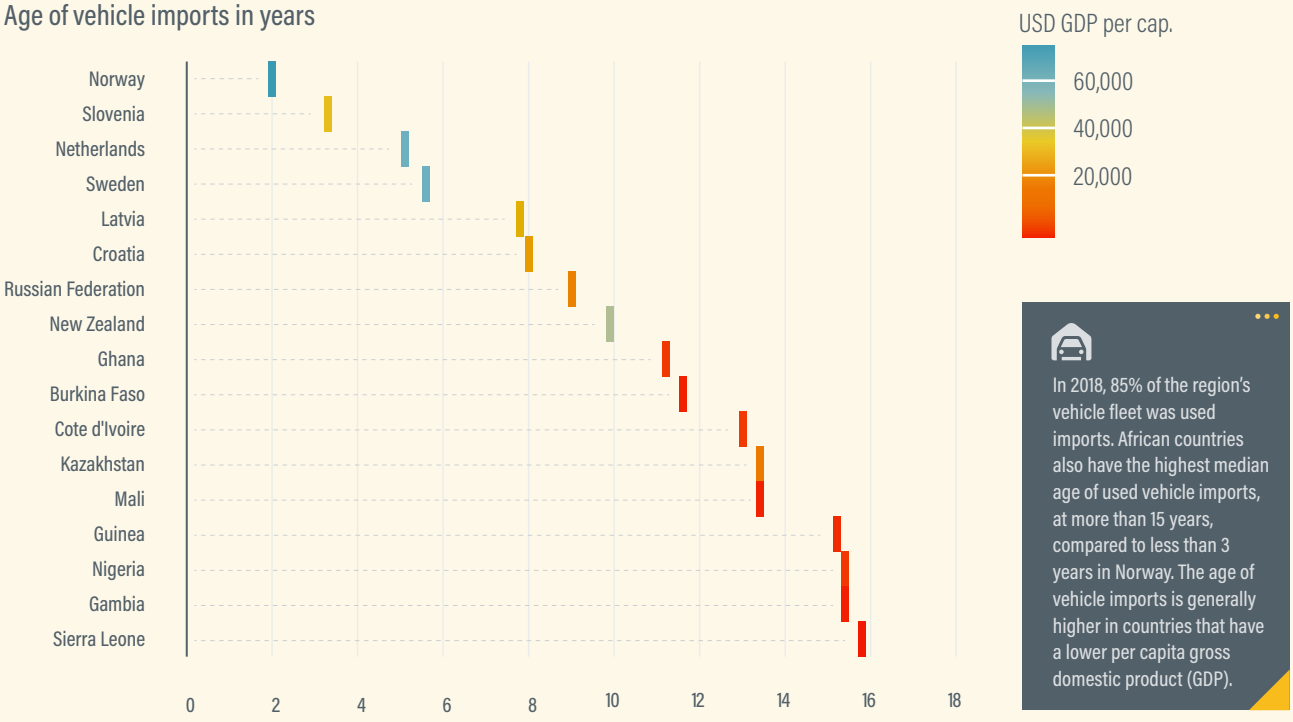
Africa was the largest importer of second-hand light-duty vehicles between 2015 and 2022, receiving around 7.5 million units (33%) (Figure 2)**.**[31] **African countries represented 6 of the top 10 importing countries of used light-duty vehicles from the EU during that period.**[32] **The next highest importing regions were Eastern Europe, the Caucasus, and Central Asia (around 5.4 million units, or 24%), Asia-Pacific (3.7 million units, 16%), the Middle East (3.3 million units, 15%) and Latin America and the Caribbean (2.8 million units, 12%).**[33]

FIGURE 2. Global used vehicle flows by region, 2015-2020



Source: See endnote 31 for this section.

FIGURE 3. Age of vehicle imports versus GDP in selected countries, 2020



Source: See endnote 39 for this section.

Although Africa was the leading importer of used vehicles, the region received only 1% of the used battery electric vehicles exported between 2015 and 2022 (1,431 units), signalling limited opportunities for clean transport technology transfer and trickle-down electrification.[34] **The largest importer of battery electric vehicles in this period was the region of Eastern Europe, the Caucasus and Central Asia.**[35]

Imported used vehicles accounted for more than 60% of the vehicles added to Africa's fleet annually as of 2020.[36] **In 2018, 85% of the region's vehicle fleet was used imports.**[37] **African countries also have the highest median age of used vehicle imports, at more than 15 years, compared to less than 3 years in Norway.**[38] The age of vehicle imports is generally higher in countries that have a lower per capita gross domestic product (GDP) (Figure 3).[39]

- In 2019, the oldest heavy-duty vehicle exports from the Netherlands had an average age of 17-20 years and were exported to Gambia, Guinea, Nigeria, and Sierra Leone, despite age restrictions for used vehicles in some African countries (15 years in Nigeria, 10 years in Ghana and 5 years in Côte d'Ivoire).[40]
- In Morocco, the average age of imported heavy-duty vehicles in 2019 was 7.7 years, despite an age limit restriction of 5 years.[41]
- In 2020, the average price of a used heavy-duty vehicle in Africa was close to USD 5,900, compared to USD 8,000 in Eastern Europe, the Caucasus, and Central Asia; USD 9,700 in the Middle East; USD 11,100 in Latin America and the Caribbean; and USD 11,200 in Asia Pacific.[42]
- In 2018, the average price of a used light-duty vehicle in Singapore was USD 21,000, nearly 16 times the average price in Lesotho (USD 1,300).[43]

Two- and three-wheelers are an increasingly popular component of Africa's second-hand vehicle fleets. Although specific data are not available, the growing share of used two- and three-wheelers in some countries' fleets calls for closer monitoring, data collection and reporting to prevent harmful environmental and safety effects. Meanwhile, a study from Uganda found that the surge in annual motorcycle registrations has occurred alongside a reduced reliance on used two-wheelers and a shift to newly imported or domestically assembled units.[44]

Factors driving the growing used vehicle market globally include supply constraints, technological and price shifts, changing vehicle preferences, environmental policies, and price disparities between new and used vehicles. Specific trends facilitating the market include:



- Limited supply or delayed procurement of new vehicles due to factors such as semiconductor shortages, coupled with soaring costs for new vehicles and auto parts due to advancements in driver-assisted technologies and navigation functions.[45]
- Growing global market shares for larger and heavier vehicles, which have increased the supply of second-hand smaller cars for export.[46]
- Electric vehicle adoption, particularly in leading used vehicle exporting regions such as China, Europe, the Republic of Korea, Japan and North America.[47]
- High vehicle replacement rates in countries where the vehicle market is largely saturated and where vehicle replacement is highly encouraged and in some cases incentivised (as in Japan).[48]
- The effects of the implementation of urban low-emission zones on the demand for low-emission cars, including second-hand electric vehicles.[49] (See 4.1 Integrated Transport Planning.)
- Limited access to new vehicle options or lack of effective demand for new vehicles, significant price disparities between new and used vehicles, and cost-effective repair services due to lower labour costs in many importing regions.[50]
- The prevalence of low-density sprawling urban developments, as well as inadequate prioritisation of investment in public transport systems.[51]

Sustainability and climate trends

The poor quality of used vehicles exported to emerging markets raises environmental, safety, and public health concerns and contributes to overall emissions from road transport. In 2023, the transport sector, excluding international aviation and shipping, accounted for 13.5% of global greenhouse gas emissions.[52] The auto industry alone contributed more than 10% of the world's CO_2 emissions, in addition to consuming 112 million tonnes of materials annually to produce around 80 million vehicles (as of 2024).[53]

In 2020, light-duty and heavy-duty vehicles together emitted more than 5,000 million tonnes of CO_2, accounting for more than 70% of total transport emissions.[54] Although the heavy-duty vehicle fleet is much smaller than the light-duty fleet, it is a major contributor to air pollution, road crashes, high fuel consumption, and black carbon and CO_2 emissions.[55] (See 4.8 Road Transport.)

Older vehicles produce significantly more air pollutant emissions than new vehicles, particularly if they lack good maintenance and high-quality components.[56] **As of 2019, more than 80% of Africa's road vehicles fell below the Euro 4 vehicle emission standards, while also lacking valid roadworthiness.**[57] In some cases, used vehicle dealers remove the after-treatment systems for vehicle exhaust to

bypass emission control systems or retain precious components, resulting in higher air pollution.[58]

- In Kampala (Uganda) – where heavy-duty vehicles average 26 years, minibuses 25 years, light-duty vehicles 19 years and motorcycles 4 years – road transport is a key contributor to ambient air pollution, accounting for 60% of nitrogen dioxide (NO_x) emissions and up to 24% of particulate matter ($PM_{2.5}$) emissions in 2021.[59]
- A 2025 study found that ambient air pollution in Kampala exceeds the World Health Organization's limits for particulate matter by up to 8-12 times.[60] More than half of the petrol passenger cars assessed had average NO_x emissions above 1,000 micrograms per kilometre (consistent with pre-Euro certifications), suggesting the malfunctioning or removal of catalytic converters.[61] Diesel minibuses had NO_x emissions more than nine times above Euro 4 limits, as well as high black carbon emissions.[62]
- Inspections of vehicles exported to Africa from the Netherlands showed that several vehicles had their catalytic converters removed before shipment, and the vehicles lacked diesel particulate filters because of their old age.[63]

In addition to higher pollution rates, inspections of vehicles being exported to Africa found numerous vehicles to be unsafe, having been involved in accidents or with severe structural damage.[64] Concerns included ineffective braking systems, non-operational lights and indicators, missing airbags and severely worn tyres.[65]

- A study of used heavy-duty vehicles exported from the Netherlands to Africa found that most vehicles were worn out, had very high mileage (above 250,000 kilometres) and lacked valid roadworthiness certificates at the time of export.[66]
- Even in cases where such certificates are available, importing economies rarely have appropriate testing procedures to ensure that faulty, dangerous or highly polluting vehicles are properly maintained and meet roadworthiness standards (Box 1).[67]

Box 1. Who is setting roadworthiness standards, and who is governing them?

A clear, unambiguous legal framework is an essential foundation for introducing and implementing vehicle roadworthiness standards. Internationally, the World Forum for Harmonization of Vehicle Regulations (WP.29), a working party of the Inland Transport Committee of the United Nations Economic Commission for Europe, is responsible for harmonising vehicle regulations and rules on vehicle performance, vehicle parts and equipment, vehicle safety, environmental pollution, energy efficiency, anti-theft and security. Key areas of concern include:

- Active safety of vehicles and their parts (crash avoidance), aimed at improving the behaviour, handling and equipment of vehicles so as to decrease the possibility of a road crash.
- Passive safety of vehicles and their parts (crashworthiness), aimed at minimising the risk and severity of injury to the occupants of a vehicle or to other road users in the event of a crash.
- Environmental considerations, aimed at addressing the environmental performance (e.g., emissions of gaseous pollutants, particulates and CO_2, noise levels) of vehicles with conventional propulsion engines, hydrogen and fuel cell vehicles, hybrid-electric vehicles and electric vehicles.

The 1997 Agreement on Periodical Technical Inspections provides the legal framework and procedures for the adoption of uniform UN Rules for carrying out technical inspections of vehicles that are in use and for delivering international inspection certificates. By 2020, the 1997 Agreement had 16 contracting parties, and four UN Rules had been established under its umbrella, for heavy-duty vehicles, light-duty vehicles and passenger cars. These Rules may be useful for countries aiming to introduce or strengthen a periodic inspection system based on international expertise

At the national level, high-income countries, manufacturing countries, and larger vehicle markets typically set their own roadworthiness standards and vehicle design manuals. For example, the United Kingdom uses four types of manuals – for light vehicles, motorcycles, heavy goods vehicles and public service vehicles (buses and coaches) – and the European Commission's Roadworthiness Package (RWP) consists of directives for Periodical Technical Inspections (PTI), Roadside Inspections (RSI) and vehicle registrations. Low- and middle-income and importing countries typically adapt legislation from bigger markets, in some cases altering it to local driving conditions. This is mainly to ensure that the countries remain economically viable for vehicle exporters.

Even with harmonised standards in place, studies show that in-depth controls at ports are very difficult without essential information exchange across countries and among customs, export declarations and national vehicle registers.

Source: See endnote 67 for this section.



In 2021, an estimated 1.19 million people were killed in road traffic crashes globally; such crashes were the leading cause of death for young people aged 5-29 and the 12th leading cause of death among all age groups as of 2021.[68] **The vast majority (90%) of the deaths in 2021 were in low- and middle-income countries, even though these countries accounted for only 54% of the global vehicle fleet that year.**[69] (See 1.7. Driving Health and Wellbeing Forward: The Critical Link with Transport and 4.8 Road Transport.)

- Africa had the highest rate of road traffic fatalities at 18.7 deaths per 100,000 people in 2021, followed by Asia (15.5 deaths) and Latin America and the Caribbean (14.6 deaths).[70]
- Half of all road deaths and injuries in Africa affect unprotected road users such as pedestrians, cyclists, motorcyclists and their passengers.[71]

Although the used vehicle trade supports resource efficiency in automobile production, the importing countries carry the burden of dismantling and responsibly disposing of used vehicles when they reach their end of life, to avoid environmental damage. Externalising this responsibility to low-skilled informal waste workers, usually with limited or no protective equipment, exposes the workers to personal and occupational health and safety problems.[72] These risks are heightened by the inadequacy or absence of recycling and safe disposal facilities across Sub-Saharan Africa, where in 2020 more than 85% of municipal solid waste was uncontrolled.[73] The importance of safe disposal of materials and liquids from vehicles will only increase with the shift towards electric vehicles that tend to contain even more hazardous materials.

Although second-hand vehicles are cheaper and have reduced foreign exchange requirements for importing countries, a growing dependence on used car imports has hindered the development of domestic auto manufacturing industries in many places. (See 3.1 Africa Regional Overview.) In Africa, domestic vehicle production rose 16% in 2021, yet the region contributed only 1.2% of global vehicle output as of 2023; manufacturing is concentrated in Algeria, Egypt, Morocco, and South Africa, with some vehicle assembly in Angola, Ethiopia and Ghana.[74]

As high-income economies switch to electric vehicles, growing numbers of low-demand used ICE vehicles are being exported to emerging economies; this will likely undermine importers' efforts to shift to electric vehicles. Even where used electric vehicles are available for export, demand for them is limited by a lack of extensive charging infrastructure networks in some importing countries.[75]

The supply and pricing of second-hand vehicles has evolved in some regions. In the United States, the price of "lightly used vehicles" hit record highs in 2025, in part because the shortage of semiconductor chips during the COVID-19 pandemic affected the supply of then-new (later used) vehicles.[76] This trend is expected to continue, given the potential effects of expanding tariffs on vehicle supply chains.[77]

The used vehicle market provides employment opportunities for large numbers of people in the sales and after-sales sectors in both exporting and importing countries, although data on the latter are limited. Second-hand cars also provide increasing opportunities for the aftermarket sector, as these vehicles require more frequent maintenance, repairs and parts replacements.[78]

- The United States was home to more than 300,000 used car dealers as of May 2025, while Japan had an estimated 30,000 major used car dealerships in 2023, excluding the ubiquitous smaller firms engaged in the industry.[79]
- In the Middle East and Africa, the market share of the auto repair and maintenance services sector has grown steadily, reaching 2% (USD 18.1 billion) in 2023.[80]

Policy and investment developments

A key way for countries to address the negative and potentially exploitative impacts of second-hand vehicles is to stop exporting vehicles that are no longer roadworthy and that fail environment and safety inspections; meanwhile, importing countries must adopt up-to-date, minimum harmonised standards and regulations.[81] Several international, regional and national mechanisms have been enacted or proposed.

In 2023, the EU – as a leading exporter of used vehicles – proposed stricter export requirements through its regulation on end-of-life vehicles, covering all aspects of a vehicle from design, to market placement, to treatment during disposal (Box 2).[82] The proposal was envisaged to greatly impact the quality of EU used vehicle exports by prohibiting the export of end-of-life vehicles; requiring used vehicles to have a valid roadworthiness certificate at the point of export; establishing an enforcement and information exchange system; and helping importing countries comply with their national regulations.[83]

Box 2. End-of-Life Vehicles Regulation of the European Commission

In July 2023, the European Commission proposed the End-of-Life Vehicles Regulation, which outlines circularity requirements covering the entire life cycle of a vehicle – from design to final end-of-life treatment – in line with the objectives of the European Green Deal and the circular economy action plan.

As of July 2025, committees of the European Parliament had advanced the new regulations by adopting a final compromise amendment to the proposal including improving end-of-life management of the vehicles and enforcement of rules. They also strengthened the export rules to allow only used vehicles classified as "not end-of-life" to be exported, accompanied by the required documents for customs clearance. The report is expected to be adopted in September 2025.

As of 2025, only a fraction of the 6.5 million vehicles that reach their end-of-life annually in the EU were actually dismantled at authorised treatment facilities, with others likely being dismantled illegally, abandoned or exported illegally. Digital tools and stricter penalties are needed to trace car movements across and beyond Europe, to curb the illegal import of polluted vehicles.

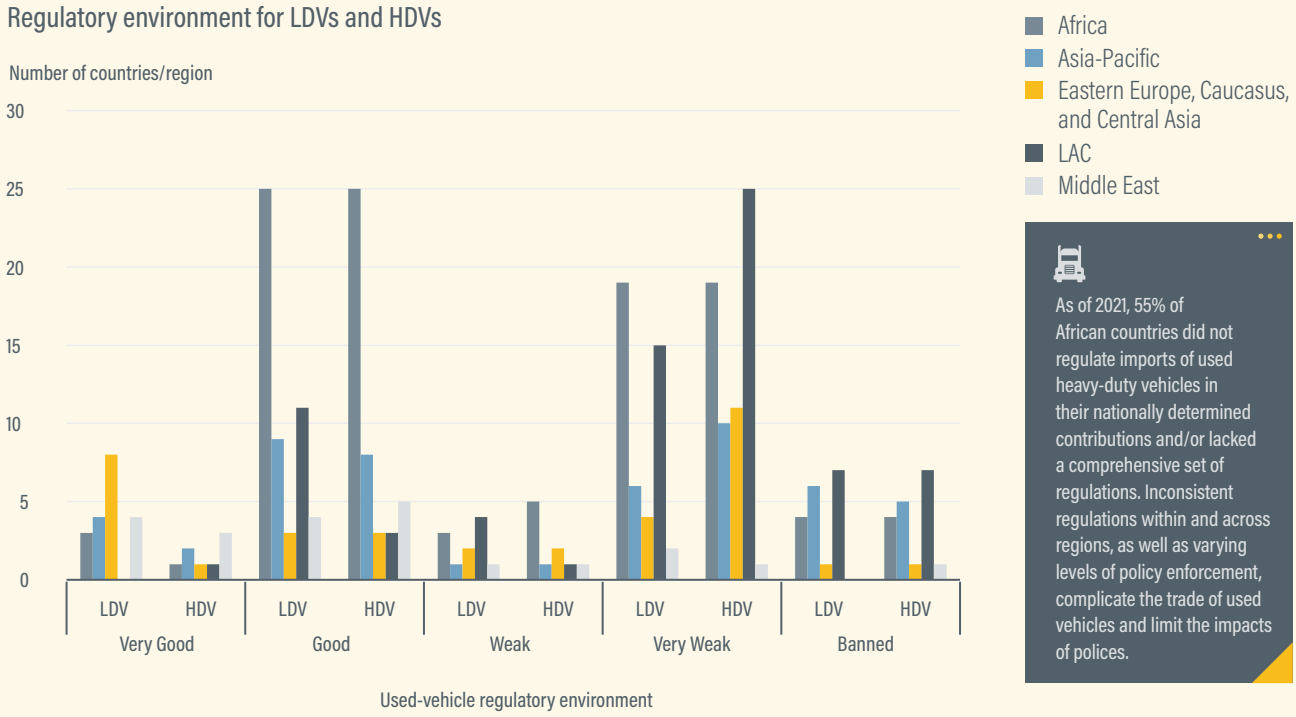
Source: See endnote 82 for this section.

This is complementary to the EU Waste Shipment Regulation, which prohibits the export of hazardous waste to non-OECD countries and aims to ensure that waste exported outside the EU does not create adverse effects on the environment or public health in the destination countries.[84] Enforcement of this regulation would stop the export of end-of-life vehicles, which in some cases constitute hazardous waste.[85]

The Safer and Cleaner Used Vehicles for Africa project, launched in 2022, aims to improve road safety and reduce pollution by promoting the import of safer and more environmentally friendly used vehicles into Africa.[86] The project is led by UNEP and the UN Economic Commission for Europe and is supported by partners including the UN Road Safety Fund, the Climate and Clean Air Coalition, the FIA Foundation and the International Motor Vehicles Inspection Committee (CITA). Specifically, it aims to:

- regulate the transfer of used vehicles to Africa by helping recipient countries develop and implement national used vehicle standards and regulations (including existing global vehicle standards and regulations), bringing significant road safety benefits for car occupants, road users, and pedestrians as well as co-benefits for the environment and economy, and
- provide a platform for major exporters of used vehicles and African importing countries to shift the paradigm on the

FIGURE 4. Regulatory environments for light-duty and heavy-duty vehicles, by region, as of 2023



As of 2021, 55% of African countries did not regulate imports of used heavy-duty vehicles in their nationally determined contributions and/or lacked a comprehensive set of regulations. Inconsistent regulations within and across regions, as well as varying levels of policy enforcement, complicate the trade of used vehicles and limit the impacts of polices.

Source: See endnote 91 for this section.

export/import of used vehicles and to develop standards and policies on the transfer of used vehicles.[87]

In 2020, the Economic Community of West African States (ECOWAS) adopted a used vehicles policy for the region, setting age limits of 10 years for heavy-duty vehicles and 5 years for light-duty vehicles, as well as a minimum Euro IV emission standard for all imported vehicles.[88] The policy has a 10-year implementation period to 2030. In 2022, the East African Community similarly adopted the Euro IV standard for new and used heavy-duty and light-duty vehicles as well as in-use emission limits.[89]

However, wider regional harmonisation of policies and standards is critical for enforcement of these policies, especially in light of the African Continental Free Trade Area (AfCFTA). As of 2021, 55% of African countries did not regulate imports of used heavy-duty vehicles in their nationally determined contributions and/or lacked a comprehensive set of regulations.[90] Inconsistent regulations within and across regions, as well as varying levels of policy enforcement, complicate the trade of used vehicles and limit the impacts of policies (Figure 4).[91]

Harmonisation of policies for heavy-duty and light-duty vehicles is critical to maximise the environmental gains from restricting imports of high-polluting vehicles. Countries often prioritise age restrictions for light-duty vehicles over heavy-duty vehicles, due mainly to cost considerations and to the limited model and market availability of the latter. This is inefficient for two key reasons: heavy-duty vehicles are more emission- and energy-intensive per kilometre than light-duty vehicles, and heavy-duty vehicles travel much farther on average than any other vehicle type annually.[92]

Several importing and exporting countries of second-hand vehicles have included regulations and measures related to these vehicles in their national policies, including in Nationally Determined Contributions (NDCs) towards reducing greenhouse gas emissions under the Paris Agreement. These measures include restricting or banning used vehicle imports (based on age, mileage or emission standards), fiscal instruments, inspection licensing and certification, and selective technology bans.

- Belize's third-generation NDC of June 2025 includes an action on possibly restricting the import of older, less efficient vehicles as a way to mitigate emissions from the transport sector.[93]
- Lesotho's second NDC from February 2025 highlights the regulation of imported used cars to reduce the number of poor-performing vehicles entering the country.[94]

- In its third-generation NDC of May 2025, the Republic of Moldova highlights the introduction of stricter emission standards for imported second-hand vehicles as a strategy to promote energy efficiency.[95]

At the national level, several countries have put in place import bans or penalties on second-hand vehicles, based on either age or mileage. Apart from the complete import bans by Egypt, Seychelles, and South Africa, age restrictions are the most prevalent in Africa.[96]

- In January 2025, the government of Sudan lifted restrictions on the import of used vehicles in an effort to ease economic pressures stemming from the ongoing conflict.[97]
- In 2023, Ethiopia banned the importation of both new and used ICE vehicles, while Morocco adopted Euro 6/VI vehicle emission standards.[98]
- In 2021, Nigeria banned the importation of vehicles older than eight years, but the age limit was later raised to 15 years.[99]
- In 2019, Libya restricted imports of light-duty and heavy-duty vehicles to those with a maximum age of 10 years.[100]

A 2022 study found that solely imposing bans and penalties on used vehicle imports does not yield meaningful, sustained gains in other areas such as reduced road traffic deaths, air pollution or shifts to zero-emission vehicles.[101] The study recommends policy alternatives such as investment in and subsidies for public transport, and pursuing integrated transport planning instead of vehicle-dependent systems.[102]

Subsidies for second-hand electric vehicles can bring equity benefits and complement subsidies for new electric vehicles, and are essential for optimal policy outcomes in the transition to net zero greenhouse gas emissions.[103]

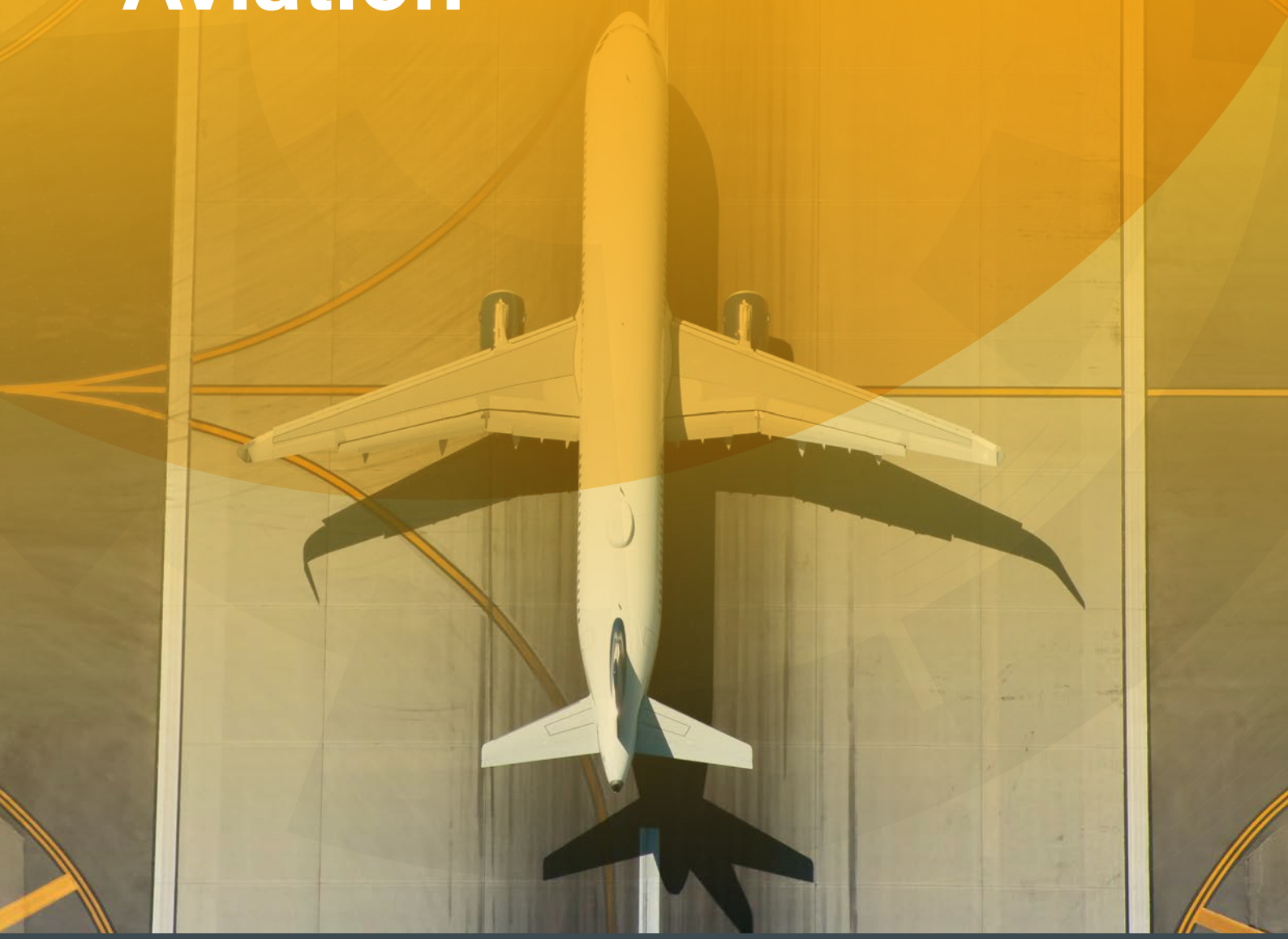
- In 2020, the Netherlands introduced a USD 2,070 (EUR 2,000) subsidy for used electric vehicles, which contributed to a 40.3% increase in registrations of both new and used electric vehicles in 2024.[104] As of 2025, the country's electric vehicle subsidies were all discontinued following depletion of the allocated budget.[105]
- In 2024, Luxembourg introduced a USD 1,553 (EUR 1,500) subsidy for used electric vehicles that are more than three years old.[106]
- In the United Kingdom, a 2025 report on decarbonising road transport called for grants on used electric vehicles to combat the volatile market, as rapid technological advancements and price drops for new models have made second-hand electric vehicles more affordable but less predictable in value.[107]

Innovations in battery life-cycle management are critical for used electric vehicles. Volvo, which has committed to becoming a fully electric car company and aims for at least 30% recycled content in new models by 2030, is developing processes to refurbish and recycle batteries from used electric vehicles, reducing reliance on unsustainable lithium and cobalt mining.[108]

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A more in-depth analysis of the aviation sector will be published soon

Aviation



KEY FINDINGS



Demand, use and access

- The air passenger market has demonstrated resilience and recent growth. Global revenue pssenger-kilometres, a standard measure of passenger traffic, increased 10.4% in 2024 and pushed total traffic 3.8% above the pre-pandemic levels of 2019, indicating a full recovery across all regions.
- Evidence of strong aviation demand was reflected in record passenger load factors, as airlines used their capacity more efficiently than ever before to reach new highs both in December 2024 (84.0%) and for the full year (83.5%). Although high load factors are positive from an operational efficiency perspective, efficiency improvements risk being overshadowed by the scale of rising demand for aviation, highlighting the core challenge of reducing absolute emissions in a growing market.
- International passenger traffic was a major driver of aviation's 2024 recovery, climbing 13.6% despite ongoing geopolitical tensions and airspace restrictions that necessitated adjustments to global networks. Domestic markets also contributed to the sector's growth, expanding 5.7% globally in 2024.
- Aviation has played a minor role in global freight transport, representing only 1% of the global trade volume and just 0.1% of global freight tonne-kilometres in 2021. Even so, cargo flights remain a key revenue stream for the airline industry, with commercial airlines making around 5-10% of their total revenue from hauling freight.
- Freight aviation volumes experienced strong performance in 2024, with industry-wide cargo tonne-kilometres increasing 11.3%, setting a new record above 2021's volumes and above the pre-pandemic levels of 2019. Contributing factors included booming e-commerce demand and continued disruptions in maritime shipping.
- Available cargo capacity (in tonne-kilometres) hit a record high in the third quarter of 2024, supporting a rise in cargo load factors.
- Global aviation's recovery masks significant regional differences in demand growth, with particular dynamism in developing economies. The Asia Pacific region experienced a 16.9% increase in passenger traffic in 2024, driven by strong domestic markets in China and India, but international travel in the region remained below 2019 levels. Africa ranked second with a 13.2% increase in passenger traffic and notable growth on the Africa-Asia route.
- Strong passenger growth in Asia Pacific and Africa suggests a potential long-term shift in aviation expansion towards developing and emerging economies. China and India (and Asia Pacific as a whole) are projected to account for nearly half (46%) of the 42,430 new passenger and freighter deliveries in the 2024-2043 period. This has implications for future global emission trajectories, as these regions generally have lower historical emissions but higher growth potential. It underscores the critical need for globally inclusive and equitable decarbonisation strategies that support sustainable development alongside climate action.
- In addition to economic and demographic factors, geopolitical events have influenced regional aviation patterns, posing threats to the stability needed for long-term investments in decarbonisation. Both demand forecasts and effective decarbonisation planning must account for this volatility.
- Direct risks to airline operations and demand can stem from policy instability following major elections, potential trade disputes (e.g., US tariffs), a shifting global power balance (potentially leading to more conflict), and even reduced political commitment to climate action.
- Behavioural factors and consumer preferences are increasingly influencing travel choices, including a potential shift from air travel to high-speed rail for shorter journeys.
- The cost of air travel is a significant factor influencing demand, and decarbonisation efforts are widely expected to exert upward pressure on prices. The deployment of SAF, which currently costs 2-8 times more than conventional fuel, is a primary driver of anticipated cost increases.

KEY FINDINGS



Sustainability and climate trends

- The global transition towards net zero aviation will inevitably have consequences; it is not solely a technical and economic challenge, but also carries significant social and equity implications. These must be carefully managed to ensure fairness and to minimise negative impacts on connectivity, equity in access, and economic growth related to jobs and tourism.

- In 2024, aviation supported an estimated 11.6 million direct jobs and 20.4 million indirect jobs globally and contributed USD 4.1 trillion (3.9%) to the global gross domestic product (GDP) – reflecting the strong link between economic prosperity and air travel growth.

- Aviation's role in facilitating global connectivity supports economic growth, enables trade and tourism, fosters international collaboration, and provides access to essential services and humanitarian aid. Overall, the sector supports many of the 17 United Nations Sustainable Development Goals (SDGs), including SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships). Maintaining these positive contributions while mitigating the sector's emissions and supporting climate action (SDG 13) is a key aspect of a sustainable and just transition.

- As both air passenger and air cargo demand recovered in 2023, aviation-related greenhouse gas emissions rose to reach 90% of their 2019 (pre-pandemic) peak level. Aviation emissions grew in nearly all regions to just over 900 million tonnes of carbon dioxide (CO_2) equivalent, of which around 10% was from cargo planes.

- International aviation emitted 498 million tonnes of CO_2 equivalent, while domestic aviation contributed 406 million tonnes. Aviation's CO_2 equivalent emissions were expected to surpass their 2019 level in 2025.

- Aviation contributed only around 2.2% of the total global CO_2 emissions from human activities in 2023; however, the sector's absolute volume of emissions was still substantial. Between 1990 and 2023, air traffic grew 5% annually on average, while CO_2 emissions from aviation grew 2%, indicating some efficiency gains but still resulting in a net increase in emissions over the period. The sector's demand growth rate has outpaced overall emission reductions in many economies.

- Around 80% of the CO_2 emissions from aviation originate from flights of more than 1,500 kilometres, distances that generally cannot be substituted by rail. This has profound implications for decarbonisation strategies and underscores the importance of developing and deploying scalable solutions that can effectively reduce emissions from medium- and long-haul flights; the leading solution is SAF, and potentially also future fuel-efficient aircraft and propulsion technologies.

- The International Civil Aviation Organization (ICAO) has adopted a Long-term Global Aspirational Goal (LTAG) for the international aviation sector of achieving net zero carbon emissions by 2050. To meet this goal, the ICAO and its Member States strive to reduce CO_2 emissions in international aviation 5% by 2030 through the use of cleaner fuels such as SAF, without specific obligations or commitments in the form of emission reduction goals attributed to individual members.

- The aviation sector would need to adhere to stringent carbon budgets to align with the goals of the Paris Agreement to keep global temperature rise below 1.5 degrees Celsius (°C) and well below 2°C. As of 2023, the global commercial aviation fleet already in service was set to emit around 9 gigatonnes of CO_2 over its lifetime, or nearly half the indicative carbon budget of 18.4 gigatonnes of CO_2 that is required for the sector to align with a net zero emission pathway. New aircraft delivered from 2024 onwards might exhaust the sector's 1.5°C carbon budget by 2032.

- Aviation's carbon budget constraints underscore that relying solely on incremental efficiency gains and SAF deployment in conventional aircraft may be insufficient, particularly to achieve the ambitious 1.5°C target. This points to an urgent need either for much sooner and larger-scale deployment of genuinely zero-emission aircraft (powered by hydrogen or electricity), or for the delivery of aircraft from the mid-2030s onwards that operate exclusively on 100% SAF, with extremely low life-cycle emissions.

- The risk of remaining dependent on the current (high-carbon) pathway is significant. The continued production and delivery of new aircraft designed primarily for fossil fuels, even if they incorporate efficiency improvements, locks in emissions for decades due to the long operational lifespan of aircraft (20-30 years).

- Models of future CO_2 emission trajectories for the aviation sector illustrate the critical levers for decarbonisation, based on varying assumptions about technology, policy and demand. If current growth trends continue without significant intervention, aviation's CO_2 emissions could potentially triple by 2050. The stark contrast between

KEY FINDINGS

potential net zero pathways and the possibility of emissions tripling highlights the transformative nature of the changes required and the high stakes involved in failing to implement effective mitigation measures.

- Operational improvements such as enhancing the efficiency of air traffic management and aircraft operations can yield immediate fuel savings and emission reductions. Collectively, operational efficiencies offer a maximum emission reduction potential of 10%.

- Fleet renewal remains a cornerstone of aviation's decarbonisation strategy. New-generation aircraft delivered by major manufacturers such as Airbus, Boeing, COMAC and Embraer are a reported 20-30% more efficient than the older models they replace. However, the rate of fuel efficiency improvement (around 1% per year) has stagnated since 2020. If all cost-effective technologies are adopted, annual fuel burn reductions of up to 2.2% are technically possible through 2034, although current trends are slower.

- Airlines have invested heavily in new aircraft, with more than 19,360 new planes delivered since 2009 and a production backlog of around 15,700 new-technology aircraft set to enter the fleet from 2023 onwards. The combination of new technology, operational efficiencies and infrastructure improvements avoided an estimated 14.6 billion tonnes of CO_2 between 1990 and 2023.

- Research and development continue to target further incremental improvements. Disruptive technologies such as battery electric and hydrogen propulsion hold promise for zero-emission flight but face large hurdles to widespread adoption by 2050, with commercial deployment not expected before the late 2030s. Their contribution to overall aviation fuel consumption and emission reduction by 2050 is projected to be limited in most scenarios.

- The critical timing gap reinforces the importance of SAF, which is widely regarded as the most significant near- to medium-term solution for decarbonising aviation. Global SAF production more than doubled in 2024 to 1 million tonnes (1.3 billion litres) – up from around 0.5 million tonnes (600 million litres) in 2023 – and is projected to double again to 2.1 million tonnes (2.7 billion litres) in 2025 (albeit starting from a very low base).

- Despite its rapid growth rate, SAF's share of total global aviation fuel consumption was only around 0.15% in 2023, rising to 0.3% in 2024 and a projected 0.7% in 2025.

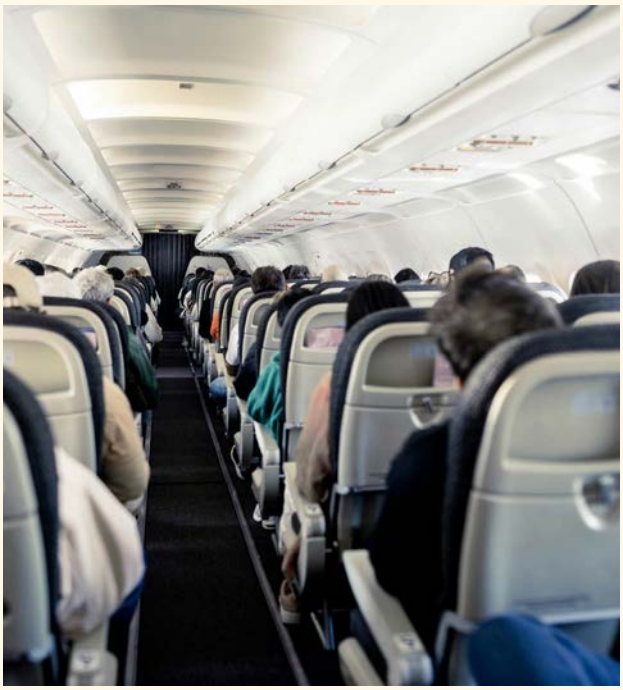
- Scaling SAF production to meet 2050 targets is a monumental undertaking, requiring an estimated USD 1.5 trillion in capital investment over 30 years.

- Demand signals for SAF have arisen from policy mandates in the European Union (EU) and the United Kingdom, goals in the United States, and growing voluntary commitments from airlines. Yet securing the necessary long-term off-take agreements remains a hurdle.

- Beyond CO_2 emissions, aviation impacts the climate greatly through non-CO_2 effects, including the release of nitrogen oxide (NO_x) emissions at altitude and the formation of persistent condensation trails (contrails) and contrail-induced cirrus clouds. These effects could equal or exceed the total climate warming impact of aviation's CO_2 emissions alone.

- Despite the growing recognition of non-CO_2 effects and the initiation of monitoring requirements, the implementation of large-scale trials and mitigation strategies to address these effects appears less advanced compared to measures targeting CO_2. Translating this into effective, globally co-ordinated mitigation action remains a key challenge and opportunity for the coming years.

- In addition to mitigating its own climate impact, the aviation sector must adapt to the unavoidable consequences of climate change already under way, including increasing disruptions from more frequent and intense extreme weather events. Initiatives are emerging to study these impacts and to develop adaptation strategies.



KEY FINDINGS



Policy and investment developments

- In 2022, the ICAO Assembly adopted its Long-Term Aspirational Goal (LTAG) for international aviation to achieve net zero carbon emissions by 2050. This global goal signals a collective ambition to align the sector with the global warming targets of the Paris Agreement, although it is not binding on individual member states.
- To support the LTAG, in November 2023 the third ICAO Conference on Aviation and Alternative Fuels adopted the "ICAO Global Framework for Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other Aviation Cleaner Energies". The Framework includes a collective global aspirational vision to reduce CO_2 emissions in international aviation 5% by 2030 through the use of cleaner energy sources, compared to a baseline that assumes zero use of cleaner energy.
- The EU has taken a leading role in translating international goals into binding regional legislation with its landmark ReFuelEU Aviation regulation, in effect since January 2025 and part of the "Fit for 55" climate package. The regulation sets legally binding minimum shares of SAF that must be blended into aviation fuel supplied at EU airports, starting at 2% in 2025 and rising to 6% in 2030, 20% in 2035 and 70% by 2050.
- ReFuelEU creates the world's largest mandated market for SAF and provides a strong, long-term demand signal intended to drive investment in production, particularly within the EU; however, implementation challenges remain due to the high costs.
- In January 2025, the incoming Trump administration issued an executive order halting the disbursement of funds for implementing the 2024 US Aviation Climate Action Plan. In July 2025, the so-called One Big Beautiful Bill Act reduced SAF production incentives from USD 1.75 per gallon to USD 1 per gallon.
- Some European countries have implemented or considered demand-side measures that restrict short-haul flights where viable transport alternatives exist. In France, a 2022 law prohibits domestic flights on routes where a direct train journey of less than 2 hours and 30 minutes is available. Policy analysis has explored extending this ban to routes with train alternatives under five hours, which could greatly increase the number of affected routes and potential emission savings. However, critics argue that airlines may simply reallocate the freed-up slots to longer, potentially more carbon-intensive international flights; thus, short-haul bans should be implemented alongside broader measures that address potential rebound effects or emission leakage.
- Although the adoption of SAF and other decarbonisation technologies is expected to increase the cost of flying, it can also serve as a key means to moderate the growth in aviation demand. As of 2018, the demand for aviation from 1% of the world's population produced 50% of the sector's emissions, while around 80% of people had never set foot on a plane.
- Research from 2022 found that, globally, the wealthiest 5% of people accounted for 55% of aviation activity and emissions. However, the impact of higher flying costs will vary across regions and socio-economic groups. Addressing these distributional effects is crucial to maintain public support and ensure that the transition is perceived as fair.
- Policies aimed at mitigating these impacts could include targeted subsidies for essential routes, progressive taxation schemes that shield infrequent flyers, and using the revenue from aviation taxes to support lower-income groups or invest in alternative transport infrastructure.
- Some countries are applying the "polluter pays" principle more directly to aviation, including through aviation fuel taxes, national ticket taxes, frequent flyer levies and international solidarity levies to internalise the environmental costs of flying, moderate demand and generate revenue to fund climate mitigation or cleaner technologies such as SAF.
- With a small percentage of the population accounting for a large share of flights and emissions, frequent flyer levies are seen as an equitable tool targeting those who fly most frequently and often farthest (typically, higher-income individuals). This contrasts with the potentially regressive impact of flat taxes or general price increases resulting from SAF adoption, which could disproportionately affect those who rely on flying for essential connectivity.
- Despite the substantial revenue potential of taxes and levies, which could be channelled towards climate finance or subsidising SAF, significant implementation hurdles remain. These include persistent legal complexities surrounding fuel tax exemptions and the challenge of international co-ordination for global levies.
- As of December 2023, within the broad "transport services" sector, 337 companies globally had validated targets for emission reductions under the Science Based Targets initiative (SBTi), which provides a framework for companies to set emission reduction targets aligned with climate science.

KEY FINDINGS

- In July 2024, Air New Zealand, only the second carrier globally to have its targets validated under the SBTi aviation framework, abandoned its SBTi-validated goal to reduce its carbon intensity 28.9% below 2019 levels by 2030 (including a 16.3% cut in absolute emissions). Although the carrier reaffirmed its long-term goal of net zero emissions by 2050, its decision to abandon the 2030 goal underscores the practical difficulties the industry faces in delivering deep emissions cuts in the near term, given the state of technology deployment, fuel supply chains and enabling policies.
- Major aircraft manufacturers play a pivotal role in decarbonisation through the development and delivery of more efficient aircraft and enabling the use of future fuels.
- Ensuring that all manufacturers accept their life-cycle responsibility and set ambitious targets covering the in-use emissions of the aircraft they sell is critical for driving progress. Airbus' adoption of a specific Scope 3 intensity reduction target reflects an important signal.
- There are two main carbon market schemes in the aviation sector: the EU Emissions Trading System (ETS) and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). To avoid double-claiming benefits under the different schemes, airlines must carefully account for SAF use.
- This fragmentation of carbon reduction efforts for aviation, lacking a single, globally consistent carbon price signal, potentially leads to compliance complexities and competitive distortions.
- Financial support mechanisms are crucial enablers of the SAF transition, given the high cost of the fuels and the significant investment risks associated with developing new technologies and production facilities.
- Although the primary focus of aviation decarbonisation is on avoiding and reducing emissions at the source, there is growing recognition of the potential role of carbon dioxide removal (CDR) in addressing the residual emissions that remain after maximising reduction efforts.
- Decarbonising aviation is not an isolated challenge but requires unprecedented levels of collaboration across multiple stakeholder groups. This need for collaboration stems from the sheer complexity of the transition. Collaboration also faces challenges, as different stakeholders have varying, sometimes conflicting, interests.
- Building aviation's resilience requires a collaborative effort across the interconnected aviation network to ensure operational continuity and safety in a changing climate. There is a need for aviation stakeholders (airports, airlines, air navigation service providers) to conduct systematic climate risk assessments and develop adaptation plans. This involves understanding local climate projections, assessing vulnerabilities, prioritising risks and identifying adaptation measures.
- National adaptation plans are also beginning to incorporate transport sector strategies.





Context, challenges and opportunities

Measurable progress has been made since 2023 in addressing the climate impacts of aviation. However, achieving the sector's ambitions for net zero carbon emissions by 2050 remains a monumental challenge. Demand from both air passengers and air cargo has rebounded strongly, surpassing levels prior to the COVID-19 pandemic in 2020, driven especially by growth in developing economies. Although operational efficiencies are being pursued and fleet renewals continue to deliver incremental gains, these efforts alone will not be enough to counteract the emissions generated by rising traffic volumes in the coming decades, especially in low- and middle-income countries.

Sustainable aviation fuel (SAF) has emerged as the central pillar of the industry's decarbonisation strategy in the near to medium term. Production volumes have grown rapidly, with SAF supplies doubling to 1 million tonnes in 2024, but they remain a tiny fraction (less than 1%) of aviation's total fuel consumption.[1] Scaling SAF production to meet ambitious policy targets (e.g., 5-10% by 2030) requires overcoming hurdles related to high costs, securing sustainable feedstocks (beyond constrained waste oil supplies), attracting massive investment and accelerating the deployment of advanced conversion technologies such as power-to-liquids (e-fuels). Ensuring the environmental integrity of SAF through robust life-cycle analysis and certification remains critical.

Policy frameworks have advanced since 2023. The International Civil Aviation Organization's (ICAO) Global Framework provides high-level guidance and aspirational vision, and several regions have created greater market pull for SAF, including the European Union (EU) (through ReFuelEU), the United Kingdom (through legally binding mandates for SAF) and the United States.[2] The diversity of national policy approaches underscores the need for greater international harmonisation. Carbon market mechanisms such as the EU Emissions Trading System are being strengthened, and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) provides a global framework for carbon offsetting. Financial mechanisms are evolving beyond support for research and development (R&D) and towards de-risking commercial investment through instruments such as revenue guarantees.

Major manufacturers are actively developing disruptive technologies such as hydrogen and electric propulsion, but widespread deployment faces substantial technical and economic barriers within the 2050 time frame. Analysis of the emissions already committed from existing and planned conventional aircraft underscores the urgency of accelerating this transition, as current trajectories risk exceeding climate budgets as early as the mid-2030s.[3] In addition, impacts on global warming from sources other than carbon dioxide (CO_2) – such as nitrogen oxide (NO_x) emissions at altitude and the formation of persistent condensation trails (contrails) – have gained policy attention, with monitoring requirements commencing, but large-scale mitigation strategies appear less developed.

Decarbonising the aviation sector carries significant socio-economic consequences. Rising ticket prices, while potentially progressive in cost distribution, necessitate careful consideration of the equity impacts on people's connectivity and access. Managing the transition in the aviation labour market and ensuring environmental justice in fuel production are crucial components of an equitable shift. Finally, the sector must pro-actively adapt its activities, such as airport infrastructure and aircraft operations, to the increasing physical risks posed by climate change (flooding, extreme heat, turbulence, etc.).

So far, the scale and pace of change required to align aviation with a pathway to keep the average global temperature rise within 1.5 degrees Celsius (°C), or even to align it with a net zero emission pathway by 2050, remain immense. Bridging the gap requires sustained and intensified efforts across all fronts: accelerating the scale-up of SAF with robust sustainability safeguards, pushing the boundaries of technological innovation for both conventional and future aircraft, implementing effective and globally co-ordinated policies that include carbon pricing and demand management, mobilising

substantial and well-directed finance, and ensuring that the transition is environmentally sound and socially equitable. Continued collaboration among governments, industry, finance and research institutions is paramount to navigating this critical transformation.

Demand, use and access

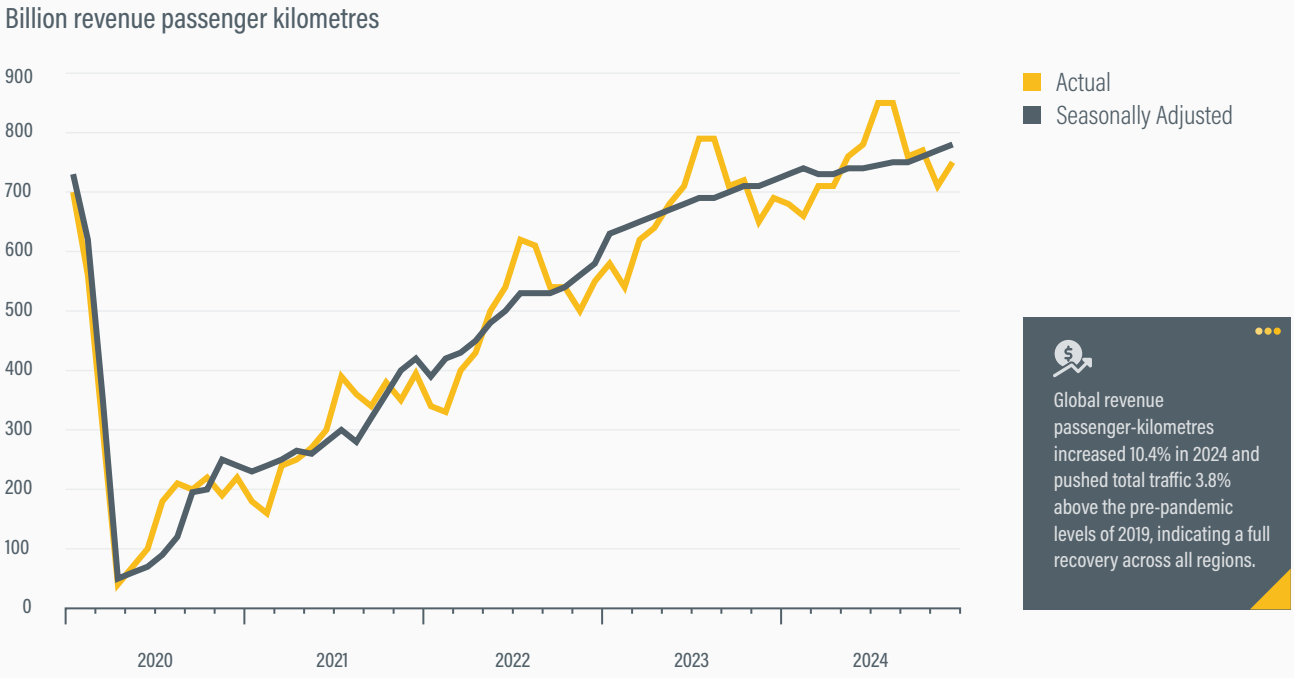
The air passenger market has demonstrated resilience and recent growth. Global revenue passenger-kilometres, a standard measure of passenger traffic, increased 10.4% in 2024 and pushed total traffic 3.8% above the pre-pandemic levels of 2019, indicating a full recovery across all regions (Figure 1).[4]

Evidence of strong aviation demand was reflected in record passenger load factors, as airlines used their capacity more efficiently than ever before to reach new highs both in December 2024 (84.0%) and for the full year (83.5%).[5] Although high load factors are positive from an operational efficiency perspective, efficiency improvements risk being overshadowed by the scale of rising demand for aviation, highlighting the core challenge of reducing absolute emissions in a growing market.

International passenger traffic was a major driver of aviation's 2024 recovery, climbing 13.6% despite ongoing geopolitical tensions and airspace restrictions that necessitated adjustments to global networks.[6] Domestic markets also contributed to the sector's growth, expanding 5.7% globally in 2024.[7] In the United States, domestic aviation grew 9% in 2023 to a record high of 1.25 billion passenger-kilometres.[8] However, the strong global growth trajectory showed signs of deceleration in 2024 compared to the initial sharp recovery in 2023, settling into rates more aligned with pre-pandemic long-term trends.[9]

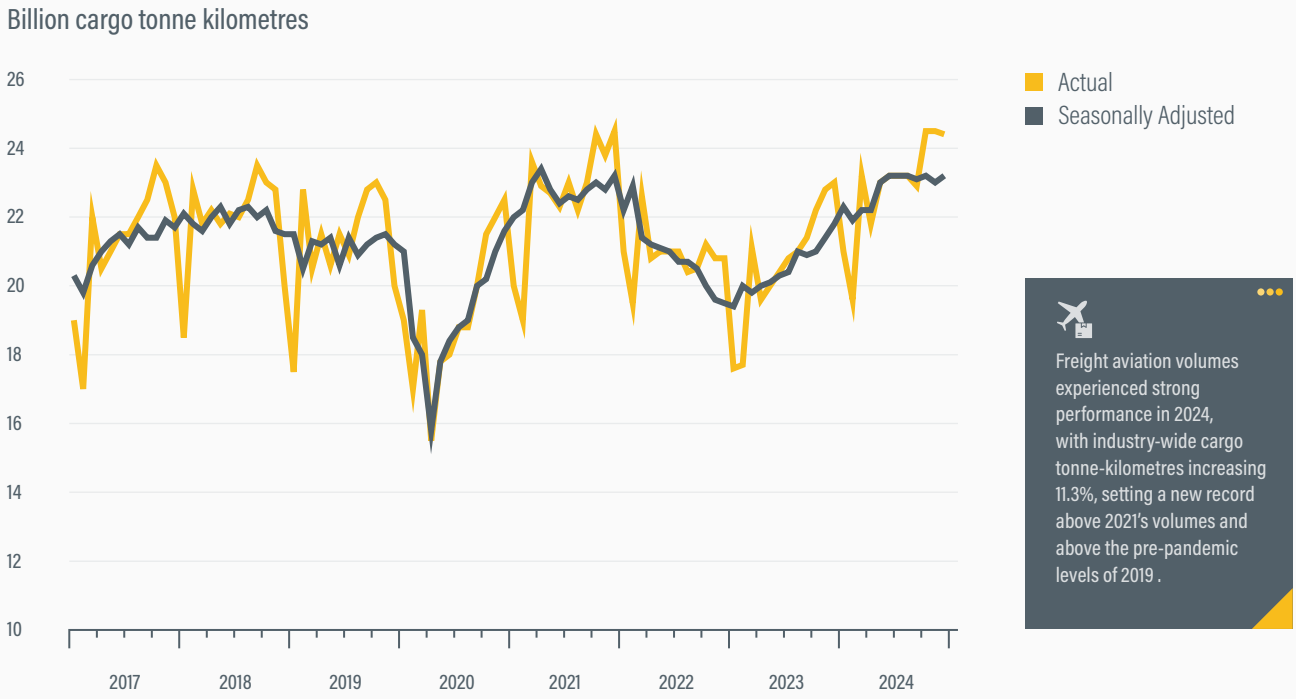
Aviation has played a minor role in global freight transport, representing only 1% of the global trade volume and just 0.1% of global freight tonne-kilometres in 2021.[10] Even so, cargo flights remain a key revenue stream for the airline industry, with commercial airlines making around 5-10% of their total revenue from hauling freight.[11]

FIGURE 1. Aviation passenger volumes (in billion revenue passenger kilometres), 2020-2024



Source: See endnote 4 for this section.

FIGURE 2. Freight aviation volumes (in billion cargo tonne kilometres), 2017-2024



Source: See endnote 12 for this section.

Freight aviation volumes experienced strong performance in 2024, with industry-wide cargo tonne-kilometres increasing 11.3%, setting a new record above 2021's volumes and above the pre-pandemic levels of 2019 (Figure 2).[12] **Contributing factors included booming e-commerce demand and continued disruptions in maritime shipping.** However, as with passenger traffic, the momentum in air cargo appeared to slow by the end of 2024.[13]

Available cargo capacity (in tonne-kilometres) hit a record high in the third quarter of 2024, supporting a rise in cargo load factors.[14] This capacity growth was due mainly to the increased availability of belly-hold space on recovering passenger flights.[15] Global air cargo yields saw their first annual increase since late 2022.[16]

Global aviation's recovery masks significant regional differences in demand growth, with particular dynamism in developing economies. The Asia Pacific region experienced a 16.9% increase in passenger traffic in 2024, driven by strong domestic markets in China and India, but international travel in the region remained below 2019 levels.[17] **Africa ranked second with a 13.2% increase in passenger traffic and notable growth on the Africa-Asia route.**[18]

- Air traffic in the Middle East benefited from airspace restrictions elsewhere in the world (provoked by conflicts), leading to greater traffic on Europe-Asia routes and substantial cargo growth in the region.[19]
- Europe experienced steady passenger growth and strong cargo volumes, while Latin America had moderate passenger growth but significant cargo growth.[20]
- North America had the slowest passenger growth in 2024 but experienced a late-year surge in domestic demand and moderate cargo growth.[21]

Strong passenger growth in Asia Pacific and Africa suggests a potential long-term shift in aviation expansion towards developing and emerging economies. China and India (and Asia Pacific as a whole) are projected to account for nearly half (46%) of the 42,430 new passenger and freighter deliveries in the 2024-2043 period.[22] **This has implications for future global emission trajectories, as these regions generally have lower historical emissions but higher growth potential. It underscores the critical need for globally inclusive and equitable decarbonisation strategies that support sustainable development alongside climate action.**

In addition to economic and demographic factors, geopolitical events have influenced regional aviation

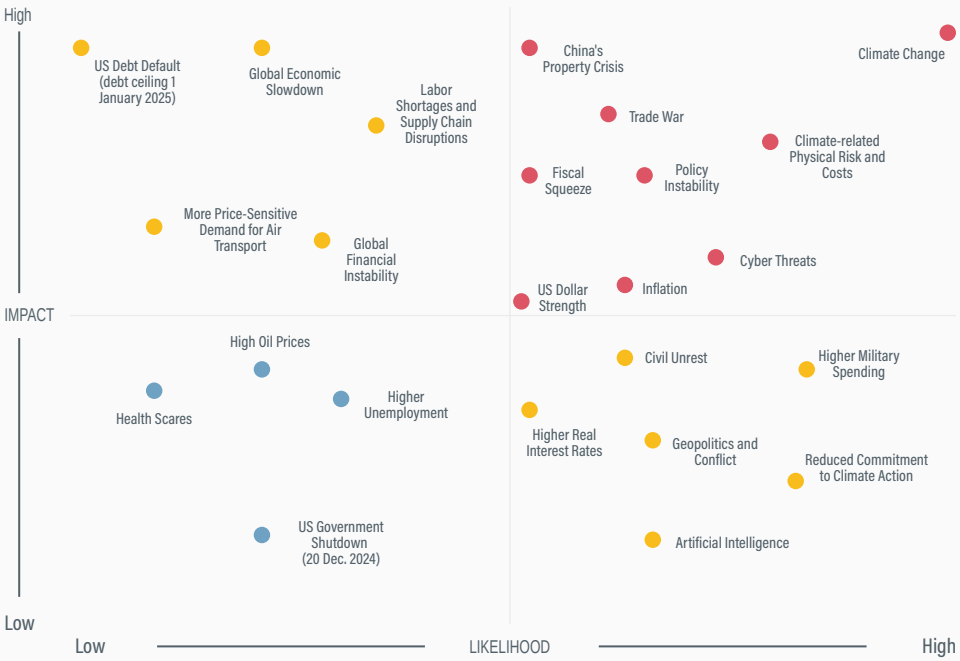
patterns, posing threats to the stability needed for long-term investments in decarbonisation. Both demand forecasts and effective decarbonisation planning must account for this volatility.[23] **Direct risks to airline operations and demand can stem from policy instability following major elections, potential trade disputes (e.g., US tariffs), a shifting global power balance (potentially leading to more conflict), and even reduced political commitment to climate action** (Figure 3)**.**[24] These factors pose indirect risks to sustainability initiatives by fostering economic (and investment) uncertainty, shifting policy priorities away from climate action and potentially disrupting supply chains for new technologies, critical minerals and sustainable fuels.

- Conflicts leading to airspace restrictions – such as the curtailment of international flights over the Russian Federation following its invasion of Ukraine in 2022 – have directly altered global air traffic patterns, while disrupting others.[25]
- Political tensions, such as between the United States and China, have limited airline capacity on certain routes and impacted the recovery of international travel in regions such as Asia Pacific.[26]

Behavioural factors and consumer preferences are increasingly influencing travel choices, including a potential shift from air travel to high-speed rail for shorter journeys. The resurgence in international travel, particularly from the Asia Pacific region, reflects pent-up demand as travel restrictions related to the COVID-19 pandemic eased. Record-breaking load factors also point to a strong underlying desire to travel. For high-speed rail, evidence of a shift exists on specific routes: in Spain, the decision of airline Vueling to terminate its Madrid-Barcelona flights explicitly cited the growing market share of high-speed rail, which reduced the journey to as little as 2 hours and 30 minutes.[27]

The cost of air travel is a significant factor influencing demand, and decarbonisation efforts are widely expected to exert upward pressure on prices. The deployment of SAF, which currently costs 2-8 times more than conventional fuel, is a primary driver of anticipated cost increases.[28] Modelling of a decarbonisation scenario suggests that higher ticket prices will likely moderate the rise in demand, with passenger growth in Europe expected to fall from a baseline of 2.0% per year to 1.4% per year due to cost impacts.[29]

FIGURE 3. Assessment of potential risks to the global economy that can affect aviation, as of 2025



In addition to economic and demographic factors, geopolitical events have influenced regional aviation patterns, posing threats to the stability needed for long-term investments in decarbonisation. Both demand forecasts and effective decarbonisation planning must account for this volatility. Direct risks to airline operations and demand can stem from policy instability following major elections, potential trade disputes (e.g., US tariffs), a shifting global power balance (potentially leading to more conflict), and even reduced political commitment to climate action.

Source: See endnote 24 for this section.

Sustainability and climate trends

The global transition towards net zero aviation will inevitably have consequences; it is not solely a technical and economic challenge, but also carries significant social and equity implications. These must be carefully managed to ensure fairness and to minimise negative impacts on connectivity (particularly for remote regions or island states), equity in access, and economic growth related to jobs and tourism.[30]

In 2024, aviation supported an estimated 11.6 million direct jobs and 20.4 million indirect jobs globally and contributed USD 4.1 trillion (3.9%) to the global gross domestic product (GDP) – reflecting the strong link between economic prosperity and air travel growth.[31] A further 17.2 million jobs were induced by the spending of aviation employees in the wider economy, and aviation also supported 37.3 million jobs through tourism.[32] The sector's extensive supply chain amplifies its impact on job creation worldwide.

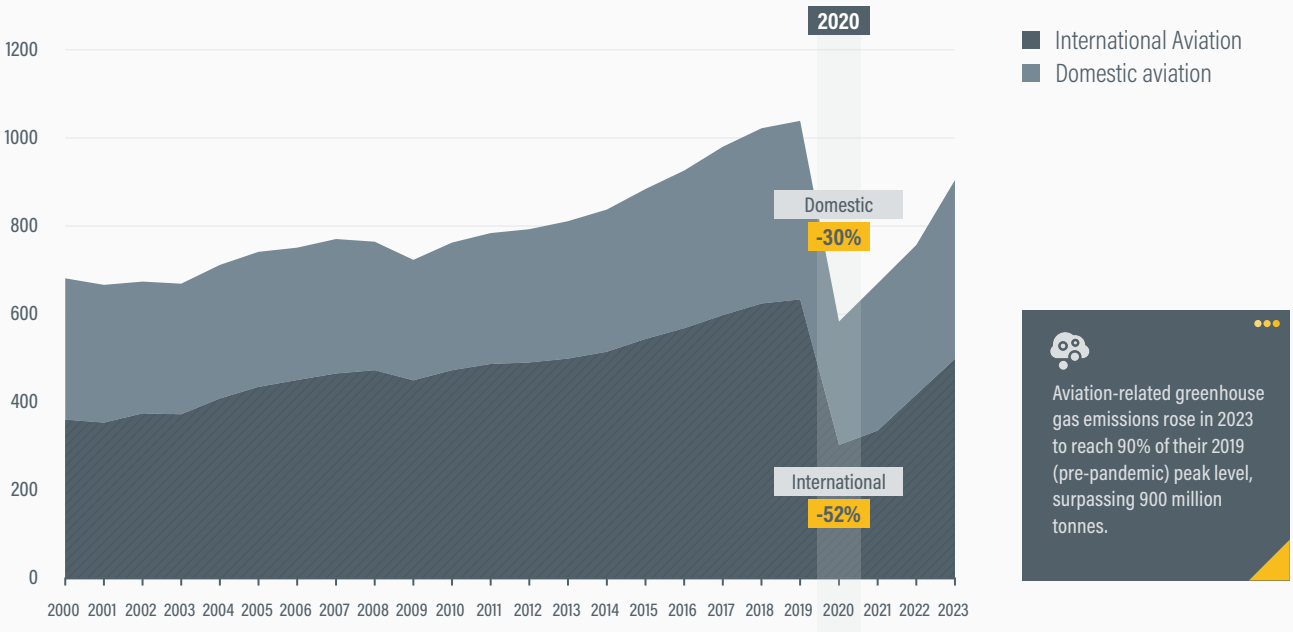
- Regional estimates for the Asia Pacific region, based on other methodologies, found that air transport (domestic, regional and international) employed 42 million people in 2023 and contributed USD 890 billion to the region's GDP.[33]
- Air transport in Asia – and related job opportunities – have expanded rapidly, driven by rising middle-class demand, low-cost carrier networks and international tourism. (See 3.2 Asia Regional Overview.)

Aviation's role in facilitating global connectivity supports economic growth, enables trade and tourism, fosters international collaboration, and provides access to essential services and humanitarian aid. Overall, the sector supports many of the 17 United Nations Sustainable Development Goals (SDGs), including SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships). Maintaining these positive contributions while mitigating the sector's emissions and supporting climate action (SDG 13) is a key aspect of a sustainable and just transition.

As both air passenger and air cargo demand recovered in 2023, aviation-related greenhouse gas emissions rose to reach 90% of their 2019 (pre-pandemic) peak level (Figure 4)**.**[34] **Aviation emissions grew in nearly all regions to just over 900 million tonnes of CO_2 equivalent, of which around 10% was from cargo planes.**[35] **International aviation emitted 498 million tonnes of CO_2 equivalent, while domestic aviation contributed 406 million tonnes.**[36] **Aviation's CO_2 equivalent emissions were expected to surpass their 2019 level in**

FIGURE 4. Global aviation emissions (domestic and international), 2000-2023

Greenhouse gas emissions from aviation in million tonnes CO_2 equivalent



Source: See endnote 34 for this section.



2025.[37] Historically, the sector's emissions grew 2.2% annually on average between 2000 and 2019, then dropped from more than 1,000 million tonnes in 2019 to less than 600 million tonnes in 2020, in the context of the COVID-19 pandemic.[38]

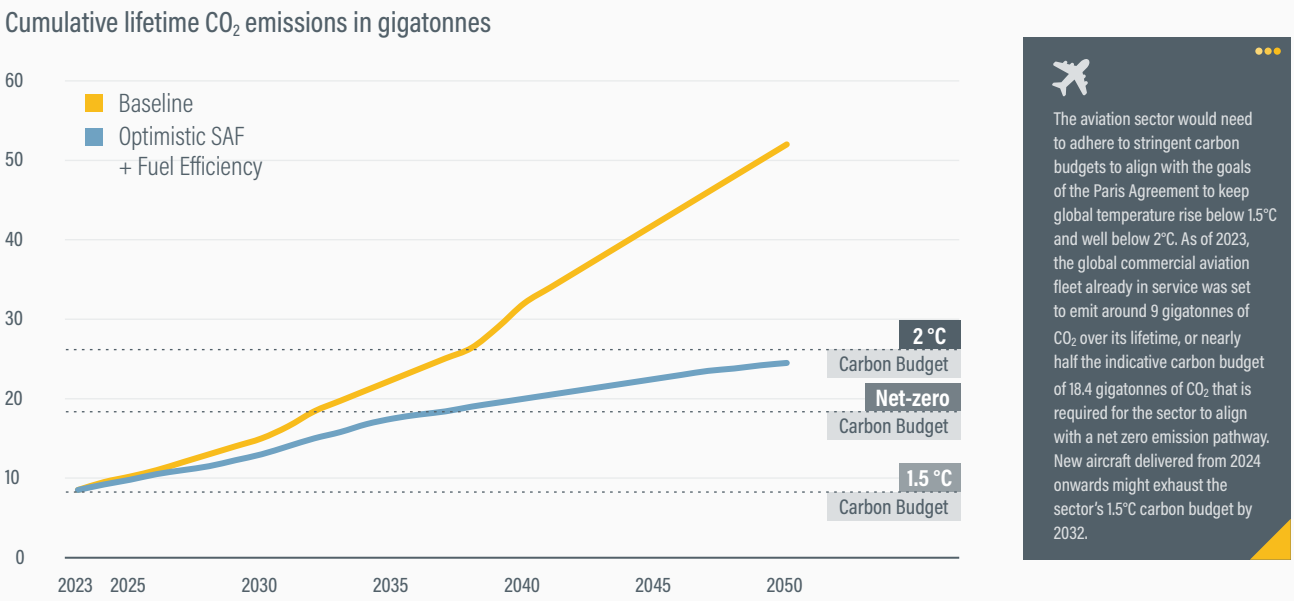
Aviation contributed only around 2.2% of the total global CO_2 emissions from human activities in 2023; however, the sector's absolute volume of emissions was still substantial.[39] **Between 1990 and 2023, air traffic grew 5% annually on average, while CO_2 emissions from aviation grew 2%, indicating some efficiency gains but still resulting in a net increase in emissions over the period.**[40] **The sector's demand growth rate has outpaced overall emission reductions in many economies.**[41]

- In 2024, rising energy demand, particularly aviation fuel consumption, contributed to an increase in global oil-related CO_2 emissions, even as the overall growth in energy-related CO_2 emissions slowed compared to 2023.[42]
- In the EU, aviation has experienced the fastest emission growth among transport modes in recent decades, contributing 13.9% of the region's transport greenhouse gas emissions in 2022 (the second largest source after road transport).[43] (See 3.3 Europe Regional Overview.)

Around 80% of the CO_2 emissions from aviation originate from flights of more than 1,500 kilometres, distances that generally cannot be substituted by rail.[44] **This has profound implications for decarbonisation strategies and underscores the importance of developing and deploying scalable solutions that can effectively reduce emissions from medium- and long-haul flights; the leading solution is SAF, and potentially also future fuel-efficient aircraft and propulsion technologies.** The impact on global aviation emissions of a modal shift from air to high-speed rail appears limited, based on the available information.

The International Civil Aviation Organization has adopted a Long-term Global Aspirational Goal (LTAG) for the international aviation sector of achieving net zero carbon emissions by 2050.[45] **To meet this goal, the ICAO and its Member States strive to reduce CO_2 emissions in international aviation by 5% by 2030 through the use of cleaner fuels such as SAF, without specific obligations or commitments in the form of emission reduction goals attributed to individual members.**[46] Analysis of cumulative emissions reveals the immense scale of the challenge.

FIGURE 5. Consumption of aviation carbon budget from cumulative lifetime emissions of projected fleet



The aviation sector would need to adhere to stringent carbon budgets to align with the goals of the Paris Agreement to keep global temperature rise below 1.5°C and well below 2°C. As of 2023, the global commercial aviation fleet already in service was set to emit around 9 gigatonnes of CO_2 over its lifetime, or nearly half the indicative carbon budget of 18.4 gigatonnes of CO_2 that is required for the sector to align with a net zero emission pathway. New aircraft delivered from 2024 onwards might exhaust the sector's 1.5°C carbon budget by 2032.

Source: See endnote 48 for this section

The aviation sector would need to adhere to stringent carbon budgets to align with the goals of the Paris Agreement to keep global temperature rise below 1.5°C and well below 2°C.[47] **As of 2023, the global commercial aviation fleet already in service was set to emit around 9 gigatonnes of CO_2 over its lifetime, or nearly half the indicative carbon budget of 18.4 gigatonnes of CO_2 that is required for the sector to align with a net zero emission pathway** (Figure 5)**.**[48] **New aircraft delivered from 2024 onwards might exhaust the sector's 1.5°C carbon budget by 2032.**[49]

For flights within and departing the EU-27, the United Kingdom, and the European Free Trade Association region, cumulative net aviation CO_2 emissions between 2020 and 2050 would total around 3.3 gigatonnes under the region's proposed net zero pathway.[50] This is 52% below the 6.9 gigatonnes of emissions that would result in a reference scenario without climate action.[51]

Aviation's carbon budget constraints underscore that relying solely on incremental efficiency gains and SAF deployment in conventional aircraft may be insufficient, particularly to achieve the ambitious 1.5°C target. This points to an urgent need either for much sooner and larger-scale deployment of genuinely zero-emission aircraft (powered by hydrogen or electricity), or for the delivery of aircraft from the mid-2030s onwards that operate exclusively on 100% SAF, with extremely low life-cycle emissions.[52]

The risk of remaining dependent on the current (high-carbon) pathway is significant. The continued production and delivery of new aircraft designed primarily for fossil fuels, even if they incorporate efficiency improvements, locks in emissions for decades due to the long operational lifespan of aircraft (20-30 years).[53] This inertia makes the transition progressively harder and increases the likelihood that the sector will need to rely on large-scale, potentially costly, and technologically nascent carbon dioxide removal (CDR) technologies towards 2050 to balance the residual emission budget.[54]

Models of future CO_2 emission trajectories for the aviation sector illustrate the critical levers for decarbonisation, based on varying assumptions about technology, policy and demand.[55] **If current growth trends continue without significant intervention, aviation's CO_2 emissions could potentially triple by 2050.**[56] **The stark contrast between potential net zero pathways and the possibility of emissions tripling highlights the transformative nature of the changes required and the high stakes involved in failing to implement effective mitigation measures.** The divergence across scenarios underscores the high degree of uncertainty about the sector's future emission trajectory.

- The ICAO projects that by 2050, aviation's CO_2 emissions will drop to 200 million tonnes of residual emissions (those that remain unabated, even after maximising reduction efforts), achieved through aircraft technologies (21%), operations (11%) and fuels (55%).[57]

- The International Energy Agency's (IEA) Net Zero Emissions (NZE) Scenario envisions around 210 million tonnes of CO_2 emissions by 2050, achieved through efficiency improvements, policies favouring high-speed rail and curbing business travel, and increases in SAF and hydrogen-based synthetic fuels.[58]
- The European industry roadmap Destination 2050 outlines the achievement of net zero CO_2 emissions by 2050 for flights within and departing the EU-27, United Kingdom and European Free Trade Association region, to be attained through SAF (35%), aircraft and engine technology (27%), optimised operations (6%) and demand reduction due to higher prices; the remaining 10% reduction (around 29 million tonnes) is through carbon removals outside the sector.[59]
- The Air Transport Action Group (ATAG) envisions net zero emissions by 2050, achieved through SAF (53-71%), technology improvements (12-34%), operational improvements (7-10%) and market-based measures (6-8%).[60]
- The International Council on Clean Transportation's (ICCT) Budget-Based Scenarios for aviation are focused on carbon budget alignment, aggressive SAF uptake and efficiency, and the need for zero-emission aircraft or 100% low-emission SAF for new deliveries by the mid-2030s.[61]

Operational improvements such as enhancing the efficiency of air traffic management and aircraft operations can yield immediate fuel savings and emission reductions. Collectively, operational efficiencies offer a maximum emission reduction potential of 10%.[62] Initiatives to modernise airspace management include the US Next Generation Air Transportation System (NextGen) and Europe's Single European Sky ATM Research (SESAR).[63] Improving data quality, automation and weather information systems can further enable flight path optimisation and more fuel-efficient routing.

Fleet renewal remains a cornerstone of aviation's decarbonisation strategy. New-generation aircraft delivered by major manufacturers such as Airbus, Boeing, COMAC and Embraer are a reported 20-30% more efficient than the older models they replace.[64] **However, the rate of fuel efficiency improvement (around 1% per year) has stagnated since 2020.**[65] **If all cost-effective technologies are adopted, annual fuel burn reductions of up to 2.2% are technically possible through 2034, although current trends are slower.**[66] The efficiency lull exists in part because manufacturers have focused on refining existing models rather than launching new "clean sheet" designs, which limits incorporation of the latest technologies.[67]

Airlines have invested heavily in new aircraft, with more than 19,360 new planes delivered since 2009 and a production backlog of around 15,700 new-technology aircraft set to enter the fleet from 2023 onwards.[68] **The combination of new technology, operational efficiencies and infrastructure improvements avoided an estimated 14.6 billion tonnes of CO_2 between 1990 and 2023, according to industry sources.**[69]

Research and development continue to target further incremental improvements. Disruptive technologies such as battery electric and hydrogen propulsion hold promise for zero-emission flight but face large hurdles to widespread adoption by 2050, with commercial deployment not expected before the late 2030s.[70] **Their contribution to overall aviation fuel consumption and emission reduction by 2050 is projected to be limited in most scenarios.**[71] This is because of challenges related to energy density, range, payload capacity, infrastructure requirements, and the long timelines for aircraft development, certification and fleet turnover.

The critical timing gap reinforces the importance of SAF, which is widely regarded as the most significant near- to medium-term solution for decarbonising aviation. Global SAF production more than doubled in 2024 to 1 million tonnes (1.3 billion litres) – up from around 0.5 million tonnes (600 million litres) in 2023 – and is projected to double again to 2.1 million tonnes (2.7 billion litres) in 2025 (albeit starting from a very low base).[72] SAF offers a "drop-in" replacement for conventional jet fuel with substantially lower life-cycle emissions (see 5.1 Transport Energy Sources). Tracking its production is key to assessing progress (for example, through the ICAO's Cleaner Energy Tracker Tools).[73]

Despite its rapid growth rate, SAF's share of total global aviation fuel consumption was only around 0.15% in 2023, rising to 0.3% in 2024 and a projected 0.7% in 2025.[74] **Scaling SAF production to meet 2050 targets is a monumental undertaking, requiring an estimated USD 1.5 trillion in capital investment over 30 years.** [75]

Demand signals for SAF have arisen from policy mandates in the EU and the United Kingdom, goals in the United States, and growing voluntary commitments from airlines. Yet securing the necessary long-term off-take agreements remains a hurdle. SAF producers typically require bankable contracts of 10 or more years to secure financing for new plants. However, off-takers (such as airlines) often prefer shorter-term contracts due to price and volume uncertainties. This mismatch contributed to a slowdown in off-take agreement announcements in 2023/2024 after a peak in 2022.[76]

Beyond CO_2 emissions, aviation impacts the climate greatly through non-CO_2 effects, including the release of nitrogen oxide (NO_x) emissions at altitude and the formation of persistent condensation trails (contrails) and contrail-induced cirrus clouds. These effects could equal or exceed the total climate warming impact of aviation's CO_2 emissions alone (Figure 6).[77]

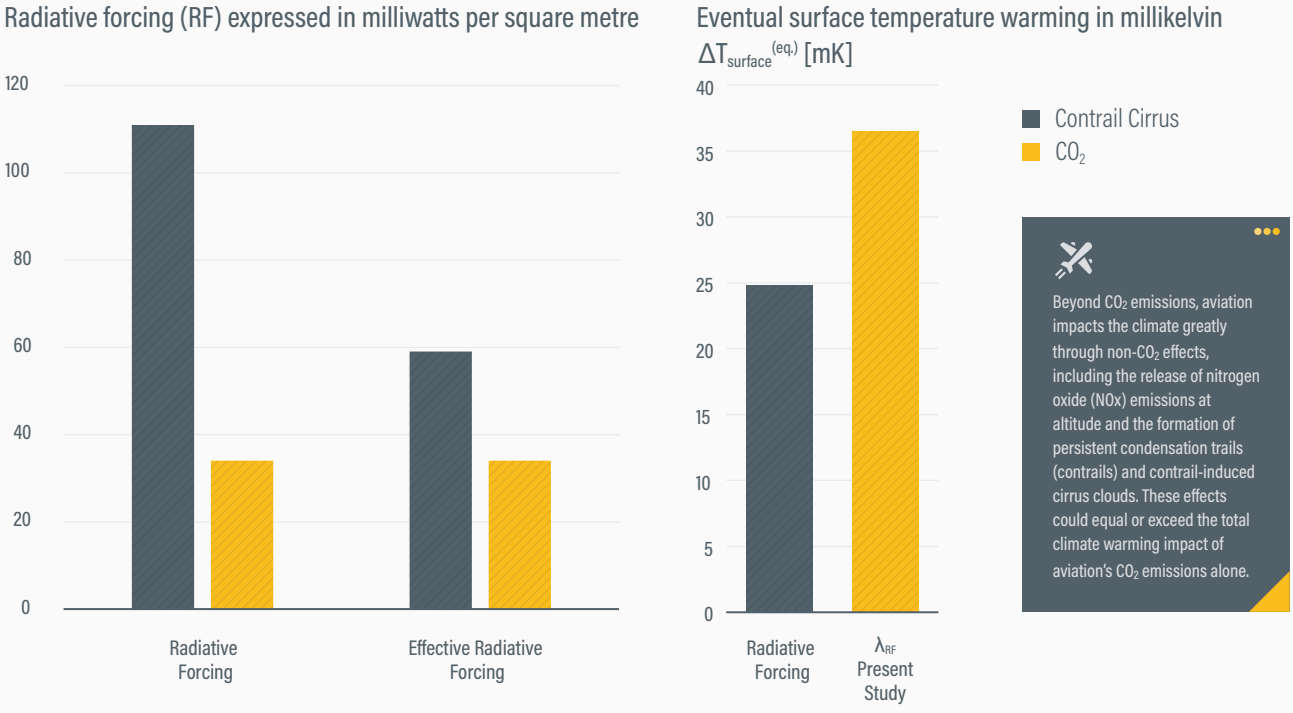
Despite the growing recognition of non-CO_2 effects and the initiation of monitoring requirements, the implementation of large-scale trials and mitigation strategies to address these effects appears less advanced compared to measures targeting CO_2.[78] Translating this into effective, globally co-ordinated mitigation action remains a key challenge and opportunity for the coming years, provided uncertainties related to ice super-saturated regions to avoid are properly quantified.[79] Data are lacking on the widespread implementation or regulatory status of operational measures such as flight rerouting to avoid contrail-prone atmospheric regions, and on changes in fuel composition (potentially a co-benefit of certain SAF with lower aromatic content).[80]

In addition to mitigating its own climate impact, the aviation sector must adapt to the unavoidable consequences of climate change already under way, including increasing disruptions from more frequent and intense extreme weather events. Initiatives are emerging to study these impacts and to develop adaptation strategies.[81] In Europe, physical risks facing aviation infrastructure and operations include increased temperatures (leading to reduced aircraft performance, heat damage to pavements, increased demand for cooling, and heat stress for personnel/passengers); changes in storms and precipitation (causing operational disruptions such as delays, cancellations and diversions); flooding of airfields and infrastructure; damage from wind and lightning; disruption to ground access; and sea-level rise (threatening coastal airports with inundation and loss of capacity).[82] Additional impacts include changes in wind patterns (affecting routes and turbulence), shifts in biodiversity (such as increased risk of bird strikes), changes in icing conditions and potential desertification effects.[83]

Policy and investment developments

In 2022, the ICAO Assembly adopted its Long-Term Aspirational Goal (LTAG) for international aviation to achieve net zero carbon emissions by 2050.[84] This global goal signals a collective ambition to align the sector with the

FIGURE 6. Estimation of the contrail cirrus climate impact on global surface temperature



Source: See endnote 77 for this section.

global warming targets of the Paris Agreement, although it is not binding on individual member states. The ICAO provides the primary platform for co-ordinating global action on the aviation sector's efforts to address climate change. Although the LTAG has global application, initial participation is explicitly non-binding on individual ICAO members (whereas the net zero regulations recently adopted by the International Maritime Organization also apply worldwide but are mandatory across the maritime sector from October 2025).[85]

To support the LTAG, in November 2023 the third ICAO Conference on Aviation and Alternative Fuels adopted the "ICAO Global Framework for Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other Aviation Cleaner Energies".[86] The Framework includes a collective global aspirational vision to reduce CO_2 emissions in international aviation 5% by 2030 through the use of cleaner energy sources, compared to a baseline that assumes zero use of cleaner energy.[87] This framework outlines a comprehensive strategy, emphasising that cleaner energy sources such as SAF are expected to make the largest contribution to CO_2 reductions by 2050. Its four building blocks are: policy and planning, regulatory framework, implementation support and financing.[88]

The EU has taken a leading role in translating international goals into binding regional legislation with its landmark ReFuelEU Aviation regulation, in effect since January 2025 and part of the "Fit for 55" climate package. The regulation sets legally binding minimum shares of SAF that must be blended into aviation fuel supplied at EU airports, starting at 2% in 2025 and rising to 6% in 2030, 20% in 2035 and 70% by 2050.[89]

ReFuelEU creates the world's largest mandated market for SAF and provides a strong, long-term demand signal intended to drive investment in production, particularly within the EU; however, implementation challenges remain due to the high costs. Within the overall SAF share, a specific, escalating sub-mandate for e-SAF aims to accelerate the development and deployment of this advanced, potentially highly sustainable pathway; it starts at an average of 1.2% for 2030-2031, rising to 5% in 2035 and 35% by 2050.[90]
(See 5.1 Transport Energy Sources for national-level efforts on SAF.)

In January 2025, the incoming Trump administration issued an executive order halting the disbursement of funds for implementing the 2024 US Aviation Climate Action Plan.[91] In July 2025, the so-called One Big Beautiful Bill Act reduced SAF production incentives from USD 1.75 per gallon to USD 1 per gallon.[92] The bill reinforced crop-based production using corn and soybeans, resulting in increases in food prices and emissions from land use.[93]

Some European countries have implemented or considered demand-side measures that restrict short-haul flights where viable transport alternatives exist. In France, a 2022 law prohibits domestic flights on routes where a direct train journey of less than 2 hours and 30 minutes is available.[94] Policy analysis has explored extending this ban to routes with train alternatives under five hours, which could greatly increase the number of affected routes and potential emission savings.[95] However, critics argue that airlines may simply reallocate the freed-up slots to longer, potentially more carbon-intensive international flights; thus, short-haul bans should be implemented alongside broader measures that address potential rebound effects or emission leakage.[96]

Although the adoption of SAF and other decarbonisation technologies is expected to increase the cost of flying, it can also serve as a key means to moderate the growth in aviation demand. As of 2018, the demand for aviation from 1% of the world's population produced 50% of the sector's emissions, while around 80% of people had never set foot on a plane.[97] Research from 2022 found that, globally, the wealthiest 5% people accounted for 55% of aviation activity and emissions.[98] However, the impact of higher flying costs will vary across regions and socio-economic groups.[99] Addressing these distributional effects is crucial to maintain public support and ensure that the transition is perceived as fair.[100]

Policies aimed at mitigating these impacts could include targeted subsidies for essential routes, progressive taxation schemes that shield infrequent flyers, and using the revenue from aviation taxes to support lower-income groups or invest in alternative transport infrastructure. In western Europe, the highest-income households (over USD 103,505 or EUR 100,000 per year) are at least six times more likely to take three or more return flights per year than those on the lowest incomes (under USD 20,701 or EUR 20,000 per year).[101] Among the lowest-income group in western Europe, nearly 70% of households do not fly in any given year, compared with just over 20% among the highest-income households.[102]

Some countries are applying the "polluter pays" principle more directly to aviation, including through aviation fuel taxes, national ticket taxes, frequent flyer levies and international solidarity levies to internalise the environmental costs of flying, moderate demand and generate revenue to fund climate mitigation or cleaner technologies such as SAF.[103] Growing consideration of direct pricing mechanisms indicates a potential shift towards making passengers and airlines bear a greater share of the climate cost of aviation, with the aim of ensuring a just transition.[104]



With a small percentage of the population accounting for a large share of flights and emissions, frequent flyer levies are seen as an equitable tool targeting those who fly most frequently and often farthest (typically, higher-income individuals).[105] **This contrasts with the potentially regressive impact of flat taxes or general price increases resulting from SAF adoption, which could disproportionately affect those who rely on flying for essential connectivity.**[106] The Global Solidarity Levies Task Force is co-ordinating growing international momentum to implement levies on aviation (either fuel or tickets, and potentially frequent flyer levies) to generate predictable funding – estimated at USD 6.2 billion to USD 20.7 billion (EUR 6-20 billion) annually for climate adaptation and mitigation in vulnerable countries.[107]

Despite the substantial revenue potential of taxes and levies, which could be channelled towards climate finance or subsidising SAF, significant implementation hurdles remain. These include persistent legal complexities surrounding fuel tax exemptions (despite arguments for their permissibility) and the challenge of international co-ordination for global levies. While recognising the need to support the reduction and stabilisation of CO_2 emissions from all sources, ICAO and its Member States have expressed concern on the use of international aviation as a potential source for the mobilisation of revenue for climate finance to other sectors, in order to ensure that international aviation would not be targeted in a disproportionate manner.[108]

As of December 2023, within the broad "transport services" sector, 337 companies globally had validated targets for emission reductions under the Science Based Targets initiative (SBTi), which provides a framework for companies to set emission reduction targets aligned with climate science.[109] The SBTi published an "Interim 1.5°C Aviation Pathway" in February 2023, enabling airlines and potentially other companies in the sector to set science-based net zero targets.[110] However, the exact number of aviation companies with validated targets under this pathway is not specified.

- The SBTi Corporate Net-Zero Standard (CNZS) is under revision, with potentially significant changes introduced for target setting for Scope 3 emissions, clearer integration of carbon removals, as well as reporting on progress in achieving targets.[111] The revision will be crucial for the SBTi to remain one of the most widely recognised standards and a reference for companies to set science-based targets.

- A separate assessment noted that more than three-quarters of the world's 20 largest airlines have now established public targets for SAF uptake.[112]

In July 2024, Air New Zealand, only the second carrier globally to have its targets validated under the SBTi aviation framework, abandoned its SBTi-validated goal to reduce its carbon intensity 28.9% below 2019 levels by 2030 (including a 16.3% cut in absolute emissions).[113] **Although the carrier reaffirmed its long-term goal of net zero emissions by 2050, its decision to abandon the 2030 goal underscores the practical difficulties the industry faces in delivering deep emissions cuts in the near term, given the state of technology deployment, fuel supply chains and enabling policies.** Stated reasons for Air New Zealand's shift included delays in the delivery of new, more fuel-efficient aircraft due to global manufacturing issues; the prohibitive cost and insufficient availability of SAF; and challenging policy settings.[114] Other airlines may similarly question their ambitious 2030 targets if the necessary conditions for success do not materialise rapidly.

Major aircraft manufacturers play a pivotal role in decarbonisation through the development and delivery of more efficient aircraft and enabling the use of future fuels. Their strategies and targets reflect the key technological pathways being pursued.

- Airbus is focused on improving its fleet efficiency (around a 25% gain in the latest generation), achieving 100% SAF capability by 2030 and advancing key technologies for next-generation aircraft.[115] It researches non-CO_2 impacts and invests in carbon removals. Airbus has SBTi-validated targets, including a 63% absolute reduction in operational (Scope 1 and 2) emissions by 2030 and a 46% reduction in the emissions intensity (Scope 3) of its commercial aircraft in service by 2035.[116] The company links its activities to contributing to various UN SDGs.[117]
- Through its "Cascade Climate Impact Model", Boeing is prioritising fleet renewal (newest jets 20-30% more efficient), operational efficiency improvements (working with airlines and air traffic management providers), SAF enablement (targeting 100% compatibility by 2030, investing in testing, and partnering on production) and advancing future technologies.[118] Key technology projects include the Transonic Truss-Braced Wing (TTBW) demonstrator with the US space agency NASA.[119]
- Embraer aims for carbon neutrality in its operations (Scope 1 and 2) by 2040 (including 100% renewable energy use by 2030) and supports the industry goal of net zero aviation by 2050.[120] Its strategy focuses on improving the efficiency of aircraft (the E2 family offers around a 25% improvement), achieving 100% SAF compatibility and developing electric/hybrid propulsion (Energia family concepts).[121]
- As a state-owned enterprise, COMAC's approach reflects the Chinese government's emphasis on balancing economic growth with environmental responsibility. The company is focused on developing more fuel-efficient aircraft and increasing the adoption of SAF. Additionally, COMAC is investing in research and development for next-generation technologies, in line with China's strategic focus on innovation and technological self-sufficiency.[122]

However, the primary climate impact of aircraft manufacturers lies not in their own operations (Scope 1 and 2 emissions) but in the emissions generated by the aircraft they sell, throughout their decades-long service lives (Scope 3 emissions). **Ensuring that all manufacturers accept their life-cycle responsibility and set ambitious targets covering the in-use emissions of the aircraft they sell is critical for driving progress. Airbus' adoption of a specific Scope 3 intensity reduction target reflects an important signal.**[123]

There are two main carbon market schemes in the aviation sector: the EU Emissions Trading System (ETS) and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). To avoid double-claiming benefits under the different schemes, airlines must carefully account for SAF use.[124]

- The EU ETS' cap-and-trade system applies to flights within the European Economic Area.[125] It sets a declining cap on emissions, and operators must surrender allowances to cover their verified emissions. Recent revisions have strengthened the system, phasing out free allowances for aviation by 2027 to increase the sector's contribution to EU climate goals. The EU ETS is also expanding its scope to include monitoring and reporting of non-CO_2 climate effects, starting in 2025.[126] Revenues generated or allowances saved through SAF use can potentially support further decarbonisation.
- CORSIA is the ICAO's global market-based measure to address CO_2 emissions from international flights above a defined baseline, with the goal of achieving carbon-neutral growth.[127] Airlines operating international flights between participating states can offset any emissions exceeding this baseline by purchasing and cancelling CORSIA Eligible Emissions Units (EEUs) generated from approved carbon reduction projects elsewhere.[128]
- As of autumn 2024, global emissions had reportedly not yet reached the threshold triggering offsetting obligations under CORSIA.[129] From 2024 to 2035, the baseline is set at 85% of 2019 emission levels, and the scheme is expected to mitigate between 1.2 billion and 2 billion tonnes of CO_2 during this period.[130] Participating in CORSIA remains voluntary until 2027.[131]



This fragmentation of carbon reduction efforts for aviation, lacking a single, globally consistent carbon price signal, potentially leads to compliance complexities and competitive distortions. The EU ETS and CORSIA interact: the EU uses ETS rules to implement CORSIA obligations for extra-EEA flights operated by EU-based airlines. The EU ETS covers intra-EEA flights, whereas CORSIA targets the growth in international emissions (but has yet to require offsetting); various national taxes or levies add another layer.

The environmental integrity of CORSIA, as an offset-based mechanism, depends critically on the quality of the EEUs and the robust implementation of accounting rules under Article 6 of the Paris Agreement by host countries providing the offsets. This involves rigorous processes for authorisation, tracking, reporting and applying "corresponding adjustments" to national emission inventories to prevent double counting of emission reductions.[132] Ensuring this integrity across countries with varying capacities is an ongoing governance challenge for the ICAO and the international climate regime, also requiring co-ordination with the UN Framework Convention on Climate Change. With the progress made on Article 6 at the 2024 UN Climate Change Conference in Azerbaijan (COP 29) and the existence of stringent CORSIA Emissions Units Eligibility Criteria as approved by the ICAO Council, governments hosting activities that generate EEUs now have the guidelines they need to authorise the use of these units under CORSIA.[133]

Financial support mechanisms are crucial enablers of the SAF transition, given the high cost of the fuels and the significant investment risks associated with developing new technologies and production facilities.

- For risk mitigation, access to low-interest loans and loan guarantees from public finance institutions (such as the European Investment Bank or national development banks) and export credit agencies is seen as vital, particularly for first-of-a-kind projects.[134]
- To support market aggregation and facilitation, concepts such as Green Market Makers, potentially using blended finance (public/private capital), aim to bridge the price gap, provide liquidity, absorb risk and facilitate off-take agreements. Demand pooling instruments have also been proposed.[135]
- Efforts are under way to improve access to international climate finance, especially for low- and middle-income

countries. The ICAO Finvest Hub aims to improve access to international climate finance for aviation decarbonisation, particularly for low- and middle-income countries, by connecting countries and project developers with funding opportunities, whereas and proposals for Global Solidarity Levies target high-emitting sectors (e.g., aviation) for climate and development financing to other sectors.[136]

Although the primary focus of aviation decarbonisation is on avoiding and reducing emissions at the source, there is growing recognition of the potential role of carbon dioxide removal (CDR) in addressing the residual emissions that remain after maximising reduction efforts. CDR activities remove CO_2 from the atmosphere and durably store it in geological, terrestrial, or ocean reservoirs, or in products. It is distinct from carbon capture and storage (CCS) from fossil fuel point sources, and from carbon offsetting that typically involves funding emission reductions elsewhere. CDR is primarily considered a means to neutralise the residual emissions that might come from legacy aircraft still in operation or from specific flight operations where SAF or low-emission aircraft are not yet feasible, or that could persist if the deployment of primary mitigation measures falls short of expectations.

- The Destination 2050 roadmap for European aviation relies on CDR – specifically direct air carbon capture and storage (DACCS) – to achieve net zero emissions by 2050, modelling it to address the final 10% (around 29 million tonnes) of emissions.[137]
- The ICCT's carbon budget analysis suggests that without a rapid shift to zero-emission aircraft or 100% low-emission SAF, substantial amounts of CDR (potentially tens of billions of tonnes via direct air capture, or DAC) would be required to offset the committed emissions from conventional aircraft delivered in the coming decades.[138]
- The US Aviation Climate Action Plan acknowledges the potential need for robust out-of-sector measures, including CDR, to close any remaining emission gap, and mentions US government support for research and development of CDR (for example, through the Department of Energy's Carbon Negative Shot).[139]
- Airbus has indicated investment in DAC technology and agreements for purchasing carbon removal credits, positioning it as part of the company's broader decarbonisation toolkit.[140]

Decarbonising aviation is not an isolated challenge but requires unprecedented levels of collaboration across multiple stakeholder groups. This need for collaboration stems from the sheer complexity of the transition. Developing and scaling SAF involves agriculture, waste management, chemical processing, energy production and logistics. Developing new aircraft involves advanced materials, propulsion physics and complex systems integration. Optimising operations requires co-ordination among airlines, airports and air navigation service providers. Financing the transition requires alignment among project developers, governments, and public and private financial institutions. Furthermore, aviation's decarbonisation is inextricably linked to the broader global energy transition, particularly the scale-up of renewable electricity and green hydrogen needed for e-fuels, requiring integrated planning across sectors.

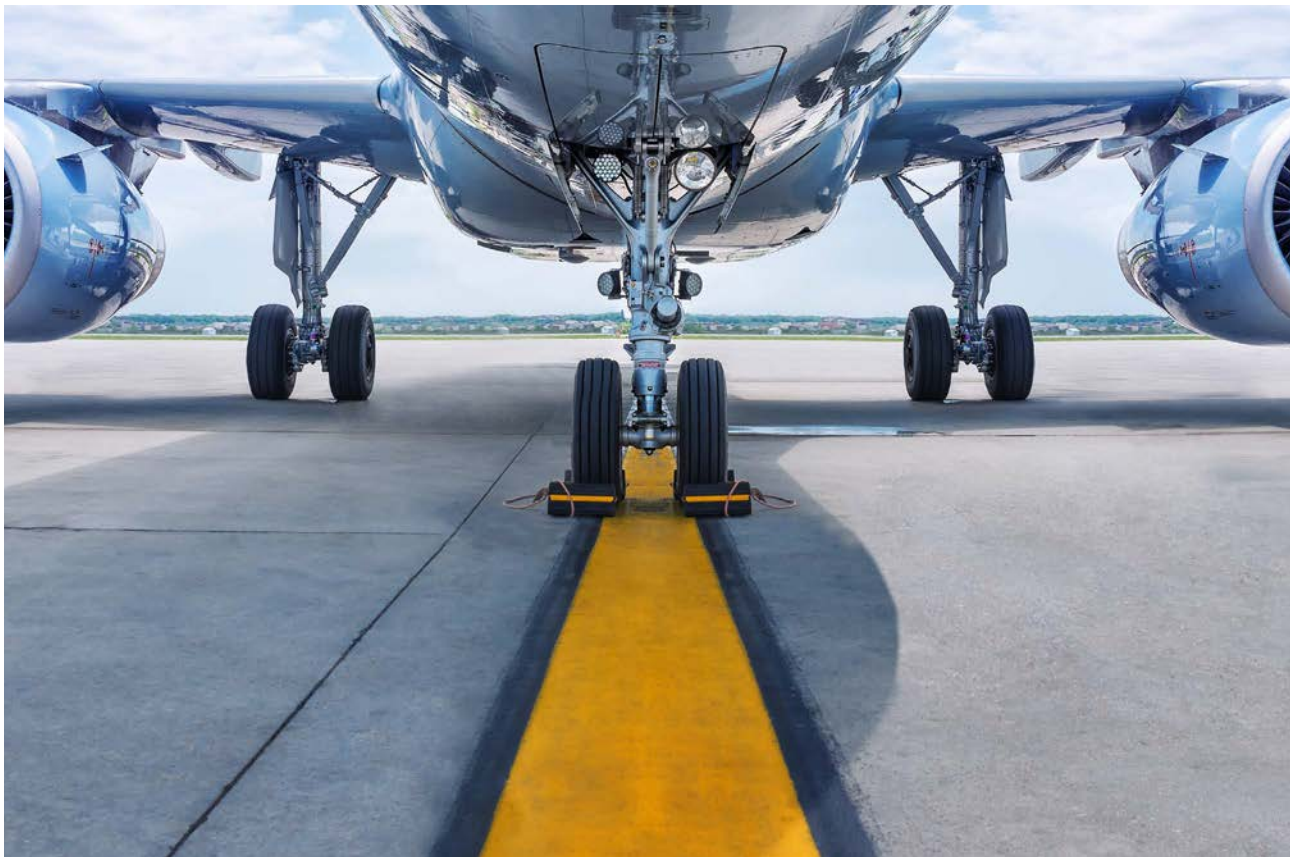
Collaboration also faces challenges, as different stakeholders have varying, sometimes conflicting, interests. Fuel producers may desire long-term off-take certainty, while airlines might prefer shorter-term flexibility. Competition for limited resources such as sustainable feedstocks or renewable energy can create tensions among companies or even sectors. Differing views on the optimal policy mix (e.g., mandates versus incentives) also exist. Successful collaboration requires not only a willingness to work together but also effective mechanisms for dialogue, negotiation, risk-sharing, and incentive alignment to bridge these differences and foster collective action towards the common goal. Initiatives such as the proposed Green Market Makers aim to provide such mediating structures.[141]

Building aviation's resilience requires a collaborative effort across the interconnected aviation network to ensure operational continuity and safety in a changing climate. There is a need for aviation stakeholders (airports, airlines, air navigation service providers) to conduct systematic climate risk assessments and develop adaptation plans. This involves understanding local climate projections, assessing vulnerabilities, prioritising risks and identifying adaptation measures. Potential infrastructure adaptation measures include enhancing drainage systems, reinforcing structures against higher wind loads, using heat-resistant materials for pavements, protecting critical equipment from flooding or heat, potentially relocating critical infrastructure and building sea defences for coastal airports. Measures to enhance aircraft systems and operations include improving weather forecasting and decision support tools to better manage disruptions, adapting operational procedures for extreme heat or storms, enhancing aircraft systems' resilience to turbulence or icing, and potentially adjusting network planning and schedules to account for increased weather variability.

National adaptation plans are also beginning to incorporate transport sector strategies. France's third National Climate Change Adaptation Plan (PNACC3) includes measures relevant to aviation resilience.[142]

Partnerships in action

- In 2025, the first **ICAO Aviation Climate Week** brought together 500 delegates to discuss global aviation's path to net zero carbon emissions by 2050; focal topics included SAF, the clean energy transition and implementation support.[143]
- The **ICAO Global Coalition for Sustainable Aviation**, with 58 members as of August 2025, brings together partners such as academia, aircraft manufacturers, airlines, SAF producers and other companies to facilitate new approaches and solutions for sustainable aviation.[144] In 2021, the coalition presented a report featuring a collection of innovations.[145]
- In 2024, the **International Transport Forum** and the **ICAO** released a joint agreement to advance sustainable aviation, with the ambition to deepen collaboration, data sharing and research.[146] The agreement enables research to address complex challenges: for example, the ITF report *Decarbonising Aviation: Exploring the Consequences* looks at connectivity, sustainable tourism, just transition and other impacts of moving towards net zero aviation.[147]



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Shipping



KEY FINDINGS



Demand, use and access

- Global maritime trade grew 2.4% in 2023 to 12.3 billion tonnes, after contracting 0.4% in 2022. Recent events have revealed how susceptible global trade and maritime transport are to distortions caused by geopolitical conflicts, climate change and economic slowdowns.
- Since 2022, the Russian Federation's invasion of Ukraine has had significant effects on global trade.
- Unrest in the Middle East and attacks on merchant ships in the Red Sea have greatly reduced vessel crossings of the Suez Canal, the shortest maritime route between Asia and Europe, through which around 15% of global maritime trade volume normally passes; most ships have since opted for a much longer route around the Cape of Good Hope in Africa. In the first two months of 2024, the volume of trade that passed through the Suez Canal dropped 50% from a year prior, while the volume of trade transiting around the Cape of Good Hope increased an estimated 74%.
- Climate change has affected one of the most important shipping routes – the Panama Canal – with the region's extreme drought resulting in a 50% reduction in crossings in the second half of 2023 and early 2024. This caused a significant slowdown in global trade and disruption to supply chains – including prolonged waiting times or re-routing around the Cape of Good Hope – leading to delays, increased operational costs and higher greenhouse gas emissions.
- The countries most affected by these disruptions have been small island developing states (SIDS) and least developed countries (LDCs). SIDS are highly dependent on maritime trade, even for essential consumer goods, and often face poor shipping connectivity. Countries that are located farther from major shipping routes can experience steep increases in consumer prices, especially for food.
- The global merchant fleet continues to grow steadily. For containerised cargo, trade flows have been mostly stable, with slight growth on the Trans-Pacific route and minor drops on the Europe-Asia-Europe and Transatlantic routes. In 2023, the largest container ports based on throughput were Shanghai (China) at 49.2 million twenty-foot equivalent (TEU), Singapore (39.0 million TEU) and Ningbo-Zhoushan (China; 35.05 million TEU). The cargo types that expanded most in 2023 were cars (15% growth), liquefied petroleum gas (LPG; 6%) and dry bulk (4.3%).
- As of mid-2025, the leading countries for ship registration were Liberia, with 424 million DWT, Panama (371 million DWT) and the Marshall Islands (305 million DWT). Out of a total of 112,495 ship registrations, SIDS accounted for 13.7% (15,462), and low- and middle-income countries (also including SIDS) represented 70.3% (79,098). By registering their vessels in SIDS, shipowners can benefit from less-costly registration fees, lower safety and worker welfare standards, and fewer restrictions overall.
- As of 2025, a total of 1.9 million seafarers were supporting USD 14 trillion worth of trade moving around the world. Working conditions are generally poor: in a 2022 survey, 25% of seafarers reported experiencing some kind of harassment and bullying (more than 50% for female seafarers) and 90% reporting having no weekly day off. Women accounted for 1.2% (24,000) of seafarers in 2020, up 46% from 2015.
- The global shipping fleet grew 3.2% in 2023 to 2.3 billion DWT, with most of this capacity represented by bulk carriers, followed by crude oil tankers and container ships. In 2024, oil tankers used to transport fossil fuels accounted for 28% of the world's shipping fleet. Although the total capacity of container ships fell in 2023, the fleet expanded 8% and the global shipyard output increased 10%, to 35 million compensated gross tonnage. In 2023, for the first time, China delivered half of the global shipbuilding output. Chinese shipyards controlled 65% of the world's vessel order books in 2024.
- As of 2024, the shipping sector was only partially on track to meet the IMO target for 5-10% zero-emission fuels by 2030. In 2023, just 0.44% of gross tonnage was capable of using scalable zero-emission fuels, up slightly from 0.32% in 2022.
- Around half of all new-build ship tonnage ordered in 2024 (62.2 million gross tonnage) was capable of using alternative fuels. The order book included vessels running on methanol (118 ships), ammonia (25), LPG (72), and hydrogen (12), in addition to LNG (820 total orders, including 390 LNG carriers).
- In addition to the shift to alternative fuels, 37% of the vessel tonnage as of 2024 was fitted with energy-saving technologies to improve the carbon intensity performance of ships.
- Global sales of marine fuel grew 1.8% in 2023 and 4% in 2024 – propelled by rerouting due to the Red Sea crisis –

KEY FINDINGS

after falling sharply in 2020 and 2022 due to economic slowdowns. The demand for marine bunker fuels hit an all-time high in 2024, with total sales of 143.6 million tonnes.

- Digitalisation and automation have played a key role in transforming maritime logistics and operations. The use of new technologies has occurred across operations ranging from vessel control to port logistics to route planning.



Sustainability and climate trends

- Greenhouse gas emissions from shipping (domestic and international) totalled around 950 million tonnes of CO_2 equivalent in 2023. International shipping contributed more than three-quarters of the total, or 746 million tonnes (up 1.1% from 2022 and 11.2% from 2020), while domestic shipping (or waterborne navigation) contributed 205 million tonnes, up 26% from 2020.
- If shipping emissions were measured alongside countries, the sector would rank as the ninth-largest contributor of greenhouse gas emissions worldwide in 2023, comparable to major industrialised countries. In a single year, the emissions from shipping were nearly equivalent to the total transport emissions from all countries in Africa and Latin America and the Caribbean combined.
- As of 2025, the shipping sector was on a trajectory to completely exhaust its proportional share of the world's carbon budget – the amount of emissions it can release without surpassing global warming of 1.5 degrees Celsius (°C). At the current pace, shipping will exceed its budget for staying within 1.5°C of warming by 2030, its 1.7°C budget by 2037 and its 2°C budget by 2047.
- To fully contribute to the Paris Agreement goal of limiting global warming to 1.5°C, shipping's greenhouse gas emissions need to decline drastically to reach zero by 2050. Up to 90% of the reductions could be achieved by replacing fossil fuels with zero-emission fuels, and 10% through operational efficiency improvements.
- Emissions of sulphur dioxide (SO_2) from shipping have fallen since January 2020, when the IMO cap on sulphur came into force. Shipping's SO_2 emissions totalled 3.7 million tonnes in 2022, down two-thirds from 10.4 million tonnes in 2019.
- The most common ways to reduce a ship's energy intensity and fuel consumption are energy-saving technologies such as air lubrication, wind-assisted propulsion, and waste heat recovery, which can deliver energy savings of 5-20% or more (for example, with wind propulsion on favourable routes). Route optimisation can result in similar emission savings, and even higher cuts can be achieved through "slow steaming", or intentionally reducing the travel speed.
- Improving the energy efficiency of ships will be key to meeting the sector's climate targets set by the IMO, but also help the transition to sustainable zero-emission fuels.
- Climate change is likely to impact the shipping sector more frequently and severely in the future, with the greatest hazards being sea-level rise, severe tropical storms and extreme heat events. Weather was the main factor behind at least one-fifth of the roughly 400 vessel losses globally between 2015 and 2019.
- The impacts of climate change could bring an additional financial burden of USD 25 billion every year to the shipping industry by 2100. This includes estimates for port damages and disruptions, but not the wider impact on logistics and supply chains. These are extremely high costs compared to the industry's total operating profits of USD 20 billion annually between 2018 and 2020.

KEY FINDINGS

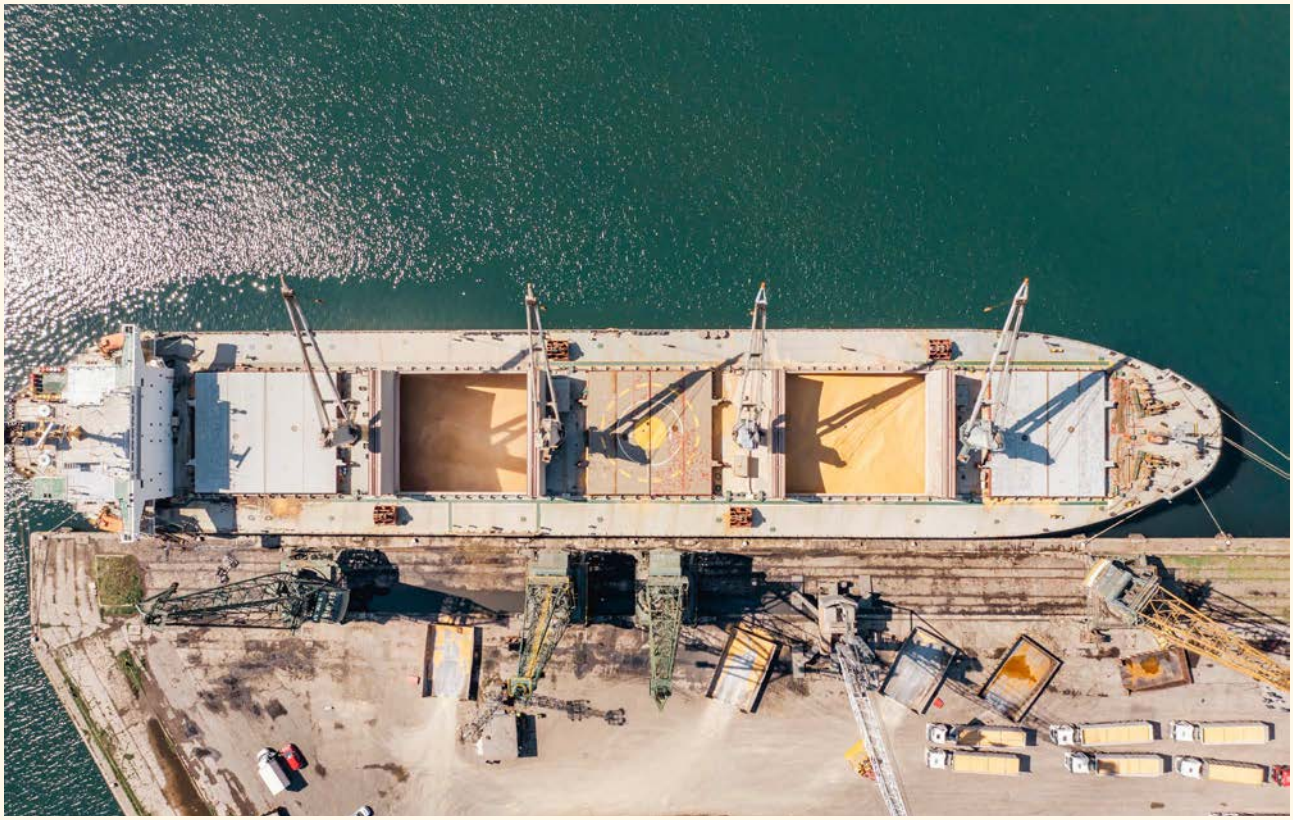
Policy and investment developments

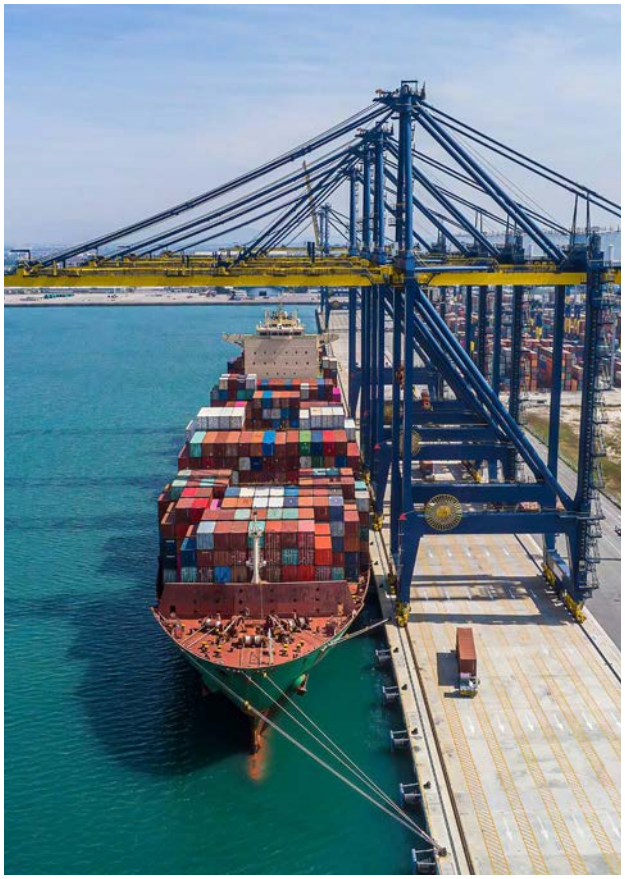
- The 2023 IMO Strategy on Reduction of GHG Emissions from Ships, adopted in June 2023, raised the level of ambition set in the IMO's 2018 Initial Strategy on Reduction of GHG Emissions from ships. The 2023 Strategy features two new components: indicative checkpoints and a general understanding of the basic elements for the development of a basket of mid-term measures.
- The 2023 IMO Strategy's indicative checkpoints outline a clear emission reduction trajectory for international shipping: reduce the sector's total annual greenhouse gas emissions 20-30% by 2030 and 70-80% by 2040 (compared to 2008 levels), on a path to net zero emissions by or close to 2050. The Strategy is designed to place the sector within scenarios that keep global temperature rise well below 2°C, although it falls short of scenarios that keep temperature rise below 1.5°C.
- In April 2025, after extensive negotiations and external geopolitical pressures, the IMO agreed to the IMO Net-Zero Framework, a landmark regulatory package of mid-term measures that (if adopted in October 2025 and entered into force in 2027) would become the first legally binding carbon price across an entire industry sector.
- Under the Net-Zero Framework's emissions trading rules, compliant ships would be eligible to generate surplus emission units that can be sold to under-compliant ships (under specific conditions). The revenues would be allocated to the IMO Net-Zero Fund to support the adoption of zero- and near-zero emission fuels and technologies, as well as infrastructure development, capacity building, climate resilience in developing countries, and the mitigation of adverse impacts on vulnerable countries.
- In 2024, IMO Member States began a review of two short-term greenhouse gas reduction measures – the Energy Efficiency Ship Index (EEXI) and the Carbon Intensity Indicator (CII) – adopted in 2021 and effective as of January 2023.
- At the regional level, some regulators have moved much faster in addressing emissions from the shipping sector. As of 1 January 2024, under the EU's Emissions Trading System (EU ETS), all ships above 5,000 gigatonnes arriving to EU ports are subject to carbon prices. The FuelEU Maritime regulation, adopted in 2023 and in force as of January 2025, sets maximum limits on the annual average greenhouse gas intensity of the energy used by ships calling at EU ports.



KEY FINDINGS

- As of mid-2025, Australia was in the process of developing a Maritime Emissions Reduction National Action Plan, following public consultations held in 2023 and 2024.
- China's Emissions Trading System (ETS), the world's largest by covered emissions, does not yet apply to international or domestic shipping. However, the sub-national carbon market in Shanghai covers ports and shipping companies that emit more than 50,000 tonnes of CO_2 from domestic shipping.
- The UK Emissions Trading Scheme will apply to domestic shipping emissions starting in 2026, and maritime sector emissions are approved for inclusion in the country's sixth carbon budget (2033-37).
- in the United States, the California Air Resources Board (CARB) expanded the coverage of its 2020 At-Berth Regulation, which requires operators of ocean-going vessels and marine terminals to report every visit made to a California terminal.
- Multiple voluntary initiatives for reducing shipping emissions have been established in recent years, covering various types and groups of maritime stakeholders.
- Only 7 of the 29 third-generation Nationally Determined Contributions (NDCs) submitted as of 1 August 2025 included shipping-focused actions towards reducing greenhouse gas emissions under the Paris Agreement.109 The seven submissions were from Belize, Canada, Marshall Islands, Monaco, Niue, the United Kingdom and the United States.
- A total of 62 green shipping corridor initiatives had been announced worldwide as of November 2024, 40% more than in 2023. One-third of this activity was in Europe, while the Asia Pacific and North Pacific regions each represented around one-fifth. With only six initiatives preparing for implementation, a key bottleneck has been the lack of national policy incentives to bridge fuel costs.
- Additional projects have focused on alternative fuel production and infrastructure development, green shipping innovation, resilience and climate mitigation in ports, and decarbonisation efforts in developing countries.





Context, challenges and opportunities

Maritime shipping remains the backbone of global trade, responsible for transporting more than 80% of total goods by volume.[1] However, its centrality in the global economy also makes it vulnerable to geopolitical shocks, climate disruptions and increasing scrutiny for its growing greenhouse gas emissions. The sector has navigated profound challenges in recent years, including the COVID-19 pandemic in 2020 and 2021, armed conflict in Ukraine and the Red Sea region since 2022, and drought-related constraints in the Panama Canal in 2023. These events have reshaped trade routes, increased costs and reinforced the urgency of building a more resilient and sustainable maritime sector.

In 2023, global maritime trade rebounded 2.4% to reach 12.3 billion tonnes of goods transported, despite continued volatility.[2] These shifts also underscored the sector's exposure to climate risks and its role in shaping the economic vulnerability of small island developing states (SIDS) and least developed countries (LDCs), many of which depend almost entirely on maritime imports for basic goods. At the same time, the global fleet has continued to expand and modernise, with a growing share of new ships designed to use alternative fuels such as methanol, ammonia and biofuels. Even so, the transition to zero-emission fuels in the sector remains slow (and only partially on track) due to factors including limited infrastructure, high costs and the modest climate benefits of transitional fuels such as liquefied natural gas (LNG).

In 2023, the global shipping sector (domestic and international) was the ninth-largest emitter of greenhouse gases worldwide, when ranked alongside the economy-wide emissions of countries.[3] Considering only transport greenhouse gas emissions, it was the third-largest emitter after the United States and China.[4] In 2023, global shipping contributed 950 million tonnes of carbon dioxide (CO_2) equivalent; more than three-quarters of this (79% or 746 million tonnes) was from international shipping.[5]

Progress on shipping decarbonisation has been incremental, although the implementation of measures such as the International Maritime Organization's (IMO) cap on sulphur emissions has reduced pollutants such as sulphur dioxide (SO_2). Wind-assisted propulsion, route optimisation driven by artificial intelligence (AI), and slow steaming have helped improve energy efficiency, but the uptake of truly low- and zero-emission vessels and technologies remains limited. In 2024, sales of alternative marine fuels surpassed 1 million tonnes for the first time, yet they represented only a small share of total marine fuel consumption.[6]

Policy momentum has accelerated, particularly with the adoption of the 2023 IMO GHG Strategy, which sets emission reduction checkpoints for 2030 and 2040 and aims for net zero greenhouse gas emissions from international shipping by or around 2050. The April 2025 agreement on the IMO's Net-Zero Framework, a first-of-its-kind standard for global greenhouse gas pricing and lifecycle fuels, marks a potentially transformative step. If adopted in October 2025, it would provide a predictable regulatory pathway for the sector's decarbonisation. In parallel, the IMO is reviewing its short-term greenhouse gas reduction measures – including the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII) – to strengthen their effectiveness and address implementation challenges.

At the regional level, some regulators have moved faster with their own mechanisms. The European Union's (EU) Emissions Trading System now includes maritime emissions, and the FuelEU Maritime regulation mandates steep reductions in greenhouse gas intensity through 2050. Similar initiatives have emerged in China, the United Kingdom and the United States at the sub-national level.

Beyond regulation, industry-led initiatives have expanded. As of November 2024, 62 green shipping corridor initiatives had been announced globally, with several moving towards implementation.[7] Voluntary frameworks such as the Poseidon

Principles and the Science Based Targets Maritime Guidance are also helping guide finance and freight actors towards climate-aligned practices. These developments reflect a growing recognition that innovation, investment and international co-operation are essential to enable a just and effective transition.

To reach net zero emissions by mid-century, the shipping sector must scale up its use of zero-emission fuels to achieve 5-10% by 2030, accelerate efficiency improvements and ensure that no country is left behind.[8] The interplay between regulation, market signals and technological innovation will determine whether the maritime transport sector can successfully navigate the path to a sustainable future.

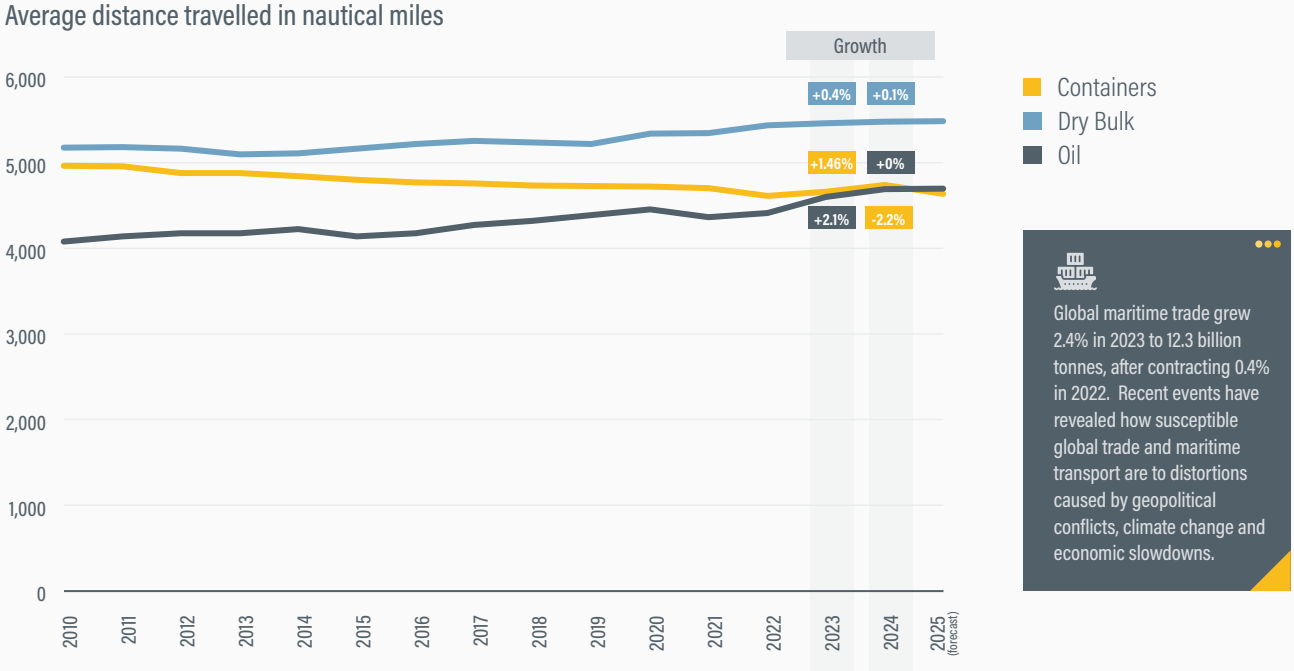
Demand, use and access

Global maritime trade grew 2.4% in 2023 to 12.3 billion tonnes, after contracting 0.4% in 2022.[9] Recent events have revealed how susceptible global trade and maritime transport are to distortions caused by geopolitical conflicts, climate change and economic slowdowns (Figure 1).[10] The shipping sector, and especially travel distances, have been impacted by disruptive events including the COVID-19 pandemic and related recession in 2020 and 2021, the Russian Federation's invasion of Ukraine in 2022, disruptions in the Panama Canal in 2023 and ongoing geopolitical tensions in the Red Sea region.[11]

Since 2022, the Russian Federation's invasion of Ukraine has had significant effects on global trade. Ukraine is a major global producer and exporter of grain (wheat, barley and corn) and sunflower oil, and these exports fell 90% during the first half of 2022.[12] Pre-war export levels of agricultural products from Ukraine were restored only in April 2024, and the operation of vessels in the Black Sea has remained a risky business.[13]

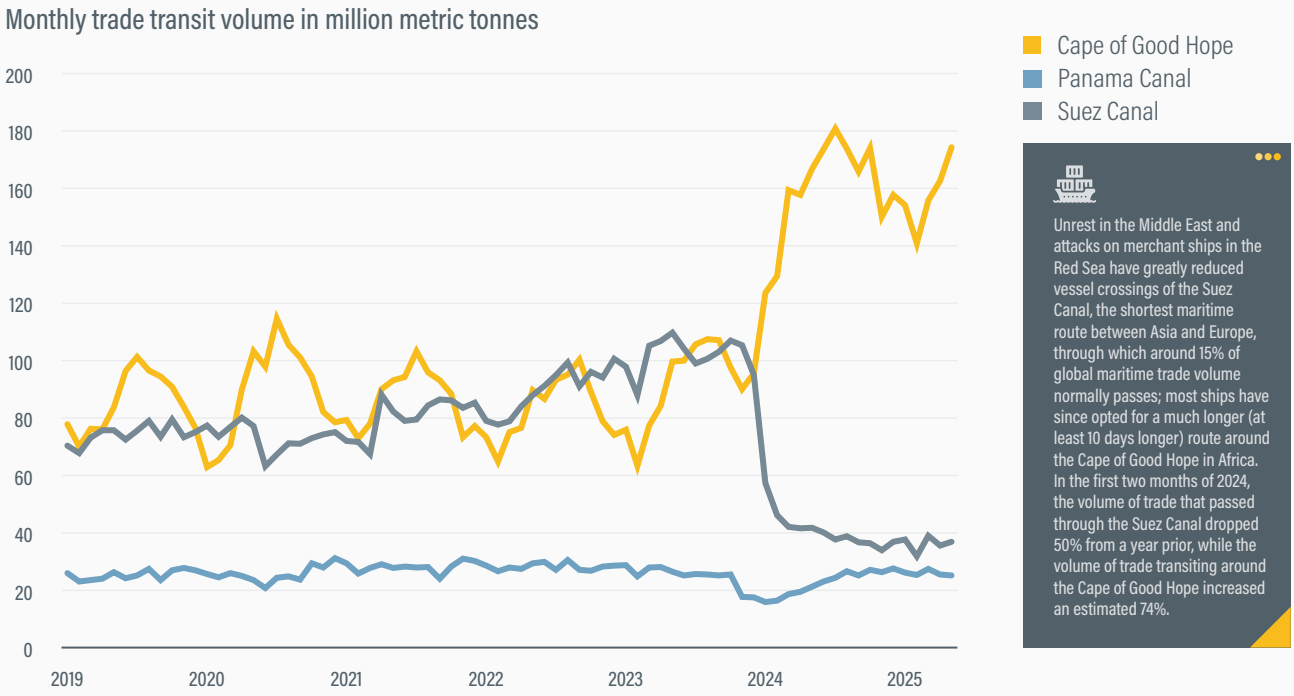
Unrest in the Middle East and attacks on merchant ships in the Red Sea have greatly reduced vessel crossings of the Suez Canal, the shortest maritime route between Asia and Europe, through which around 15% of global maritime trade volume normally passes; most ships have since opted for a much longer (at least 10 days longer) route around the Cape of Good Hope in Africa.[14] In the first two months of 2024, the volume of trade that passed through the Suez

FIGURE 1. World seaborne trade by type, 2010-2024 and forecast for 2025



Source: See endnote 10 for this section.

FIGURE 2. Monthly trade transit volume of major shipping routes



Source: See endnote 15 for this section.

Canal dropped 50% from a year prior, while the volume of trade transiting around the Cape of Good Hope increased an estimated 74% (Figure 2).[15]

Climate change has affected one of the most important shipping routes – the Panama Canal – with the region's extreme drought resulting in a 50% reduction in crossings in the second half of 2023 and early 2024.[16] This caused a significant slowdown in global trade and disruption to supply chains – including prolonged waiting times or re-routing around the Cape of Good Hope – leading to delays, increased operational costs and higher greenhouse gas emissions. Many ships had to look for alternative (and much longer) routes, and trade patterns shifted.[17]

The countries most affected by these disruptions have been small island developing states (SIDS) and least developed countries (LDCs). SIDS are highly dependent on maritime trade, even for essential consumer goods, and often face poor shipping connectivity.[18] Countries that are located farther from major shipping routes can experience steep increases in consumer prices, especially for food.[19]

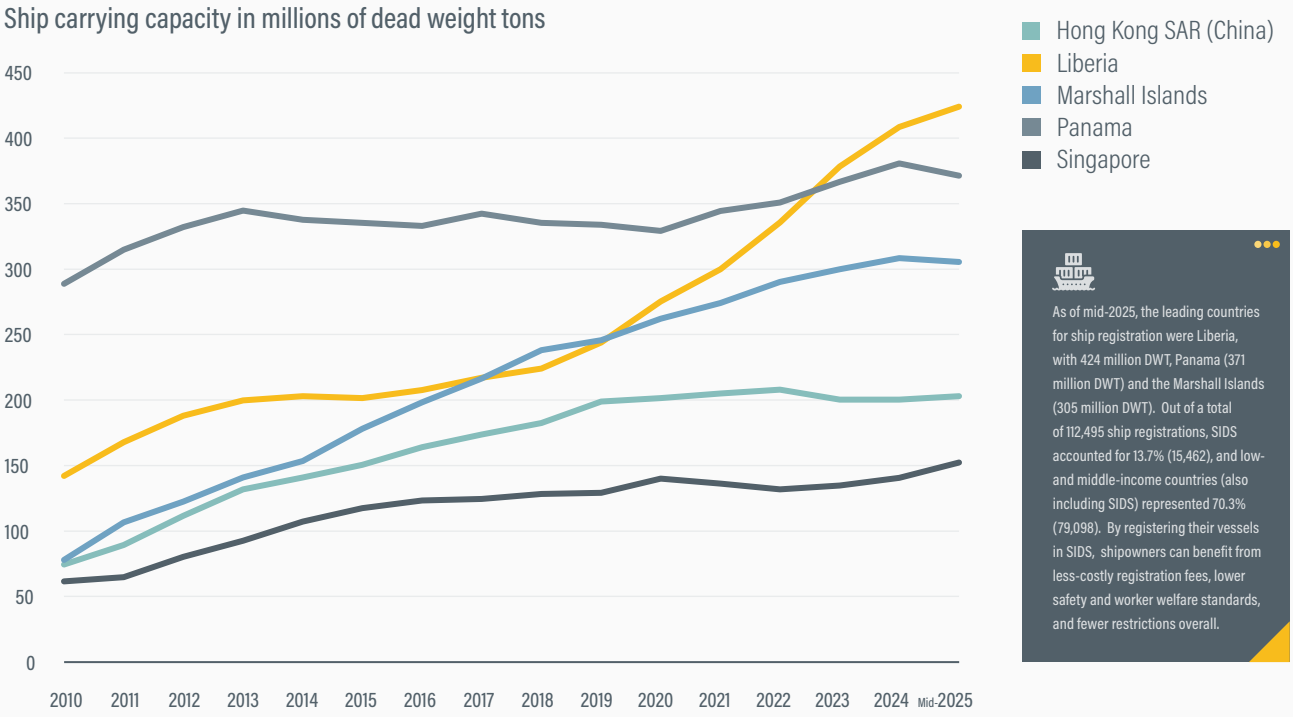
- The combination of the COVID-19 pandemic and the Russian invasion of Ukraine resulted in 46.8% of the global SIDS population experiencing moderate to severe food insecurity between 2020 and 2022.[20]
- In SIDS that are tourism-oriented, up to 90% of food is imported, compared to a global average of around 5%.[21]

The global merchant fleet continues to grow steadily.[22] For containerised cargo, trade flows have been mostly stable, with slight growth on the Trans-Pacific route and minor drops on the Europe-Asia-Europe and Transatlantic routes.[23] In 2023, the largest container ports based on throughput were Shanghai (China) at 49.2 million twenty-foot equivalent (TEU), Singapore (39.0 million TEU) and Ningbo-Zhoushan (China; 35.05 million TEU).[24] The cargo types that expanded most in 2023 were cars (15% growth), liquefied petroleum gas (LPG; 6%) and dry bulk (4.3%).[25]

As of mid-2025, the leading countries for ship registration were Liberia, with 424 million DWT[i], Panama (371 million DWT) and the Marshall Islands (305 million DWT) (Figure 3).[26] **Out of a total of 112,495 ship registrations, SIDS accounted**

i Deadweight tonnage (DWT) is a measure of how much weight a ship can carry, usually in metric tons; this includes cargo, bunker oil, fresh water, ballast water, provisions, passengers and crew.

FIGURE 3. World's top five countries for ship registration, 2010-2025



Source: See endnote 26 for this section.

for 13.7% (15,462), and low- and middle-income countries (also including SIDS) represented 70.3% (79,098).[27] **By registering their vessels in SIDS, shipowners can benefit from less-costly registration fees, lower safety and worker welfare standards, and fewer restrictions overall.** The flag that a ship is registered under is often unrelated to the nationality of the owner.[28] The Marshall Islands alone had 4,254 registered ships as of mid-2025, or 3.8% of the total maritime fleet.[29]

As of 2025, a total of 1.9 million seafarers were supporting USD 14 trillion worth of trade moving around the world.[30] **Working conditions are generally poor: in a 2022 survey, 25% of seafarers reported experiencing some kind of harassment and bullying (more than 50% for female seafarers) and 90% reporting having no weekly day off.**[31] **Women accounted for 1.2% (24,000) of seafarers in 2020, up 46% from 2015.**[32] By 2026, a shortfall of 90,000 trained seafarers is projected, creating risks for global supply chains and safety at sea.[33] Significant efforts will be required in the coming decades to train seafarers on alternative fuels and new technologies.[34]

The global shipping fleet grew 3.2% in 2023 to 2.3 billion DWT, with most of this capacity represented by bulk carriers, followed by crude oil tankers and container ships.[35] **In 2024, oil tankers used to transport fossil fuels accounted for 28% of the world's shipping fleet.**[36] **Although the total capacity of container ships fell in 2023, the fleet expanded 8% and the global shipyard output increased 10%, to 35 million compensated gross tonnage (CGT)**[ii]**.**[37] **In 2023, for the first time, China delivered half of the global shipbuilding output.**[38] **Chinese shipyards controlled 65% of the world's vessel order books in 2024.**[39]

As of 2024, the shipping sector was only partially on track to meet the IMO target for 5-10% zero-emission fuels by 2030.[40] **In 2023, just 0.44% of gross tonnage was capable of using scalable zero-emission fuels, up slightly from 0.32% in 2022.**[41] While the technologies to achieve this are readily available, the major bottlenecks are low supplies (i.e., low production volumes of zero-emission fuels), low demand from vessel operators and low investment levels. An estimated USD 6-10 billion in public finance is needed by 2030 for scalable zero-emission fuels; as of 2023, around USD 1 billion was

ii Compensated gross tonnage (CGT) reflects the shipbuilding output based on the amount of work required to build a ship relative to a vessel's gross registered tonnage.



secured and available for use, and USD 2 billion was committed by governments.[42]

Around half of all new-build ship tonnage ordered in 2024 (62.2 million gross tonnage) was capable of using alternative fuels.[43] **The order book included vessels running on methanol (118 ships), ammonia (25), LPG (72), and hydrogen (12), in addition to LNG (820 total orders, including 390 LNG carriers)**.[44] Although LNG is listed as an alternative fuel for ships, research has shown that it does not provide any substantial climate or environmental benefits compared to conventional fuels.[45] Its use is also not compatible with the climate objectives of the 2023 IMO GHG Strategy to reduce emissions from ships.[46]

In addition to the shift to alternative fuels, 37% of the vessel tonnage as of 2024 was fitted with energy-saving technologies to improve the carbon intensity performance of ships.[47] There were 145 retrofits and new orders for vessels with wind assistance, and 49 with onboard carbon capture.[48]

Global sales of marine fuel grew 1.8% in 2023 and 4% in 2024 – propelled by rerouting due to the Red Sea crisis – after falling sharply in 2020 and 2022 due to economic slowdowns.[49] **The demand for marine bunker fuels hit an all-time high in 2024, with total sales of 143.6 million tonnes.**[50] In Singapore, the Maritime and Port Authority revealed that bunker sales reached a new high of 54.9 million tonnes in 2024, with alternative fuel sales exceeding 1 million tonnes for the first time (1.34 million tonnes).[51] Most of these alternatives were biofuel blends (0.88 million tonnes) and LNG (0.46 million tonnes), followed by a small share of methanol (1,626 tonnes) and a first-ever trial of bunkering of ammonia (9.7 tonnes).[52]

Digitalisation and automation have played a key role in transforming maritime logistics and operations. The use of new technologies has occurred across operations ranging from vessel control to port logistics to route planning. Artificial intelligence (AI) has been increasingly applied in areas such as port management, cargo tracking, planning for maintenance and servicing, fuel and energy efficiency improvement, and route planning and voyage optimisation.[53] Digitalisation and automation can improve the shipping sector's sustainability and efficiency, helping to reach decarbonisation targets while reducing costs. Future technologies include autonomous ships and technicians, port automation, and AI-based data analysis, among many other applications.[54]

- Major ports in China and Singapore have invested in automation and digitalisation since 2018 to handle increased trade volumes.[55]
- In 2021, a Norwegian company launched the world's first autonomous and fully electric container ship, the *Yara Birkeland*.[56]
- The Global Fishing Watch platform is using big data, machine learning and other advanced technologies to monitor fishing vessels globally and to enable co-operation against illegal fishing.[57]

Sustainability and climate trends

Greenhouse gas emissions from shipping (domestic and international) totalled around 950 million tonnes of CO_2 equivalent in 2023.[58] International shipping contributed more than three-quarters of the total, or 746 million tonnes (up 1.1% from 2022 and 11.2% from 2020), while domestic shipping (or waterborne navigation) contributed 205 million tonnes, up 26% from 2020 (Figure 4).[59]

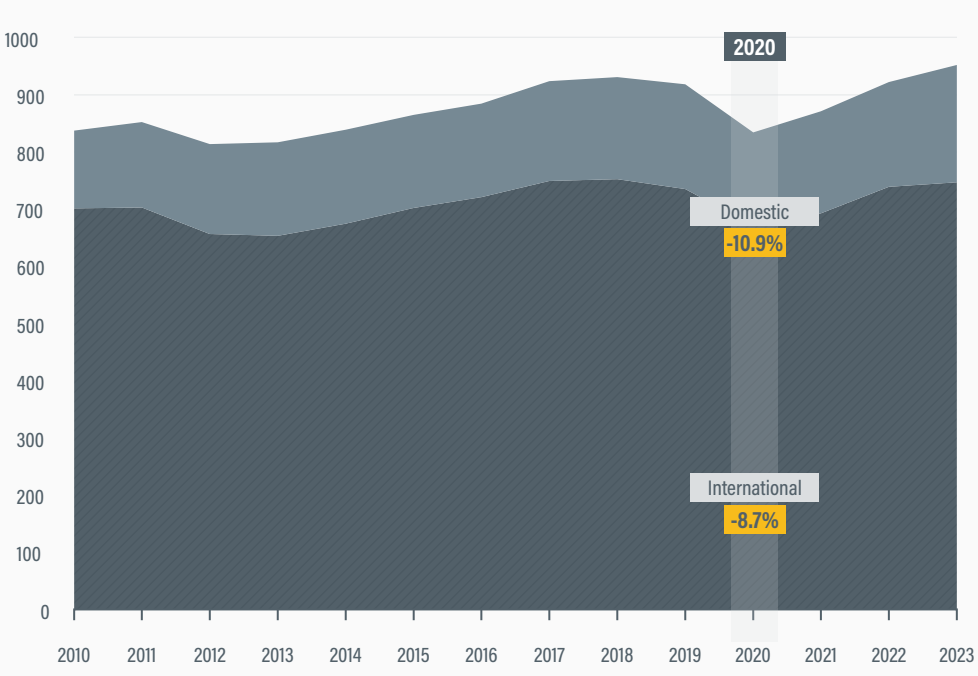
If shipping emissions were measured alongside countries, the sector would rank as the ninth-largest contributor of greenhouse gas emissions worldwide in 2023, comparable to major industrialised countries.[60] In a single year, the emissions from shipping were nearly equivalent to the total transport emissions from all countries in Africa and Latin America and the Caribbean combined.[61] Shipping's carbon emissions have nearly doubled since 1990, with periodic declines in the last two decades related to economic recessions and other developments that negatively affected trade.[62] Emissions have continued to increase despite global ambitions to limit global temperature rise under the Paris Agreement.

As of 2025, the shipping sector was on a trajectory to completely exhaust its proportional share of the world's carbon budget – the amount of emissions it can release without surpassing global warming of 1.5 degrees Celsius (°C).[63] At the current pace, shipping will exceed its budget for staying within 1.5°C of warming by 2030, its 1.7°C budget by 2037 and its 2°C budget by 2047.[64]

To fully contribute to the Paris Agreement goal of limiting global warming to 1.5°C, shipping's greenhouse gas emissions need to decline drastically to reach zero by 2050 (Figure 5).[65] **Up to 90% of the reductions could be achieved by replacing fossil fuels with zero-emission fuels, and 10% through operational efficiency improvements.[66]**

Emissions of sulphur dioxide (SO_2) from shipping have fallen since January 2020, when the IMO cap on sulphur came into force.[67] Shipping's SO_2 emissions totalled 3.7 million tonnes in 2022, down two-thirds from 10.4 million tonnes in 2019.[68] The IMO regulation reduced the maximum allowed sulphur content in marine fuel oil used outside Emission Control Areas (ECAs) to 0.5% (down from 3.5%).[69]

FIGURE 4. Greenhouse gas emissions from shipping (international and domestic), 2010-2023

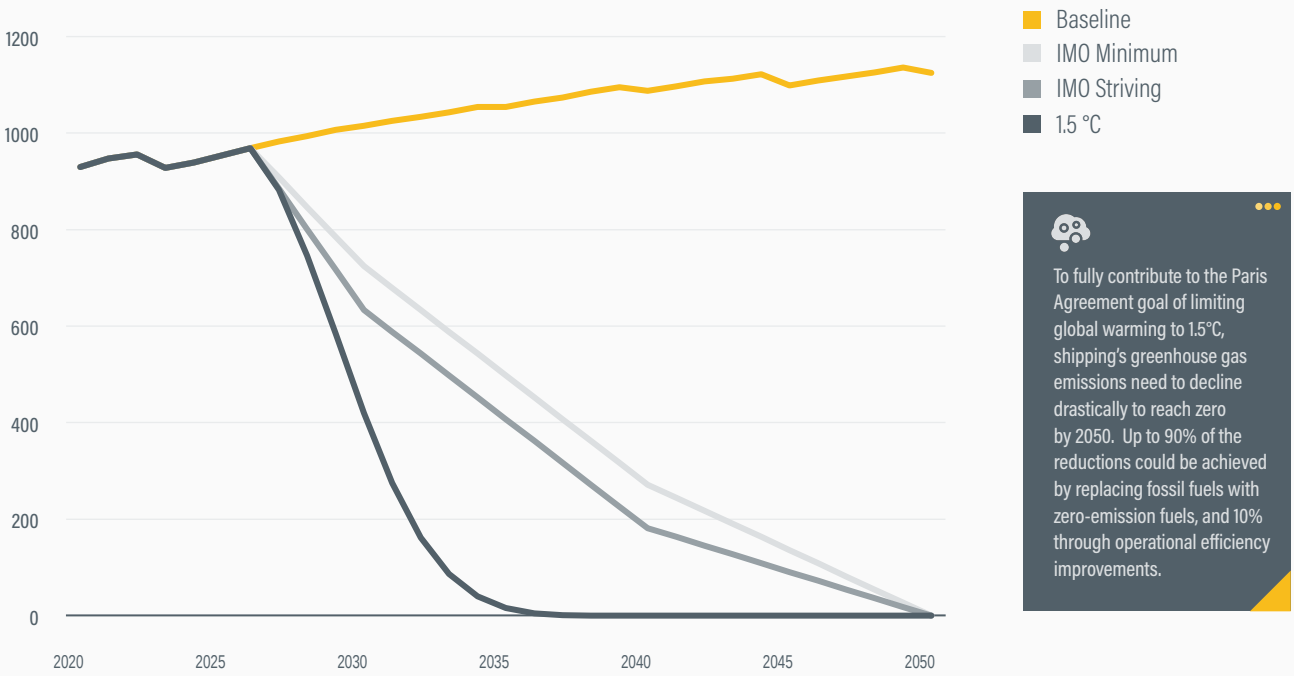


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Source: See endnote 59 for this section.

FIGURE 5. Potential emission trajectories for shipping, 2020-2050

GHG emissions trajectories for global shipping in million tonnes CO_2 equivalent



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Source: See endnote 65 for this section.

The most common ways to reduce a ship's energy intensity and fuel consumption are energy-saving technologies such as air lubrication, wind-assisted propulsion, and waste heat recovery, which can deliver energy savings of 5-20% or more (for example, with wind propulsion on favourable routes).[70] **Route optimisation can result in similar emission savings, and even higher cuts can be achieved through "slow steaming", or intentionally reducing the travel speed.**

- Depending on the speed, slowing down can reduce vessel emissions by 20-40% in general, but up to 60% in the case of extremely slow steaming.[71] Wind propulsion can reduce energy demand by up to 30% in specific scenarios and also greatly reduce the need for stored energy.[72]
- Through efficiency measures, retrofits for alternative fuels, and the use of zero-emission vessels, greenhouse gas emissions from ocean-based shipping could be reduced by an estimated 0.59 gigatonnes annually by 2030 and 2 gigatonnes annually by 2050.[73]

Improving the energy efficiency of ships will be key to meeting the sector's climate targets set by the IMO, but also help the transition to sustainable zero-emission fuels. Most fuels being considered as near-zero carbon alternatives (such as methanol, hydrogen and ammonia) are likely to be much more expensive, at least during the transition period.[74] Some (such as hydrogen) also have a much lower energy intensity, which in practice means that a greater volume of fuel is needed to travel the same cargo-kilometres.[75]

Climate change is likely to impact the shipping sector more frequently and severely in the future, with the greatest hazards being sea-level rise, severe tropical storms and extreme heat events.[76] **Weather was the main factor behind at least one-fifth of the roughly 400 vessel losses globally between 2015 and 2019.**[77] Potential impacts include damage to port infrastructure as well as damage and disruptions to port and shipping operations. Inland flooding and droughts impact supply chains, while extreme heat can damage vessels and infrastructure as well as affect workers.[78]

The impacts of climate change could bring an additional financial burden of USD 25 billion every year to the shipping industry by 2100.[79] **This includes estimates for port damages and disruptions but not the wider impact on logistics and supply chains. These are extremely high costs compared to the industry's total operating profits of USD 20 billion annually between 2018 and 2020.**[80]

Policy and investment developments

The 2023 IMO Strategy on Reduction of GHG Emissions from Ships, adopted in June 2023, raised the level of ambition set in the IMO's 2018 Initial Strategy on Reduction of GHG Emissions from Ships.[81] The 2023 Strategy features two new components: indicative checkpoints and a general understanding of the basic elements for the development of a basket of mid-term measures. The Strategy aims to:

- review the energy efficiency design requirements for new ships, with the aim of strengthening them;
- reduce CO_2 emissions per transport work at least 40% by 2030 compared to 2008 levels, across international shipping;
- supply at least 5% (striving for 10%) of the energy demand in international shipping by 2030 through zero or near-zero greenhouse gas emission technologies, fuels and/or energy sources; and
- peak greenhouse gas emissions from international shipping as soon as possible, and reach net zero emissions by or close to 2050.[82]

The 2023 IMO Strategy's indicative checkpoints outline a clear emission reduction trajectory for international shipping: reduce the sector's total annual greenhouse gas emissions 20-30% by 2030 and 70-80% by 2040 (compared to 2008 levels), on a path to net zero emissions by or close to 2050.[83] The Strategy is designed to place the sector within scenarios that keep global temperature rise well below 2°C, although it falls short of scenarios that keep temperature rise below 1.5°C.[84]

In April 2025, after extensive negotiations and external geopolitical pressures, the IMO agreed to the IMO Net-Zero Framework, a landmark regulatory package of mid-term measures that (if adopted in October 2025 and entered into force in 2027) would become the first legally binding carbon price across an entire industry sector.[85] The measure would combine: 1) a mandatory global fuel standard targeting ships over 5,000 gross tonnage, requiring progressive reductions in the life-cycle greenhouse gas intensity of ships; and 2) a carbon price on vessel emissions that exceed set thresholds, with compliant ships that use zero or near-zero fuels and technologies being eligible for financial rewards.[86]

Under the Net-Zero Framework's emissions trading rules, compliant ships would be eligible to generate surplus emission units that can be sold to under-compliant ships (under specific conditions).[87] The revenues would be allocated to the IMO Net-Zero Fund to support the adoption of zero- and near-zero emission fuels and technologies, as well as infrastructure development, capacity building, climate resilience in developing countries, and the mitigation of adverse impacts on vulnerable countries.[88]

In 2024, IMO Member States began a review of two short-term greenhouse gas reduction measures – the Energy Efficiency Ship Index (EEXI) and the Carbon Intensity Indicator (CII) – adopted in 2021 and effective as of January 2023.[89] The review process is focused on: 1) the effectiveness of measures to reduce the carbon intensity of international shipping; 2) experiences with enforcing the measures; 3) data needs and the need to enhance the IMO Data Collection System (DCS); 4) impacts on Member States; 5) revising the emission reduction factors; 6) possible changes to the CII metric; 7) possible correction factors and voyage adjustments to the CII, 8) application of the IMO Lifecycle Assessment Guidelines; and 9) any related amendments to existing IMO instruments.[90] In April 2025, Member States completed the first phase of the review, agreeing to CII reduction factors through 2030, finalising a work plan through 2028 to address challenges or gaps in the CII regulatory framework, and approving draft amendments to the DCS that intend to provide greater access and transparency to vessel fuel consumption data.[91]

At the regional level, some regulators have moved much faster in addressing emissions from the shipping sector. These include initiatives in Australia, the EU, the United Kingdom, and parts of China and the United States.

- **As of 1 January 2024, under the EU's Emissions Trading System (EU ETS), all ships above 5,000 gigatonnes arriving to EU ports are subject to carbon prices.**[92] The system covers 100% of CO_2 emissions from voyages between EU ports and 50% of emissions from voyages that either start or end outside the EU.[93] Starting in 2026, the system will also account for methane and nitrous oxide (N_2O) emissions.[94]
- **The FuelEU Maritime regulation, adopted in 2023 and in force as of January 2025, sets maximum limits on the annual average greenhouse gas intensity of the energy used by ships calling at EU ports**; the aim is to encourage the adoption of renewable, lowcarbon fuels and clean energy technologies.[95] The limits apply to CO_2, N_2O and methane emissions on a well-to-wake basis (covering the entire environmental impact of the fuel production process, delivery and use onboard the vessel) and grow from a 2% reduction in intensity by 2025 to an 80% reduction by 2050.[96]
- **As of mid-2025, Australia was in the process of developing a Maritime Emissions Reduction National Action Plan, following public consultations held in 2023 and 2024.**[97] The plan will outline Australia's commitments to maritime decarbonisation.[98]
- **China's Emissions Trading System (ETS), the world's largest by covered emissions, does not yet apply to**

international or domestic shipping.[99] However, the sub-national carbon market in Shanghai covers ports and shipping companies that emit more than 100,000 tonnes of CO_2 from domestic shipping.[100]

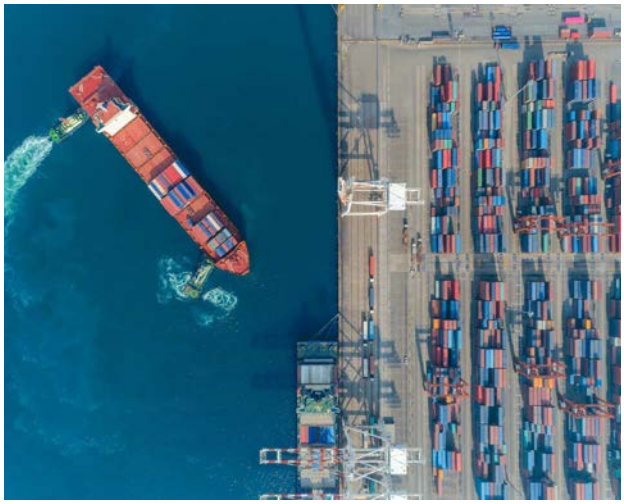
- **The UK Emissions Trading Scheme will apply to domestic shipping emissions starting in 2026, and maritime sector emissions are approved for inclusion in the country's sixth carbon budget (2033-37).[101]**
- **In the United States, the California Air Resources Board (CARB) expanded the coverage of its 2020 At-Berth Regulation, which requires operators of ocean-going vessels and marine terminals to report every visit made to a California terminal.[102]** Starting in 2025, the regulation requires not only containers, refrigerated cargo and cruise vessels – but also roll-on roll-off and tanker vessels – to use a CARB Approved Emission Control Strategy to control emissions for the duration of each visit.[103]

Multiple voluntary initiatives for reducing shipping emissions have been established in recent years, covering various types and groups of maritime stakeholders. (See also Partnerships in action.)

- The Green Shipping Challenge (2022) brings together stakeholders across the maritime ecosystem to reduce shipping's greenhouse gas emissions.[104]
- The Poseidon Principles for responsible ship finance (2019) and responsible marine insurance (2021) are aimed at aligning portfolios with climate objectives.[105]
- The Science-Based Targets for the Maritime Sector (2022) support companies to set climate targets aligned with the 1.5°C decarbonisation pathway.[106]
- The 2020 Sea Cargo Charter provides a global framework for aligning chartering activities with responsible environmental behaviour to promote the decarbonisation of international shipping. As of mid-2025, the charter had 37 signatories, and 34 of them (accounting for around 18% of the total bulk cargo transported by sea in 2024) had disclosed the climate alignment of their chartering activities.[107]
- The Zero Emission Maritime Buyers Alliance (ZEMBA), launched in 2023, brings together freight buyers to accelerate commercial deployment of the most scalable clean energy shipping solutions.[108]

Only 5 of the 27 third-generation Nationally Determined Contributions (NDCs) submitted as of 8 July 2025 included shipping-focused actions towards reducing greenhouse gas emissions under the Paris Agreement.[109] The five submissions were from Belize, Canada, Marshall Islands, the United Kingdom and the United States.[110]

- Belize's third-generation NDC highlights the importance of maritime transport for the economy and notes that a project to improve vessel fuel efficiency and reduce port infrastructure emissions will be piloted by 2035.[111]
- Marshall Islands' NDC sets a target to reduce domestic shipping emissions 40% below 2010 levels by 2030, with full decarbonisation by 2050.[112] It highlights pilot projects on low-emission vessels, wind-assisted propulsion, fuel-efficient engines and the use of solar power.[113]



A total of 62 green shipping corridor initiatives had been announced worldwide as of November 2024, 40% more than in 2023.[114] One-third of this activity was in Europe, while the Asia Pacific and North Pacific regions each represented around one-fifth.[115] With only six initiatives preparing for implementation, a key bottleneck has been the lack of national policy incentives to bridge fuel costs.[116] Green shipping corridors are specific routes where public and private actors have catalysed the feasibility of zero- and near-zero emission shipping; they were first introduced under the Clydebank Declaration, launched at the UN Climate Change Conference in Glasgow, Scotland (COP 26).[117] As of 2024, 17 of the corridors (40%) had progressed to a new stage of development, and 6 had successfully completed the Advanced Exploration phase and moved to the Preparation stage (completing feasibility studies, cost assessments, and establishing workstreams tackling specific barriers to realisation).[118]

Additional projects have focused on alternative fuel production and infrastructure development, green shipping innovation, resilience and climate mitigation in ports, and decarbonisation efforts in developing countries. In 2025, a tender by the Zero Emission Maritime Buyers Alliance (ZEMBA) kicked off the first-ever commercial deployment of e-fuels in the maritime sector, with the aim of aggregating 86 billion tonne-nautical miles of demand for e-fuel-powered shipping from 2027 onwards (equal to transporting around 1.5 million TEU from Shanghai to Los Angeles).[119]

Partnerships in action

- The **Getting to Zero Coalition**, launched in 2019, boasts more than 200 members working towards the operation of commercially viable zero-emission vessels by 2030.[120] The coalition's 2025 Action Framework documents the actions and progress towards decarbonising shipping.[121]
- In July 2025, the **Global Alliance for Maritime Electrification** (**GAME**) was jointly launched by the International Electric Marine Association, the Zero Emission Ship Technology Association, the Maritime Battery Forum, and the European Onshore Power Supply Association – which collectively represent more than 250 member organisations globally.[122] The primary aim is to accelerate the electrification of maritime transport, with a focus on inland, near-shore and commercial vessels.[123]
- At the United Nations (UN) Climate Change Conference (COP 28) in 2023, key public and private actors launched the **Green Maritime Africa Coalition** (**GMAC**) with the aim of building a zero-emission, resilient maritime sector in the region.[124] The GMAC was formed to address the lack of unified sustainability efforts in the sector and is focused on promoting the supply and use of zero-emission fuels.[125]
- The **Green Shipping Challenge**, launched by Norway and the United States at the 2022 UN Climate Change Conference (COP 27), has spurred increased action: two years later, at COP 29 in 2024, stakeholders made more than 40 announcements and updates showcasing concrete progress by countries, companies, ports and other actors in the shipping value chain.[126]
- Launched at COP 28 in 2023, **Resilience4Ports** is a multi-stakeholder whole-system approach seeking to enhance the resilience of ports and the communities that rely on them. At COP 29 in 2024, the initiative issued a call to action to accelerate the resilience and adaptation of port systems, and released a strategic plan for 2025-2027.[127]
- At COP 29 in 2024, a coalition led by the Regional Maritime University, the South African International Maritime Institute and the Climate Champions Team issued a **call to action to ensure a just transition for African seafarers**, building on the Maritime Just Transition Task Force's 10-point action plan.[128]

Transport and Energy

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION



MODULE **5**

5.1 Transport Energy Sources **602**

5.2 Road Vehicle Electrification **622**

LIST OF FIGURES

Transport Energy Sources

Figure 1. Energy demand in transport by region, 2010, 2022 and 2023 609
Figure 2. Energy demand in transport by sector and source, 2023 610
Figure 3. Renewable energy consumption in transport, 2015-2023 611
Figure 4. Global sales of internal combustion engine vehicles and electric vehicles, 2010-2024 612
Figure 5. Equivalent passenger car CO_2 emissions and fuel consumption in countries with mandatory vehicle efficiency or emission standards, 2015-2035. 615
Figure 6. Renewable energy targets in the transport sector, as of 2024 618

Road Vehicle Electrification

Figure 1. Electric passenger car stock (top) and sales (bottom), 2010-2024. 632
Figure 2. Market shares of electric cars in selected markets, 2017-2024 633
Figure 3. Battery price development from 2012-2024 (left) and compared with cumulative production (right) 636
Figure 4. Oil displacement through electric vehicles, 2020-2024 640

MODULE 5 | 5.1

AUTHORS:
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Transport Energy Sources



KEY FINDINGS

Demand, use and access

- Global energy consumption in the transport sector increased 20.6% between 2010 and 2023, rising from 101 exajoules (EJ) to 122 EJ. The sector's 2023 energy use exceeded pre-pandemic (2019) levels by 2 EJ and signalled a continuation of the consistent, long-term growth trend of recent decades.
- Energy demand from transport rose 4% in 2023, doubling the average annual growth rate of 2010-2023, driven by rising personal mobility in developing economies, global economic expansion, growing freight transport volumes and continued reliance on energy-intensive transport modes despite efficiency improvements in vehicle technologies.
- Transport energy demand is projected to grow 10% between 2023 and 2030. The rise in energy demand poses significant challenges for decarbonisation efforts.
- Disparities in transport energy consumption and growth rates were evident across regions. The Asia-Pacific region led with 38% of total sectoral demand in 2023 and recorded a 7% increase that year, reflecting economic development, urbanisation and an expanding middle class.



- North America remained the second largest consumer, accounting for 29% of transport energy demand in 2023, whereas Europe, ranking third, experienced a slight decline in energy use for transport, due likely to energy efficiency policies, modal shifts and economic factors.
- In Africa, the region with the lowest transport energy use, demand fell 1.6% in 2023, possibly due to economic constraints, fuel price increases and structural transport changes.
- North America led by far in per capita energy demand from transport in 2023, with values 22 times those of Africa and more than twice those of Europe. Between 2010 and 2023, per capita energy demand from transport grew 33% in Asia-Pacific, 17% in Eurasia and 13% in Latin America and the Caribbean.
- Road transport continued to dominate energy consumption in transport, accounting for 75% of demand in 2023. Passenger cars consumed 38% of the total energy used in transport, followed by heavy-duty trucks (22%), aviation (10%) and shipping (9%).
- Aviation's relatively high share of transport energy use, despite its smaller share of total passenger-kilometres, reflects the energy-intensive nature of air travel. The shipping sector is comparatively energy efficient per tonne-kilometre of freight moved.
- The trend towards larger and fuel-intensive sport-utility vehicles (SUVs) contributes greatly to transport's rising energy demand. On average, SUVs consume around 20% more energy per kilometre than medium-sized cars, further increasing the energy intensity of the passenger vehicle fleet.
- SUVs reached a record 48% of global car sales in 2023, reinforcing the shift towards larger and heavier cars and making SUVs the defining automobile trend of the early 21st century across both developing and advanced economies.
- Despite ongoing diversification efforts, fossil oil still supplied 90% of transport energy demand in 2023. This highlights the persistent technological and infrastructure lock-in effects that hinder energy transition efforts in the transport sector.
- In line with trends since 2015, renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport

KEY FINDINGS



in 2023; this underscores the significant challenge of decarbonising the sector.

- Global demand for liquid biofuels reached 175.2 billion litres in 2023, marking a steady increase since 2013 as blending mandates have resulted in increased biofuel use in road transport. Bioethanol remained the dominant biofuel used in transport, followed by biodiesel (fatty acid methyl ester, or FAME) and a growing share of renewable diesel.
- In 2024, more than 58 million electric cars were on the world's roads, representing 4.5% of the global car fleet.
- Sales of electric vehicles (including battery electric and plug-in hybrids) grew 25% to reach 17.5 million units, accounting for more than a fifth (21.7%) of all passenger car sales that year. However, this was not enough to counterbalance the energy demand from ICE vehicles. Electric vehicle sales growth was slower than in 2022 (60%) and 2023 (34%).
- Meanwhile, electric bus sales increased 30% in 2024, reaching a total fleet of 730,000 units. Electric medium- and heavy-duty truck sales surged nearly 80% in 2024 to approach 2% of the total truck market.
- In maritime transport, battery-electric shipping corridors began to take shape, although they were largely limited to short sea routes in Northern Europe. In aviation, early innovation included the successful test flight of a 4-tonne civil electric aircraft, developed in collaboration with battery manufacturer CATL, marking a notable step in electrifying short-haul aviation.
- Overall, renewable energy sources – mainly wind and solar power – supplied nearly one-third (32%) of the world's electricity in 2024. A renewable electricity supply is critical for ensuring that transport electrification contributes meaningfully to emission reductions.
- However, advancements in renewable electricity and electric vehicles alone are insufficient to fully decarbonise the transport sector, as aviation and shipping respectively contributed around 11% of transport greenhouse gas emissions in 2023.
- Sustainable aviation fuel (SAF) production doubled in 2024 to reach 1 million tonnes (1.3 billion litres). Despite this growth, SAF represented only 0.3% of global jet fuel production and 11% of total renewable fuel.
- In 2025, the International Maritime Organization (IMO) approved its Net-Zero Framework, combining mandatory emission limits and greenhouse gas pricing. Low- and middle-income countries – despite strong renewable energy potential – face persistent financing gaps, underscoring the need for targeted international support to scale up green shipping supply chains.

KEY FINDINGS

Sustainability and climate trends

- Transport is now the second-largest and fastest-growing contributor to global greenhouse gas emissions. In 2023, the sector was responsible for 21.9% of carbon dioxide (CO_2) emissions.
- Air pollution caused an estimated 8.1 million deaths globally in 2021 (including 700,000 deaths among children under five years), with 61% of these fatalities linked to fossil fuel combustion.
- Scaling up public transport, walking and cycling – which are more energy-efficient than private vehicles – can support a reduction in transport energy demand, as well as in related emissions from road transport.
- A shift towards renewable energy in transport offers a critical pathway to reduce emissions and improve health outcomes. By 2028, biofuels and renewable electricity are projected to cut oil demand from transport by nearly 4 million barrels per day (or more than 7% of the forecasted transport oil demand).
- Electrification across all modes is transforming the transport landscape; however, energy access and affordability challenges remain significant barriers to scaling up electric vehicle adoption. Although 91.6% of the global population had access to electricity as of 2023, at least 1.18 billion people remained "energy poor", lacking basic electricity access. Price volatility and regional differences in electricity costs create barriers for electric vehicle charging.
- More than 1.3 million public electric vehicle charging points were added to the global stock in 2024 (mostly in Asia and Europe), expanding the infrastructure needed for electric vehicle adoption. Although essential, this growth places additional strain on power grids and increases uncertainty in electricity demand.
- An estimated USD 6.9 trillion is required annually by 2030 to expand and stabilise grids and electric vehicle charging infrastructure, and to build their resilience.
- The transition to low-carbon transport creates new jobs, and global employment in the renewable energy sector reached a record 16.2 million jobs in 2023. However, education and reskilling are needed to address the requirements of a shifting workforce and to ensure a just transition.



KEY FINDINGS



Policy and investment developments

- The transport sector plays an essential role in meeting international climate and energy targets. However, policies and climate commitments that support the uptake of renewables in transport have fallen short of the pace needed to drive meaningful change.
- At the 2023 United Nations Climate Change Conference in Dubai, United Arab Emirates (COP 28), governments agreed to triple global renewable energy capacity and double energy efficiency improvements by 2030. For the transport sector, comparable ambition and measures remain limited, highlighting a gap between high-level energy targets and sectoral implementation.
- As of 1 August 2025, a total of 26 of the 29 submitted third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement included mitigation measures or adaptation actions related to transport. However, many of these intended transport actions lack coherence with broader renewable energy objectives, limiting their transformative potential.
- In the Long-Term Low Emission Development Strategies (LT-LEDS) submitted by countries under the Paris Agreement in the first half of 2025, countries highlight the key roles of both the transport and energy sectors; however, they provide little to no detail on how renewables are integrated into the transport sector.
- Of the 31 countries with a carbon tax in 2024, 22 targeted the transport sector with this tax. Of the 44 countries that had an emissions trading system (ETS) in 2024, 36 countries had one that covered transport emissions.
- By 2024, a total of 13 countries had established or proposed fuel efficiency or greenhouse gas emission standards for passenger vehicles or light commercial vehicles and trucks. Although these regulations lacked global reach, they applied to more than 85% of all passenger vehicle sales, guiding the strategic decisions of major vehicle manufacturers worldwide.
- Most standards apply only to light-duty vehicles, but in 2024 the EU introduced the world's first heavy-duty vehicle standard, with a mandatory target to reduce CO_2 emissions from new trucks 90% by 2040.
- Jurisdictions that had enacted targets for both passenger vehicles and light commercial vehicles as of 2024 included Australia, Canada, China, Chile, the EU, Mexico, New Zealand, the Republic of Korea, the United Kingdom, and the United States, while Japan enacted a passenger car target of 106 grams of CO_2 per kilometre by 2030. Three jurisdictions had targets for 2035, including Canada, the United Kingdom, and the EU, and only the EU had a target for 100% zero-emission passenger cars and light commercial vehicles by 2035.
- In 2025, the Euro 7 emission standard came into force, combining regulations for light- and heavy-duty vehicles in a single regulation. From 2025, all European manufacturers must comply with fleet-wide average CO_2 emissions and reduce the emissions of new trucks by 15% by 2025 and 45% by 2030. However, some jurisdictions including the EU have scaled back or delayed their fuel efficiency plans and emission standards, and very few governments worldwide have enacted their announced bans on sales of ICE vehicles.
- In certain regions and sectors, such as aviation, efficiency improvements have stalled due to a lack of sufficiently strong standards.
- In recent years, several countries have strengthened or introduced vehicle efficiency labelling schemes, which have become a growing practice globally; meanwhile, the EU plans a 2026 review to boost the uptake of zero-emission vehicles.
- Pollutant emission standards are crucial to address the health impacts of poor air quality, especially in urban areas, but the stringency of such measures needs to be increased.
- Although 89 countries had economy-wide renewable energy targets in place as of 2024, only 23 countries had new or revised renewable energy targets for the transport sector. Targets for 2030 range from 13.4% in Greece, to 14% in Estonia and Hungary, to 40% in China and Iceland. All the countries that adopted new renewable targets for transport in 2024 were EU Member States.
- As of 2024, 20 countries had in place biofuel blending mandates, with growing emphasis on stricter sustainability criteria. Countries that have enacted new or updated biofuel blending mandates since 2023 are Belgium, Brazil, Indonesia, Japan, Nigeria, the Philippines and Poland.
- In 2024, seven jurisdictions – China, the EU, India, the Republic of Korea, Malaysia, Singapore and Thailand – announced new targets for the production or use of SAF.

KEY FINDINGS

- As of 2024, 68 countries had in place electric vehicle targets, reflecting a growing prioritisation of electric vehicle adoption and zero-emission transport as part of climate and energy strategies. However, electric vehicle targets alone do not necessarily lead to increased renewable energy use unless they are coupled with specific mandates or bans on ICE vehicles, as well as efforts to boost the overall share of renewables in a country's electricity mix.
- Although global ambitions for electric vehicle adoption have increased, trade tensions have grown as major export markets apply tariffs to protect domestic industries. Geopolitical tensions, regional conflicts, energy security concerns and continued fossil fuel subsidies risk delaying progress on electric vehicle and renewable energy uptake and climate action in the transport sector.
- Beyond electricity and biofuels, advancements in other alternative fuels included initiatives to promote hydrogen-powered transport. However, persistent challenges such as high production costs, limited infrastructure and regulatory uncertainties have hindered widespread adoption.





Context, challenges and opportunities

Energy consumption in the global transport sector has rebounded from the impacts of the COVID-19 pandemic and continued to grow steadily, increasing more than 20% between 2010 and 2023 to surpass pre-pandemic levels.[1] This growth, driven by rising personal mobility, freight transport, and economic activity, was especially pronounced in the Asia-Pacific region, whereas Europe and Africa experienced declines in transport energy use due to efficiency improvements and structural shifts.[2]

Road transport remained the dominant energy consumer in the transport sector in 2023, accounting for three-quarters of transport's total energy demand and for 74% of its greenhouse gas emissions.[3] Fossil fuels still supplied 90% of transport energy, despite rising electrification.[4] Electric vehicle sales surged to nearly 22% of global passenger car sales in 2024; however, internal combustion engine (ICE) vehicles and large, fuel-intensive sport utility vehicles (SUVs) contributed to rising energy demand.[5] Aviation's final energy consumption in 2023 totalled 13 exajoules, while fuel consumption in maritime transport grew 4% in 2024, propelled by rerouting due to the Red Sea crisis.[6] Aviation and shipping emissions continued to increase, with sustainable fuels only in the early stages of adoption.

As the transport sector's environmental impact continues to grow, air pollution from vehicle emissions has contributed to millions of premature deaths annually. Transitioning to renewable energy sources in transport offers critical climate and health benefits, with biofuels and renewable electricity projected to reduce oil demand substantially by 2028.[7] Achieving this reduction will require substantial investments in energy infrastructure as well as addressing inequities in energy access and affordability.

Although transport is increasingly recognised in climate frameworks, most policies do not adequately support the uptake of renewables, limiting the potential for synergies in the transformation of the transport and energy sectors. Energy efficiency and emission standards for transport reflect ambitions but remain concentrated in a few countries. As more jurisdictions implement such standards, this sends signals to vehicle manufacturers and enables them to follow a timeline towards zero-emission vehicles. However, geopolitical tensions, fossil fuel subsidies and regional conflicts have hampered progress and even led to setbacks. Co-ordinated policy action and investment are essential to accelerate the transition to low-carbon transport through renewable electrification, clean fuels and integrated renewable energy solutions.

By 2024, 89 countries had economy-wide targets for renewable energy, but only 23 had sector-specific renewable targets for transport, and 20 had biofuel blending mandates, with a rising emphasis on sustainability criteria.[8] Both Brazil and Indonesia have increased biofuel blending mandates in recent years. However, large-scale biofuel production can raise concerns about land use, food prices, and biodiversity, highlighting the need for careful policy and investment choices. Sustainable biofuels are expected to play a key transitional role in transport sectors less suited to direct electrification, such as long-distance aviation and shipping, and in heavy-duty road transport where electric vehicle charging infrastructure remains limited. Sectors long-considered "hard to abate", such as heavy-duty trucks and aviation, are exploring new energy solutions through legislation (Euro 7) and other frameworks (such as targets for sustainable aviation fuels).

Demand, use and access

Global energy consumption in the transport sector increased 20.6% between 2010 and 2023, rising from 101 exajoules (EJ) to 122 EJ.[9] The sector's 2023 energy use exceeded pre-pandemic (2019) levels by 2 EJ and signalled a continuation of the consistent, long-term growth trend of recent decades.[10]

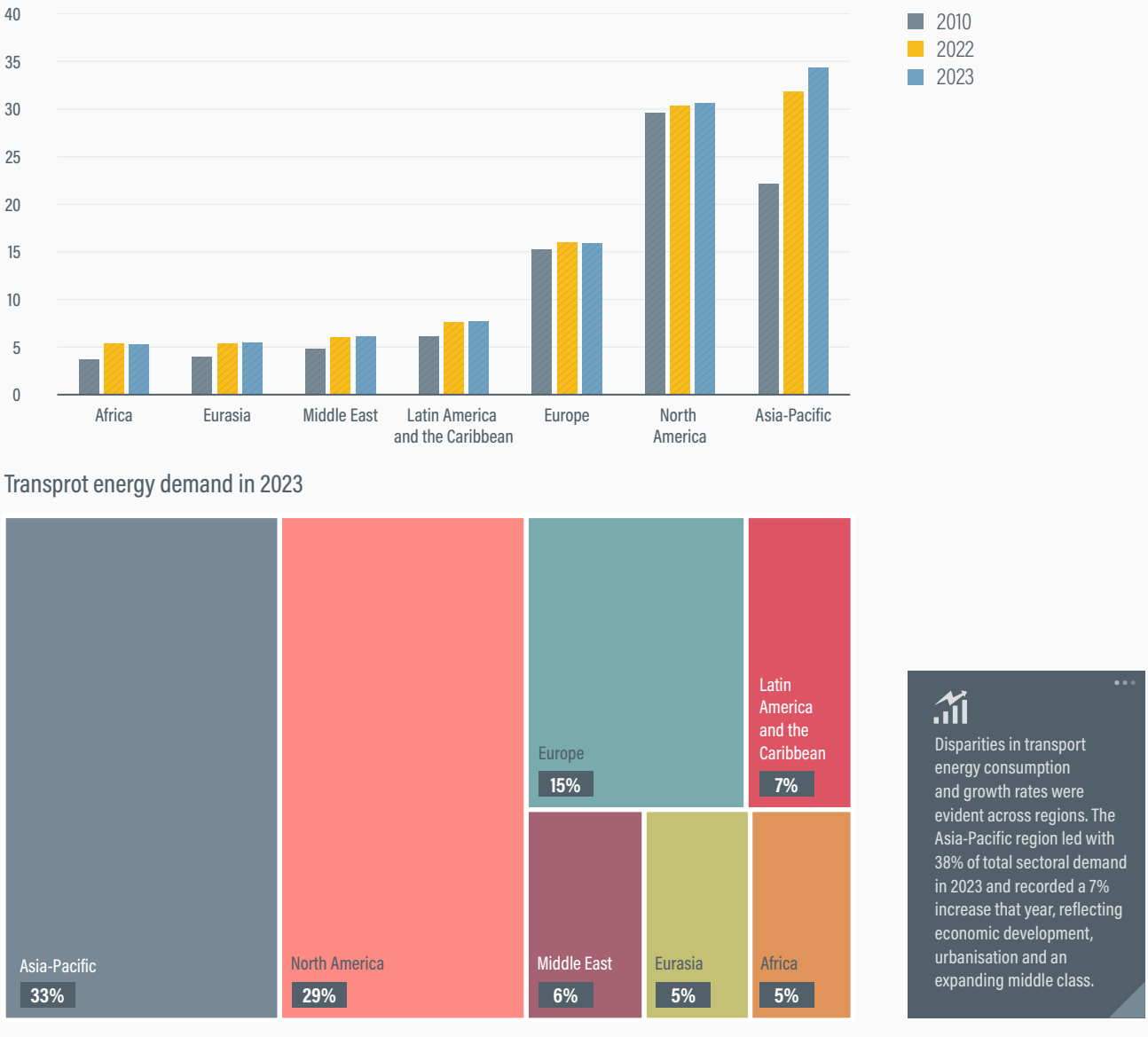
Energy demand from transport rose 4% in 2023, doubling the average annual growth rate of 2010-2023, driven by rising personal mobility in developing economies, global economic expansion, growing freight transport volumes and continued reliance on energy-intensive transport modes despite efficiency improvements in vehicle technologies.[11] Transport energy demand is projected to

grow 10% between 2023 and 2030.[12] The rise in energy demand poses significant challenges for decarbonisation efforts.

Disparities in transport energy consumption and growth rates were evident across regions (Figure 1).[13] The Asia-Pacific region led with 38% of total sectoral demand in 2023 and recorded a 7% increase that year, reflecting economic development, urbanisation and an expanding middle class.[14]

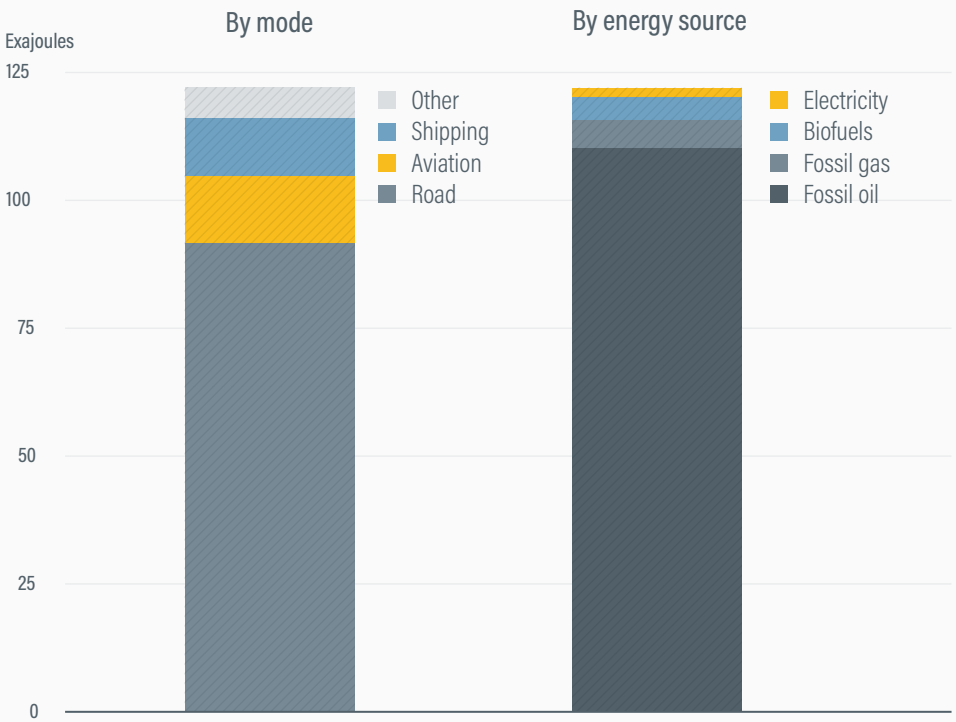
- North America remained the second largest consumer, accounting for 29% of transport energy demand in 2023, whereas Europe, ranking third, experienced a slight decline in energy use for transport, due likely to energy efficiency policies, modal shifts and economic factors.[15]
- In Africa, the region with the lowest transport energy use, demand fell 1.6% in 2023, possibly due to economic constraints, fuel price increases and structural transport changes.[16] The fuel price increases are likely linked to higher import costs, triggering unaffordability and inflation.[17]

FIGURE 1. Energy demand in transport by region, 2010, 2022 and 2023



Source: See endnote 13 for this section.

FIGURE 2. Energy demand in transport by sector and source, 2023



Road transport continued to dominate energy consumption in transport, accounting for 75% of demand in 2023. Passenger cars represented 38% of total energy consumption in transport, heavy-duty trucks 22%, aviation 10%, and shipping 9% reflecting the energy-intensive nature of air travel despite its smaller share of total passenger kilometres seasoned revenue passenger kilometres reaching around 700 revenue billions passenger kilometer for aviation and shipping's notable energy efficiency in per tonne-kilometre of freight moved.

Source: See endnote 21 for this section.

- Eurasia, Latin America and the Caribbean, and North America all saw moderate growth in energy for transport use of 1-2% in 2023.[18]

North America led by far in per capita energy demand from transport in 2023, with values 22 times those of Africa and more than twice those of Europe.[19] Between 2010 and 2023, per capita energy demand from transport grew 33% in Asia-Pacific, 17% in Eurasia and 13% in Latin America and the Caribbean.[20]

Road transport continued to dominate energy consumption in transport, accounting for 75% of demand in 2023 (Figure 2)**.[21] Passenger cars consumed 38% of the total energy used in transport, followed by heavy-duty trucks (22%), aviation (10%) and shipping (9%).[22] Aviation's relatively high share of transport energy use, despite its smaller share of total passenger-kilometres, reflects the energy-intensive nature of air travel.[23] The shipping sector is comparatively energy efficient per tonne-kilometre of freight moved.[24]**

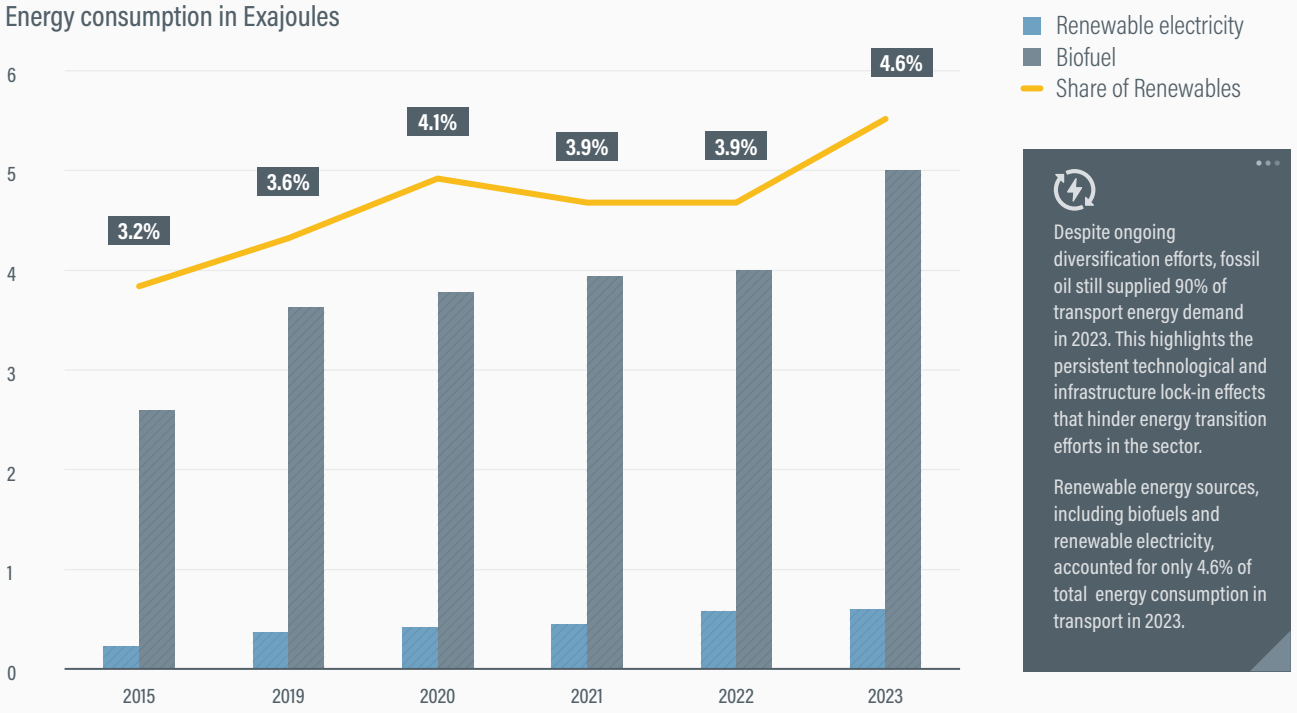
The trend towards larger and fuel-intensive sport-utility vehicles (SUVs) contributes greatly to transport's rising energy demand. On average, SUVs consume around 20% more energy per kilometre than medium-sized cars, further increasing the energy intensity of the passenger vehicle fleet.[25] SUVs reached a record 48% of global car sales in 2023, reinforcing the shift towards larger and heavier cars and making SUVs the defining automobile trend of the early 21st century across both developing and advanced economies.[26]

Despite ongoing diversification efforts, fossil oil still supplied 90% of transport energy demand in 2023.[27] This highlights the persistent technological and infrastructure lock-in effects that hinder energy transition efforts in the transport sector. Biofuels and fossil gas each contributed 4% of global transport energy use, while electricity, although growing, represented only 2%.[28]

In line with trends since 2015, renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport in 2023 (Figure 3)**; this underscores the significant challenge of decarbonising the sector.[29]** Despite rising climate ambitions, the share of renewables in transport has increased only marginally since 2015, due to the continued dominance of fossil fuels and the steady growth in overall transport energy demand.[30]

Global demand for liquid biofuels reached 175.2 billion litres in 2023, marking a steady increase since 2013 as

FIGURE 3. Renewable energy consumption in transport, 2015-2023



Despite ongoing diversification efforts, fossil oil still supplied 90% of transport energy demand in 2023. This highlights the persistent technological and infrastructure lock-in effects that hinder energy transition efforts in the sector.

Renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport in 2023.

Source: See endnote 29 for this section

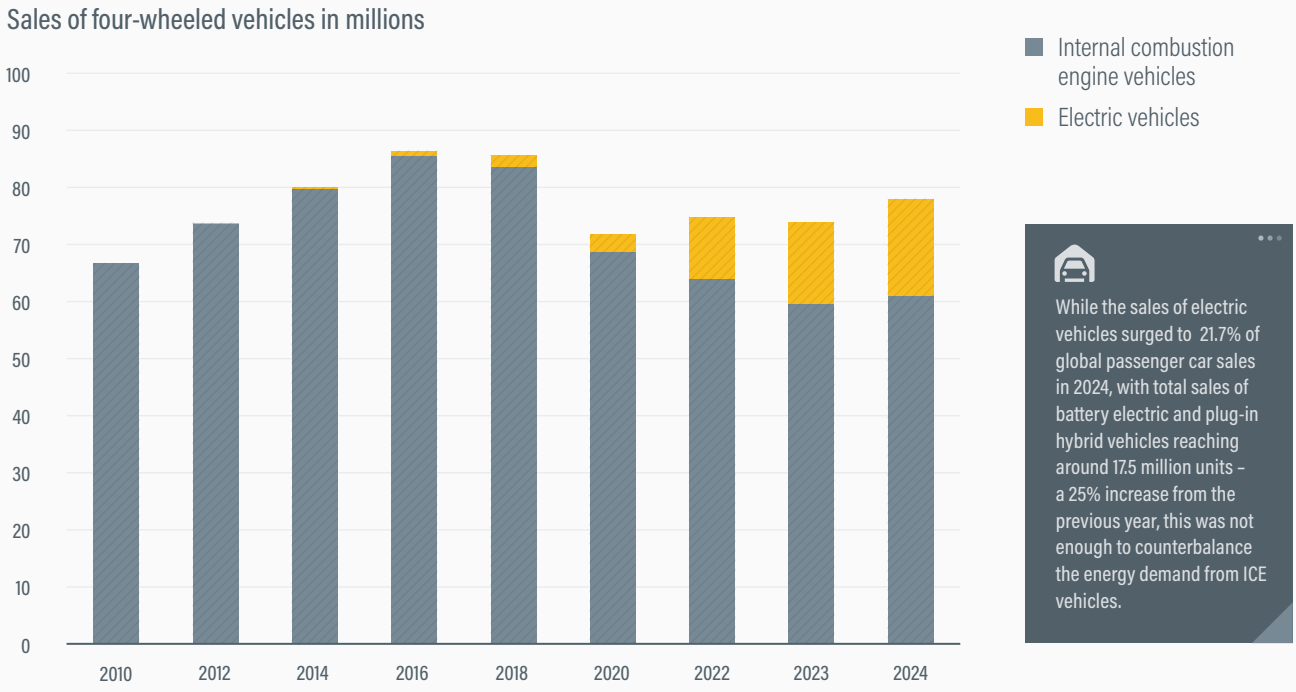
blending mandates have resulted in increased biofuel use in road transport.[31] **Bioethanol remained the dominant biofuel used in transport, followed by biodiesel (fatty acid methyl ester, or FAME) and a growing share of renewable diesel.**[32] Renewable diesel has experienced a notable rise, in recent years, reflecting growing interest in drop-in fuels that are compatible with existing infrastructure.[33]

- In early 2025, Indonesia implemented the highest national biofuel mandate globally, requiring a biodiesel mix of 40%, up from 35% previously.[34] In May 2025, the government announced plans for a 50% blending rate by early 2026.[35]
- Biofuels represent 22% of energy used in transport in Brazil, a very high share compared to other countries in the world.[36] Bioethanol dominates, representing nearly 40% (by energy) of combined gasoline and ethanol use.[37] The role of biodiesel as a substitute for diesel in heavy-duty vehicles is growing; in 2022, it represented 9.3% (by energy) of diesel use.[38]
- The United States and the European Union (EU) continued to be the most advanced markets for ethanol and biodiesel.[39]



In 2024, more than 58 million electric cars were on the world's roads, representing 4.5% of the global car fleet.[40] **Sales of electric vehicles (including battery electric and**

FIGURE 4. Global sales of internal combustion engine vehicles and electric vehicles, 2010-2024



Source: See endnote 41 for this section

plug-in hybrids) grew 25% to reach 17.5 million units, accounting for more than a fifth (21.7%) of all passenger car sales that year (Figure 4)**.**[41] **However, this was not enough to counterbalance the energy demand from ICE vehicles.**[42] **Electric vehicle sales growth was slower than in 2022 (60%) and 2023 (34%).**[43] Sales of ICE vehicles rose slightly in 2024 to around 61 million units, up from 59.6 million in 2023.[44]

Meanwhile, electric bus sales increased 30% in 2024, reaching a total fleet of 730,000 units.[45] **Electric medium- and heavy-duty truck sales surged nearly 80% in 2024 to approach 2% of the total truck market.**[46] Across all electric vehicles, challenges persist in scaling up charging infrastructure, ensuring grid stability and addressing the life-cycle emissions associated with battery production. (See 5.2 Road Vehicle Electrification for more on electric cars, buses, trucks and two- and three-wheelers.)

In maritime transport, battery-electric shipping corridors began to take shape, although they were largely limited to short sea routes in Northern Europe.[47] **In aviation, early innovation included the successful test flight of a 4-tonne civil electric aircraft, developed in collaboration with battery manufacturer CATL, marking a notable step in electrifying short-haul aviation.**[48] (See 4.9 Aviation and 4.10 Shipping.)

Overall, renewable energy sources - mainly wind and solar power - supplied nearly one-third (32%) of the world's electricity in 2024.[49] **A renewable electricity supply is critical for ensuring that transport electrification contributes meaningfully to emission reductions. However, advancements in renewable electricity and electric vehicles alone are insufficient to fully decarbonise the transport sector, as aviation and shipping respectively contributed around 11% of transport greenhouse gas emissions in 2023.**[50] Renewable electricity consumption has outpaced the consumption of non-renewable electricity.[51]

Sustainable aviation fuel (SAF) production doubled in 2024 to reach 1 million tonnes (1.3 billion litres).[52] **Despite this growth, SAF represented only 0.3% of global jet fuel production and 11% of total renewable fuel.**[53] SAF production growth fell short of forecasts due to delays in US facility timelines.[54] Europe led in SAF commitments, with binding mandates but facing high costs; the United States offered strong incentives yet suffered from production delays; and Asia focused mainly on SAF exports.[55] Emerging markets remained under-represented in SAF production, highlighting the need for greater global policy alignment and capacity building.[56] (See 4.9 Aviation.)



- As of May 2025, the International Civil Aviation Organization (ICAO) estimated 13.9 million tonnes of SAF capacity from 67 facilities already operational or under construction.[57]
- The EU's ReFuelEU Aviation regulation, in effect since January 2025 and part of the Fit for 55 climate package, sets legally binding minimum shares of SAF that must be blended into aviation fuel supplied at EU airports, starting at 2% in 2025 and rising to 6% in 2030, 20% in 2035 and 70% by 2050.[58]
- India, Indonesia and the Republic of Korea all issued new SAF mandates between 2023 and 2024.[59]

Sustainability and climate trends

Transport is now the second-largest and fastest-growing contributor to global greenhouse gas emissions. In 2023, the sector was responsible for 21.9% of carbon dioxide (CO_2) emissions. Transport has a sustained dependence on petroleum fuels and is a major energy consumer and a leading source of global emissions.[60]

Air pollution caused an estimated 8.1 million deaths globally in 2021 (including 700,000 deaths among children under five years), with 61% of these fatalities linked to fossil fuel combustion.[61] Transport-related pollutants, particularly particulate matter ($PM_{2.5}$), have direct and consistent linkages to poor health outcomes.[62]

Scaling up public transport, walking and cycling – which are more energy-efficient than private vehicles – can support a reduction in transport energy demand, as well as in related emissions from road transport.[63] (See 4.3 Walking, 4.4 Cycling and 4.5 Public Transport.)

A shift towards renewable energy in transport offers a critical pathway to reduce emissions and improve health outcomes. By 2028, biofuels and renewable electricity are projected to cut oil demand from transport by nearly 4 million barrels per day (or more than 7% of the forecasted transport oil demand).[64] If biofuels replaced 90% of conventional aviation fuels, emissions from aviation could be reduced 53% by 2050.[65]

Electrification across all modes is transforming the transport landscape; however, energy access and affordability challenges remain significant barriers to scaling up electric vehicle adoption. Although 91.6% of the global population had access to electricity as of 2023, at least 1.18 billion people remained "energy poor", lacking basic electricity access.[66] **Price volatility and regional**

differences in electricity costs create barriers for electric vehicle charging. Decentralised solar photovoltaics coupled with battery storage – which have lifetime electricity costs at or below USD 0.20 per kilowatt-hour – could help serve populations that lack electricity access.[67] Electricity access for basic services (lighting, refrigerator, washing machines) takes priority over charging electric vehicles. (See 5.2 Road Transport Electrification.)

More than 1.3 million public electric vehicle charging points were added to the global stock in 2024 (mostly in Asia and Europe), expanding the infrastructure needed for electric vehicle adoption.[68] Although essential, this growth places additional strain on power grids and increases uncertainty in electricity demand. Emerging technologies, such as time-shifted charging and bi-directional charging, offer the potential to balance demand and allow electric vehicles to send power back to the grid when needed.[69]

An estimated USD 6.9 trillion is required annually by 2030 to expand and stabilise grids and electric vehicle charging infrastructure, and to build their resilience.[70] Climate-related hazards such as wildfires, floods, sea-level rise and heat waves threaten not only physical transport infrastructure, but also the stability of renewable-powered mobility systems.

The transition to low-carbon transport creates new jobs, and global employment in the renewable energy sector reached a record 16.2 million jobs in 2023.[71] However, education and reskilling are needed to address the requirements of a shifting workforce and to ensure a just transition. The electrification of transport creates job opportunities in scientific research, design, manufacturing, maintenance, and sales, as well as in the installation and maintenance of millions of charging stations. However, in some countries, such as the United States, the decline of ICE vehicle manufacturing has triggered backlash from traditional labour groups and led to strikes.[72]

- China led in both electric vehicle and renewable energy employment in 2023, accounting for more than 45% of global renewables employment and experiencing a 32% increase in electric vehicle industry recruitment.[73]
- In the United States, software developers and chemical engineers, two key occupations related to electric vehicles, are projected to grow 17% and 10%, respectively, between 2023 and 2033, well above the average for all occupations.[74]
- In 2023, Tesla and Panasonic initiated an apprenticeship programme with the American Association of Community Colleges focused on charging infrastructure, with a USD 8 million grant from the US Department of Labor.[75]

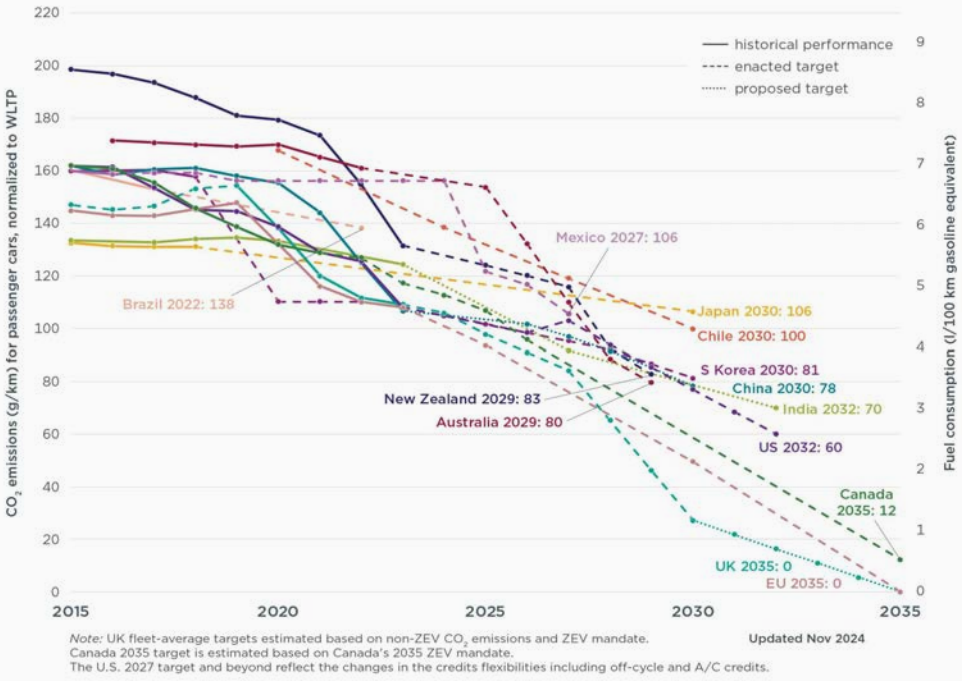
Policy and investment developments

The transport sector plays an essential role in meeting international climate and energy targets. However, policies and climate commitments that support the uptake of renewables in transport have fallen short of the pace needed to drive meaningful change. At the 2023 United Nations Climate Change Conference in Dubai, United Arab Emirates (COP 28), governments agreed to triple global renewable energy capacity and double energy efficiency improvements by 2030.[76] For the transport sector, comparable ambition and measures remain limited, highlighting a gap between high-level energy targets and sectoral implementation.

As of 1 August 2025, a total of 26 of the 29 submitted third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement included mitigation measures or adaptation actions related to transport.[77] However, many of these intended transport actions lack coherence with broader renewable energy objectives, limiting their transformative potential.

- The 26 third-generation NDCs integrated a total of 32 non-greenhouse gas transport targets, including 14 targets on zero-emission vehicles and 5 targets on vehicle efficiency.[78] Most of the zero-emission vehicle targets refer to the uptake of electric vehicles, but none specifies the use of renewable electricity.[79]
- Only three of the transport targets in the third-generation NDCs are biofuel targets – in Brazil, Monaco and the United Arab Emirates (UAE).[80]
- Only Botswana, Canada, Nepal, Saint Lucia and Uruguay included renewable energy support for transport in their third-generation NDCs as of August 2025, mostly focusing on renewable fuels.[81]
- Saint Lucia's third-generation NDC calls for a 14.7% reduction in energy sector emissions by 2030 relative to 2010, to be achieved through 40% renewable energy penetration (solar, wind and battery storage), increased energy efficiency and electric vehicle uptake.[82]
- In its third-generation NDC, Botswana aims to increase the renewable energy share in the transport sector 10% each decade.[83]
- The "New Industry Brazil" programme, launched in January 2024, aims to increase the share of biofuels in Brazil's transport energy mix 50% by 2033, as specified in the country's third-generation NDC.[84]
- The third-generation NDCs of Moldova, Singapore and the United Kingdom emphasise their commitment to banning ICE vehicles.[85] Only the United Kingdom refers to the elimination of fossil fuel subsidies, while Singapore highlights its fossil fuel tax.[86]

FIGURE 5. Equivalent passenger car CO_2 emissions and fuel consumption in countries with mandatory vehicle efficiency or emission standards, 2015-2035



By 2024, a total of 13 countries had established or proposed fuel efficiency or greenhouse gas emission standards for passenger vehicles or light commercial vehicles and trucks. Although these regulations lacked global reach, they applied to more than 85% of all passenger vehicle sales, guiding the strategic decisions of major vehicle manufacturers worldwide.

Source: See endnote 91 for this section.

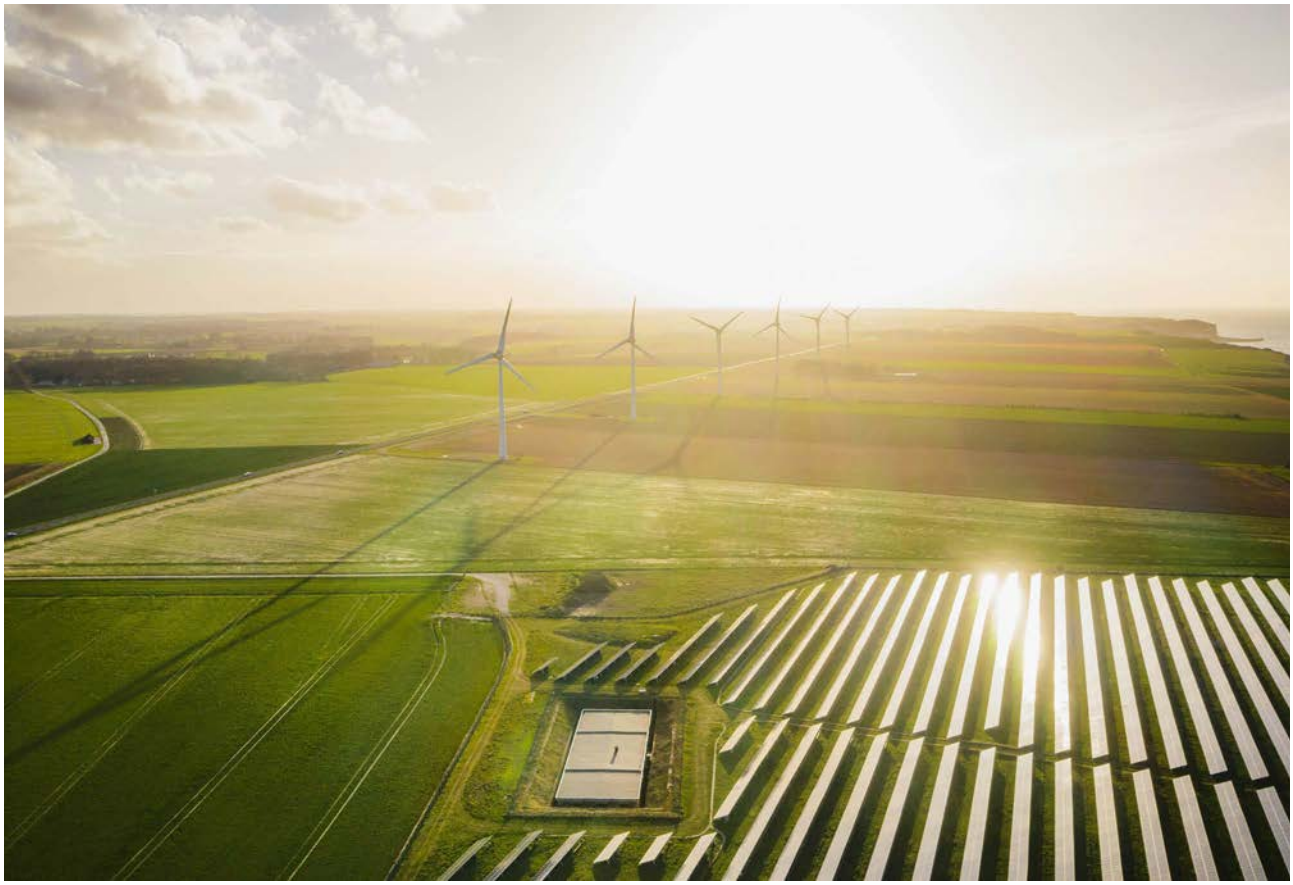
In the Long-Term Low Emission Development Strategies (LT-LEDS) submitted by countries under the Paris Agreement in the first half of 2025, countries highlight the key roles of both the transport and energy sectors; however, they provide little to no detail on how renewables are integrated into the transport sector.[87]

Of the 31 countries with a carbon tax in 2024, 22 targeted the transport sector with this tax.[88] **Of the 44 countries that had an emissions trading system (ETS) in 2024, 36 countries had one that covered transport emissions.**[89] As of 2024, a total of 53 countries had in place carbon pricing policies – including carbon taxes and ETS – and 45 countries had both carbon pricing policies and net zero emission targets.[90]

By 2024, a total of 13 countries had established or proposed fuel efficiency or greenhouse gas emission standards for passenger vehicles or light commercial vehicles and trucks (Figure 5)**.**[91] **Although these regulations lacked global reach, they applied to more than 85% of all passenger vehicle sales, guiding the strategic decisions of major vehicle manufacturers worldwide.**[92] **Most standards apply only to light-duty vehicles, but in 2024 the EU introduced the world's first heavy-duty vehicle standard, with a mandatory target to reduce CO_2 emissions from new trucks 90% by 2040.**[93] Fuel efficiency and emission standards are crucial to accelerate production and sales of electric vehicles to meet emission targets.

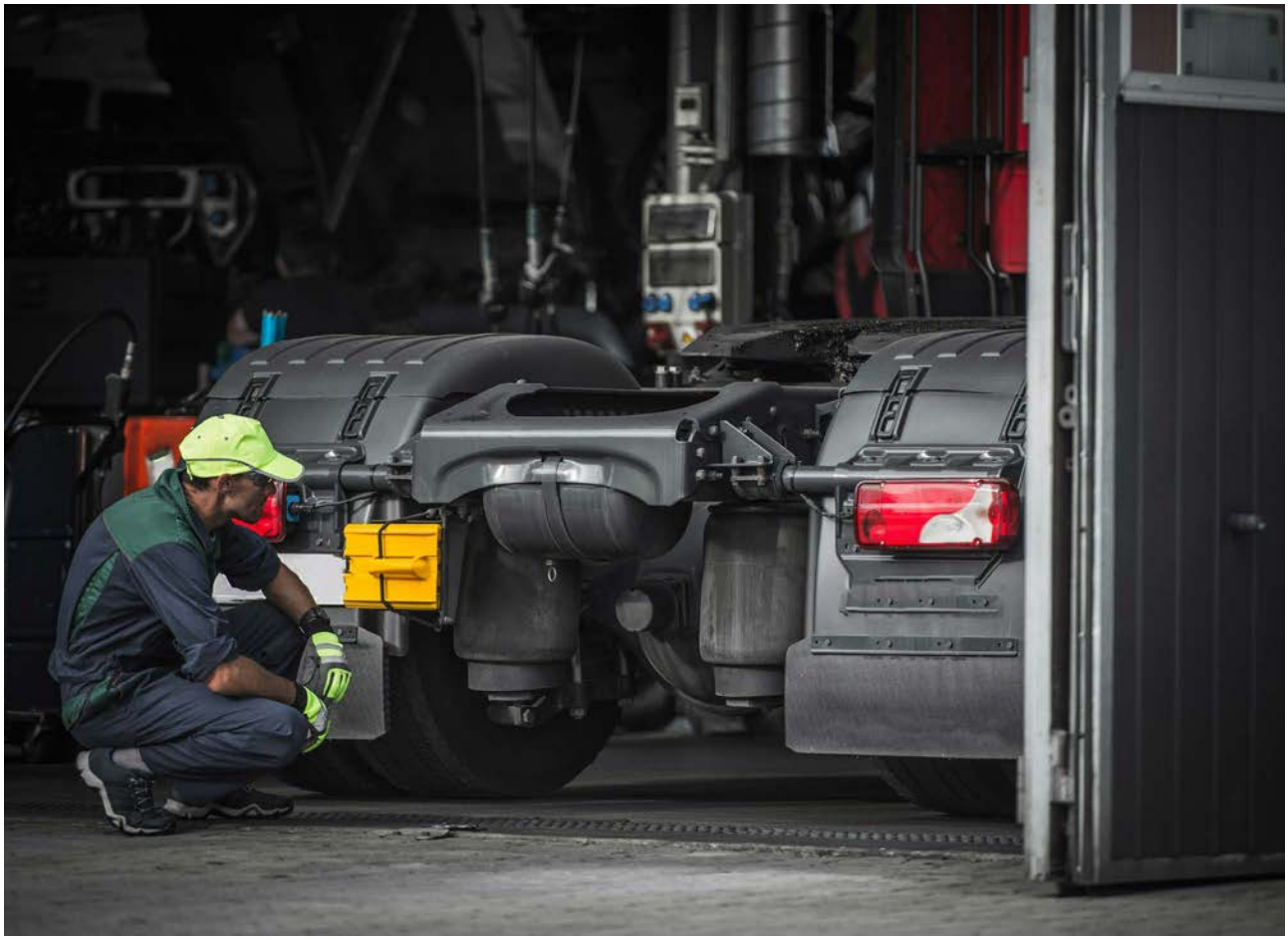
Jurisdictions that had enacted targets for both passenger vehicles and light commercial vehicles as of 2024 included Australia, Canada, China, Chile, the EU, Mexico, New Zealand, the Republic of Korea, the United Kingdom, and the United States, while Japan enacted a passenger car target of 106 grams of CO_2 per kilometre by 2030.[94] **Three jurisdictions had targets for 2035, including Canada, the United Kingdom, and the EU, and only the EU had a target for 100% zero-emission passenger cars and light commercial vehicles by 2035.**[95]

- In 2024, Australia adopted its first-ever CO_2 emission standards for new light-duty vehicles, setting annual targets from 2025 to 2029, with a 2026 review to consider stricter post-2029 targets and reclassifying SUVs as passenger vehicles.[96] The measure is projected to reduce 321 million tonnes of emissions by 2050 and to result in health cost savings of USD 3 billion (AUD 5 billion) by 2050.[97]
- Chile's first fuel efficiency standards for light-duty vehicles took effect in 2024, with the aim of increasing fuel economy from a 2020 baseline of 14.9 kilometres per litre of petrol equivalent (km/lpe) to 18.8 km/lpe from 2024 to 2026, 22.8 km/lpe from 2027 to 2029, and 28.9 km/lpe in 2030.[98]
- In China, Phase V of the fuel consumption standards set a fleet average target of 4.0 litres per 100 kilometres (l/100km) by 2025 and 3.2 l/100km by 2030, based on



the New European Driving Cycle (NEDC).[99] The draft of Phase VI, released in August 2024, proposes a target fuel consumption for passenger cars of 3.3 l/100km by 2030.[100] It sets progressively stricter annual compliance rates from 2026 to 2030 and provides a 0.14 l/100km flexibility for the 2030 target.[101]

- In 2024, the Republic of Korea updated its Enforcement Order of the Energy Use Rationalisation Act, stating that automakers in the country must comply with either fuel efficiency standards (33.1 km/litre for passenger cars and 17.3 km/litre for light trucks) or CO_2 emission standards (70 grams of CO_2 per kilometre for passenger cars and 146 grams of CO_2 per kilometre for light trucks.[102] If manufacturers fail to meet their chosen target, a surcharge is imposed based on the shortfall.
- In its 2025 second-generation NDC submission, Lesotho aims to improve the fuel efficiency of road vehicles, with targets for 2030 including 21,838 efficient petrol vehicles and 4,368 efficient diesel vehicles (reducing greenhouse gas emissions by 9 kilotonnes of CO_2 equivalent per year and 1 kilotonne of CO_2 equivalent per year, respectively).[103] Additional targets are for 43,677 efficient petrol vehicles and 8,735 efficient diesel vehicles (reducing 18 kilotonnes of CO_2 equivalent per year and 2 kilotonnes of CO_2 equivalent per year respectively), alongside regulations to reduce the number of poor-performing imported used cars.[104]
- In 2024, the United States finalised new, more stringent greenhouse gas emission standards for light-duty and medium-duty vehicles, starting with model year 2027 and aiming to achieve fleet-wide emission reductions of 56% and 44%, respectively, by 2032 (compared to 2026 levels).[105] As part of phase 3 emission standards for heavy-duty vehicles, new 2024 standards aimed for up to a 60% reduction in CO_2 emissions for vocational trucks and 40% for tractor trucks by 2032, compared to 2027 levels.[106]
- The United States also established new Corporate Average Fuel Economy (CAFE) standards requiring passenger cars to improve fuel efficiency 2% annually from model years 2027 to 2031, reaching an average of 50.4 miles per gallon (mpg) by 2031.[107] However, the new Trump administration has indicated intentions to review and potentially roll back these regulations, citing concerns about industry competitiveness and the legality of the standards.[108]
- Viet Nam's Ministry of Transport introduced a new national standard – which took effect in June 2025 – that sets mandatory fleet-average fuel consumption limits and evaluation methods for newly manufactured, assembled and imported passenger cars with up to eight seats, including ICE, hybrid, battery electric and fuel cell vehicles.[109]



In 2025, the Euro 7 emission standard came into force, combining regulations for light- and heavy-duty vehicles in a single regulation.[110] **From 2025, all European manufacturers must comply with fleet-wide average CO_2 emissions and reduce the emissions of new trucks 15% by 2025 and 45% by 2030.**[111] **However, some jurisdictions including the EU have scaled back or delayed their fuel efficiency plans and emission standards, and very few governments worldwide have enacted their announced bans on sales of ICE vehicles.**[112]

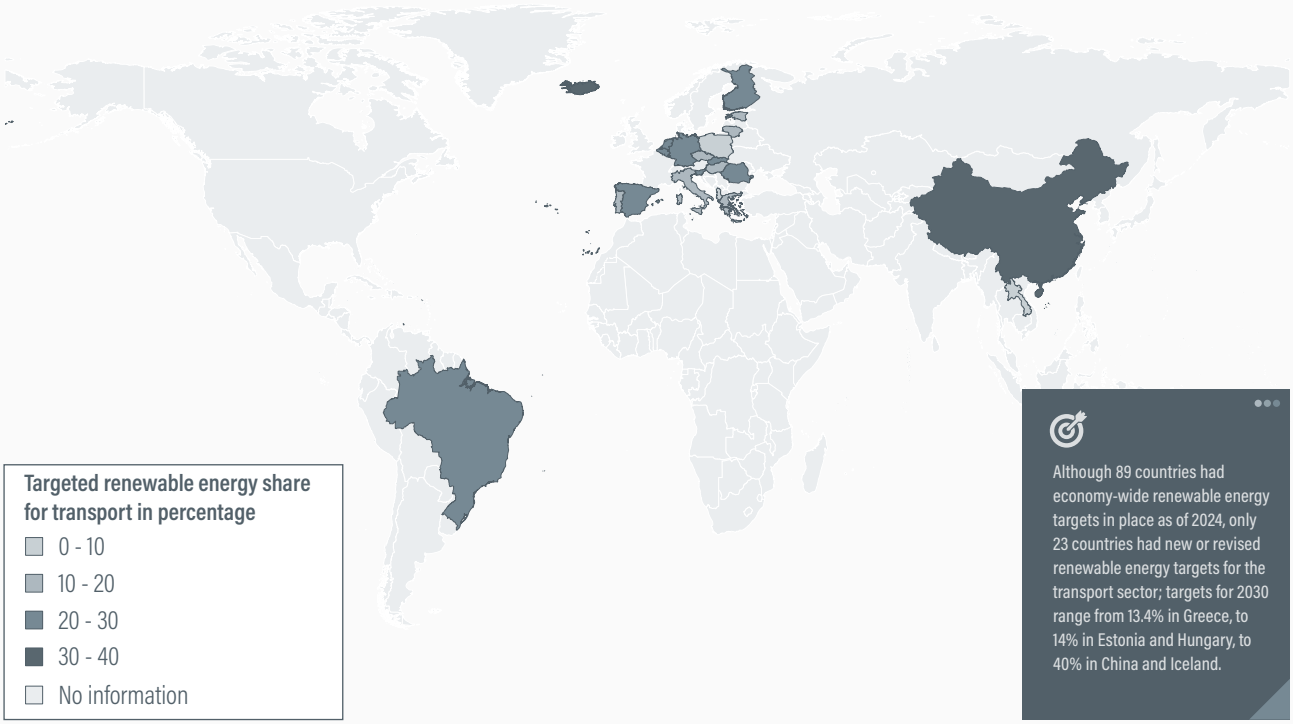
- In 2023, the EU amended its regulation to allow ICE cars with CO_2-neutral fuels beyond 2035.[113]
- In early 2025, the European Commission announced a relaxation of the EU's 2024 CO_2 emission targets for car manufacturers in Europe, allowing for a three-year compliance period instead of annual compliance to account for the challenging circumstances facing the industry.[114]

In certain regions and sectors, such as aviation, efficiency improvements have stalled due to a lack of sufficiently strong standards.[115] Improvements in aircraft fuel efficiency have stalled since international CO_2 standards took effect in 2020.[116]

In recent years, several countries have strengthened or introduced vehicle efficiency labelling schemes, which have become a growing practice globally; meanwhile, the EU plans a 2026 review to boost the uptake of zero-emission vehicles.[117] Vehicle efficiency labelling informs consumers and encourages cleaner vehicle choices, although many countries still lack such programmes.

- The EU's Car Labelling Directive requires standardised fuel economy and CO_2 emissions information at the point of sale, informing consumer choices and supporting emission reduction targets.[118]
- In 2024, China issued a policy requiring auto manufacturers and imported vehicle dealers to ensure that their light-duty vehicles are affixed with energy consumption labels at the time of sale.[119]
- Germany enhanced its car energy efficiency labelling in 2024, mandating more comprehensive information on vehicles' carbon emissions and fuel efficiency. This amendment, based on the European Car Labelling Directive, aims to empower consumers with better data for informed purchasing decisions and to incentivise manufacturers to develop more efficient vehicles.[120]
- In 2024, the Philippines introduced a new Vehicle Fuel Economy Labeling Program covering both ICE and electric

FIGURE 6. Renewable energy targets in the transport sector, as of 2024



Source: See endnote 126 for this section.

vehicles, requiring manufacturers and importers to display standardised fuel economy labels to help consumers compare efficiency and reduce emissions.[121]

- Taiwan (Province of China) amended its fuel economy regulations in 2024 to require energy efficiency labels for all manufactured or imported petrol, diesel and electric vehicles – including passenger cars, motorcycles, light-duty trucks and commercial vehicles under 3,500 kilograms – with labelling for heavier electric trucks to take effect in 2030.[122]

Pollutant emission standards are crucial to address the health impacts of poor air quality, especially in urban areas, but the stringency of such measures needs to be increased.

- The EU's Euro 7 standards, which entered into force in 2024, aim to reduce air pollutant emissions from all vehicles, including cars, vans and trucks.[123] A study shows that the regulation could avoid 7,200 premature deaths linked to nitrogen oxide (NO_x) emissions in Europe by 2050.[124]
- Phase B of China's National Stage 6 Vehicle Emission Standards was fully implemented in July 2023, setting new limits on carbon monoxide (CO), NO_0, particulate matter, non-methane hydrocarbons and hydrocarbon (THC) emissions.[125]

Although 89 countries had economy-wide renewable energy targets in place as of 2024, only 23 countries had new or revised renewable energy targets for the transport sector (Figure 6)**.**[126] **Targets for 2030 range from 13.4% in Greece, to 14% in Estonia and Hungary, to 40% in China and Iceland.**[127] **All the countries that adopted new renewable targets for transport in 2024 were EU Member States**, reflecting the impact of region-wide legally binding standards.[128] Seven countries enacted new renewable energy targets for transport, while some introduced targets ranging from a 15.8% renewable target by 2030 in Lithuania to a 30% target in Finland.[129]

- China, in its Plan for Carbon Peaking in the Industry Sector, aims for 40% of transport to be powered by "new energy" – such as hydrogen and renewable-based electricity – and other clean energy sources by 2030.[130]
- Estonia aims for a 14% renewable energy share in transport by 2030, primarily through domestic biomethane production – targeting up to 340 gigawatt-hours annually – and increased use of electric vehicles powered by renewable electricity.[131]
- The EU's revised Renewable Energy Directive (RED III), adopted in late 2023, targets an overall renewable energy share of at least 42.5% in overall energy consumption binding at the EU level by 2030.[132] In the transport

sector, EU Member States can choose between a target of reducing greenhouse gas intensity 14.5% by 2030 or ensuring a share of at least 29% of renewables in final energy consumption by 2030.[133]

- Germany aims for 30% of gross final energy consumption in transport to come from renewable sources by 2030, in line with the RED II methodology.[134]
- The Slovak Republic targets a progressive increase from 10.4% renewable energy in transport in 2025 to 29% by 2030, including multipliers.[135]

As of 2024, 20 countries had in place biofuel blending mandates, with growing emphasis on stricter sustainability criteria.[136] **Countries that have enacted new or updated biofuel blending mandates since 2023 are Belgium, Brazil, Indonesia, Japan, Nigeria, the Philippines and Poland.**[137] In recent years, countries have introduced stricter sustainability criteria to ensure that biofuel production does not lead to deforestation or other environmental harm.

- Indonesia further raised its already leading biofuel blending mandate from 35% to 40% (and 50% in 2026).[138]
- Blending mandates for 2030 range from 7% in the Netherlands to more than 10% in Burkina Faso and Japan, 12% in Argentina and 34% in Finland.[139]
- In its NDC from November 2024, Brazil aims to increase the share of biofuels in transport energy use from 21.4% in 2025 to 50% in 2033.[140]
- The EU's RED III sets out a binding target for non-crop-based advanced biofuels of 1% by 2025 and 5.5% by 2030, with at least one percentage point being from renewable fuels of non-biological origin by 2030.[141]
- Indonesia's new B50 palm oil-based biodiesel blending mandate for 2026 is part of a wider energy transition plan aimed at cutting emissions, but it will require a stark increase in local production and more than 9.2 million hectares of new palm oil plantations.[142] The government has continued to carry out tests for renewable diesel and SAF.[143]
- Since January 2024, Poland has introduced E10 fuel containing 10% bioethanol to replace E5 petrol, aligning with EU directives to reduce fossil fuel use, although older vehicles may require higher-octane fuel due to compatibility issues.[144]
- In its NDC, submitted in November 2024, the UAE announced that it would shift portion of diesel consumption in land transport to biodiesel by introducing B7 (7% biodiesel in conventional diesel) by 2030 and B20 (20% biodiesel) by 2050.[145]
- In the EU, the use of conventional palm biofuel fell 80% between 2019 and the end of 2023, due to early phase-outs in multiple EU countries in response to concerns about deforestation.[146]

In 2024, seven jurisdictions – China, the EU, India, the Republic of Korea, Malaysia, Singapore and Thailand – announced new targets for the production or use of SAF.[147]

- In 2024, Brazil adopted the Fuel of the Future law, which requires airlines to reduce domestic flight greenhouse gas emissions 1% by 2027, increasing to 10% by 2037 through SAF.[148]
- The EU's Fuel Quality Directive limits ethanol blends to 10% or less when ethanol is used as an oxygenate, and places limits on palm oil and soy oil content of biodiesel.[149] ReFuelEU targets 6% SAF by 2030 with a 1.2% sub-target for renewable fuels of non-biological origin.[150]
- In 2024, the United Kingdom mandated minimum targets of 2% in 2025, 10% in 2030, and 22% in 2040, with sub-targets for synthetic fuels.[151] In 2023, the UK government announced grant funding through a USD 207 million (GBP 165 million) Advanced Fuels Fund to support the development of commercial-scale SAF plants in the country.[152]

As of 2024, 68 countries had in place electric vehicle targets, reflecting a growing prioritisation of electric vehicle adoption and zero-emission transport as part of climate and energy strategies.[153] **However, electric vehicle targets alone do not necessarily lead to increased renewable energy use unless they are coupled with specific mandates or bans on ICE vehicles, as well as efforts to boost the overall share of renewables in a country's electricity mix.** Several countries announced financial support for electric vehicle adoption, including purchase incentives and tax credits.[154] In Europe, the withdrawal of electric vehicle purchase subsidies in Germany, combined with an anticipated roll-out of EU-wide CO_2 standards in 2025, led to a cooling of electric vehicle sales and sales volumes decreasing by 0.6%.[155] (See 5.2 Road Vehicle Electrification.)

Although global ambitions for electric vehicle adoption have increased, trade tensions have grown as major export markets apply tariffs to protect domestic industries.[156] **Geopolitical tensions, regional conflicts, energy security concerns and continued fossil fuel subsidies risk delaying progress on electric vehicle and renewable energy uptake and climate action in the transport sector.**[157]

In 2024, major export markets implemented a range of unilateral tariffs on Chinese-made electric vehicles.[158] In return, China launched a series of countermeasures, such as anti-dumping investigations on EU and Canadian products, and has increasingly looked to diversify exports to Australia and other emerging markets.[159]

- Canada imposed a 100% surtax on Chinese-produced electric vehicles effective 1 October 2024, to counteract unfair trade practices in China, including subsidisation and lax labour and environmental standards.[160]
- In 2024, the EU imposed countervailing duties on Chinese electric vehicles for five years, with rates varying by company: BYD at 17.0%, Geely at 18.8%, SAIC at 35.3%, and other co-operating companies at 20.7%, while Tesla faces a duty of 7.8%; non co-operating companies are subject to a duty of 35.3%.[161]
- In 2024, the United States increased tariffs on imported electric vehicles from China from 25% to 100%, and raised tariffs on batteries from China from 7.5% to 25%.[162]

Beyond electricity and biofuels, advancements in other alternative fuels included initiatives to promote hydrogen-powered transport. However, persistent challenges such as high production costs, limited infrastructure and regulatory uncertainties have hindered widespread adoption.[163]

- In 2024, the Netherlands earmarked USD 129 million (EUR 125 million) to put hydrogen-powered vehicles on the road, with the aim of increasing the number of hydrogen-powered trucks, vans and buses, as well as establishing hydrogen refuelling stations across the country.[164] The scheme for hydrogen trucks and vans runs from 2024 to 2028 and will subsidise thousands of fuel cell electric vehicles and set up 40 new hydrogen refuelling stations, offering up to USD 310,515 (EUR 300,000) per vehicle and up to USD 2.1 million (EUR 2 million) per refuelling station.[165]
- The EU's first binding target to supply green hydrogen and e-fuels to the transport sector under RED II only aims for hydrogen and e-fuel to account for 1% of all fuels used in the transport sector by 2030; the EU also includes non-binding sub-targets for shipping and aviation.[166]
- The EU's Alternative Fuels Infrastructure Regulation (AFIR), which entered into force in 2024, mandates legally binding national targets for the deployment of electric charging stations, hydrogen refuelling stations, liquefied natural gas refuelling points and shore-side electricity supply across all transport modes.[167]
- As of 2024, China had introduced 556 hydrogen energy policies, including 221 development plans, accounting for 39.7% of the total; the country's hydrogen energy applications were focused mainly on transport, with projects reaching a total capacity of 351.3 megawatts.[168]
- Panama's second-generation NDC from 2024 includes a target for 2% of heavy-duty transport vehicles and machinery to use green hydrogen and/or its derivatives by 2027.[169]

Initiatives on clean shipping by Australia, the EU, the United Kingdom, and parts of China and the United States are addressing emissions from the shipping sector.[170] **In 2025, the International Maritime Organization (IMO) approved**



its Net-Zero Framework, combining mandatory emission limits and greenhouse gas pricing.[171] Low- and middle-income countries – despite strong renewable energy potential – face persistent financing gaps, underscoring the need for targeted international support to scale up green shipping supply chains. (See 4.10 Shipping.)

- The FuelEU Maritime regulation, adopted in 2023 and in force as of January 2025, sets maximum limits on the annual average greenhouse gas intensity of the energy used by ships calling at EU ports; the aim is to encourage the adoption of renewable, low-carbon fuels and clean energy technologies.[172]
- In Europe, policy mechanisms such as the EU Emissions Trading System and FuelEU Maritime have spurred significant investments in green fuels and vessel efficiency.[173]
- In Asia and North America, major projects have emerged around methanol and ammonia infrastructure, including port upgrades and fuel production facilities.[174]

Partnerships in action

The **Global Fuel Economy Initiative** (**GFEI**) has advanced global vehicle fleet transformation to support transport decarbonisation, as a partnership among the International Energy Agency, the UN Environment Programme, the International Transport Forum, the International Council on Clean Transportation (ICCT), the University of California at Davis and FIA Foundation. In Australia, the GFEI's long-standing engagement — including analysis by ICCT — informed the consultation on a mandatory standard for light-duty vehicle CO_2 emissions.[175]

In 2023, the **International Energy Agency** (**IEA**) conducted a workshop on Low-emissions Transport Fuels: Technology and Policy Pathways to Decarbonise Shipping and Aviation, and in 2024 it held two technical workshops on the Global EV Outlook 2024, supported by the Global EV Data Explorer and Global EV Policy Explorer tools.[176]

The **International Renewable Energy Agency** (**IRENA**) hosted a Policy Talk in 2025 on advancing the renewables-based electrification of road transport, presenting findings from its report on this topic. The event highlighted key policies, examples and regional best practices to overcome barriers and accelerate adoption.[177]

REN21's **Global Futures Report: Renewables for Sustainable Transport** examines pathways to rapidly scale renewable energy in transport, emphasising tailored policies, strategies and guidance for stakeholders. The report forms part of REN21's work as the renewable energy voice of the NDC Transport Initiative for Asia consortium.[178]

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Road Vehicle Electrification



Note: This section (5.2) is focused on the electrification of road transport, specifically the transition of road vehicles (passenger cars, buses, trucks, two- and three-wheelers) to electric drivetrains. The main scope is battery-powered electric vehicles. Other specific transport modes and their developments (besides electrification) are captured in Module 4, such as 4.4 Cycling, 4.7 Rail, 4.9. Aviation and 4.10 Shipping. Trends and developments for road vehicles more broadly are captured in 4.8 Road Transport. Section 5.1 Transport Energy Sources discusses the broader picture of energy demand and energy sources for freight and passenger transport.

KEY FINDINGS

Context, challenges and opportunities

- Electrification is central to the decarbonisation of both road and rail transport, and is also relevant for ferries, short-distance shipping and port emissions. Electric passenger cars, in particular, are one of the bright spots of the clean energy industry. Electric powertrains for road transport are a mature, scalable technology aligned with trends in energy decarbonisation, digitalisation and industrial innovation.
- The electrification of road transport vehicles is a pivotal part of a broader transformation needed in transport systems. This transformation will need to proceed rapidly worldwide and to encompass universal access to sustainable, low-carbon transport, and broader societal and industrial goals. This transformative change requires an integrated multi-modal, multi-level approach that goes beyond transport electrification and addresses all aspects of the transport system.
- The technological transition brought by EVs and low-carbon electricity has implications for supply chains, with deep impacts on skills, jobs and their geographical distribution. This and other socio-economic, equity, and access implications of the transition to electric mobility require careful and calibrated policy to anticipate and manage in a fair manner that protects vulnerable groups and enables shared and resilient prosperity.
- Despite the success of electric two- and three-wheelers and urban public transport buses, including in emerging markets and developing economies, the risk of an electric mobility divide remains a concern. Early EV markets in most countries have been dominated by expensive, high-end models, limiting affordability and access, particularly for low-income households and countries.



Demand, use and access

- A total of 58 million electric cars were on the world's roads in 2024, more than 11 times the number in 2018. The global electric car fleet was 5.7 times larger in 2024 than in 2020, maintaining four-year average growth of 54%.
- Despite this growth, electric cars accounted for less than 5% (4.5%) of vehicles globally, with more than two-thirds of the fleet operating in China.
- In 2024, global sales of electric cars (including battery electric and plug-in hybrid models) increased more than 25% to reach 17.5 million units. More than one-fifth (20%) of all passenger cars sold during the year were electric (13.8% battery electric, 8.2% plug-in hybrid), up from 14% in 2021.
- Electric car sales in China reached 11 million units in 2024, accounting for 65% of EVs sold worldwide and for nearly half (48%) of all domestic car sales. Monthly sales of electric cars in China have overtaken sales of new ICE cars since July 2024, marking a major milestone in the transition of the world's largest automotive market.
- EV sales in Europe remained relatively constant in 2024, with around a 20% share. The limited growth in European sales was aligned with regulatory requirements that did not require an increase in the region's EV market share until 2025. Several European countries also phased out EV purchase subsidies.
- Electric car sales in the United States grew 40% in 2023, driven by policy support from the Inflation Reduction Act. In 2024, however, sales growth fell to only 10%, with a total of 1.6 million units sold.
- During 2023 and 2024, consumer interest in electric cars expanded from the dominant markets of China, Canada, Europe, Japan, the Republic of Korea and the United States towards a broader group of emerging markets and developing countries. These include Costa Rica, Thailand, Türkiye, and Viet Nam, followed closely by Brazil, Colombia, Indonesia and Uzbekistan.
- Electric car sales in South-East Asia surged nearly 50% in 2024, accounting for 9% of the region's total car sales.
- Electric car sales in Latin America more than doubled in 2024, with the regional market share rising to 4%. Brazil led with 125,000 electric cars sold (a two-times increase), reaching 6.5% of total car sales.

KEY FINDINGS

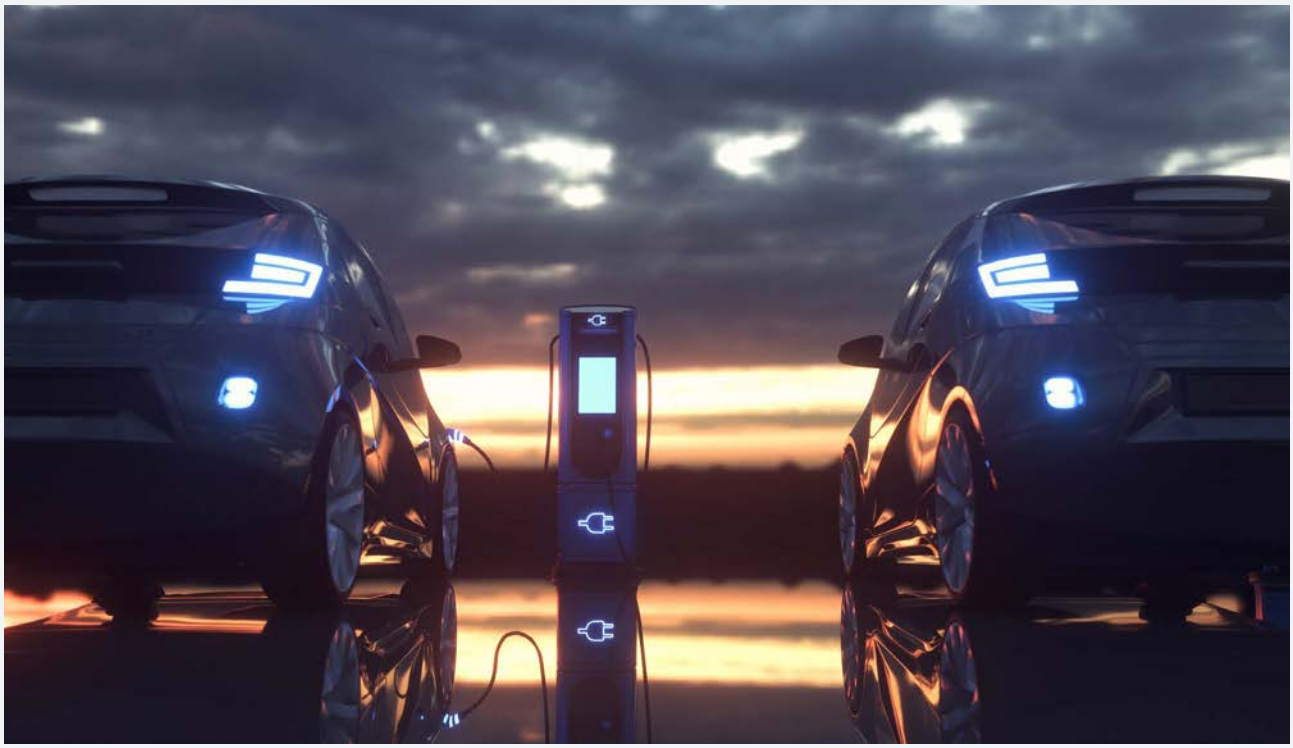
- Africa's electric car market remained nascent in 2024 but showed signs of acceleration, with sales more than doubling to 11,000 units in 2024; however, EVs still comprised less than 1% of total car sales. Challenges included limited charging infrastructure and parts availability.
- Electric two- and three-wheelers continued to far exceed numbers of other electric vehicles, although estimates of their stock and sales vary greatly. Available data for 2024 suggest close to 400 million units globally, including nearly 80 million electric motorcycles and 320 million electric mopeds and low-speed electric scooters (and not including electric bicycles and micromobility vehicles such as kick-scooters). China accounted for 85% of all electric motorcycles, with other Asia-Pacific countries contributing an additional 12%.
- Annual sales of electric motorcycles, mopeds and low-speed electric scooters totalled an estimated 35-50 million between 2021 and 2024, or between 40% and 50% of all two-wheeler sales annually. Electric motorcycle sales ranged from 6 million to 10 million annually during this period, accounting for a global sales share of 15% compared with ICE motorcycles.
- In 2024, electric two-wheelers made up over 30% of total sales in South-East Asia, with strong progress in Indonesia, Thailand and Viet Nam. Electrification of two- and three-wheelers has advanced rapidly in the region due to the vehicles' high market presence and suitability for short-range urban travel. Governments have encouraged adoption through fiscal incentives, reduced VAT and local manufacturing requirements.
- Electrification of two-wheelers in Africa is still emerging but has gained momentum in cities. Local start-ups and partnerships have focused on battery swapping networks and low-cost models suited for shared mobility and deliveries. Kenya, Rwanda and Uganda are noted hubs of innovation, although data on market penetration are limited. Barriers across the continent include import tariffs, financing access and lack of standards.
- Globally, an estimated 40 million electric bikes (a bicycle equipped with a battery-powered motor, typically with pedal-assist) were sold annually as of 2023 (representing around 30% of all bikes) as well as an estimated 50 million electric kick-scooters.
- The global electric light commercial vehicle stock (vans) reached 1.9 million vehicles in 2024.Electric sales totalled 650,000 units, or 7.1% of all sales. Both the sales and stock more than doubled between 2022 and 2024.
- Sales of electric buses totalled 70,000 in 2024 (6% of total sales), up 30% from 2023; this brought the global stock to 730,000 units, or 4.9% of the total fleet. Battery-electric buses continued to outpace fuel cell electric buses 35 to 1 due to their lower operational costs.



KEY FINDINGS

- China continued to dominate the electric bus market, accounting for 68% of global new sales and 89% of the global electric bus stock.
- In the European Union (EU), nearly 6,000 e-buses were delivered in 2024, up from 4,900 in 2023. Electric buses accounted for 17% of the region's total bus sales in 2024. However, EV adoption has varied widely depending on the size class and type of operations.
- Electric bus adoption in the United States has been slower than in European and Chinese markets; nonetheless, in the first quarter of 2024, zero-emission[4] buses accounted for 11% of all bus sales, with 641 newly registered units.
- Outside China, Europe, and North America, new sales of electric buses in 2024 totalled 9,500, a similar scale as in the European market. Frontrunners included India, with 3,200 new sales in 2024, and the Republic of Korea with 2,800.
- Latin American countries – notably Chile and Colombia – continued to lead emerging markets in electric bus deployment, driven by strong public transport electrification initiatives.
- Electrification of buses in Africa has remained limited but is growing, with developments centred in Egypt, Kenya and South Africa. Key hurdles include a lack of financing, grid limitations and insufficient charging infrastructure.

- Electrification of buses in Africa has remained limited but is growing, with developments centred in Egypt, Kenya and South Africa. Key hurdles include a lack of financing, grid limitations and insufficient charging infrastructure.
- EV charging infrastructure more than doubled between 2022 and 2024, to exceed 5 million charge points globally. An estimated 1.3 million new publicly available chargers were installed during 2024. China was home to roughly two-thirds (65%) of the world's public charge points in 2024, with more than 3 million.
- By 2024, the global stock of fast chargers (with a power output of more than 22 kW) reached 2 million; stocks of ultra-fast chargers (150 kW or higher) grew more than 50% to account for nearly 10% of all fast chargers. China remained the global leader in fast-charging deployment.



KEY FINDINGS



Sustainability and Climate Trends

- The EV transition provides wide-ranging environmental, social and economic benefits and should be considered in the broader context of sustainable development. EVs offer a pathway to improved air quality and health and reduced fossil fuel dependency, particularly in countries that rely on imported oil products. They also support integration with renewable power systems and lead a broader energy and economic transition.

- Global energy consumption for electric mobility increased 60% in 2024, with more than half of this demand coming from electric cars.

- To put the transport sector on track to limit warming to around 1.8°C, electric passenger cars will need to reach 100% of new sales by 2030 (at the latest) in leading markets (China and member countries of the Organisation for Economic Co-operation and Development, OECD), with other markets reaching 100% by 2040. Electric trucks will need to reach 100% adoption by 2035 in leading markets and by 2040 in other markets, with urban buses reaching these targets by 2027 and 2030, respectively.

- Recent roll-backs and delays are likely to slacken the pace of EV adoption at a time when substantial acceleration is needed to keep the 2°C goal within reach.

- Excluding low-speed electric scooters and mopeds (but including all other motorised vehicle categories covered in this section), EVs displaced an estimated 1.32 million barrels of oil per day (Mbd) in 2024, nearly double the level of 2022. This exceeds the national oil demand of large countries such as Spain (1.27 Mbd), Italy (1.24 Mbd) and Australia (1.12 Mbd). Light-duty vehicles accounted for around three-quarters of the oil displaced by EVs as of 2024; however, this share is set to fall to around 60% by 2030 as the deployment of heavy-duty EVs increases.

- Excluding low-speed electric scooters and mopeds, EVs led to an estimated net reduction of 180 million tonnes of greenhouse gas emissions (well-to-wheel emissions) in 2024, more than double the reduction in 2022.If low-speed electric scooters and mopeds are included, the savings near an estimated 250 million tonnes.

- Overall, battery electric vehicles emit far fewer greenhouse gas emissions on a life-cycle basis than fossil fuel-powered vehicles, especially when the vehicles are charged using low-carbon electricity. On average, a battery electric car sold in 2023 was expected to emit 50% fewer emissions over its entire life (including the emissions from vehicle production and end-of-life) than a comparable ICE vehicle. Similar or even greater life-cycle emission reductions have been calculated for other vehicle categories including micromobility modes, buses, and trucks in the EU, buses in Latin America, trucks in India, two-wheelers in India and Indonesia, and cars in China and the Middle East and North Africa region.

- Supply chains for EV batteries have become increasingly concentrated in recent years, even as battery demand has increased. In 2024, the top three refining nations controlled 86% of global production for key minerals (up from 82% in 2020), with China dominating cobalt, graphite, rare earths, and refiners of 19 of 20 minerals. Concentration of mining has also increased, from 73% in 2020 to 77% in 2024 for the top three producers – the Democratic Republic of the Congo for cobalt, Indonesia for nickel, and China for graphite and rare earths.

- Evidence suggests that a gender gap exists in the adoption and use of EVs, with women being under-represented across nearly all segments of the e-mobility ecosystem.

- Systemic barriers to EV adoption include a general tendency for men to travel longer distances than women, greater risk perception among women in using remote charging points, advertising more often targeting men, and few policies directly addressing gender equity in transport electrification, particularly in emerging markets. Solutions to help close the gender gap include increasing female participation in transport planning and e-mobility industries and better considering gender factors in e-mobility.

KEY FINDINGS



Policy and Investment developments

- Since 2023, both the Group of Seven (G7) governments and a broad set of countries under the United Nations framework have made high-level international commitments to decarbonising road transport.
- At the national level, policy developments towards vehicle electrification included new regulations as well as challenges and repeals of existing regulations (as in the United States) and modifications to vehicle standards (as in the United Kingdom and the EU).
- China's target for electric cars to comprise 47% of new car sales by 2027 was met two years early, with quarterly sales in 2025 already reflecting this target.
- In early 2025, the EU pushed back its initial target requiring manufacturers to reduce the CO_2 emission intensities of new passenger cars by 2025; instead, it allowed manufacturers to average their emissions intensities over the three-year period 2025-2027, thereby reducing the stringency.
- Canada's EV Availability Standard, adopted in December 2023, requires rising shares of battery-electric and plug-in hybrid vehicles, starting at 20% and increasing annually to 100% in 2035.
- Australia's New Vehicle Efficiency Standard, adopted in 2024, requires emission reductions (in grams of CO_2 per kilometre) of more than 60% for new passenger vehicles and around 50% for light-commercial vehicles (vans), from 2025 to 2029.
- In the United Kingdom, amendments to the zero-emission vehicle (ZEV) mandate, proposed in April 2025, expand and extend flexibilities for ICE and plug-in hybrid vehicles to 2030.
- Clean fleet mandates, which require fleets to transition to zero-emission vehicles, have increasingly been established at the national and sub-national levels.
- Several governments across high-income countries and emerging economies have promoted electric buses and put in place policies that have enabled them to leverage concessional finance, thanks in part to collaboration and support from development finance institutions.
- In the United States, policies to reduce greenhouse gas emissions from road vehicles and to promote EV sales were being rolled back by the Trump administration as of early 2025. However, the situation remained dynamic and difficult to anticipate.
- Several countries have announced policy packages providing financial support to promote EV adoption, including purchase incentives and tax credits. Newly adopted fiscal policies increasingly promote EVs by reducing or exempting them from registration and taxes, rather than explicitly subsidising their purchase. Especially in advanced economies, subsidies and tax exemptions are increasingly targeted to apply only to lower-cost EVs (such as through price caps) and/or to lower-income households.
- Countries have increasingly used exemptions or reductions in import tariffs – often coupled with similar reductions/exemptions to VAT, registration and circulation fees – to incentivise EV adoption, with increased adoption notable in emerging markets and developing economies. Many of these markets have implemented selective import duty and/or VAT or excise tax exemptions on EVs.
- Multiple policy initiatives have aimed to accelerate the deployment of charging and refuelling infrastructure for zero-emission vehicles. To increase the availability of charging in apartment complexes, policies have included: regulations that require charge points in the garages of renovated or new apartments, subsidies targeting multi-unit dwellings and apartments, competitive bidding for public charging infrastructure, and credit guarantees to reduce lending risks.
- The EU's Alternative Fuels and Infrastructure Regulation (AFIR) sets mandatory targets for the deployment of charging stations and hydrogen refuelling along the main TEN-T motorway network.
- China's National Development and Reform Commission and State Council both set deployment targets for EV supply equipment in 2022 and 2023.
- Other Asian countries have announced policies supporting the deployment of charging infrastructure, and in some cases concrete policies have been set up to implement targets.
- In the United States, as of mid-2025, the new Trump administration had taken significant steps towards rolling back EV infrastructure initiatives established by the previous administration.
- Several initiatives like The Global Green Road Corridors Initiative aim to develop "green corridors" with charging and refuelling infrastructure for heavy-duty vehicles on major roads around the world. Additionally, significant

KEY FINDINGS

progress was made towards piloting and testing a standard for heavy vehicles.

- In addition to governments, manufacturers have announced increasing ambition for heavy-duty vehicle electrification. Although most industry initiatives were announced in Europe, some also occurred in the United States.
- Policies are increasingly being adopted to promote strategic on-shoring of parts of the EV and battery value chains, as a means of securing better jobs and industrial development prospects and to ensure resilience of this rapidly emerging clean energy sector. Policies to help diversify supply chains for EV battery manufacturing and related industries include government incentives to attract new mining and processing players, with fiscal and financial incentives on both the supply and demand sides.
- Producer and consumer subsidies for EVs and batteries are increasingly being coupled with local content conditions. Alternatively or in addition, countries have begun to impose selective tariffs on fully built-up imported EVs.
- In the EU, efforts have been made to frame EV uptake using a circular economy approach that includes the end-of-life recycling of batteries and the re-use and recovery of other materials (e.g., electronics, metals, minerals).





Context, challenges and opportunities

Current transport systems are highly emissions intensive. Meeting the world's climate and sustainability goals requires transitioning to low-emission and energy- and resource-efficient ways of moving people and goods, supported by appropriate measures to manage transport demand, adopt infrastructure and technologies, and ensure access to sustainable transport. This transition must enable a fair and resilient socio-economic transformation that protects vulnerable groups and promotes economic opportunity.

Electrification is central to the decarbonisation of both road and rail transport, and is also relevant for ferries, short-distance shipping and port emissions. Electric passenger cars, in particular, are one of the bright spots of the clean energy industry. Electric powertrains for road transport are a mature, scalable technology aligned with trends in energy decarbonisation, digitalisation and industrial innovation. Electric vehicles (EVs) offer a pathway to improved air quality and health and reduced fossil fuel dependency. They also support integration with renewable power systems, enabling a broader energy transition.

The electrification of road transport vehicles is a pivotal part of a broader transformation needed in transport systems. This transformation will need to proceed rapidly worldwide and to encompass universal access to sustainable, low-carbon transport, and broader societal and industrial goals. This transformative change requires an integrated multi-modal, multi-level approach that goes beyond transport electrification and addresses all aspects of the transport system.

The technological transition brought by EVs and low-carbon electricity has implications for supply chains, with deep impacts on skills, jobs and their geographical distribution. This and other socio-economic, equity, and access implications of the transition to electric mobility require careful and calibrated policy to anticipate and manage in a fair manner that protects vulnerable groups and enables shared and resilient prosperity.

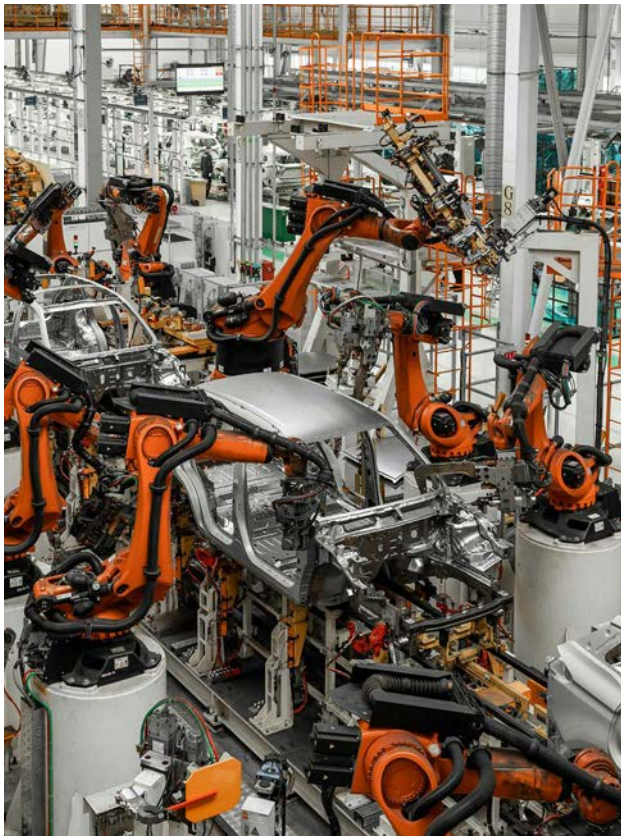
Complementing electrification are low-emission technologies such as sustainable biofuels, hydrogen and hydrogen-based fuels. Sustainable biofuels remain critical for sectors less suited to electrification, such as long-distance aviation and shipping (see 4.9 Aviation and 4.10 Shipping). Alternative fuels can help reduce emissions from heavy-duty road transport, where EV charging infrastructure is currently lacking or unaffordable. However, not all of the biofuels used in road transport meet sustainability criteria, and large-scale biofuel production poses risks to food prices and biodiversity. Meanwhile, clean hydrogen remains costly and investment-intensive, making fuel cell and other hydrogen vehicles unable to compete economically with direct electrification or conventional vehicles (see 5.1 Transport and Energy).[1]

Despite the success of electric two- and three-wheelers and urban public transport buses, including in emerging markets and developing economies, the risk of an electric

mobility divide remains a concern. Early EV markets in most countries have been dominated by expensive, high-end models, limiting affordability and access, particularly for low-income households and countries.[2] Low-cost charging is often scarce, especially in multi-unit (apartment) buildings.[3]

In recent years, many countries have adopted policies to accelerate EV and renewable electricity uptake, aiming to meet economic development, environmental and sustainability goals in a resilient and cost-effective manner. Some countries have set targets to phase out internal combustion engine (ICE) vehicles. Increasingly, policy efforts combine technology transition with greater consideration for social protections, wealth redistribution and trade. Some low- and middle-income countries have also started to set ambitions and targets for local EV manufacture or assembly (for example, based minimum local content or value-added requirements).

Key regulatory policies to improve the efficiency of road vehicles and accelerate EV adoption include removing subsidies for fossil fuels (and factoring in their true pollution and climate costs) and setting fuel economy or vehicle efficiency standards, carbon dioxide (CO_2) emission standards and EV sales targets for road vehicles to drive the adoption of efficient technologies.[4] Governments can also use fiscal policies, such as "feebates", to incentivise the purchase or use of more efficient vehicles (including EVs). Policies to promote EV sales have increasingly shifted from direct subsidies or purchase tax rebates to targeted tax exemptions or reductions. Examples include import duties, value-added tax (VAT), luxury taxes, road tolls and parking fares, and registration and/or circulation taxes.



For electric buses and trucks, the availability of affordable and convenient charging is particularly important. Electrification of buses is proceeding based on public funding, leveraged by loans from multilateral development banks, and supported by clean fleet mandates at the national and sub-national levels. Corporate and civil society initiatives, together with public policies and international standardisation (such as megawatt charging standards) are creating the necessary conditions to upscale electrification in medium- and heavy-duty truck segments.

Large EV fleets alone will not address a variety of challenges to sustainable transport, such as improving the inclusivity of access, reducing emissions to the levels required for climate action, or resolving congestion, land-use pressures and other environmental impacts. Extreme weather can also reduce vehicle performance, although modern EVs increasingly feature IP67-rated, water- and shock-resistant battery systems and can provide back-up power sources during electricity outages.[5]

An additional risk is the increasing concentration of supply chains for EV battery manufacturing and related industries in a few countries (particularly China), which can create potential bottlenecks for critical materials such as copper and lithium (see Box 1).[6] Addressing this will require a co-ordinated response across countries, including proactive industrial, resource, and trade policies as well as national policies that promote value-added in batteries and automotive sectors, where relevant and feasible from a competitive and industry policy perspective. International co-operation will remain vital to reduce risks of conflict and enhance supply security.

The overall contribution of low-emission vehicles to climate and sustainability goals will critically depend on their integration with wider socio-economic systems. The uptake of EVs can better align with broader integration of transport systems when they are rolled out among broad measures under the Avoid-Shift-Improve (A-S-I) framework – avoiding unnecessary travel while guaranteeing access to sustainable transport; shifting to public, shared and active transport; and improving vehicle and fuel efficiency. The key is to focus on a diverse set of options to provide access to sustainable mobility for all and to achieve a net zero emission pathway.[7]

(See 1.2 The Right to Mobility in a Sustainable and Inclusive Society, 1.3 Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet; 4.2 Integrated Transport Planning Across Urban and Rural Contexts; 4.5 Public Transport, 4.6 Popular Transport, 4.7 Rail and 4.8 Road Transport.)

Box 1: Mining and material use, and their sustainability implications for battery production

Authors: Jad Baba, Janne Luise Piper, Jiayi Wang, REN21

Key minerals are essential for a wide range of industries, from construction to automobiles and electronics. Driven by battery production and clean energy deployment, the demand for certain minerals – copper, lithium, nickel, cobalt, graphite and rare earth elements – has surged in the past years. In 2023, demand for critical minerals experienced strong growth, with lithium demand increasing 30%, while demand for nickel, cobalt, graphite, and rare earth elements grew 8% to 15%. This growth trend is predicted to continue, resulting in turbulence in the mineral market.

Globally, mining of minerals increased in 2023. Critical mineral supply outpaced demand growth, and, combined with inventory build-up in downstream industries, it led to a decline in market prices. Key mineral extraction is concentrated in several countries; however, the geographic distribution of mining production ownership differs greatly. Chile is the world's largest copper producer, but European companies dominate as the leading producers. Similarly, while lithium mining is centred in Australia and Chile, major US companies control production. Nickel and cobalt mining in Indonesia and the Democratic Republic of Congo is largely controlled by Chinese and European companies. In 2025, Indonesia has banned export of raw nickel and requires processing before exporting to local use and supporting the domestic mineral market.

Electric vehicles are the major source of demand for batteries. Global electric vehicle sales in 2024 reached 17.5 million units, growing 25%. Electric vehicles have become the largest consumer of lithium and account for a remarkable share of nickel, cobalt and graphite. Battery demand from storage also rose sharply, with installed capacity reaching over 85 gigawatts. More than 90% of the market share is dominated by lithium-ion batteries, while lithium iron phosphate (LEP) batteries are rising rapidly due to different technical needs between electric vehicles and storage.

The prosperous development of the mining and battery industries has raised concerns around sustainability. Mining and refining activities have significant impacts on ecosystems due to land degradation, water pollution, and greenhouse gas emissions, while also having effects related to human rights, local community conflicts and geopolitical relations. To enhance their sustainability, various methods exist. From the technological and industrial perspective, technology advancement and recycling can reduce waste and emissions, as well as relieve mineral demand pressure. For example, the use of silver and silicon in solar cells has decreased in the past decade, which alleviates supply strains. Although the recycling of some metals is mature, recycling processes for key minerals used in batteries are still under development.

As the first generation of electric vehicles reaches the end of its life, large-scale battery recycling will become a critical challenge. The International Energy Agency assesses that around 30 gigawatt-hours of spent electric vehicle batteries will be available for recycling by 2030. It is also crucial to monitor environmental, social and governance (ESG) risks in the mineral supply chain, with transparent and reliable reports and data. Finally, consumer behaviours also influence sustainability. SUVs accounted for two-thirds of battery-electric models on the market in 2023, with a demand for bigger batteries using more materials. Regulating vehicle battery sizes and promoting efficient travel patterns could help reduce mineral demand and mitigate sustainability concerns.

- Canada imposed a 100% surtax on Chinese-produced electric vehicles effective 1 October 2024, to counteract unfair trade practices in China, including subsidisation and lax labour and environmental standards.
- In 2024, the EU imposed countervailing duties on Chinese electric vehicles for five years, with rates varying by company: BYD at 17.0%, Geely at 18.8%, SAIC at 35.3%, and other co-operating companies at 20.7%, while Tesla faces a duty of 7.8%; non-cooperating companies are subject to a duty of 35.3%.
- In 2024, the United States increased tariffs on imported electric vehicles from China from 25% to 100%, and raised tariffs on batteries from China from 7.5% to 25%.

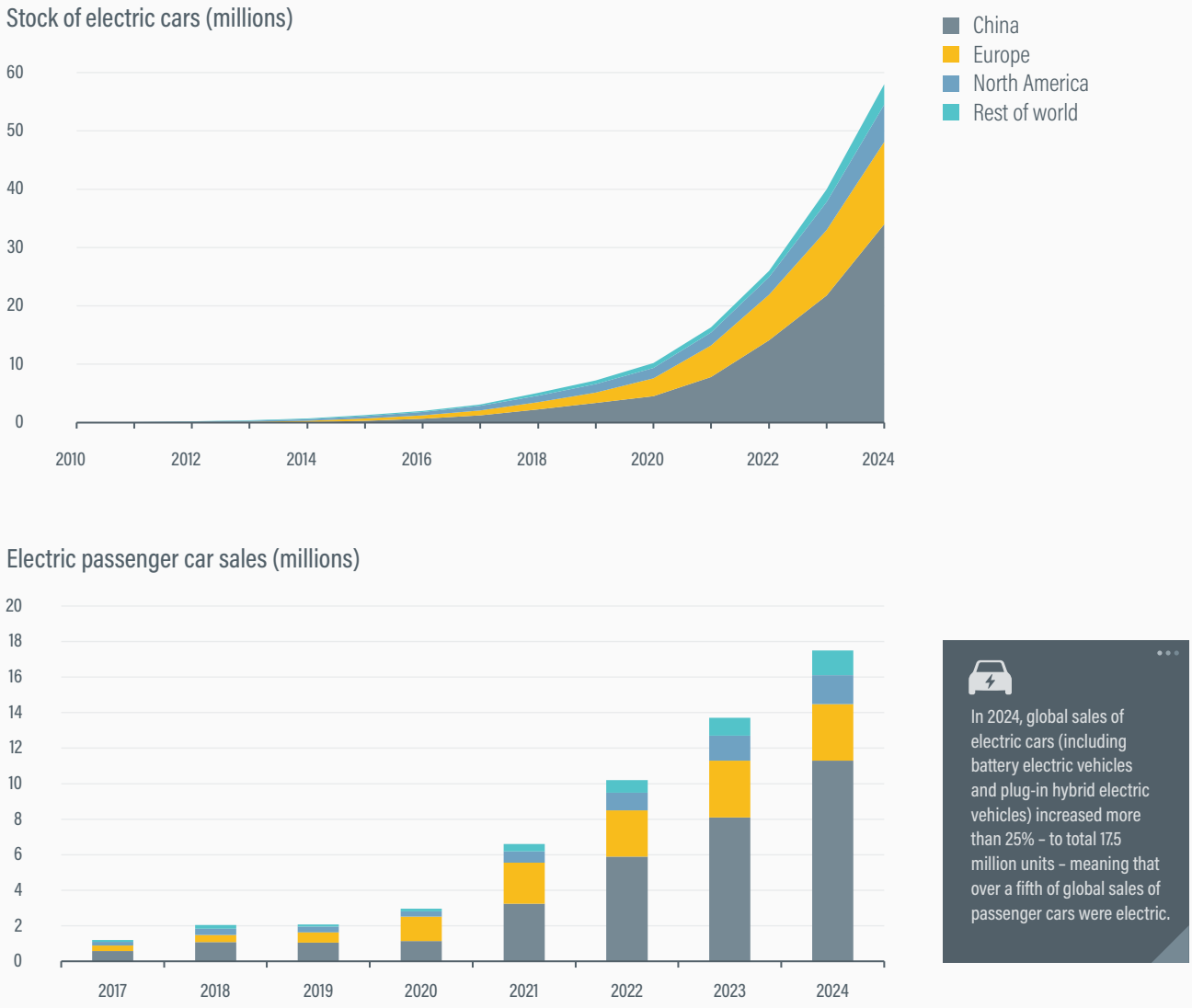
Source: See endnote 6 for this section

Demand, use and access

A total of 58 million electric cars were on the world's roads in 2024, more than 11 times the number in 2018 (Figure 1)**.**[8] **The global electric car fleet was 5.7 times larger in 2024 than in 2020, maintaining four-year average growth of 54%.**[9] **Despite this growth, electric cars accounted for less than 5% (4.5%) of vehicles globally, with more than two-thirds of the fleet operating in China.**[10] Around 67% of electric cars in 2024 were battery electric vehicles, and the rest consisted of plug-in hybrids.[11]

In 2024, global sales of electric cars (including battery electric and plug-in hybrid models) increased more than 25% to reach 17.5 million units (Figure 1)**.**[12] **More than one-fifth (20%) of all passenger cars sold during the year were electric (13.8% battery electric, 8.2% plug-in hybrid), up from 14% in 2021.**[13] Early estimates suggest that in 2025, more than one-in-four car sales will be electric, with sales exceeding 20 million units.[14] However, EV sales may reach only 18.5 million units for the year due to tariff-related uncertainties, evolving EV sales targets in Europe and the roll-back of incentives in the United States.[15]

FIGURE 1. Electric passenger car stock (top) and sales (bottom), 2010-2024



In 2024, global sales of electric cars (including battery electric vehicles and plug-in hybrid electric vehicles) increased more than 25% – to total 17.5 million units – meaning that over a fifth of global sales of passenger cars were electric.

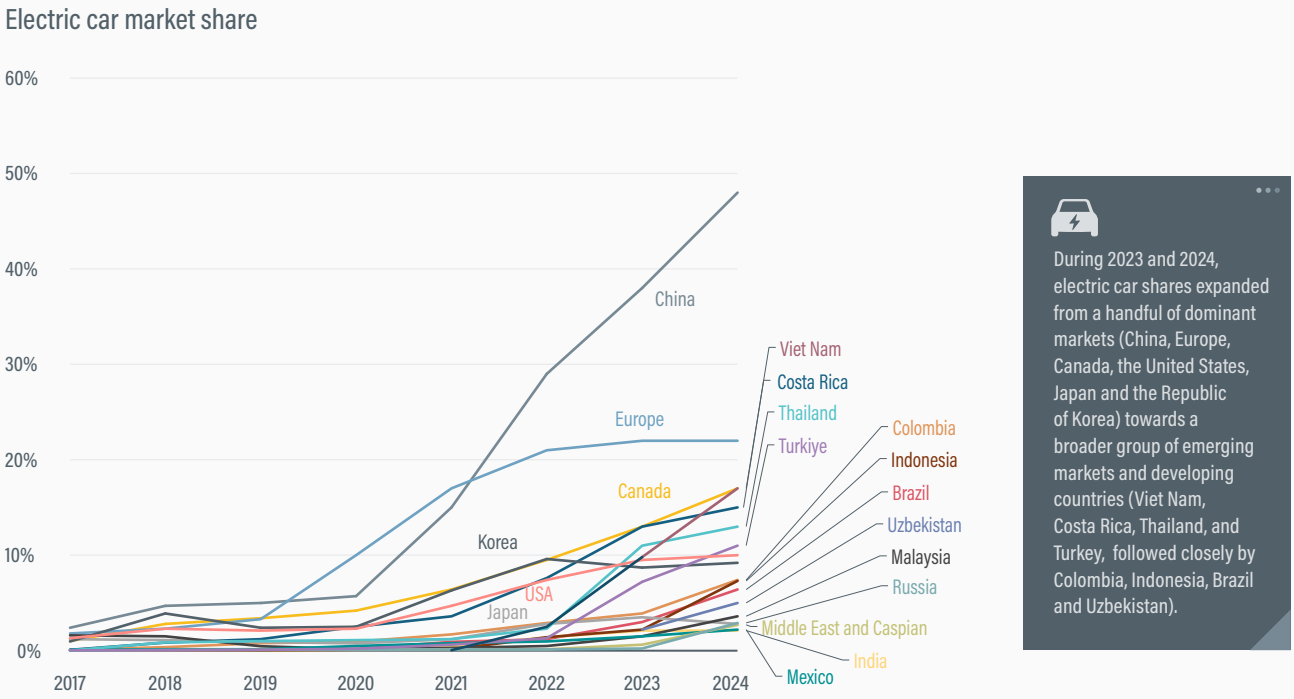
Source: See endnote 8 for this section.

Electric car sales in China reached 11 million units in 2024, accounting for 65% of EVs sold worldwide and for nearly half (48%) of all domestic car sales.[16] **Monthly sales of electric cars in China have overtaken sales of new ICE cars since July 2024, marking a major milestone in the transition of the world's largest automotive market.**[17]

EV sales in Europe remained relatively constant in 2024, with around a 20% share.[18] **The limited growth in European sales was aligned with regulatory requirements that did not require an increase in the region's EV market share until 2025.**[19] **Several European countries also phased out EV purchase subsidies.**[20]

- Norway continued to lead the world in electric car sales, with shares of 92% in 2024 and 95.2% in early 2025, up from 90% in 2023.[21]
- EV sales shares in Denmark grew from 46% in 2023 to 56% in 2024.[22]
- In Germany, EV sales shares dropped from 31% in 2022, to 25% in 2023, to 20% in 2024.[23]
- Data for the first quarter of 2025 showed that European EV sales resumed their growth in almost all countries – with Germany reaching a 26.6% sales share and Denmark 68.3% – as manufacturers aimed to meet European regulatory CO_2 emission requirements by year's end.[24]

FIGURE 2. Market shares of electric cars in selected markets, 2017-2024



During 2023 and 2024, electric car shares expanded from a handful of dominant markets (China, Europe, Canada, the United States, Japan and the Republic of Korea) towards a broader group of emerging markets and developing countries (Viet Nam, Costa Rica, Thailand, and Turkey, followed closely by Colombia, Indonesia, Brazil and Uzbekistan).

Source: See endnote 27 for this section.

Electric car sales in the United States grew 40% in 2023, driven by policy support from the Inflation Reduction Act.[25] In 2024, however, sales growth fell to only 10%, with a total of 1.6 million units sold.[26]

During 2023 and 2024, consumer interest in electric cars expanded from the dominant markets of China, Canada, Europe, Japan, the Republic of Korea and the United States towards a broader group of emerging markets and developing countries. These include Costa Rica, Thailand, Türkiye, and Viet Nam, followed closely by Brazil, Colombia, Indonesia and Uzbekistan[i] (Figure 2).[27] Electric car sales showed promising signs of expanding in South-East Asia, Latin America and Africa. Across all three regions, Chinese auto manufacturers played a dominant role, in many cases representing more than 85% of EV imports.[28]

Electric car sales in South-East Asia surged nearly 50% in 2024, accounting for 9% of the region's total car sales.[29]

- Indonesia's EV sales tripled to reach over 7% market share, aided by reduced VAT and waived import duties for auto manufacturers investing in local production.[30]
- Malaysia's EV sales more than doubled, with local production ramping up by firms such as Perodua and Proton.[31]
- Thailand led the region in 2024, with a 13% EV sales share despite a decline in total car sales.[32]
- Viet Nam nearly doubled its EV sales (17% share), buoyed by local champion VinFast, which also began exporting to nearby countries.[33]

Electric car sales in Latin America more than doubled in 2024, with the regional market share rising to 4%.[34] Brazil led with 125,000 electric cars sold (a two-times increase), reaching 6.5% of total car sales.[35] Other strong performers were Costa Rica (15% share), Uruguay (13%) and Colombia (7.5%).[36] This growth was supported by government incentives (such as tax exemptions, reduced registration fees and traffic privileges for EVs) as well as relatively high fossil fuel prices.[37]

Africa's electric car market remained nascent in 2024 but showed signs of acceleration, with sales more than doubling to 11,000 units in 2024; however, EVs still comprised less than 1% of total car sales.[38] Challenges included limited charging infrastructure and parts availability.

i With the exception of Costa Rica, all these countries have domestic automotive manufacturing and/or assembly capacity. Indonesia and Brazil also have access to domestically available mineral resources. In many cases, these market share increases are associated with investments from China, reflecting its technology lead in EVs and its drive for growth opportunities in emerging markets.

- Notable growth occurred in Egypt and Morocco, driven by policy support and planned local manufacturing; the two countries have focused on building export-oriented EV supply chains.[39]
- Ethiopia implemented a ban on importing fossil fuel vehicles in 2024, reportedly leading to 100,000 EVs deployed, although reliable sales data are lacking.[40]
- Nigeria joined the Zero Emission Vehicles Declaration, aiming for 100% zero-emission car sales by 2040.[41]

Electric two- and three-wheelers continued to far exceed numbers of other electric vehicles, although estimates of their stock and sales vary greatly. Available data for 2024 suggest close to 400 million units globally, including nearly 80 million electric motorcycles and 320 million electric mopeds and low-speed electric scooters (and not including electric bicycles and micromobility vehicles such as kick-scooters).[42] China accounted for 85% of all electric motorcycles, with other Asia-Pacific countries contributing an additional 12%.[43]

Annual sales of electric motorcycles, mopeds and low-speed electric scooters totalled an estimated 35-50 million between 2021 and 2024, or between 40% and 50% of all two-wheeler sales annually.[44] Electric motorcycle sales ranged from 6 million to 10 million annually during this period, accounting for a global sales share of 15% compared with ICE motorcycles.[45] Outside of China, electric two- and three-wheelers in other Asian markets (India and South-East Asia) are significant – with close to 1 million units sold in India in 2024 – and are expected to add 10 million more units by 2030.[46]

In 2024, electric two-wheelers made up over 30% of total sales in South-East Asia, with strong progress in Indonesia, Thailand and Viet Nam.[47] Electrification of two- and three-wheelers has advanced rapidly in the region due to the vehicles' high market presence and suitability for short-range urban travel. Governments have encouraged adoption through fiscal incentives, reduced VAT and local manufacturing requirements.

- In Indonesia, the government has mandated local production for companies wishing to benefit from tax breaks, leading to growth in domestic assembly.[48]
- Viet Nam's VinFast is expanding its electric scooter offerings and exports, while Thailand's subsidies have boosted uptake among delivery fleets and private users alike.[49]

Electrification of two-wheelers in Africa is still emerging but has gained momentum in cities. Local start-ups and partnerships have focused on battery swapping networks and low-cost models suited for shared mobility and deliveries. Kenya, Rwanda and Uganda are noted hubs of innovation, although data on market penetration are limited. Barriers across the continent include import tariffs, financing access and lack of standards.

Globally, an estimated 40 million electric bikes (a bicycle equipped with a battery-powered motor, typically with pedal-assist) were sold annually as of 2023 (representing around 30% of all bikes) as well as an estimated 50 million electric kick-scooters.[50]

The global electric light commercial vehicle stock (vans) reached 1.9 million vehicles in 2024.[51] Electric sales totalled 650,000 units, or 7.1% of all sales.[52] Both the sales and stock more than doubled between 2022 and 2024, with the vehicles' stock share growing from 0.9% in 2023 to 1.3% in 2024.[53]

- By 2024, China accounted for 57% of the global stock of electric vans, with new sales reaching a 33% sales share.[54]
- In Europe, leading markets in 2024 included Norway (29% sales share), Sweden (22.7%), and Denmark (17.6%), followed distantly by France (7.1%), the United Kingdom (6.6%) and Germany (5.3%).[55]
- Data from the first quarter of 2025 show that electric vans have grown rapidly in all European markets, with high sales shares in Norway (41%), Sweden (27.5%), Denmark (25%), the United Kingdom (10.3%), France (9.7%) and Germany (6.6%).[56]

Sales of electric buses totalled 70,000 in 2024 (6% of total sales), up 30% from 2023; this brought the global stock to 730,000 units, or 4.9% of the total fleet.[57] Battery-electric buses continued to outpace fuel cell electric buses 35 to 1 due to their lower operational costs.[58]

China continued to dominate the electric bus market, accounting for 68% of global new sales and 89% of the global electric bus stock.[59] In the first half of 2024, 96% of urban bus sales in China were battery electric, with the rest being hybrid electric (2% of sales) and fuel cell buses (2%).[60] (Globally, battery-electric buses and trucks continued to far outpace fuel cell electric options, due to their lower operational costs.[ii]) Electric coaches comprised only 9% of sales, reflecting their earlier state of technological development.[61]

ii Fuel cell electric vehicles (FCEVs) face the major challenges of low conversion efficiency (and high costs) in the production of low-emission hydrogen (especially electrolytic hydrogen), as well as lower efficiency (compared with battery electric vehicles) in converting the energy stored in hydrogen to motive energy at the wheels (Bai et al., 2024; ITF, 2024). FCEVs require dedicated fuel transport and dispensing infrastructure, which implies further energetic losses and costs (Shao and Zheng, 2023).

In the European Union (EU), nearly 6,000 e-buses were delivered in 2024, up from 4,900 in 2023.[62] Electric buses accounted for 17% of the region's total bus sales in 2024.[63] However, EV adoption has varied widely depending on the size class and type of operations. In the class 1 segment (typically used for urban operations and with a low floor), electric bus sales overtook conventional diesel bus sales for the first time in 2024, reaching 55% of sales in the fourth quarter.[64] Coaches, which account for around half of bus sales in Europe and typically drive longer distances, had fewer electric models but reached 6% of new sales in the fourth quarter, with new European-made models due in 2026.[65] Non-EU European countries (including Norway and the United Kingdom) brought the region's 2024 e-bus sales to around 9,750.[66]

Electric bus adoption in the United States has been slower than in European and Chinese markets; nonetheless, in the first quarter of 2024, zero-emission[iii] buses accounted for 11% of all bus sales, with 641 newly registered units.[67]

Outside China, Europe, and North America, new sales of electric buses in 2024 totalled 9,500, a similar scale as in the European market.[68] Frontrunners included India, with 3,200 new sales in 2024, and the Republic of Korea with 2,800.[69]

Latin American countries – notably Chile and Colombia – continued to lead emerging markets in electric bus deployment, driven by strong public transport electrification initiatives.

- Santiago (Chile) operates one of the largest electric bus fleets outside China.[70]
- Bogotá (Colombia) has rapidly expanded its fleet through public-private partnerships and concessional financing models.[71]
- Brazil, despite being the region's largest vehicle market, has been slower to scale electric bus deployment but is building momentum with support for local manufacturing and municipal pilot programmes.[72]

Bus electrification in South-East Asia has accelerated in Indonesia, Thailand and Malaysia.

- Thailand's electric bus sales more than tripled in 2024, supported by government fleet procurement and infrastructure support.[73]
- Indonesia has begun electrifying urban transport fleets in Jakarta, aiming for a full transition in the coming years. Domestic assembly by local firms and Chinese manufacturers (such as BYD, which is active across the region) is contributing to cost reductions and faster deployment.[74]
- Malaysia has committed to greening public transport, with electric buses being adopted in select cities through public-private projects.[75]

Electrification of buses in Africa has remained limited but is growing, with developments centred in Egypt, Kenya and South Africa. Key hurdles include a lack of financing, grid limitations and insufficient charging infrastructure.

- Cairo (Egypt) is piloting electric buses in its urban fleet, supported by local manufacturing of components.[76]
- Kenya has seen progress through start-ups and utility-backed programmes for e-bus deployment in Nairobi.[77]
- South Africa is exploring integrating electric buses into bus rapid transit systems but faces challenges of high upfront costs, vehicle homologation[iv] and limited infrastructure.[78]

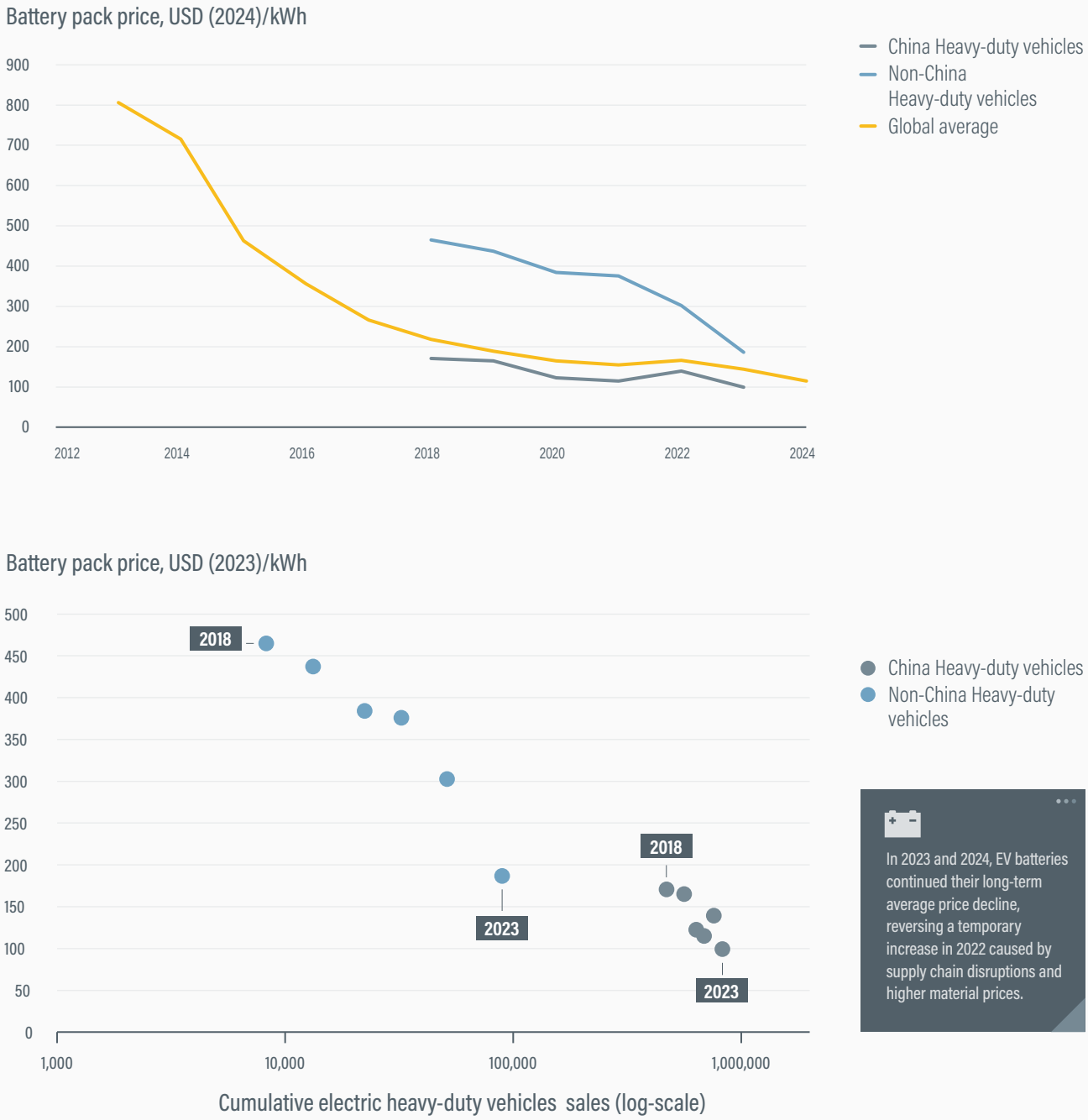
The number of zero-emission medium- and heavy-duty trucks on the world's roads increased 20% between 2022 and 2024 to 420,000 vehicles (around 0.5% of the global fleet); battery electric trucks represented 96% of the total.[79] Sales of zero-emission trucks increased from 36,000 units in 2022 to around 98,000 units in 2024, although this equates to just 1.7% of total truck sales.[80]

- Electric trucks accounted for 9% of both medium- and heavy-duty truck sales in China in the first half of 2024.[81] The Chinese market remained the largest market for zero-emission trucks, accounting for 82% of global sales.[82]
- In the EU-27, zero-emission heavy duty truck sales reached 3,356 in 2024, representing 1.2% of total sales (1.5% in the fourth quarter of 2024).[83]
- Germany had the largest sales volume of electric heavy-duty trucks in Europe in 2024, at 1,198 trucks, accounting for 36% of total EU sales.[84]
- The highest sales share of electric heavy-duty trucks in Europe was in Sweden (home to many large EU truck manufacturers), where the e-trucks accounted for 6.4% of new truck sales in 2024.[85]
- European adoption of electric light- and medium-duty trucks (weighing 3.5-12 tonnes) was much higher, accounting for 6,000 new registrations in the EU in 2024, or a 17% sales share.[86] Leading markets were Finland (83% sales share), Luxembourg (76%), Denmark (68%), and the Netherlands (46%), while the largest market was Italy with 1,047 new registrations.[87]
- In the United States, 764 zero-emission heavy-duty trucks

iii Zero-emission is used here to identify vehicles with zero tailpipe CO_2 emissions, using electricity or hydrogen as energy carrier. Ensuring that these vehicles effectively deliver very low emissions depends on how the electricity and hydrogen are produced. Today, battery electric options are better placed to deliver actual emission reductions, using a life-cycle perspective, due to their better energy efficiency and to the fact that nearly all hydrogen is currently produced from fossil energy, without carbon capture.

iv In South Africa, all new, built-up, or modified vehicles – local or imported – must meet compulsory safety-critical specifications and be homologated by the NRCS under SANS 10267 via a sample and manufacturer evidence, including recognised lab reports for the vehicle and components; only then is a NATIS number issued, enabling sale, registration and licencing.

FIGURE 3. Battery price development from 2012-2024 (left) and compared with cumulative production (right)



Sources: See endnote 91 for this section.

were registered in 2023, accounting for around 0.3% of total sales.[88] In the first half of 2024, this share rose to around 0.5% of heavy-duty vehicle sales.[89] Sales of electric medium-duty trucks (weight of 6.4 to 15 tonnes) remained low, at just 0.14% of sales in the first half of 2024.[90]

In 2023 and 2024, EV batteries continued their long-term average price decline, reversing a temporary increase in 2022 caused by supply chain disruptions and higher material prices (Figure 3).[91] **The ongoing battery price reductions are due to a combination of economies of scale (as EV deployment continues to increase) and innovation, including a shift to cheaper battery chemistries. The global**



average battery pack price (across all sectors) fell 31% between 2022 and 2024, to reach USD 115 per kilowatt-hour (kWh) (in real 2024 USD).[92]

- Chinese manufacturers have enjoyed a competitive advantage due to lower battery prices for electric heavy-duty vehicles, with average battery pack prices in 2023 estimated at USD 99 per kWh, compared with USD 186 per kWh elsewhere (both in real 2023 USD).[93]
- Chinese cumulative sales of electric heavy-duty vehicles are around an order of magnitude larger than the rest of the world, contributing to lower production costs[v]. Scaling up the deployment of electric heavy-duty vehicles will likely drive further price reductions, accelerating adoption.

EV charging infrastructure more than doubled between 2022 and 2024, to exceed 5 million charge points globally.[94] **An estimated 1.3 million new publicly available chargers were installed during 2024.**[95] **China was home to roughly two-thirds (65%) of the world's public charge points in 2024, with more than 3 million.**[96] To reach the levels of EV deployment targeted for 2035 under current policies worldwide, public charging infrastructure would need to increase six-fold compared to 2023 levels.[97]

- Charging infrastructure in the EU more than doubled between 2022 and 2024, reaching 880,000 EV charge points.[98] By the second quarter of 2025, the EU had a total of 948,000 charge points, including 155,000 direct current (DC) units.[99]
- In North America, the number of public charge points reached 208,000 in the United States and 34,000 in Canada as of May 2025, with DC fast chargers accounting for around 25% of the total.[100]
- Charging infrastructure also expanded in markets such as Brazil (with 12,000 charge points in 2024), and in Indonesia, Malaysia, Thailand and Viet Nam.[101]

By 2024, the global stock of fast chargers (with a power output of more than 22 kW) reached 2 million; stocks of

v However, it is not clear from the data how differences in battery chemistry mixes between regions may influence these results, nor is it clear whether the data on batteries produced outside of China excludes all Chinese-made components (BNEF, 2024).

ultra-fast chargers (150 kW or higher) grew more than 50% to account for nearly 10% of all fast chargers.[102] **China remained the global leader in fast-charging deployment.** Ultra-fast charging infrastructure has seen rapid global growth since 2022, with prices dropping 20% between 2022 and 2024.[103] Fast and ultra-fast public chargers deliver more energy daily than slow chargers, serving more vehicles. However, this electricity comes at higher costs, except with extremely high (and not common) use rates.

- China added 400,000 fast chargers in 2024 (80% of global growth) for a total of 1.6 million.[104] As of 2024, China offered more than 3 kW of public fast charging capacity per electric light-duty vehicle.[105]
- In China, cities such as Beijing and Chongqing, along with companies like XPeng and Volkswagen, aim to install tens of thousands of ultra-fast chargers by 2025 to support growing EV demand.[106]
- The United States expanded its fast charger network from 40,000 to 50,000 in 2024, yet had less than 1.5 kW of capacity per electric light-duty vehicle.[107]
- In the EU, the number of fast chargers (excluding ultra-fast) increased nearly 50% in 2024, to 71,000.[108] Ultra-fast chargers grew 60% to more than 77,000, with 20% of these offering 350 kW or more.[109]
- In Denmark, Finland, France, and Germany, the number of ultra-fast charger units increased 70-95% in 2024.[110] The Charge France initiative plans to invest USD 4.1 billion (EUR 4 billion) to more than double France's ultra-fast charger stock by 2028.[111]
- The Republic of Korea increased its fast charger count 38% in 2024, to 47,000 units, and planned to add 4,400 more in 2025, backed by an infrastructure budget of USD 425 million (KRW 620 billion).[112]
- In India, three state-run oil companies installed nearly 8,000 fast chargers between late 2021 and the first quarter of 2024, under the FAME II programme.[113]

In addition to road vehicle electrification, efforts to rapidly electrify and modernise rail networks has continued, led by China and India. Direct electrification is generally the most promising option to reduce emissions associated with diesel trains, particularly for urban and inter-city rail systems that provide efficient and high-throughput passenger and cargo transport.[114] For markets that continue to rely heavily on diesel trains – including the United States and Canada as well as Eastern European countries, Indonesia, and South Africa – capital needs to be allocated rapidly and rationally to electrify lines and locomotives, starting with the most heavily utilised assets, where the payback is typically faster .[115] Climate and development finance, as well as loans from international finance institutions, can help ensure the implementation of high-priority projects in emerging markets and developing countries. (See 4.7 Rail.)

Sustainability and climate trends

The EV transition provides wide-ranging environmental, social and economic benefits and should be considered in the broader context of sustainable development (Box 2)**.**[116] **EVs offer a pathway to improved air quality and health and reduced fossil fuel dependency, particularly in countries that rely on imported oil products. They also support integration with renewable power systems and lead a broader energy and economic transition.**

Box 2. Benefits to sustainable development from the transition to electric vehicles

Lower emissions and energy use: EVs emit no tailpipe CO_2, consume much less energy per kilometre than petrol or diesel vehicles, and produce fewer greenhouse gas emissions over their life cycle. These benefits grow as electricity grids decarbonise: in 2024, low-carbon electricity contributed more than 40% of global generation (over 30% from renewables, a record share). In all major EV markets, the CO_2 intensity of electricity generation fell between 2015 and 2024 – including in the EU (-6.3%), the United States (-3.9%) and China (-1.7%). As renewable capacity expands and EVs become even cleaner, this will lead to further emission cuts and air quality improvements. (See 5.1 Transport Energy Sources.)

Enabling the energy transition: EVs enable the broader energy transition by reducing oil dependence, improving energy efficiency, increasing renewable power use, providing flexibility in electricity demand, and enabling innovation in grid management and digital services. Renewable electricity can lower EV charging costs, especially in countries that have volatile fossil energy prices and/or carbon taxes. (See 5.1 Transport Energy Sources.)

Managed EV charging during the cheapest periods and via vehicle-to-grid services can reduce costs and improve the efficiency of the electricity system. In the United Kingdom, some utilities offer vehicle-to-grid deals with free charging overnight in exchange for using the EV's battery for grid support. Bi-directional energy transfer, combined with smart-grid technology, is reshaping energy management.

Cost-effectiveness: EVs are often the most cost-effective option for reducing transport costs, with other low-emission technologies also contributing. Declining costs for batteries and renewable power have improved affordability.

Digital integration: Digital advances – from connected services and software updates to smart charging and bi-directional energy transfer – are enhancing EV capabilities.[117] For connected EVs, their functionality and performance are primarily controlled, enhanced and updated through software. The top digital automakers include EV manufacturers such as US-based Lucid, Rivian,

and Tesla, and Chinese rivals like Nio, Xpeng and BYD, while legacy automakers have struggled to keep pace. The low operating costs of EVs makes them well suited for high-use digital applications such as ride-sharing (e.g., Waymo's Jaguar I-PACE electric cars) and passenger and freight co-loading. In the United States, digital platforms optimise EV charging access, sitting and costs.

Economic and employment impacts: As they become increasingly cost-competitive, EV batteries and renewable power can support economic development and job creation. EVs and their batteries benefit from so-called "technology learning effects" and have been driving significant technological innovations and economic productivity, also due to their clear synergies with digital technologies. Economic diversification will be critical in oil-exporting countries as energy demand shifts toward renewables.

However, this technological transition has implications for supply chains and for countries whose auto industries are focused on ICE vehicles, with impacts on skills, jobs and their geographical distribution. Targeted investment in diversifying automotive value chains, along with workforce retraining, are essential to offset job losses in auto parts and components industries with new job opportunities. Job losses in ICE vehicle manufacturing can be compensated by net job growth in battery and low-carbon value chains and in charging infrastructure, as battery and renewable energy value chains are generally more labour-intensive than fossil fuel supply chains.

This transition must be managed in a fair manner that protects vulnerable groups and enables shared and resilient prosperity (see 1.6 A Just Transition in Transport: A Double Challenge) and calls for the integration of energy, transport, industrial, social, and trade policies and investment through co-ordinated public and private sector action.

Source: See endnote 116 for this section.

Global energy consumption for electric mobility increased 60% in 2024, with more than half of this demand coming from electric cars.[118] **In total, EV fleets consumed an estimated 180 terawatt-hours of electricity in 2024.**[119] Comprehensive EV deployment is essential to achieve aggressive emission reduction pathways aligned with the Paris Agreement's goal of keeping global temperature rise within 1.5 degrees Celsius (°C) – and well below 2°C – by 2100.[120]

To put the transport sector on track to limit warming to around 1.8°C, electric passenger cars will need to reach 100% of new sales by 2030 (at the latest) in leading markets (China and member countries of the Organisation for Economic Co-operation and Development, OECD), with other markets reaching 100% by 2040.[121] **Electric trucks will need to reach 100% adoption by 2035 in leading markets and by 2040 in other markets, with urban buses reaching these targets by 2027 and 2030, respectively.**[122]

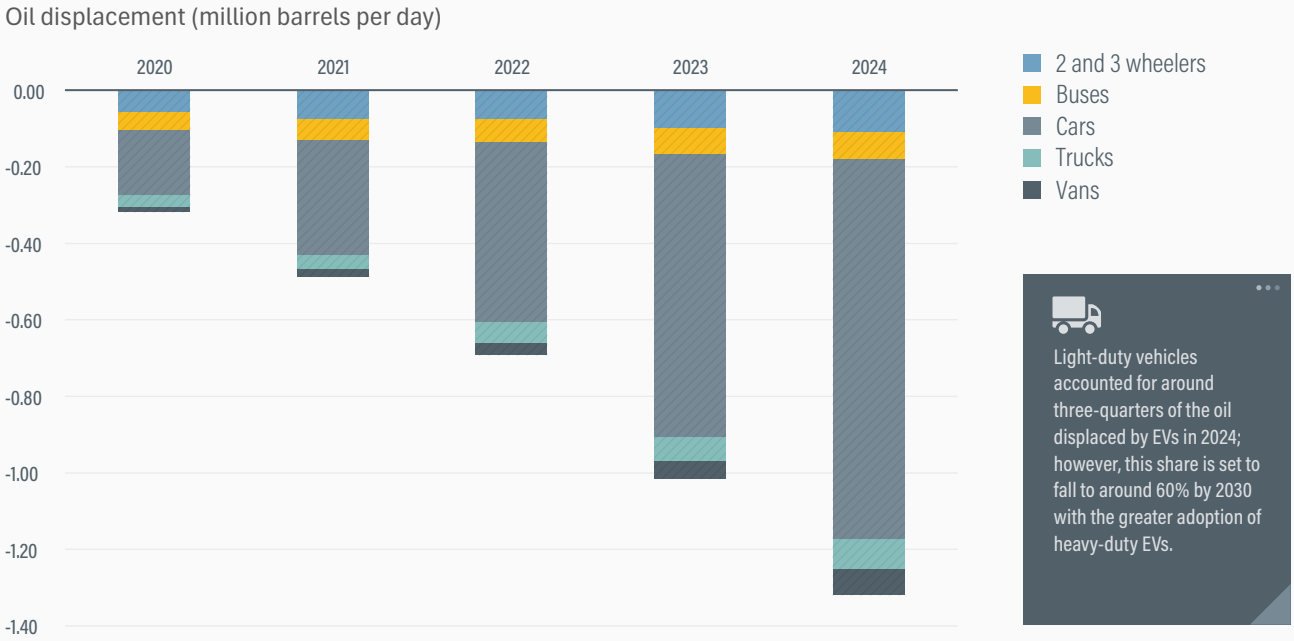
Recent roll-backs and delays are likely to slacken the pace of EV adoption at a time when substantial acceleration is needed to keep the 2°C goal within reach.[123] Reducing emissions to be compatible with 1.5°C of warming would require meeting all current targets for EV adoption along with extremely ambitious reductions in travel demand.[124] Despite the high expected EV adoption under current policies, more is needed to greatly reduce emission levels by 2060.

Excluding low-speed electric scooters and mopeds (but including all other motorised vehicle categories covered in this section), EVs displaced an estimated 1.32 million barrels of oil per day (Mbd) in 2024, nearly double the level of 2022 (Figure 4).[125] **This exceeds the national oil demand of large countries such as Spain (1.27 Mbd), Italy (1.24 Mbd) and Australia (1.12 Mbd).**[126] **Light-duty vehicles accounted for around three-quarters of the oil displaced by EVs as of 2024; however, this share is set to fall to around 60% by 2030 as the deployment of heavy-duty EVs increases.**[127]

- Electric two- and three-wheelers (excluding low-speed electric scooters and mopeds) accounted for around 8% of the reduced oil demand from EVs, while electric buses, trucks and vans each contributed around 5-6%.[128]
- Considering low-speed electric scooters and mopeds as replacements for petrol-powered mopeds (comparable to ones used in Southern Europe in the 1970s) delivers an additional 0.5 Mbd in oil demand savings.[129] These estimates are based on assumptions of the shares of car, bus, and walking and cycling travel that are displaced by electric two- and three-wheelers.[130]



FIGURE 4. Oil displacement through electric vehicles, 2020-2024



Source: See endnote 125 for this section.

Excluding low-speed electric scooters and mopeds, EVs led to an estimated net reduction of 180 million tonnes of greenhouse gas emissions (well-to-wheel emissions) in 2024, more than double the reduction in 2022.[131] **If low-speed electric scooters and mopeds are included, the savings near an estimated 250 million tonnes.**[132] The reductions in transport emissions are due mainly to the rising numbers of EVs on the road, and will be accelerated further as the increasing penetration of renewable energy reduces the carbon intensity of electricity – a trend that is clear across nearly all of the world's countries.

Overall, battery electric vehicles emit far fewer greenhouse gas emissions on a life-cycle basis than fossil fuel-powered vehicles, especially when the vehicles are charged using low-carbon electricity.[133] **On average, a battery electric car sold in 2023 was expected to emit 50% fewer emissions over its entire life (including the emissions from vehicle production and end-of-life) than a comparable ICE vehicle.**[134] **Similar or even greater life-cycle emission reductions have been calculated for other vehicle categories** (Box 3)**, including micromobility modes, buses, and trucks in the EU, buses in Latin America, trucks in India, two-wheelers in India and Indonesia, and cars in China and the Middle East and North Africa region.**[135]

The exact emission reduction potential of a battery or plug-in hybrid EV relative to a conventional ICE vehicle depends on many factors, including the battery size, electricity grid emission intensity, annual mileage and vehicle efficiency; even so, greenhouse gas emission reductions can be expected even in the most coal-intensive and highly emitting grids.[136] An electric car sold today can be expected to achieve life-cycle greenhouse gas emission reductions of 20% in India and 40% in China.[137]

Box 3. Comparative analysis of life-cycle emissions of low-emission vehicles in the European Union

- **Battery electric vehicles** emit **73% fewer** life-cycle greenhouse gases than petrol cars (63 versus 235 grams of CO_2 equivalent per kilometre) on the 2025-2044 average EU electricity mix — and **78% less** (52 gCO_2e/km) when powered by renewable electricity.
- **Production emissions** of battery electric vehicles (notably from battery manufacturing) are offset within **17,000 kilometres**, well within the first 1-2 years of use.
- **Hybrid and plug-in hybrid vehicles** offer modest reductions of **20-30%**, but still emit **2-3 times more** than battery electric vehicles.

- **Fuel cell electric vehicles** only match the emissions of battery electric vehicles when using **renewable hydrogen**; using fossil-based hydrogen yields emissions of **175 gCO_2e/km**, only 26% better than petrol.
- An ICCT study found that Doubling biofuel blending in Europe from today's levels would only improve the lifecycle GHG emissions of an ICEV sold in 2025 by 0.5-3%

Source: See endnote 135 for this section.

Supply chains for EV batteries have become increasingly concentrated in recent years, even as battery demand has increased[vi]. In 2024, the top three refining nations controlled 86% of global production for key minerals (up from 82% in 2020), with China dominating cobalt, graphite, rare earths, and refiners of 19 of 20 minerals.[138] **Concentration of mining has also increased, from 73% in 2020 to 77% in 2024 for the top three producers – the Democratic Republic of the Congo for cobalt, Indonesia for nickel, and China for graphite and rare earths.**[139] So far, the production and processing needed for nickel, cobalt, graphite, and rare earths may be sufficient to meet projected demand growth; however, copper and lithium remain at risk, with copper facing a projected 30% supply gap by 2035 unless measures are taken to ensure its availability.[140]

Evidence suggests that a gender gap exists in the adoption and use of EVs, with women being under-represented across nearly all segments of the e-mobility ecosystem. Although the use of electric three-wheelers has shown promise in enhancing women's mobility in low-income regions, this has not been the case everywhere. High costs limit women's access to e-bikes and to electric two-wheelers globally.[141]

- In the United States, women accounted for 41.2% of new car registrations but for only 28% of EV registrations as of 2022.[142]
- Data from early EV markets in California (United States) found that sales and leases of electric cars were skewed towards men.[143]
- Studies in Spain and the United Kingdom found that men had greater rates of adoption and lower knowledge barriers on EVs.[144]
- In China, wealthier men were found to have a higher chance of intending to purchase plug-in hybrid and battery electric vehicles.[145]
- In India, there is clear evidence of a gender gap in the use and driving of electric two- and three-wheelers (e-rickshaws), with women being under-represented among drivers.[146]
- Men are reported to be more frequent users of shared electric micromobility services: according to one platform, men accounted for roughly 60% of ridership.[147]

Systemic barriers to EV adoption include a general tendency for men to travel longer distances than women, greater risk perception among women in using remote charging points, advertising more often targeting men, and few policies directly addressing gender equity in transport electrification, particularly in emerging markets. Solutions to help close the gender gap include increasing female participation in transport planning and e-mobility industries and better considering gender factors in e-mobility.[148]

Policy and investment developments

Since 2023, both the Group of Seven (G7) governments and a broad set of countries under the United Nations framework have made high-level international commitments to decarbonising road transport.

- The G7 targets in 2024 focused on fiscal policies to "accelerate vehicles fleet turnover" as a means to achieve greenhouse gas emission reductions aligned with the goals of the Paris Agreement.[149]
- In 2025, the United Nations Economic Commission for Europe advanced the global decarbonisation strategy for road transport (and other inland modes) by 2050, which acknowledges a broad set of policies that will be needed to cut road transport emissions.[150] Through the strategy's collaborative platform, signatory countries pledged to implement policies towards transport decarbonisation.[151]

At the national level, policy developments towards vehicle electrification included new regulations as well as challenges and repeals of existing regulations (as in the United States) and modifications to vehicle standards (as in the United Kingdom and the EU).

vi Demand for the critical materials used in EV batteries has surged. Lithium demand jumped around 30% in 2024, exceeding its average increase during the 2010s by an order of 10%. Demand for nickel, cobalt, graphite, and rare earths also rose, with more than 85% of this growth driven by energy applications, including EVs, stationary batteries, renewables and grids. Despite this strong demand growth, prices have stayed low as the new supply from each of the three top producers has outstripped demand: lithium prices fell more than 80% during 2021-22, and prices of cobalt, nickel and graphite all dropped 10-20% in 2024. This pricing squeeze has hampered mining investment, which rose just 5% in 2024 (2% in real terms), and exploration stalled. There is overdependence on China to supply low-cost and high-performance EV batteries, and to manufacture affordable EVs.



China's target for electric cars to comprise 47% of new car sales by 2027 was met two years early, with quarterly sales in 2025 already reflecting this target.[152] China's shift towards EVs has been accelerated by stricter fuel consumption and emission standards, which make it increasingly difficult for conventional ICE vehicles to comply. China's previous Stage 3 standards, incentivising the adoption of electric vans, trucks[153] Updated fuel consumption standards also set tighter limits for passenger cars to 2030[154] In 2025, China was expected to adopt China 7/VII standards, tightening pollutant emission requirements[155]

In early 2025, the EU pushed back its initial target requiring manufacturers to reduce the CO_2 emission intensities of new passenger cars by 2025; instead, it allowed manufacturers to average their emissions intensities over the three-year period 2025-2027, thereby reducing the stringency.[156] A second phase of the EU's CO_2 emission standards for heavy-duty vehicles, adopted in May 2024, expands the scope of vehicle classes covered from around 65% to over 90%, requires greater CO_2 reductions in 2030 (of 45%, up from 30%), and requires CO_2 reductions of 65% in 2035 and 90% in 2040.[157] The standards also set minimum requirements for 90% zero-emission urban bus sales by 2030 and 100% by 2035.[158] In April 2024, under Euro 7/VII, the EU adopted new pollutant emission standards for cars, vans, and trucks, as well as battery durability requirements.[159]

Canada's EV Availability Standard, adopted in December 2023, requires rising shares of battery-electric and plug-in hybrid vehicles, starting at 20% and increasing annually to 100% in 2035.[160] Canada's EV sales share grew from 13% in 2023 to 17% in 2024; this continuing growth in Canada (and in the United Kingdom), compared with the stagnating shares in the EU and the United States, hints at the benefits of linear increases in performance or technical standards.

Australia's New Vehicle Efficiency Standard, adopted in 2024, requires emission reductions (in grams of CO_2 per kilometre) **of more than 60% for new passenger vehicles and around 50% for light-commercial vehicles (vans), from 2025 to 2029.**[161]

In the United Kingdom, amendments to the zero-emission vehicle (ZEV) mandate, proposed in April 2025, expand and extend flexibilities for ICE and plug-in hybrid vehicles to 2030.[162] These flexibilities have the potential to substantially weaken the near-term effectiveness of the policy.[163]

Clean fleet mandates, which require fleets to transition to zero-emission vehicles, have increasingly been established at the national and sub-national levels. These mandates generally target urban buses as well as municipal, public service, and government fleets, requiring that all vehicles purchased or operating transition to zero-emission powertrains.

- California's Advanced Clean Fleet requirements, and aspects of it that have been integrated into the Advanced Clean Trucks rule, require government fleets to operate 50% on ZEVs by 2026 and 100% by 2036, and will require large fleets to operate 100% on ZEVs by 2036.[164]
- Colombia has set minimum EV purchase quotas of 30% for public bus fleets and 10% for city bus fleets in 2025, with the latter rising to 100% by 2035.[165]
- In 2019, both Ecuador and France required that new public transport vehicles transition to 100% electric by 2025.[166] France also required that at least 50% of city- and town-level bus purchases be low-emission by 2022.[167]
- Israel set EV sales requirements on municipal buses in 2022 for a rapid ramp-up to 100% by 2026.[168]
- In 2018, Poland set minimum ZEV sales share targets for public service and government vehicles, and city buses.[169]
- Viet Nam issued a requirement in 2024 that all urban buses purchased from 2025 onward be battery electric.[170] Similar fleet requirements have been put in place at the city and state/provincial levels.

Globally, countries are increasingly prioritising EV adoption and zero-emission transport as part of their climate and energy strategies. Moreover, countries, including Ethiopia and Kenya, have introduced policies to accelerate the shift towards electric mobility in 2024, setting ambitious targets for EV adoption in the coming decades. However, it's important to note that EV targets alone do not necessarily lead to increased renewable energy usage unless they are coupled with specific mandates or internal combustion engine (ICE) bans. The impact of these targets largely depends on a country's electricity mix; without a corresponding shift towards renewable energy sources, the environmental benefits of EV adoption may be limited.

- The government of **Ethiopia** has announced a ban on internal combustion engine (ICE) vehicle imports in 2024, effective immediately, to accelerate the transition to electric mobility and reduce fossil fuel dependence.[171]
- In 2024, **Kenya** has set a target for 5% of all registered vehicles to be electric by 2025 as part of its strategy to reduce transport emissions, although infrastructure and affordability remain challenges.[172]
- **Greece** announced in 2023 that by 2030, 50% of new passenger car registrations and 40% of new light commercial vehicle (LCV) registrations are required to be electric, supporting Greece's climate commitments and European Green Deal objectives.[173]
- **India** aims to boost the adoption of battery electric vehicles (BEVs) in part by setting a national goal of 30% of all vehicle sales in 2030 being BEVs.[174]
- As announced in its latest NDC, published in early 2025, **Cuba** aims for 15% of the total vehicle fleet to be electric by 2035, while 70% of newly registered vehicles in 2035 are expected to be electric.[175]
- **Azerbaijan**'s latest NDC sets targets for the share of electric vehicles in the total vehicle fleet, aiming for 46% in the high ambition scenario and 90% in the very high ambition scenario by 2050 for electric cars; 38% in the high ambition scenario and 75% in the very high ambition scenario by 2050 for electric scooters/motorcycles; and 38% in the high ambition scenario and 75% in the very high ambition scenario by 2050 for electric golf carts.[176]
- **Panama**'s latest NDC includes targets for 2027 and 2030: by 2027, 7% - 18% of the total private vehicle fleet will be electric, 15% - 30% of private vehicle sales will be electric, 14% - 25% of buses in authorized concession fleets will be electric, and 21% - 35% of public fleets will be electric. By 2030, these targets increase to 10% - 20% of the total private vehicle fleet being electric, 25% - 40% of private vehicle sales being electric (subject to climate financing and international market conditions), 15% - 35% of buses in authorized concession fleets being electric (subject to climate financing and international market conditions), and 25% - 50% of public fleets being electric (subject to climate financing and international market conditions).[177]
- **Lesotho** aims to electrify motorcycles, targeting 910 electric two-wheelers by 2030, resulting in a GHG reduction of 0.2 kt CO2eq per year by 2030, as announced in their latest NDC.[178]
- **Saint Lucia** has set an ambitious target in their third NDC: to achieve 30% electric vehicle (EV) sales by 2030, increasing to 40% by 2035.[179]
- As indicated in its latest NDC, the **United Kingdom**'s Zero Emission Vehicle (ZEV) mandate is the world's most ambitious national-level regulatory framework of its kind, with annual minimum targets for the proportion of new cars and vans sold in the UK from 2024 rising to 80% of cars and 70% of vans by 2030 on a pathway to 100% by 2035.[180]
- **Canada** finalised the Electric Vehicle Availability Standard (regulated targets for zero-emission vehicles) in December 2023, which requires 100% of new light-duty vehicles (LDVs) offered for sale in Canada to be ZEVs by 2035.[181]

Several governments across high-income countries and emerging economies have promoted electric buses and put in place policies that have enabled them to leverage concessional finance, thanks in part to collaboration and support from development finance institutions. Countries with policies that support the leveraging of concessional finance (i.e., finance provided by multilateral development banks with interest rates below those offered by high-street banks) to deploy electric buses include Albania (2023), Chile (2023), Colombia (2022), Jordan (2020), Kazakhstan (2024), the Kyrgyz Republic (2021), Mexico, Panama (2024), Thailand (2023), Türkiye (2024), Uzbekistan (2023) and Paraguay and Uruguay (2022). Countries that offer grants towards the purchase of e-buses include Canada (from 2022), Cyprus



(from 2023), Hungary (from 2019), Israel (from 2021) and the Republic of Korea (from 2023).[182]

In the United States, policies to reduce greenhouse gas emissions from road vehicles and to promote EV sales were being rolled back by the Trump administration as of early 2025. However, the situation remained dynamic and difficult to anticipate.

- A US executive order in early 2025 froze funding for EV-related loans, grants, and tax incentives, including for batteries, vehicles and charging infrastructure.[183] A federal judge later ordered that the funds be reinstated; however, continuing delays in disbursement led to litigation, and the uncertainty engendered by the freeze and tariffs spurred the cancellation or delay of major EV production plans.
- In May 2025, the US Congress passed a bill to phase out the tax credits of the Inflation Reduction Act which previously offered purchase subsidies for zero-emission vehicles.[184]
- To implement ambitious targets set by the previous administration, in 2024 the US Environmental Protection Agency (EPA) finalised greenhouse gas emission standards for heavy-duty vehicles, setting targets for 2032 requiring vocational trucks (such as utility vehicles and delivery trucks) to reduce their CO_2 emissions up to 60% per tonne-mile and road tractor trucks up to 40%.[185] In early 2025, the new administration's EPA announced that it would reconsider both pieces of legislation as well as the nitrogen oxide (NO_x) engine standards for heavy-duty vehicles adopted in 2022.[186]
- In 2022, the US Congress voted to rescind California's waiver to the Clean Air Act that is the basis for that state's recent EV sales requirements for light-duty vehicles (Advanced Clean Cars II) and trucks (Advanced Clean Trucks), as well as strict NO_x emission rules for heavy-duty engines.[187] The legislative actions came despite assertions that refute Congress' authority to revoke the waiver. Because California's rules are followed by multiple other US states, they have served to accelerate market diffusion of clean transport technology at a national level.[188]

Several countries have announced policy packages providing financial support to promote EV adoption, including purchase incentives and tax credits. Newly adopted fiscal policies increasingly promote EVs by reducing or exempting them from registration and taxes, rather than explicitly subsidising their purchase. Especially in advanced economies, subsidies and tax exemptions are increasingly targeted to apply only to lower-cost EVs (such as through price caps) and/or to lower-income households.

- In 2024, the Indian government announced funding of around USD 1.3 billion (INR 10,900 crore) for two years for the PM E-DRIVE policy package, which provides EV purchase incentives of around USD 440 million (INR 3,679 crore) to promote electric two- and three-wheelers, ambulances, buses, and trucks, with additional measures for charging infrastructure.[189]
- Japan announced public funding of around USD 830 million to support ZEV subsidies in 2024.[190]

- Brazil's 2023 National Green Mobility and Innovation Program (MOVER) measure, in addition to establishing new guidelines for fleet sustainability and incentives for new automotive technologies, outlines financial incentives and support for EVs, including credits and fiscal incentives for 2024- 2028.[191]
- China extended its purchase tax exemption for new energy vehicles (NEVs) to the end of 2025; through 2027, the taxes will continue to be half those for conventional ICE vehicles.[192]
- A Chinese "cash-for-clunkers" style fleet renewal subsidies programme, introduced in the third quarter of 2024 and extended through 2025 (albeit at lower per-vehicle rates), has incentivised the purchase of millions of efficient and electric vehicles.[193]
- The Republic of Korea adapted its subsidies for electric cars and trucks in 2025 to target EVs that have longer driving ranges and faster charging speeds; it will provide additional electric car subsidies to young buyers and households with multiple children.[194]
- Belgium's phase-out of tax deductions for company ICE vehicles and plug-in hybrid EVs, alongside continued incentives for battery electric and fuel cell vehicles, has driven a sharp rise in EV uptake. In 2024, registrations of new battery electric vehicles increased 37% – to nearly 128,000 – with 87% of the vehicles registered by companies.[195]

Countries have increasingly used exemptions or reductions in import tariffs – often coupled with similar reductions/exemptions to VAT, registration and circulation fees – to incentivise EV adoption, with increased adoption notable in emerging markets and developing economies. Many of these markets have implemented selective import duty and/or VAT or excise tax exemptions on EVs.

- Countries that have exempted or reduced import duties on EVs include Argentina (in 2025), Armenia (in 2024), Azerbaijan (exemption includes also VAT, and is on imported EV chargers, from 2024), Angola (50% exemption on both import duties and vehicle tax, from 2022), Belarus (from 2021), Bolivia (from 2021), Brazil (in 2022, with gradual phase-out of exemptions from 2023), Ecuador (from 2021), Ethiopia (with import duty and VAT exemptions/reductions in 2022 put in place well before the country's 2024 ICE import ban), Finland (from 2022), Georgia (from 2020), the Kyrgyz Republic (from 2019), Malaysia (from 2024), Moldova (from 2019), Morocco (from 2022), Nicaragua (from 2022), Rwanda (from 2021), Saint Lucia (from 2023), Tajikistan (from 2022), Trinidad and Tobago (from 2021), Tunisia (from 2022), Ukraine (from 2015) and Uzbekistan (from 2022).[196] Switzerland removed its EV import exemption in 2024.[197]
- Other countries have reduced or exempted EVs from registration or circulation taxes or provided purchase subsidies to individual electric car buyers. Examples include Australia (from 2022), Austria (from 2023), Bosnia and Herzegovina (from 2022), China (through 2027), Denmark (since 2023), Israel (since 2024), Latvia (from 2020), Lithuania (2021), Mexico (from 2019), the Netherlands (from 2019), Nigeria (from 2023), the Philippines (from 2017), Poland (from 2020), Portugal (from 2017), Serbia (from 2024), Singapore (from 2021; also "feebate"-based registration taxes in 2024, including EV rebates), the Slovak Republic (from 2023), Spain (from 2020), Thailand (from 2022; also for hybrid EVs from 2024) and Viet Nam (from 2022).[198]
- Countries that recently reduced or waived taxes on corporate EV buyers include Austria (from 2023), Belgium (from 2023), Denmark (from 2023), Germany (no date) and Latvia (from 2020).[199]

Some countries have begun to scale back or remove tax reductions/exemptions applied to EVs. Such reforms help support long-term public fiscal sustainability, since the foregone revenue from import and VAT tax exemptions or reductions can constitute a major drain on public finances. Charting a course between ambitious EV sales targets, such as those achieved in Norway, and fiscal responsibility is a challenge facing even the wealthiest of countries.[200] A solution in countries with tight budgets is to implement "feebate"-like schemes that impose high taxes on low-efficiency vehicles, and to use these revenues to directly subsidise tax exemptions on EVs (and, potentially, fuel-efficient ICE vehicles), ensuring that tax programmes are at least revenue-neutral (and ideally net revenue generators).

- The United Kingdom's excise duty exemptions for EVs will phase out in 2025, along other EU member states.[201]
- In Norway, the most recent revision to the VAT reduction for EVs came into effect in 2024, and high-price EVs are subject to import duties.[202]

Multiple policy initiatives have aimed to accelerate the deployment of charging and refuelling infrastructure for zero-emission vehicles. To increase the availability of charging in apartment complexes, policies have included: regulations that require charge points in the garages of renovated or new apartments, subsidies targeting multi-unit dwellings and apartments, competitive bidding for public charging infrastructure, and credit guarantees to reduce lending risks. Without the availability of robust and reliable charging infrastructure, consumers may be reluctant to purchase EVs for fear of running out of power on the road, leading to "range anxiety", although this fear is waning in markets with greater EV uptake.[203]



- In California (via California Green Building Standards Code—Part 11, Title 24, California Code of Regulations—known as CALGreen), parts of Canada (through multi-unit residential buildings (MURBs)), in the EU (via the Energy Performance of Buildings Directive).[204]
- Costa Rica continued its commitment to develop a nationwide charging network through a partnership between the national electricity distribution company (ICE) and private initiatives, with plans to install 230 new chargers – including 30 fast chargers, nearly doubling their number.[205]

The EU's Alternative Fuels and Infrastructure Regulation (AFIR) sets mandatory targets for the deployment of charging stations and hydrogen refuelling along the main TEN-T motorway network.[206] The first mandatory targets, for 31 December 2025, include installing a total minimum power of 400 kW for passenger cars in each charging pool on the core network.[207] To ensure the possibility of fast charging, one charge point in each pool must have a rated output power of at least 150 kW.[208] These targets are scaled up progressively to expand to secondary roads in the "comprehensive network" and to increase the charging capacity required at each station.

- For heavy-duty vehicles, 15% of the total TEN-T network mustbe covered with charging stations at a maximum distance of 120 kilometres with a capacity of 1,400 kW, including at least one charge point with at least 350 kW.[209]
- The AFIR also sets targets for charging infrastructure in urban areas, to rapidly expand the network across Europe and to reduce barriers to EV adoption.

China's National Development and Reform Commission and State Council both set deployment targets for EV supply equipment in 2022 and 2023.[210] These include installing charging infrastructure for more than 20 million EVs by 2025, implementing peak/off-peak pricing for EV charging by 2025, setting minimum target thresholds for off-peak EV charging across pilot cities, and by 2030 fully establishing interactive networks that enable EVs to provide flexibility to the grid. This can be done, for example, through V1G (unidirectional grid-to-vehicle charging) and in some cases V2G (bi-directional grid-to vehicle charging) and vehicle-to-grid discharging. Technological advances have been achieved for faster charging.

- In early 2025, BYD announced delivering up to 400 kilometres of range in five minutes, and CATL later announced even faster charging speeds, using megawatt charging previously limited to only heavy-duty vehicles.[211]

Other Asian countries have announced policies supporting the deployment of charging infrastructure, and in some cases concrete policies have been set up to implement targets.

- In 2023, Japan's Ministry of Energy, Trade and Industry announced targets for 300,000 charge points by 2030.[212]
- Singapore in 2020 announced targets to deploy 60,000 EV charging points by 2030.[213]
- The Indonesian government announced in 2021 a target to deploy 30,000 charge points by 2030.[214] In 2025, this target was more than doubled to 63,000 charge points.[215]
- Thailand aims for 12,000 charge points by 2030, and the Philippines for 66,500 by 2028.[216]
- Viet Nam in 2024 began to subsidise electricity tariffs for EV charging.[217]
- Malaysia adopted income tax rebates in 2024 for manufacturers of EV supply equipment.[218]
- In February 2025, the Federal Highway Administration directed states to halt all new obligations under the NEVI, rescinding prior approvals and indicating that new guidance would be issued, notably impacting the Joint Office of Energy and Transportation and undermining its mission to co-ordinate federal support for EV infrastructure.[219]
- Later in 2025, after government research found that more than USD 3.2 billion should have been considered obligated to the NEVI, California and 15 other states and the District of Columbia filed a lawsuit against the administration for withholding designated federal funds for EV charging infrastructure.[220]

In the United States, as of mid-2025, the new Trump administration had taken significant steps towards rolling back EV infrastructure initiatives established by the previous administration. A central action was suspending the National Electric Vehicle Infrastructure (NEVI) Formula Program, a USD 5 billion initiative under the Bipartisan Infrastructure Law aimed at expanding EV charging stations across the country.

Several initiatives like The Global Green Road Corridors Initiative aim to develop "green corridors" with charging and refuelling infrastructure for heavy-duty vehicles on major roads around the world.[221] **Additionally, significant progress was made towards piloting and testing a Megawatt Charging System (MCS) standard for heavy vehicles.**[222] The MCS will enable charging at a maximum rate



of 3.75 megawatts, and the final standard applicable in Europe and North America, was expected to be finalised in 2026 with publication of the International Electrotechnical Commission standard.[223] Society of Automotive Engineers (SAE) standards were already published in March 2025.[224]

In addition to governments, manufacturers have announced increasing ambition for heavy-duty vehicle electrification. Although most industry initiatives were announced in Europe, some also occurred in the United States.

- Traton and Volvo Group announced an ambition for 50% of their truck sales in Europe to be electric by 2030, with Volvo also targeting more than 35% of sales being electric globally the same year.[225]
- Daimler announced an ambition for 60% of its European truck sales to be "carbon neutral" by 2030 and 100% by 2039.[226]
- In 2022, Traton, Volvo and Daimler formed a joint venture to build 1,700 high-power charging stations for heavy-duty trucks in Europe by 2027.[227] The venture, known as Milence, has since opened numerous stations around Europe.[228]
- In 2024, Daimler announced plans to build 100 heavy-duty vehicle charging stations in California (United States).[229]

Policies are increasingly being adopted to promote strategic on-shoring of parts of the EV and battery value chains, as a means of securing better jobs and industrial development prospects and to ensure resilience of this rapidly emerging clean energy sector. Policies to help diversify supply chains for EV battery manufacturing and related industries include government incentives to attract new mining and processing players, with fiscal and financial incentives on both the supply and demand sides like the US Inflation Reduction Act, India's Production Linked Incentives, Indonesia's investment and industrial partnerships, including through the state-owned Indonesia Battery Corporation.[230]

Producer and consumer subsidies for EVs and batteries are increasingly being coupled with local content conditions. Alternatively or in addition, countries have begun to impose selective tariffs on fully built-up imported EVs. Increased tariffs on imports of Chinese-made EV extend beyond the well-known ones adopted by Canada, the United States and the EU. To strengthen supply resilience, there is scope for countries or bilateral or multilateral trade blocks to design and implement policies that promote domestic value-added in battery production and EV manufacturing and assembly (although it is not advised to place export restrictions on unrefined critical minerals).

- Consumer subsidies in the US Inflation Reduction Act are subject to local content and other sourcing restrictions.[231]
- Countries that have established subsidies contingent on local value-added include Bangladesh (from 2021), Bolivia (from 2021), Ethiopia (from 2022), Indonesia (from 2022), Malaysia (from 2023), South Africa (from 2024) and Thailand (from 2024).[232]
- Tariffs on Chinese-made EV imports have increased (in some cases markedly) in Brazil, India, Indonesia, Mexico, the Russian Federation and Türkiye.[233] In India, Indonesia, and Türkiye, Chinese EVs that are locally assembled are subject to far lower tariff rates.[234]

Such policies should be accompanied by tailored electrification policies that prioritise affordable and heavily utilised EV categories (such as electric bikes and two- and three-wheelers, public transit and informal bus services, and car- and ride-sharing fleets). Policies have already been adopted that seek to address these dual risks.

In the EU, efforts have been made to frame EV uptake using a circular economy approach that includes the end-of-life recycling of batteries and the re-use and recovery of other materials (e.g., electronics, metals, minerals). The EU has led with comprehensive legislation on battery value chain transparency and circularity, and further proposed legislation could help advance circular design and materials use at the full-vehicle level.

- In 2023, the EU approved new updates to its Battery Regulation ensuring that 1) increased demand for EV batteries will be met using lower-emission batteries sourced from recycled materials, and 2) increasing shares of battery-critical raw materials will be built using recycled materials.[235]
- The EU's Critical Raw Materials Act establishes targets for material extraction, processing, and recycling, including that 35% of each of these three processes should occur within the EU by 2030.
- The EU has also shown leadership through the proposed End-of-life Vehicles Regulation.[236]

Limited policy steps have been taken to promote technology innovation, although much more can be done. Innovations include the diversification of cathodes (including sodium-ion batteries and manganese-rich and lithium iron phosphate materials) as well as advanced solid-state battery chemistries to reduce reliance on specific minerals such as cobalt and nickel.[237]

Partnerships in action

- Through the **Accelerating to Zero Coalition**, established at the 2021 UN Climate Conference in Glasgow, Scotland (COP 26), more than 200 stakeholders – including governments, auto manufacturers, investors, financial institutions and fleet operators – committed through the Zero Emission Vehicles Declaration to transition to 100% zero-emission cars and vans globally by 2040, and no later than 2035 in key markets.[238] Signatories included 31 national governments and 13 emerging markets and developing economies (among them Colombia, Costa Rica and Nigeria).[239] Signatories pledge to support emerging economies through technical assistance, finance and capacity building.[240]
- The **Electric Vehicle Initiative's EV30@30 campaign**, launched in 2017, set a goal of achieving 30% EV sales (including cars, buses and trucks) by 2030, with the support of 15 countries and more than 20 companies and organisations.[241]
- **EV100**, a global group of businesses committed to fleet electrification, has committed to deploying more than 5.5 million EVs by 2030.[242]
- As of 2025, the **Global Facility to Decarbonise Transport** (**GFDT**) had disbursed USD 6.36 million in grant funding and catalysed USD 400 million in World Bank-financed green mobility projects, with a further USD 950 million in World Bank-financed investments expected.[243] The GFDT had supported the implementation of 16 World Bank projects, with another 24 projects under preparation.[244]
- As of mid-2025, a total of 40 countries had committed to the **Global MoU on zero-emission medium- and heavy-duty vehicles** (**Global MoU on ZE-HDVs**), which aims to achieve targets for new electric truck and bus sales by 2030 and 2040.[245] The signatories agree to report progress annually and to develop plans to support their zero-emission vehicle deployment ambitions.
- The **TUMI E-Bus Mission**, which formally ended in May 2025, assisted 20 cities in creating world-leading electric bus fleets and scaling e-bus adoption to hundreds more through city-to-city mentorship.[246]
- The **Zero Emission Bus Rapid-deployment Accelerator** (**ZEBRA**) **Partnership**, led by C40 Cities and the International Council on Clean Transportation, supports major Latin American cities in accelerating deployment of zero emission buses.[247]
- The **Zero Emission Vehicles** (**ZEV**) **Transition Council** was established by the UK COP 26 Presidency as the world's first political forum to discuss how to accelerate the global transition to zero-emission vehicles. It consists of ministers and government representatives from the world's largest and most progressive auto markets, collectively accounting for more than half of all new car sales globally.[248]
- The **ZEV Rapid Response Facility,** launched under the ZEV Transition Council, aims to provide co-ordinated, easy and quickly accessible short-term technical assistance to governments in emerging and developing economies seeking to accelerate EV adoption. Recent technical assistance has involved: 1) trainings on EV safety in the Seychelles, 2) developing a strategic roadmap for charging infrastructure and updating vehicle inspection legislation and Nationally Determined Contributions in Türkiye, 3) determining greenhouse gas emissions from petrol and diesel ICE vehicles in El Salvador, and 4) extensive engagement on Kenya's draft e-mobility policy, including recommendations on battery collection and recycling, a supply-side regulation for two- and three-wheelers, and projects on the availability and reliability of charging infrastructure.[249]
- The **2024 Battery Passport** pilot of the **Global Battery Alliance** involved 10 global consortia of battery cell makers and traceability providers to test real-world sustainability data collection.[250] It was the largest initiative of its kind and included companies responsible more than 80% of global EV battery production.[251] The effort published 10 prototype battery passports, most of which covered battery supply chains in China, marking significant progress towards the goal of building sustainable, responsible battery value chains.[252]



Economics, Finance and Capacity Building for Transformative Change in Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION

MODULE 6

6.1  Financing Sustainable Transport in Times of Constrained Public Budgets 653

 Evolving the Economic Appraisals for Land Transport Investments 670

 Improving Access to Climate Finance for Transport in Low- and Middle-Income Countries 677

6.2  Capacity Building for Transport Transformation 686

LIST OF FIGURES

Financing Sustainable Transport in Times of Constrained Public Budgets

Figure 1. G20 investments (in USD millions) in transport compared to other sectors, 2022 . . . 660
Figure 2. Survey of instruments used to finance public transport infrastructure projects, 2024 . . . 660
Figure 3. Private sector participation in transport infrastructure in low- and middle-income countries, 2015-2023 . . . 662
Figure 4. Climate finance for transport, by private and public sector, 2023 . . . 662
Figure 5. Share of bilateral overseas development assistance going to transport, 2019-2023 . . . 663
Figure 6. Sustainable bond issuance by sector, 2019-2024 . . . 665
Figure 7. Reported farebox coverage rates by region, 2024 . . . 665
Figure 8. Per capita fossil fuel subsidies by region, 2015-2023 . . . 666
Figure 9. Net tax implications of electric vehicle adoption based on International Energy Agency policy scenarios, 2023-2035 . . . 667

Capacity Building for Transport Transformation

Figure 1. Overview of capacity development levels . . . 692
Figure 2. Comparison of average durations of the identified 14 capacity building formats . . . 693
Figure 3. Average capacity gaps identified in 21 transport entities across 20 cities . . . 694

LIST OF TABLES

Financing Sustainable Transport in Times of Constrained Public Budgets

Table 1. Projections for transport investment needs by region . . . 232

Evolving the Economic Appraisals for Land Transport Investments

Table 1. Economic case for investments in public transport, walking and cycling solutions . . . 246

MODULE 6 | 6.1

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Financing Sustainable Transport in Times of Constrained Public Budgets



KEY FINDINGS



Transport Investment Needs

- As the demand for transport grows, the scale of investment required to support global transport infrastructure is immense, with an estimated USD 50 trillion needed between 2015 and 2040 to meet rising demand across key sectors such as roads, railways, ports and airports.
- No single global estimate of transport investment needs is available; however, different sources have estimated investment needs by region, with varying numbers and wide ranges. The most rapid transport growth is anticipated in Asia – driven by increases in trade and travel between major emerging economies such as China and India – as well as in Europe and North America.
- Given the ambitious investment needs, different types of financing sources will be needed. Currently the two primary financing sources are the public and private sectors. Specific sources of funds include money for climate action, official development assistance (ODA) from donors and development agencies, and issuances of green bonds in global capital markets.

Financing and investment trends

- In 2022, central governments in the Group of Twenty (G20) countries directed a substantial 42% of their total infrastructure investment to the transport sector (USD 416 billion, out of a total of USD 990 billion); this was more than double the share allocated to social infrastructure (17%) and roughly 2.5 times the combined investment in the energy, communications, and water and waste sectors.
- The road sector continued to dominate investment in transport, driven by the central role of roads in enabling freight and passenger movement and supporting economic development.
- Transport has continued to rely heavily on public sector funding – primarily government subsidies and grants – for capital investments, with only limited private sector participation. Many national governments directly finance the construction of transport infrastructure, particularly for public transport (bus rapid transit, light rail and metro systems).
- Private investment has remained an underutilised financing instrument, as indicated in a 2024 survey of public transport operators on transport infrastructure projects. The use of carbon credit mechanisms in low- and middle-income countries (LMICs) has been minimal, despite the potential of such schemes to unlock significant capital for low-emission transport projects.
- In 2023, total private participation in infrastructure across LMICs reached USD 86 billion, equivalent to just 0.2% of their combined GDP.

KEY FINDINGS

- Private investment in transport infrastructure hit a two-decade low in 2023, plummeting 76% to just USD 13.6 billion across 45 projects, or 69% below the five-year average.
- Transport accounted for only 16% of total private participation in infrastructure investments in 2023. Despite the recovery of international travel, which led to a spike in transport investment in 2022, private participation in transport infrastructure investment in 2023 fell below even pandemic-era lows.
- During 2020-2023, the road sector continued to dominate private sector investment in transport with a 59% share, while 15% of investment went to railways, 17% to airports and 9% to ports.
- The gap is widening between needs and actual climate finance for transport. In 2023, the sector received around USD 545 billion from public and private sources for climate mitigation, seven times below the estimated USD 2.7 trillion needed annually by 2050 to align with global transport climate action targets.
- Climate finance for adaptation also lags: in 2023, adaptation financing for transport totalled USD 1.8 billion, or only around 3% of the overall global adaptation financing of USD 65 billion. Emerging economies require an estimated USD 222 billion per year between 2024 and 2030.
- To stay on track, annual transport investment in LMICs (excluding China) must reach an estimated USD 575 billion by 2030. However, half of the USD 545 billion in transport-related climate finance in 2023 went to high-income countries, and the majority (77%) went to road transport followed by rail and public transport (23%).
- LMICs received only a small portion of climate finance for transport in 2023, with 0.03% (USD 145 million) going to least developed countries and 4% (USD 22 billion) to emerging markets and developing economies (excluding China). Notably, the 10 countries most affected by climate change between 2000 and 2019 received less than USD 23 billion, or under 2% of the global total.
- Against the backdrop of current climate finance flows to transport, the 2024 United Nations Climate Change Conference in Baku, Azerbaijan (COP 29) was a missed opportunity to set a new ambitious climate finance target and align it with sectoral needs, including for transport. The climate finance goal has also attracted criticism regarding its qualitative criteria.
- Official development assistance to transport has increased. Between 2019 and 2023, the transport sector received an average of USD 10 billion annually from bilateral ODA flows, including 5% of total ODA in 2022 and 8% in 2023, a share that has grown post-pandemic.



- Road transport received the largest share of transport ODA between 2013 and 2022 (around 50%), followed by rail transport (30%) and transport policy (10%).
- Overall, the distribution of transport ODA to vulnerable groups such as least developed countries and small island developing states was broadly in line with total ODA patterns.
- There is a growing need to modernise ODA labelling codes and categories (green investments, for example, are currently allocated under road infrastructure). Because of the limited range of codes, the true nature of infrastructure and services needs in transport is not reflected in ODA data.
- Global issuance of sustainable bonds, including green and other thematic bonds, rose 8% in 2024 to USD 609 billion, up from USD 567 billion in 2023; however, transport-related bonds accounted for just 9% of total issuance, or USD 57 billion.
- Growth in transport-related bond issuance has remained modest compared to the transport sector's potential. Infrastructure assets in the sector are expected to become increasingly attractive due to predictable cash flows and reasonable returns. However, the key challenge for most LMICs is the insufficient creditworthiness of cities, which limits their ability to issue bonds themselves and is often compounded by national governments not allowing sub-national governments to issue bonds.

KEY FINDINGS

- Diversification of revenue sources – such as through real estate development, advertising and regional transport taxes – increases the financial sustainability of public transport agencies. Public transport operators have traditionally relied on customer fares to cover a portion of operating costs; however, farebox coverage has remained low across most regions, commonly in the ranges of 31-40% and 41-50%.
- In cities that require employers to offer commuter benefits to employees, various options are available to fund these benefits. They include: pre-tax payroll deductions, employer-paid direct benefits, subsidies and reimbursements, and combinations of these measures.
- Non-fare revenues, which are generated through commercial or ancillary activities within public transport networks, have become an increasingly important component of financial sustainability. Newer funding mechanisms include levies on car use, freight, deliveries and property-related charges from land-value capture.
- The COVID-19 pandemic prompted transport agencies worldwide to reconsider their revenue sources and fare policies, with some offering fare-free services.
- In 2023, implicit and explicit subsidies for fossil fuels totalled around USD 7 trillion, equal to 7.2% of global GDP; per capita subsidies ranged from USD 198 in Africa to USD 2,172 in North America.
- Fuel excise taxes are a vital source of government revenue and are often used to fund road infrastructure; however, the current taxation model is unsustainable in an electrified future. In 2023, electric vehicles displaced nearly USD 12 billion in global fuel tax revenues, while generating only USD 2 billion through electricity taxes – a net loss of USD 10 billion. Even though China led the world in electric vehicle uptake in past years, 60% of fuel revenue losses were in Europe, where petrol and diesel taxes were much higher.
- This trend is expected to intensify, with net fuel tax losses projected to grow more than five-fold, based on International Energy Agency projections for electric vehicle adoption.

Way forward

- Funding is considered critical to making public sector investments viable. Governments need to find alternative ways to fund transport services, instead of relying on direct funding to transport agencies.
- The way forward for sustainable transport financing requires major rebalancing action to reduce the massive gap between current financial flows and the USD 50 trillion investment needed by 2040. However, there are key challenges in implementing this. They include: constrained public budgets, under-utilisation of private capital, inequitable climate finance flows, high upfront costs and long payback periods, weak institutional capacity, outdated funding and reporting systems, revenue loss from electrification, policy and regulatory gaps, and lack of adaptation focus.
- The way forward will require significant action in several key areas:
  - Governments must prioritise subsidising sustainable transport instead of fossil fuels. Fossil fuel subsidies still exceed most forms of climate-aligned transport finance.
  - Climate finance for transport must be scaled up significantly – with a greater share directed to LMICs, especially for adaptation – and structured to prioritise concessional lending and grants over market rate loans. As the global community works on the Baku to Belém Roadmap for 1.3T, which aims to mobilise USD 1.3 trillion in climate finance for LMICs annually by 2035, investing in sustainable transport must be part of the solution.
  - Mobilising private capital is essential.
  - Public finance mechanisms need modernisation.
  - Updating outdated transport investment taxonomies is important.
  - Institutional capacity building, especially in LMICs, is critical.
  - As electric vehicles reduce fuel tax revenues, governments must explore alternative revenue models.
  - Transport investments must be fully integrated into both national climate change mitigation and adaptation strategies and national development strategies.

KEY FINDINGS

OVERVIEW

Financing in transport refers to the various methods and sources of money that are used to support the development, operation and maintenance of transport infrastructure and services. Infrastructure and services such as roads, bridges, airports, railways and public transport networks require significant investments to be built and maintained effectively.

Funding versus financing:

- **Funding** is money provided for a specific purpose, often by an organisation or government, and typically does not need to be repaid and is not dependent on the creditworthiness of the receiver. Examples: Grants, donations, government subsidies.
- **Financing** is the process of obtaining capital (money) through various means, including borrowing (debt) or attracting investors (equity). Debt financing, such as loans or bonds, requires repayment with interest. Equity financing involves selling ownership shares in exchange for capital. To raise financing, the creditworthiness of the borrower plays a role in its ability to access the market. Examples: Bank loans, lines of credit, issuing shares, venture capital.

Transport projects can be financed from multiple sources, whereas funding comes from user fees/charges and taxpayer monies. Financing in transport involves obtaining the necessary resources to cover the costs associated with these projects and operations. It includes the following:

- **Borrowing and loans** – money that governments and transport agencies borrow (through either issuing bonds or taking out loans from financial institutions) and then repay over time, often using revenue generated from transport-related activities.
- **Capital investment** – financing for the construction, expansion or renovation of transport infrastructure, which includes building new roads, bridges, airports and other facilities.
- **Climate finance** – financing that is channelled to reach the scale of climate change mitigation and adaptation that is required in the transport sector to achieve Paris Agreement targets.
- **Earmarked taxes** – taxes (such as fuel taxes, vehicle registration taxes, etc.) collected from motorists that are generally earmarked for transport-related purposes, such as funding road construction and maintenance projects.
- **Environmental and impact fees** – payments or mitigation efforts that transport projects might require to offset the environmental impacts caused by construction or operation.
- **Grants and subsidies** – funds that governments provide to transport projects, particularly projects that serve a public interest but that may not be financially self-sustainable.
- **Innovative financing** – cross-cutting term linked to the mechanisms mentioned above but utilising new resource mobilisation mechanisms that are being explored to help finance transport projects sustainably and efficiently, such as congestion pricing, carbon credits and value capture strategies.
- **Operations and maintenance** – funding to operate and maintain transport systems, covering expenses such as staff salaries, maintenance of vehicles and infrastructure, and other operational costs.
- **Private investment** – financing from private companies and investors, whether through direct investments or in the form of public-private partnerships (whereby private entities might handle the construction, operation or maintenance of infrastructure in exchange for certain revenue-sharing arrangements).
- **Public funding** – funds provided by various levels of government to support transport projects, which can come from taxes, tolls, fees and other revenue sources dedicated to transport.
- **User fees and tolls** – funds that users of transport infrastructure pay to help finance the construction and maintenance of facilities, such as tolls used to fund highway upkeep.

Effective financing is crucial for the development of modern transport networks that facilitate sustainable economic growth, improve connectivity and enhance quality of life. It involves a combination of public and private resources, strategic planning and careful allocation of funds to ensure the efficient operation and expansion of transport infrastructure and services.

Context, challenges and opportunities

Transport is now the second largest and fastest growing contributor to global greenhouse gas emissions. In 2023, the sector was responsible for 21.9% of carbon dioxide (CO_2) emissions, driven by a staggering 95.4% reliance on fossil fuels.[1] Road vehicles alone accounted for nearly three-quarters of transport emissions.[2] Despite technological advances, emissions, air pollution, noise, and road fatalities in the sector have continued to rise, fuelled by economic growth, increased personal mobility and surging freight volumes.

Transport demand is projected to more than double by 2050, especially in low- and middle-income countries (LMICs), where a lack of access to transport services still isolates hundreds of millions of people from health care, education and economic opportunity.[3] One billion people lived more than 2 kilometres from an all-weather road as of 2019, and only half of the world's urban population had convenient access to public transport in 2022.[4]

At the same time, transport infrastructure is increasingly vulnerable to climate change. In 2023, climate-related disasters caused USD 250 billion in insured losses – more than double the five-year average – with USD 15 billion in direct damage to transport systems annually.[5] LMICs have borne the brunt, absorbing more than half of these losses relative to their gross domestic product (GDP).[6]

The transition to sustainable transport is urgent but costly. Clean transport solutions require an estimated USD 2.7 trillion annually until 2050, seven times the investment level in 2023.[7] Yet climate finance for transport remains woefully inadequate and inequitable. In 2023, the sector received just USD 545 billion per year, mostly directed to high-income countries and road transport.[8] LMICs, particularly the most climate vulnerable, received only a fraction: 3% went to least developed countries, and adaptation finance for transport averaged just USD 1.5 billion annually in 2023, barely 2% of global adaptation funding.[9]

Implementing sustainable transport financing faces several interlinked challenges. Despite constrained public budgets that limit the ability to invest, governments continue to subsidise fossil fuels. Both private capital and capital markets remain underutilised in LMICs. In 2023, private participation in transport infrastructure totalled only USD 86 billion in LMICs.[10] Although official development assistance (ODA) has increased, public funding still dominates, and climate finance continues to bypass the countries that need it most. These challenges are compounded by outdated funding classifications, limited institutional capacity, high borrowing costs and the erosion of traditional revenue sources (such as fuel taxes) due to the rise of electric vehicles. The result is a widening gap between transport investment needs and actual financing.

Sustainable transport is not simply a cost, but rather a catalyst for inclusive, low-carbon and resilient growth. It unlocks access to jobs, markets, and services, and delivers long-term returns that far exceed initial investments. The challenge now is to mobilise the right mix of public, private and climate finance to close the gap and drive a just and sustainable transport transformation.

To address the challenges of sustainable transport financing, a multi-faceted approach is essential. Governments and stakeholders must diversify funding sources by blending public, private, and climate finance, while leveraging tools such as green bonds, carbon credits and land-value capture. Equitable allocation of climate finance is critical, with greater emphasis on grants and concessional funding for LMICs, especially for adaptation.

Strengthening institutional capacity and enabling sub-national access to finance can help unlock private investment. Public finance systems need reform, including phasing out fossil fuel subsidies and introducing sustainable revenue models such as road usage charges. Updating outdated investment classification systems will improve transparency and alignment with sustainability goals. Finally, integrating transport into national climate and development strategies, and prioritising inclusive, multi-modal systems, will ensure that investments not only reduce emissions but also enhance access, resilience and economic opportunity.

Transport investment needs

As the demand for transport grows, the scale of investment required to support global transport infrastructure is immense, with an estimated USD 50 trillion needed between 2015 and 2040 to meet rising demand across key sectors such as roads, railways, ports and airports.[11] By 2050, passenger and freight transport activity (measured in passenger-kilometres and freight tonne-kilometres, respectively) is projected to surge between 55% and 100%, compared to 2019 levels.[12] Higher demand for transport necessitates expanding and improving transport networks and infrastructure (including roads, railways, ports, airports and public transport systems) and enhancing efficiency (for example, through better logistics, efficient road allocation and demand management).

No single global estimate of transport investment needs is available; however, different sources have estimated investment needs by region, with varying numbers and wide ranges (Table 1).[13] **The most rapid transport growth is**

TABLE 1. Projections for transport investment needs by region

Region	Transport investment needs
Africa	An estimated USD 411 billion in transport infrastructure is needed by 2030 to fully realise the African Continental Free Trade Area (AfCFTA). Key investment needs that are critical to unlocking AfCFTA's full economic potential include: USD 4 billion for 135 vessels USD 25 billion for 243 aircraft USD 36 billion for 169,000 rail wagons USD 345 billion for over 2.2 million trucks.
Asia-Pacific	The region will need an estimated USD 43 trillion between 2020 and 2035 to develop, maintain and repair transport infrastructure – or around 2% of regional GDP. This includes: Roads: 63% of total investment (1.3% of GDP), driven by rising vehicle ownership and connectivity needs Railways: 17% (0.4% of GDP), including high-speed rail Urban transit: 11% (0.2% of GDP) Ports: 4% (0.1% of GDP) Airports: 5% (0.1% of GDP) Maintenance: roughly 24% of total transport spending.
Latin America and the Caribbean	To meet the targets of Sustainable Development Goals (SDGs) 9 and 11 by 2030, the region requires an estimated USD 548.3 billion for new transport infrastructure, with nearly 60% allocated to roads. An additional USD 427.8 billion is needed to maintain and replace existing road assets, bringing the total to around USD 976.1 billion. Port infrastructure alone will require USD 50 billion by 2030 to close existing gaps.
European Union (EU)	Achieving carbon neutrality in the EU's transport sector will require an estimated USD 780 billion (EUR 754 billion) annually to 2030, with 80% allocated to road transport, including passenger and freight services, as well as electric vehicle charging infrastructure. While transport needs the most investment in absolute terms, clean energy supply will require the largest relative increase (around 1.7 times the historical annual average) by 2030 to accelerate decarbonisation.

Source: See endnote 13 for this section.

anticipated in Asia – driven by increases in trade and travel between major emerging economies such as China and India – as well as in Europe and North America.[14] Transport forecasts remain uncertain, as they must account for both the expected and unforeseen effects of major macroeconomic shifts and their impact on global transport systems. In the wake of the COVID-19 pandemic, new challenges have emerged including the Russian Federation's invasion of Ukraine, tensions in the Middle East, supply chain disruptions, rising inflation and fears of a global trade conflict – further destabilising global markets. Despite this volatility, long-term transport demand is projected to rise, driven by economic growth.

Given the ambitious investment needs, different types of financing sources will be needed. Currently the two primary financing sources are the public and private sectors. Specific sources of funds include money for climate action, official development assistance from donors and development agencies, and issuances of green bonds in global capital markets.

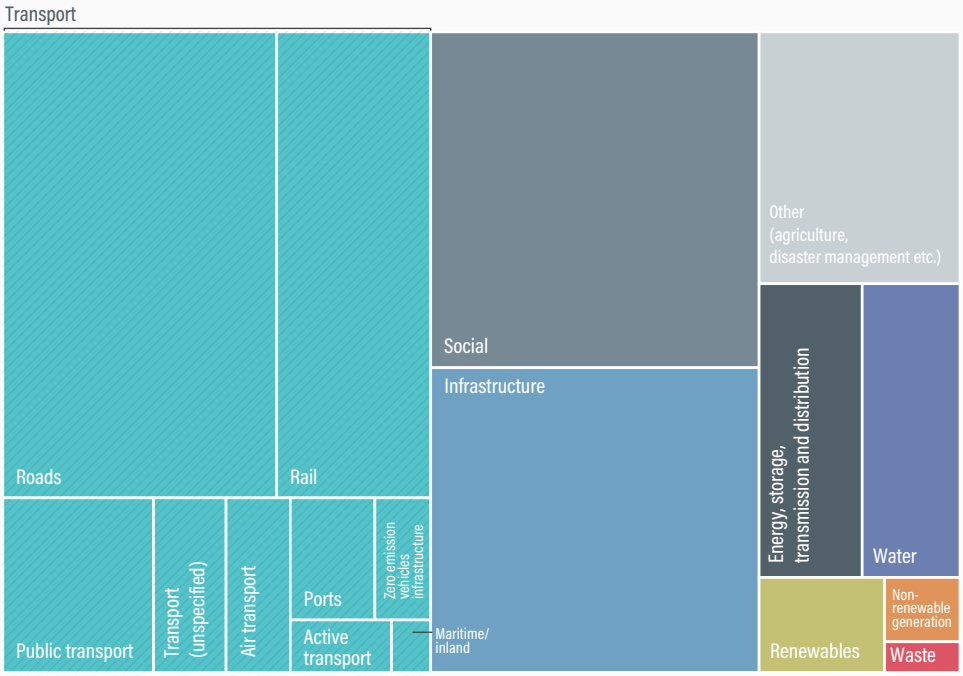
Financing and investment trends

In 2022, central governments in the Group of Twenty (G20) countries directed a substantial 42% of their total infrastructure investment to the transport sector (USD 416 billion, out of a total of USD 990 billion); this was more than double the share allocated to social infrastructure (17%) and roughly 2.5 times the combined investment in the energy, communications, and water and waste sectors (Figure 1).[15] The strong focus on transport was consistent across advanced and emerging G20 economies, where it received the largest share of central government infrastructure funding.[16]

The road sector continued to dominate investment in transport[i], driven by the central role of roads in enabling freight and passenger movement and supporting economic development. Efficient road transport infrastructure lowers transport and logistics costs for trucks, helping businesses access broader markets and operate more productively, ultimately driving jobs and economic growth. Well-developed

i Note that most finance is directed towards hard infrastructure, such as road infrastructure. The financing numbers in this report do not represent the usage and types of services that are dependent on road infrastructure.

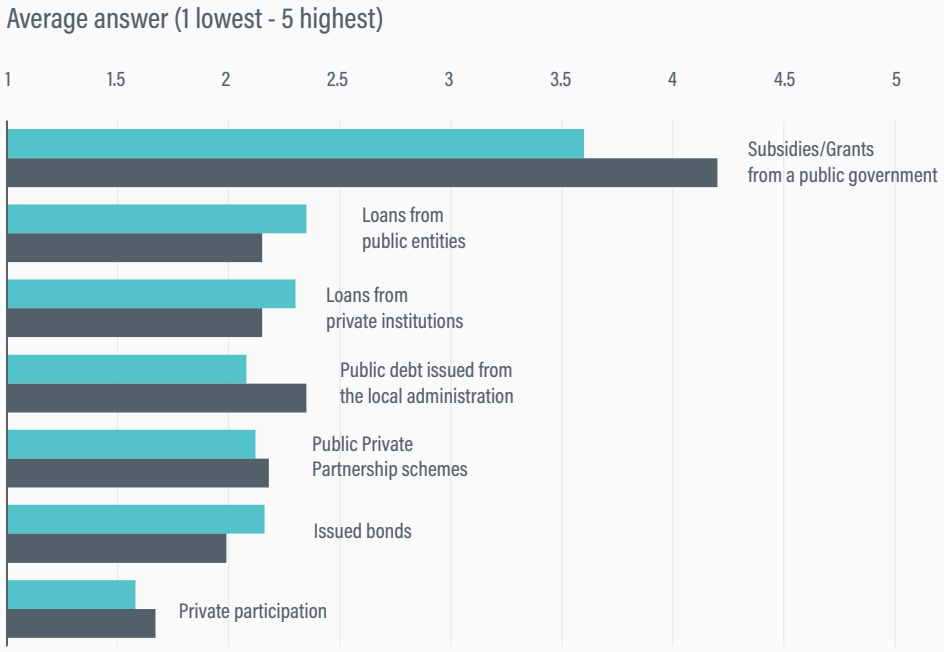
FIGURE 1. G20 investments (in USD millions) in transport compared to other sectors, 2022



In 2022, central governments in the G20 countries directed a substantial 42% of their total infrastructure investment to the transport sector (USD 416 billion, out of a total of USD 990 billion). This was more than double the share allocated to social infrastructure (17%) and roughly 2.5 times the combined investment in the energy, communications, and water and waste sectors.

Source: See endnote 15 for this section.

FIGURE 2. Survey of instruments used to finance public transport infrastructure projects, 2024



Private investment has remained an underutilised financing instrument, as indicated in a 2024 survey of public transport operators on transport infrastructure projects.

Source: See endnote 20 for this section.

roads connect rural and urban areas, ensuring equitable access to jobs and services, including education and health care. Improved connectivity reduces regional disparities and supports inclusive economic development. However, road transport is a major source of greenhouse gas emissions, contributing nearly three-quarters (74%) of global transport emissions in 2023.[17]

Transport has continued to rely heavily on public sector funding – primarily government subsidies and grants – for capital investments, with only limited private sector participation. Many national governments directly finance the construction of transport infrastructure, particularly for public transport (bus rapid transit, light rail and metro systems).[18] Funding from national governments typically cascades down through the state and local levels, with all tiers reporting some contribution to public transport funding. A survey of transport authorities found that public subsidies are the primary financing tool, whereas mechanisms such as private investment and bond issuance remain low priorities.[19]

Private investment has remained an underutilised financing instrument, as indicated in a 2024 survey of public transport operators on transport infrastructure projects (Figure 2).[20] **The use of carbon credit mechanisms in LMICs has been minimal, despite the potential of such schemes to unlock significant capital for low-emission transport projects.** Barriers include a lack of capacity to identify and design eligible projects, low market readiness, few institutional systems geared towards carbon financing and a limited presence of carbon markets in LMICs.

In 2023, total private participation in infrastructure across LMICs reached USD 86 billion, equivalent to just 0.2% of their combined GDP.[21] This was down slightly from USD 91.3 billion in 2022 but still exceeded the five-year average of USD 85.5 billion (2018-2022).[22]

Private investment in transport infrastructure hit a two-decade low in 2023, plummeting 76% to just USD 13.6 billion across 45 projects, or 69% below the five-year average (Figure 3).[23] This was the sector's lowest level in 20 years and reflected projects for ports (36% by investment USD in Brazil, Cabo Verde, Ecuador, Egypt, Ghana, India, Peru, Sri Lanka, Suriname and Tanzania), roads (33% in Brazil, China and India) and railways (23%).[24] The biggest investment project in 2023 was the USD 1.8 billion Metro Manila transit line 7 in the Philippines.[25]

Transport accounted for only 16% of total private participation in infrastructure investments in 2023.[26] **Despite the recovery of international travel, which led to a spike in transport investment in 2022, private participation in transport infrastructure investment in 2023 fell below even pandemic-era lows.**[27] Major contributors China and India, traditionally leading countries in road investments, both reported steep declines and the withdrawal of sub-national investments. The retreat of state-level investments reflects a contraction in fiscal affordability and private operators willing to take sub-national credit risk as public-private partnership (PPP) granting authorities.[28]

During 2020-2023, the road sector continued to dominate private sector investment in transport with a 59% share, while 15% of investment went to railways, 17% to airports and 9% to ports.[29] Projects mainly focused on building new roads, expanding capacity and improving maintenance.

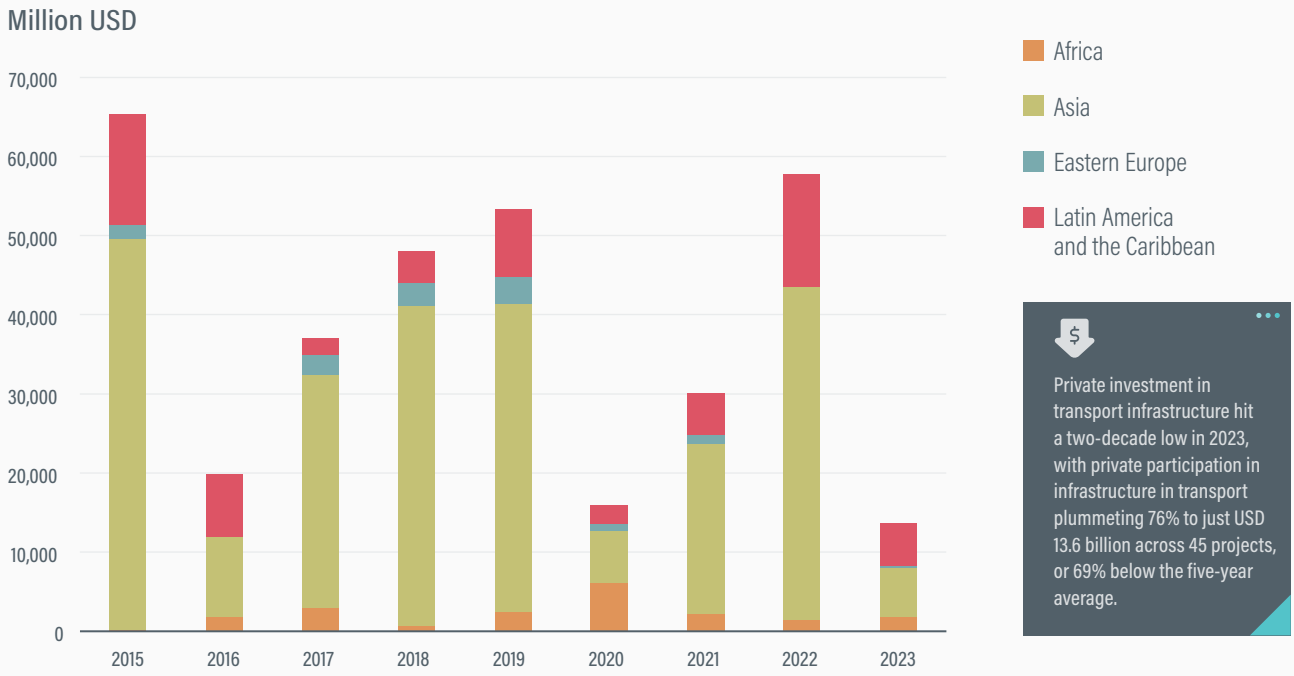
- Several highway upgrade (brownfield) PPPs were initiated in Brazil, with a few projects also in Colombia and Paraguay.[30]
- India concessioned several greenfield road projects, but at a lower volume than pre-pandemic.[31]
- In China and Vietnam, an uptick in greenfield build-operate-transfers for highways occurred in 2022.[32]

The gap is widening between needs and actual climate finance for transport. In 2023, the sector received around USD 545 billion from public and private sources for climate mitigation (Figure 4)**, seven times below the estimated USD 2.7 trillion needed annually by 2050 to align with global transport climate action targets.**[33] **Climate finance for adaptation also lags: in 2023, adaptation financing for transport totalled USD 1.8 billion, or only around 3% of the overall global adaptation financing of USD 65 billion.**[34] **Emerging economies require an estimated USD 222 billion per year between 2024 and 2030.**[35]

To stay on track, annual transport investment in LMICs (excluding China) must reach an estimated USD 575 billion by 2030.[36] **However, half of the USD 545 billion in transport-related climate finance in 2023 went to high-income countries, and the majority (77%) went to road transport followed by rail and public transport (23%).**[37] Overall, global climate finance in 2023 totalled USD 1.9 trillion, with 79% directed to East Asia and the Pacific, North America and Western Europe.[38]

LMICs received only a small portion of climate finance for transport in 2023, with 0.03% (USD 145 million) going to least developed countries and 4% (USD 22 billion) to emerging markets and developing economies (excluding China).[39] **Notably, the 10 countries most affected by climate change between 2000 and 2019 received less than USD 23 billion, or under 2% of the global total.**[40] Meeting climate targets in transport will require greatly scaling up climate finance for developing economies and leveraging these funds to attract additional investment.

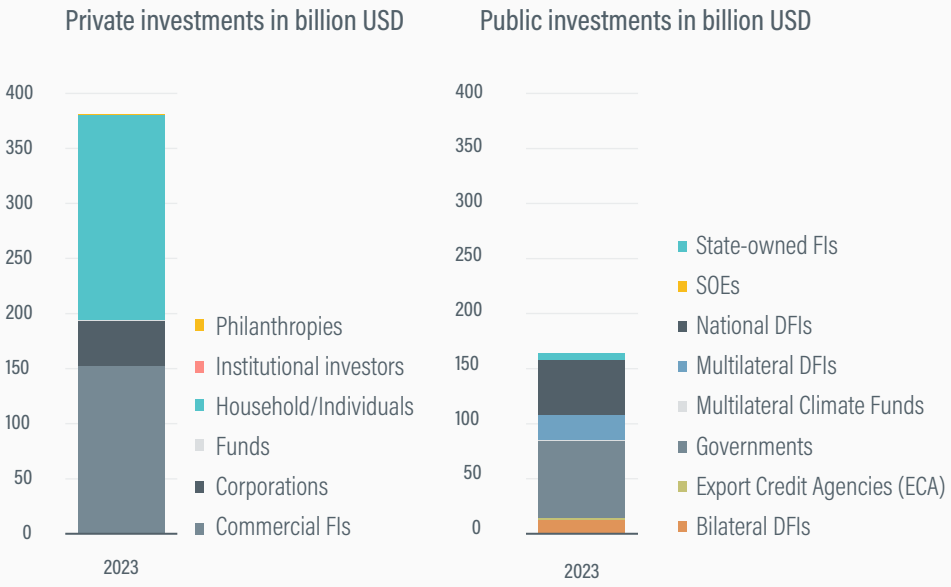
FIGURE 3. Private sector participation in transport infrastructure in low- and middle-income countries, 2015-2023



Private investment in transport infrastructure hit a two-decade low in 2023, with private participation in infrastructure in transport plummeting 76% to just USD 13.6 billion across 45 projects, or 69% below the five-year average.

Source: See endnote 23 for this section.

FIGURE 4. Climate finance for transport, by private and public sector, 2023



In 2023, the sector received around USD 545 billion from public and private sources for climate mitigation, seven times below the estimated USD 2.7 trillion needed annually by 2050 to align with global transport climate action targets.

Source: See endnote 33 for this section.

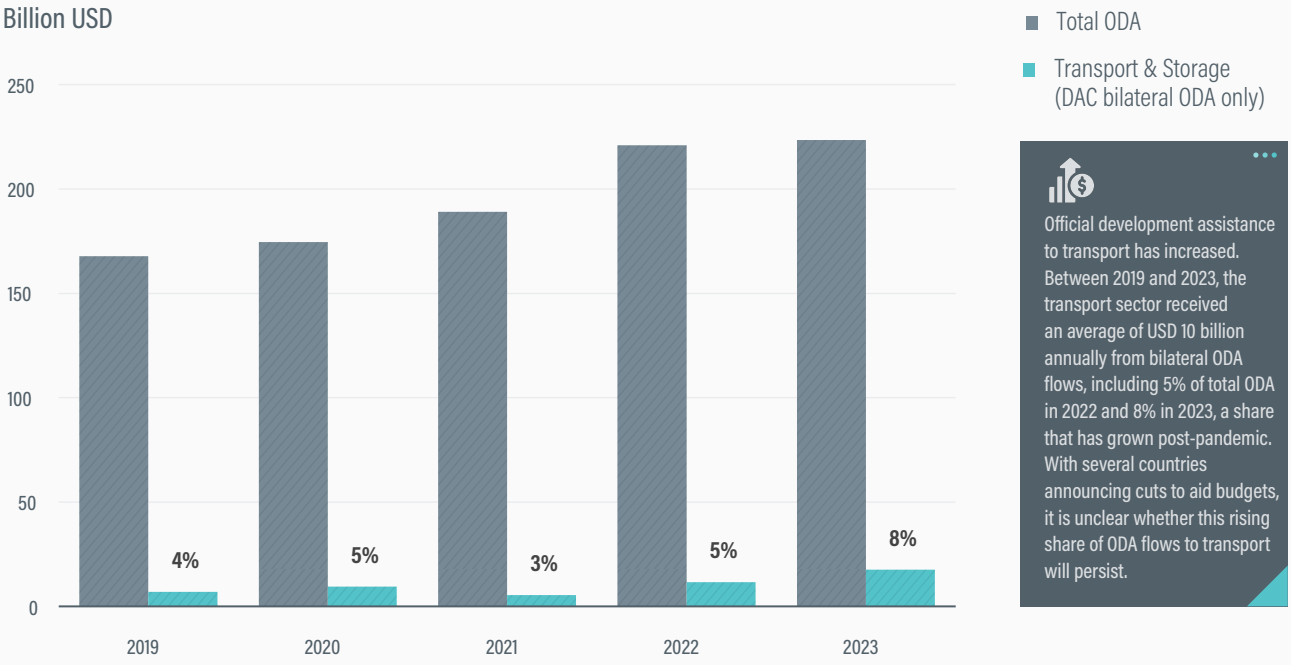
Against the backdrop of current climate finance flows to transport, the 2024 United Nations Climate Change Conference in Baku, Azerbaijan (COP 29) was a missed opportunity to set a new ambitious climate finance target and align it with sectoral needs, including for transport. High-income countries pledged to contribute USD 300 billion by 2035 to LMICs, starting in 2026.[41] In addition, all actors are supposed to scale up financing from public and private sources, amounting to at least USD 1.3 trillion per year by 2035.[42] Despite high-income countries tripling their climate finance commitments to LMICs (from the previous goal of USD 100 billion annually), the new climate finance goal, known formally as the New Collective Quantified Goal on Climate Finance, falls well short of meeting LMICs' calls for the trillions required. As a result, most of the financing agreed at COP 29 will rely on private investment and alternative sources, both of which carry uncertainties in realisation.[43]

The climate finance goal has also attracted criticism regarding its qualitative criteria. The new goal is not accompanied by minimum allocation floors for sub-groups of LMICs (such as small island developing states), nor does it set sub-targets for mitigation, adaptation, and loss and damage. Moreover, it provides no obligations to prioritise grants over loans, and no safeguards to preclude investments in fossil fuel infrastructure from being classified as "climate finance". This combination of factors brings little guarantee that the finance needed to transition to sustainable and low-carbon transport will be delivered at the speed required to meet the Paris Agreement targets and the SDGs.

Official development assistance to transport has increased.[44] Between 2019 and 2023, the transport sector received an average of USD 10 billion annually from bilateral ODA flows, including 5% of total ODA in 2022 and 8% in 2023, a share that has grown post-pandemic (Figure 5).[45] With several countries announcing cuts to aid budgets, it is unclear whether this rising share of ODA flows to transport will persist.

Road transport received the largest share of transport ODA between 2013 and 2022 (around 50%), followed by rail transport (30%) and transport policy (10%).[46] Japan was the largest donor of global transport ODA, contributing 51%, with funding directed mainly towards rail (50%) and road (33%).[47] The EU followed with 23%, and France with 9% (France allocated 63% of its transport ODA to rail).[48] Germany and the United Kingdom had a strong focus on transport policy, with the UK directing 47% of its transport ODA to this area.[49] Top recipients of transport ODA included India, the Philippines, other Asian countries and Egypt.[50] **Overall, the distribution of transport ODA to vulnerable groups such as least developed countries and small island developing states was broadly in line with total ODA patterns.**[51]

FIGURE 5. Share of bilateral overseas development assistance going to transport, 2019-2023



Source: See endnote 45 for this section.

There is a growing need to modernise ODA labelling codes and categories (green investments, for example, are currently allocated under road infrastructure). Because of the limited range of codes, the true nature of infrastructure and services needs in transport is not reflected in ODA data (Box 1).[52]

Box 1. Call to action to modernise the transport coding system

In the official development assistance (ODA) system, each sector is classified using specific reporting codes within the Creditor Reporting System (CRS) of the Organisation for Economic Co-operation and Development's (OECD) Development Assistance Committee (DAC). Notably, the "Transport and Storage" sector has a much simpler coding structure than sectors such as "Energy". Whereas the energy sector includes 27 detailed codes, distinguishing between renewable and non-renewable energy sources, transport is divided into just 7 sub-sectors: Road, Rail, Water, and Air Transport, along with Transport Policy, Transport Education and Training, and Storage.

This difference does not reflect funding levels, as both sectors receive comparable ODA. Rather, it highlights how transport codes have remained unchanged for decades, whereas energy codes have been revised multiple times to align with evolving priorities, particularly the SDGs and sustainable energy targets. **As a result, key transport themes - such as cycling, walking, public transport, electric buses, mobility access for women and the poor, and road safety - are not explicitly visible in the current creditor reporting framework. Although funding for these areas does exist, it is not clearly tracked or reflected in published statistics.**

By contrast, other global taxonomies focused on development, sustainability and climate finance have introduced more nuanced and modern classifications for transport, capturing these emerging priorities. This highlights a disconnect between the growing international focus on sustainable, inclusive transport systems and the outdated way that transport ODA is categorised and reported. Bridging this gap is essential to better align development co-operation with global climate and sustainability goals.

Source: See endnote 52 for this section.

Global issuance of sustainable bonds, including green and other thematic bonds, rose 8% in 2024 to USD 609 billion, up from USD 567 billion in 2023; however, transport-related bonds accounted for just 9% of total issuance, or USD 57 billion (Figure 6).[53] The growth in sustainable bond issuance was driven mainly by investments in energy, transport, information and communications technology, waste and industry.

Growth in transport-related bond issuance has remained modest compared to the transport sector's potential. Infrastructure assets in the sector are expected to become increasingly attractive due to predictable cash flows and reasonable returns.[54] However, the key challenge for most LMICs is the insufficient creditworthiness of cities, which limits their ability to issue bonds themselves and is often compounded by national governments not allowing sub-national governments to issue bonds.[55] Urban transport operators and certain governments (not only in high-income countries) are ranked among the Top 10 Certified Issuers of green bonds.[56]

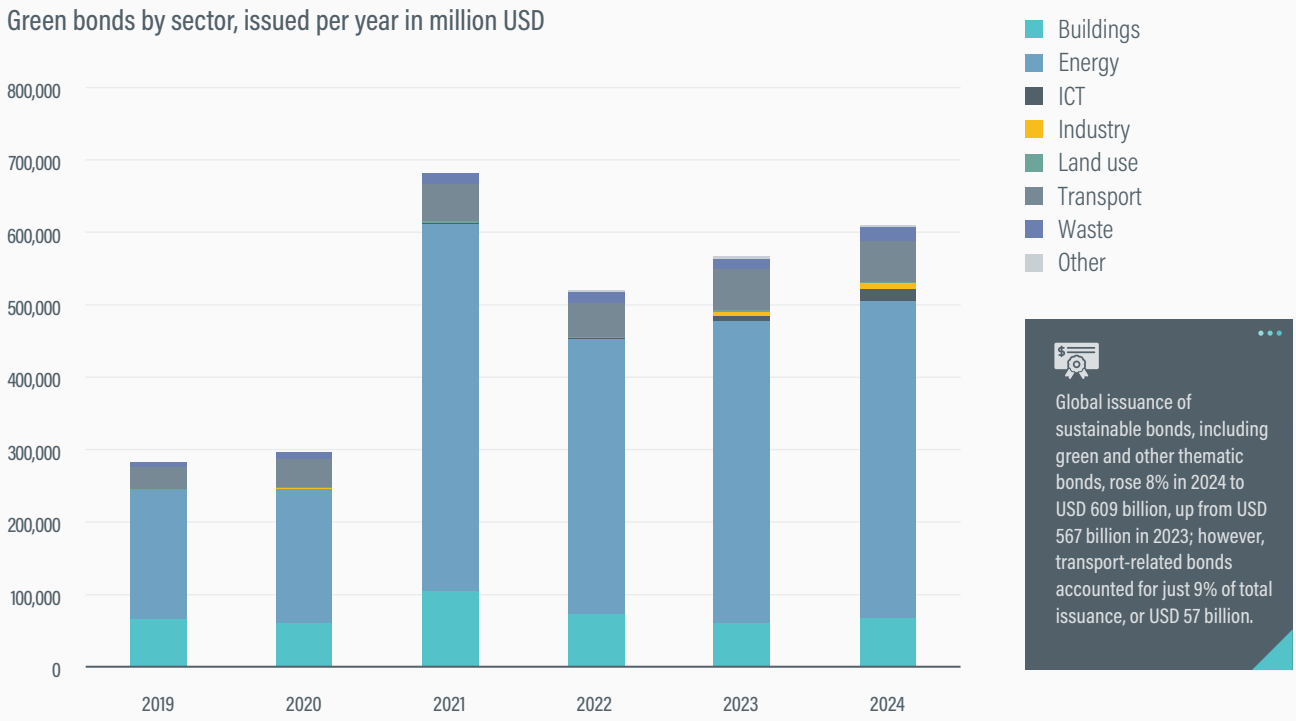
- As of mid-2025, Top 10 Certified Issuers of green bonds included the New York Metropolitan Transit Authority and the Republic of Chile, which issued several bonds targeting low-carbon transport in recent years.[57]
- Only a few cities in emerging economies (such as in Indonesia, Mexico and South Africa) have been able to issue green bonds themselves. Most green bonds were issued by development finance institutions including the World Bank and the Asian Development Bank.[58]

Diversification of revenue sources - such as through real estate development, advertising and regional transport taxes - increases the financial sustainability of public transport agencies.[59] Public transport operators have traditionally relied on customer fares to cover a portion of operating costs; however, farebox coverage has remained low across most regions, commonly in the ranges of 31-40% and 41-50%, based on a 2024 survey (Figure 7).[60] The highest farebox coverage rates were reported in Europe, the Middle East and North Africa, and Latin America, although a large share of public transport operators and transport authorities did not know or were still assessing their coverage rates.[61] Different definitions of farebox coverage and its funding structures result in large variations in reporting.

In cities that require employers to offer commuter benefits to employees, various options are available to fund these benefits. They include:

- **Pre-tax payroll deductions** – employees set aside a portion of their income pre-tax to pay for commuting expenses, saving on taxes, while employers also benefit from reduced payroll taxes.
- **Employer-paid direct benefits** – employers directly provide employees with transit passes or subsidies, which are generally tax-free for both the employer and employee up to certain limits.
- **Subsidies and reimbursements** – programmes such as the FareShare programme in Montgomery County, Maryland (United States) reimburse employers for a significant portion of employee commuting costs.[62]
- **Combination** – employers combine pre-tax deductions

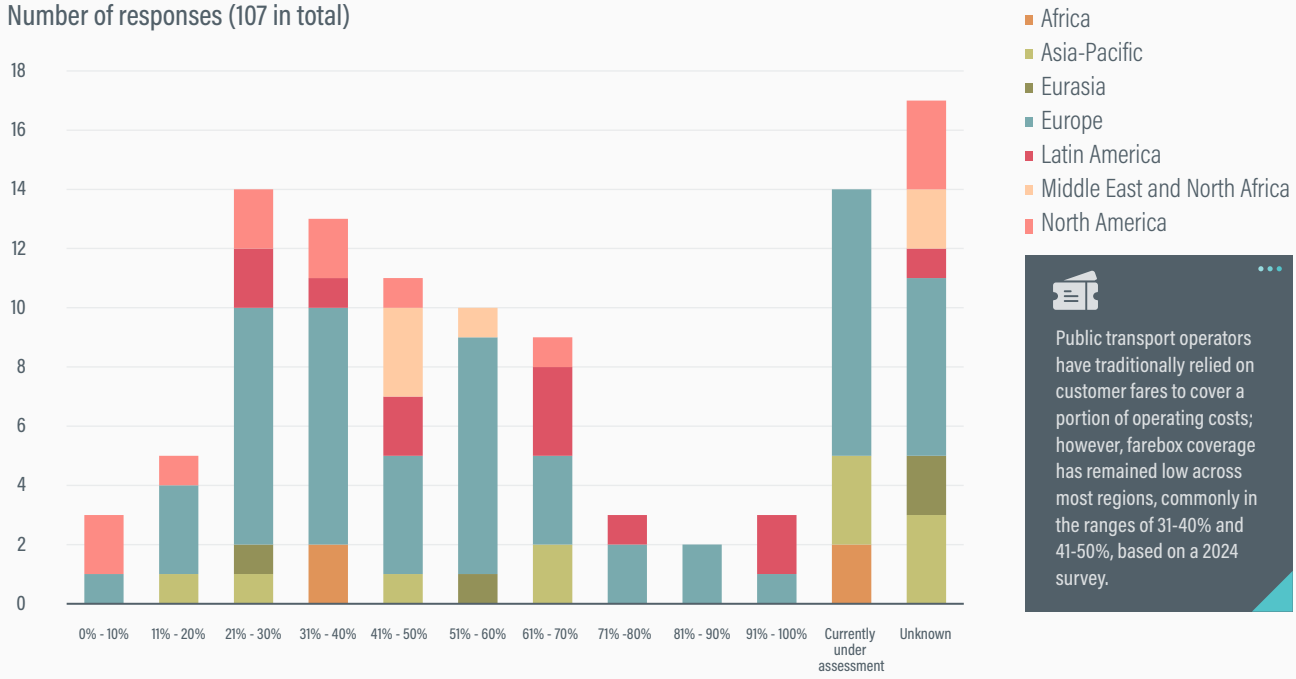
FIGURE 6. Sustainable bond issuance by sector, 2019-2024



Global issuance of sustainable bonds, including green and other thematic bonds, rose 8% in 2024 to USD 609 billion, up from USD 567 billion in 2023; however, transport-related bonds accounted for just 9% of total issuance, or USD 57 billion.

Source: See endnote 53 for this section.

FIGURE 7. Reported farebox coverage rates by region, 2024



Public transport operators have traditionally relied on customer fares to cover a portion of operating costs; however, farebox coverage has remained low across most regions, commonly in the ranges of 31-40% and 41-50%, based on a 2024 survey.

with employer contributions to maximise employee savings.

Non-fare revenues, which are generated through commercial or ancillary activities within public transport networks, have become an increasingly important component of financial sustainability. Newer funding mechanisms include levies on car use, freight, deliveries and property-related charges from land-value capture. Common non-fare activities include advertising, retail and in-station sales, real estate and land development, earmarked taxes and levies, and other commercial ventures such as special transport services for events or businesses. Overall, for public transport, a strong focus remains on identifying new market opportunities, increasing fare revenues, expanding digital services, and developing alternative funding sources.

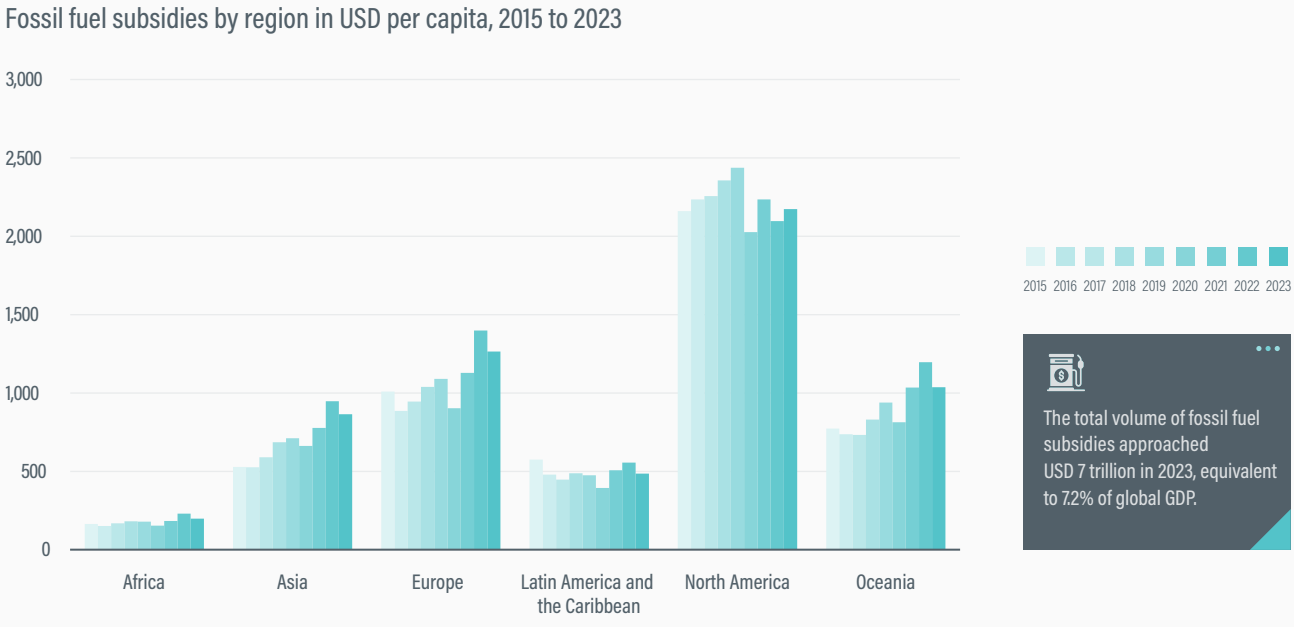
The COVID-19 pandemic prompted transport agencies worldwide to reconsider their revenue sources and fare policies, with some offering fare-free services.[63] Advocates of fare-free transit argue that eliminating fares repositions public transport from a market commodity to a public good, thereby addressing social exclusion and inequality. However, critics raise concerns about potential deterioration of service quality due to funding shortages for operations and maintenance. They suggest that targeted policies – such as subsidies for specific populations (e.g., students, elderly, etc.) – may be more sustainable than blanket fare-free systems, since transport infrastructure requires funding regardless of the fare structure. Ultimately, effective fare policies must balance access, sustainability and financial viability within broader integrated transport strategies.[64] (See 4.5 Public Transport.)

In 2023, implicit and explicit subsidies for fossil fuels totalled around USD 7 trillion, equal to 7.2% of global GDP; per capita subsidies ranged from USD 198 in Africa to USD 2,172 in North America (Figure 8).[65]

Fuel excise taxes are a vital source of government revenue and are often used to fund road infrastructure; however, the current taxation model is unsustainable in an electrified future. In 2023, electric vehicles displaced nearly USD 12 billion in global fuel tax revenues, while generating only USD 2 billion through electricity taxes – a net loss of USD 10 billion.[66] **Even though China led the world in electric vehicle uptake in past years, 60% of fuel revenue losses were in Europe, where petrol and diesel taxes were much higher.**[67] The petrol tax rate in France, Germany and Italy is more than six times that in China.[68] Overall, electric vehicles are taxed less per kilometre than internal combustion engine vehicles. The loss of fuel tax revenue could further limit the availability of state and local funds for public transport.

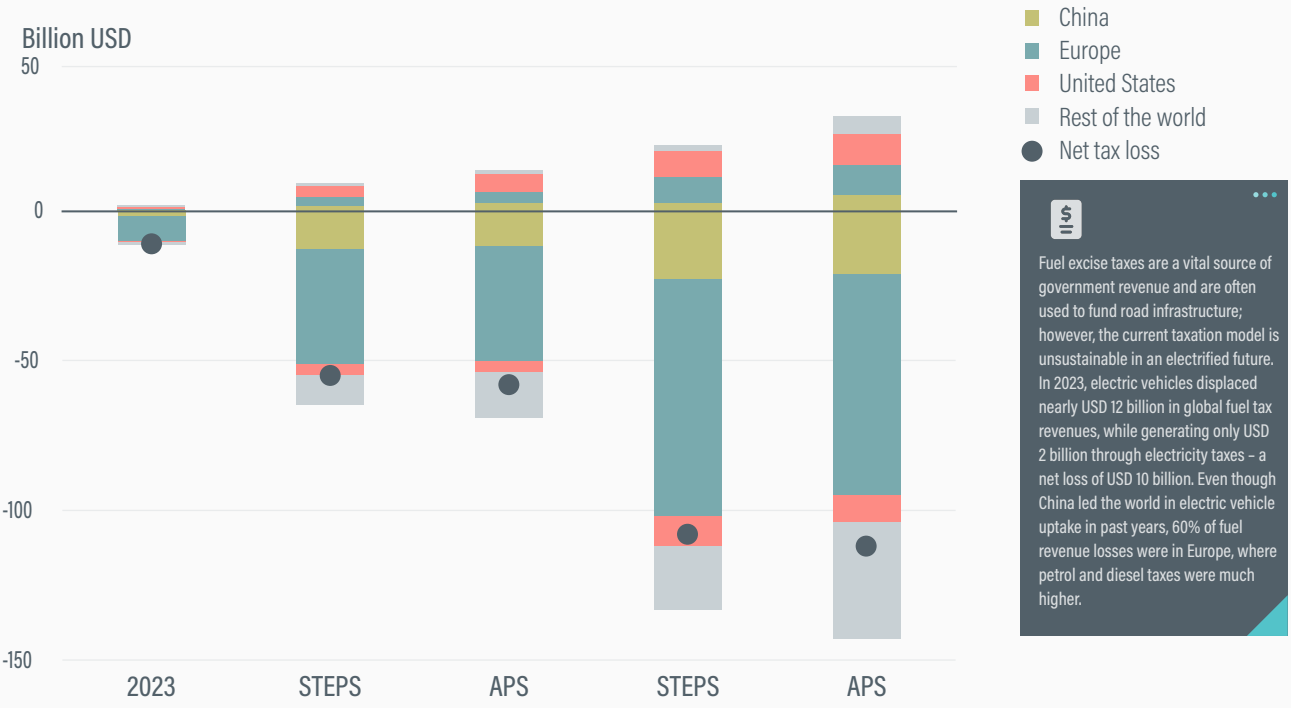
This trend is expected to intensify, with net fuel tax losses projected to grow more than five-fold, based on International Energy Agency projections for electric vehicle

FIGURE 8. Per capita fossil fuel subsidies by region, 2015-2023



Source: See endnote 65 for this section.

FIGURE 9. Net tax implications of electric vehicle adoption based on International Energy Agency policy scenarios, 2023-2035



Source: See endnote 69 for this section.

adoption (Figure 9).[69] By 2030, the global electric vehicle stock (including two- and three-wheelers) is expected to reach 460 million under the States Policies Scenario (STEPS) and nearly 500 million under the Announced Pledges Scenario (APS).[70] By 2035, fuel tax losses could total USD 105 billion in the STEPS and USD 110 billion in the APS, doubling the shortfall from 2030 as road transport electrification gains momentum.[71] In the STEPS scenario, fuel tax revenue losses by 2035 approach USD 70 billion in Europe and USD 17 billion in China, while remaining under USD 300 million in the United States due to low federal taxation of petrol and diesel (although greater impacts could be seen at the state level).[72]

Way forward

Funding is considered critical to making public sector investments viable; for instance, the use of capital grants reduces the upfront financing cost of an infrastructure asset or the operational costs of running a metro system or buses, or building an airport. However, funding often conceals the actual cost of building and operating a transport asset such as a road, port or railway. For example, fossil fuel subsidies that provide money to transport public works, service companies, concessionaires and users artificially reduce the real cost of owning a mode of transport such as a truck, airplane or ship.

Governments need to find alternative ways to fund transport services, instead of relying on direct funding to transport agencies. Government funding typically provides money for a specific purpose, often without requiring repayment (such as through grants, subsidies, donations and other forms of public support). In contrast, financing involves borrowing or lending money, typically with a requirement for repayment and interest.

The way forward for sustainable transport financing requires major rebalancing action to reduce the massive gap between current financial flows and the USD 50 trillion investment needed by 2040.[73] However, there are key challenges in implementing this. They include:

- **Constrained public budgets:** Many governments, especially in LMICs, face limited fiscal space due to high debt burdens and competing development priorities. This restricts their ability to fund large-scale transport infrastructure or to provide subsidies for sustainable transport services.
- **Under-utilisation of private capital:** Despite the growing need, private investment in transport hit a two-decade low in 2023, with only 16% of total private participation

in infrastructure investment going to transport.[74] Barriers include perceived risks, lack of bankable projects and limited creditworthiness of national and sub-national entities.

- **Inequitable climate finance flows:** Climate finance for transport is heavily skewed towards high-income countries. LMICs, particularly the most climate vulnerable, receive a disproportionately small share of both mitigation and adaptation finance, exacerbating the investment gap.
- **High upfront costs and long payback periods:** Sustainable transport solutions such as electric mobility, rail systems and multi-modal infrastructure require significant upfront investment and have long return horizons, making them less attractive to private investors without public support or guarantees.
- **Weak institutional capacity:** Many LMICs lack the technical, financial and institutional capacity to design, implement and manage complex transport projects or to access climate finance effectively.
- **Outdated funding and reporting systems:** The current classification systems for ODA and other funding streams do not adequately reflect modern transport priorities such as cycling, walking, and electric mobility, making it difficult to track and allocate resources effectively.
- **Revenue loss from electrification:** As electric vehicles replace internal combustion engine vehicles, governments are losing fuel tax revenues, a key source of transport funding. This creates a growing fiscal gap that is not yet offset by electricity taxes or alternative mechanisms.
- **Policy and regulatory gaps:** Many countries have no clear policies or incentives to support sustainable transport investment, such as enabling transport-based bond issuance, implementing transition clean transport pricing and reforming fossil fuel subsidies.
- **Lack of adaptation focus:** While decarbonisation receives attention, financing for the adaptation of transport infrastructure remains minimal, despite growing climate risks and damages, particularly in LMICs.

The way forward will require significant action in several key areas:

- **Governments must prioritise subsidising sustainable transport instead of fossil fuels. Fossil fuel subsidies still exceed most forms of climate-aligned transport finance.** Structural shifts are needed to mobilise adequate levels of funding and financing for multi-modal infrastructure and services in both passenger and freight transport that strengthen efficient and low-carbon solutions.
- **Climate finance for transport must be scaled up significantly – with a greater share directed to LMICs, especially for adaptation – and structured to prioritise concessional lending and grants over market rate loans. As the global community works on the Baku to Belém Roadmap for 1.3T, which aims to mobilise USD 1.3 trillion in climate finance for LMICs annually by 2035, investing in sustainable transport must be part of the solution.**[75] The climate finance decisions taken today will shape transport infrastructure and systems for decades.
- **Mobilising private capital is essential.** This requires improving the creditworthiness of LMIC governments and cities, enabling bond issuance, and expanding the use of green bonds and carbon markets.
- **Public finance mechanisms need modernisation** through tools such as land-value capture, congestion pricing and reform of fossil fuel subsidies.
- **Updating outdated transport investment taxonomies is important** to better track and align funding with sustainability goals.
- **Institutional capacity building, especially in LMICs, is critical** to designing bankable projects and attracting investment.
- **As electric vehicles reduce fuel tax revenues, governments must explore alternative revenue models** such as road usage charges and electricity taxation.
- **Transport investments must be fully integrated into both national climate change mitigation and adaptation strategies and national development strategies.**



PARTNERSHIPS IN ACTION

Globally, many multi-stakeholder transport initiatives are focused on reducing the environmental impact of transport by promoting eco-friendly modes, adapting to changing demographics and rising transport demand, creating resilience to socio-environment changes and reducing reliance on fossil fuels. Measures include encouraging the use of public transport, cycling and walking, and electric vehicles, as well as supporting the development of sustainable infrastructure such as energy storage, green fuels and charging stations for road, rail, air and marine transport. Many partnerships are mobilising philanthropic capital, grants and donations, and concessional financing from impact investors.

- In April 2023, the **Climate Bonds Initiative** updated its criteria for land transport to version 2.2, which can be used to certify use-of-proceeds instruments, sustainability-linked debt instruments, assets and entities related to land transport activities and assets.[76]
- The **European Investment Bank** (EIB) is using its future mobility financing platforms to champion investments in green, innovative mobility around the world. Using innovative financing tools such as intermediate loans, guarantees, and venture debt, it is helping companies access affordable funding, secure competitive pricing and attract investors. The EIB also empowers entrepreneurs to bring their ideas to market and compete globally through initiatives such as Future Mobility, InnovFin, and InvestEU, all backed by the European Commission. Through its investments, the EIB is accelerating the green and digital transformation of the transport sector.
- The **Grow Cycling Toolkit** developed by the **Institute for Transportation and Development Policy** offers practical steps to tackle immediate investment barriers to cycling, while laying the foundation for long-term cycling growth.[77] By helping cities prioritise the most effective funding actions now, it supports a shift away from car dependency, leading to cleaner air, reduced congestion and more liveable streets. The toolkit supports scenario building for both high-income countries and LMICs and provides links to useful resources for urban planners and investment modellers.
- The **LEAP Fund** (**Leapfrogging to E-mobility Acceleration Partnership**) is an effort from Climateworks' Drive Electric Campaign to support low-carbon transitions and avoid the lock-in of fossil fuel vehicles by investing in "leapfrogging" to electric transport technology.[78] Under the fund's first phase, 10 projects in Africa, Latin America and South-East Asia received a total of USD 1 million in grant funding.[79]
- The urban mobility workstream of the **World Resources Institute's** (**WRI**) **Ross Center for Sustainable Cities** promotes high-quality, integrated public transport systems such as bus rapid transit, urban buses, informal transport, micromobility and autonomous vehicles.[80] The programme encourages shifts to cycling, walking and public spaces that safely accommodate these modes. By helping cities navigate the transition to cleaner-burning fuels and electric vehicles, WRI accelerates transformative urban initiatives that turn cities into resilient, inclusive, low-carbon places that are good for people and the planet.
- Supported by the **Mitigation Action Facility**, WRI is working with the government of Kenya and the **Africa Guarantee Fund** to expand Kenya's electric vehicle sector through industrial growth, workforce upskilling and reskilling, charging infrastructure, public awareness of opportunities and benefits, and greater accessibility for purchasers.[81] The project focuses on increasing the uptake of electric two- and three-wheelers in peri-urban and rural areas, with the goal of propelling the market towards critical mass to support further market-driven transformation of the sector.

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SPOTLIGHT



Evolving the Economic Appraisals for Land Transport Investments

This spotlight is an excerpt from the paper Evolving the Economic Appraisals for Land Transport Investments, developed by SLOCAT and the Transformative Urban Mobility Initiative (TUMI), in collaboration with the European Cyclists' Federation (ECF), the International Institute for Sustainable Development (IISD), the MobiliseYourCity Partnership and Walk21.

Economic appraisals: An important piece of the economics and investments for transforming transport

Despite recent progress, the use of standardised, comprehensive sustainability criteria in transport investment appraisals remains far from the norm, compared to conventional methods. A more integrated approach is needed – one that captures additional impacts and outcomes, along with the broader economic, social and environmental synergies emerging from public transport, walking and cycling.

Economic appraisals are only one part of the broader landscape of transport investment challenges. Yet evolving them is essential to redirecting and scaling up investments towards transport systems and services that are socially inclusive, economically viable, environmentally responsible and resilient. Too often, current mechanisms work against this transition – for example, fossil fuel subsidies, tax-free fuel for high-polluting transport modes, externalised costs and "free" parking. Meanwhile, investments in sustainable, low-carbon transport remain insufficient across international finance institutions, governments and the private sector. Scaling up will require improvements in institutional frameworks, project preparation and financing, implementation and evaluation.[1]

Institutional frameworks must account for social and environmental impacts – both positive and negative – within economic appraisals to avoid short-term, one-sided decision making. This broader lens will build the evidence base needed for political decisions to redirect funding towards solutions that have the highest social and environmental returns. Greater investment in sustainable transport will improve infrastructure efficiency, lower user costs, and enhance equity in access to mobility and economic opportunity. It will also generate wider societal benefits such as improved air quality and environmental outcomes – enhancing value for money for both public and private investment.

A collaborative, multi-level approach to planning and implementation is critical. Co-ordinated strategies ensure integration across local, regional and national actors in delivering comprehensive transport solutions.

Issues with conventional economic appraisals for land transport

ISSUE 1

Narrow scope of the methods used for the quantitative analysis

The methods currently being used to inform investment decisions in transport remain narrowly focused. They primarily consider: 1) capital and operations and maintenance costs, and 2) performance indicators of the transport infrastructure (e.g., ridership, revenue generation).[2] However, investments in sustainable, low-carbon infrastructure for land transport generate much broader benefits – by enhancing connectivity and access to services. These benefits are typically undervalued in quantitative assessments.

To fully capture the direct, indirect, and induced benefits of sustainable transport, broader indicators are needed that enable greater recognition of its societal and economic value.[3] This includes capturing indirect and induced impacts, such as increased income through better employment opportunities.[4]

ISSUE 2

Disconnect between the investor and beneficiaries

Sustainable infrastructure often does not generate enough benefits for a single investor, although it generates considerable benefits for society as a whole.[5] Investments in infrastructure (especially public infrastructure) are typically centralised and made by a single organisation or entity. However, the benefits of sustainable infrastructure, including for transport, are often shared among many beneficiaries.[6]

The key is to develop planning and financing strategies involving multiple beneficiaries of the investment, beyond the direct beneficiaries and transport actors. This may require co-ordinated policy frameworks, actions and cross-sectoral performance indicators to embed and monetise shared benefits. Transport planners and investors should look beyond direct beneficiaries and engage stakeholders from sectors such as health, equity and employment. Joint planning and co-ordinated responsibility – via a high-level strategy or framework – can help ensure that these broader benefits are reflected in transport investment assessments.



ISSUE 3

Absent or limited economic valuation of so-called intangible benefits

Many benefits are labelled "intangible" simply because they have not been measured – and thus are not valued by the system. This can be due to data gaps – which are more pronounced in low- and middle-income countries – or to measurement methods that bias outcomes. For example, prioritising distance and travel time often undervalues walking compared to other transport modes.

Moreover, many of the benefits of investing in sustainable, low-carbon transport infrastructure do not generate direct cash flows, despite achieving other desirable goals.[7] For example, expanding public transport or electrifying it with renewable energy cuts emissions and air pollution. This leads to better air quality, which reduces respiratory illnesses, lowers healthcare costs and minimises income loss, especially in polluted urban areas. While these avoided costs benefit society, they do not represent direct cash transfers unless policies are introduced to put a price on emissions and air pollution.[8]

Expanding the analysis to quantify and value such broader sustainability outcomes allows their full impact to be assessed (see Box 1). **This supports better policy and investment decisions, reduces project risks and strengthens the case for integrating public transport, walking and cycling.** For example, showing economic gains from improved health and productivity can justify greater investment in sustainable, low-carbon transport.

Box 1. Economic, environmental and social benefits related to public transport, walking and cycling

- Reduction in average household expenditure in transport, as a result of the avoided costs associated with car ownership such as purchase price, maintenance, fuel, parking and insurance.
- Time savings from avoided or reduced traffic congestion and increased economic productivity.
- Improved air quality and reduced noise pollution.
- Reduction in greenhouse gas emissions.
- Improved health through more physical activity, better air quality, less noise pollution, and fewer road deaths and injuries.
- Improved access for people with disabilities through inclusive design.
- Higher perception of individual safety in public spaces for women and girls and vulnerable groups.
- Savings for governments from reduced car infrastructure and fossil fuel subsidies.
- Higher property values and municipal revenues due to increased gains from property taxes and value capture. The risks of gentrification and displacement must be addressed.
- Improved use of public space and less soil sealing.

Source: See endnote 9 for this section.

ISSUE 4

Limited systemic vision and integration of knowledge across different stakeholder groups

The challenges above underscore the need for more systemic and integrated approaches, although achieving this in practice is not easy. Integrating knowledge allows for identifying, quantifying and assessing the mutually reinforcing benefits of combined walking, cycling and public transport solutions.

A truly systemic approach requires input from diverse stakeholders, including experts, local actors and decision makers across fields such as engineering, planning, infrastructure and economics – each bringing different priorities and visions. In such multi-stakeholder settings, it can be difficult to share information effectively, interpret it objectively and focus on optimising the system as a whole rather than improving individual components.

Working at the systems level often means setting aside the goals of individual parts to achieve better overall outcomes. This demands inclusive, transparent, and participatory multi-stakeholder engagement, supported by a strong, ambitious vision and political commitment, ideally led by the highest levels of government. Such vision can unite diverse actors, challenge status quo biases in data and perceptions, and drive the integration of walking, cycling, and public transport into sustainable, low-carbon transport strategies.

The robust economic case for investing in public transport, walking and cycling

The economic case for public transport, walking and cycling has been well verified through scientific research and is visible in many practical case studies.[9] Economic appraisals based on broad sustainability criteria demonstrate how public transport, walking and cycling offer a high return on investments.

Much of the literature focuses on active mobility, combining efforts on cycling and walking. The benefit-cost ratio resulting from appraising active mobility with sustainability criteria ranges from 1.3 up to 19 for every US dollar invested, with health benefits being central (Table 1).[10]

TABLE 1. Economic case for investments in public transport, walking and cycling solutions

Transport mode	Return on investment range	Benefits most often evoked
Public transport	Every USD 1 invested returns USD 5	Avoided CO_2 emissions Mexico City bus rapid transit saves 26,000 tonnes per year.
Cycling	Every USD 1 invested returns between USD 2 and USD 19	Health benefits Estimated annual value of USD 80 billion in Europe. Patna (India) saves an estimated USD 166 million per year and averts 755 premature deaths per year. Fuel cost savings
Walking	Every USD 1 invested returns between USD 1.3 and USD 20	Longer and healthier lives Job creation Walking projects create on average 9.9 jobs per USD 1 million invested. Transport cost savings People walking to city centres spend on average 40% more than those arriving by car.
Active mobility (combined walking and cycling)	Every USD 1 invested returns between USD 1.3 and USD 19	Job creation Cycling projects generate on average 11.4 jobs per USD 1 million invested. Health benefits Interventions in London (United Kingdom) of USD 105 million investment would generate USD 950 million in health benefits after 20 years. Avoided costs of crashes Addis Ababa (Ethiopia) projects 80% fewer pedestrian and cyclist fatalities once the non-motorised transport strategy is implemented.
Integrated public transport, walking and cycling	Every USD 1 invested returns between USD 1.1 and USD 4.5	Improved access Congestion relief Safety benefits An urban transport improvement project in Tianjin (China) reduced crashes involving cyclists or pedestrians by 8%.

Source: See endnote 10 for this section.



Fewer studies focus on the economic case for integrated public transport, walking and cycling solutions. Such integrated approaches deliver a benefit-cost ratio of 1.1 to 4.5 for every US dollar invested, based on several projects in Argentina, China, Peru, Tanzania and the United Kingdom. The identified benefits include improved accessibility, congestion relief and localised safety benefits.[11]

Four recommendations to evolve conventional economic appraisals for land transport

RECOMMENDATION 1

Establish suitable policy and institutional frameworks

Policy and institutional changes can create an enabling environment for investments in sustainable, low-carbon transport. Sending the right policy and institutional signals and adopting phased implementation mechanisms from the short to the long term will incentivise transport economists to embed in their economic appraisals the appropriate sustainability criteria (see Recommendation 4). This will lead to the development and wide adoption of standardised, comprehensive and integrated economic appraisals and tools (Recommendation 2).

Efforts should focus on achieving a systemic and ambitious guiding vision – preferably established by national governments – that can galvanise multi-stakeholder action. Raising awareness among decision makers of systemic and integrated frameworks for sustainable, low-carbon land transport is key. While these frameworks should be based on best practices, it is essential to customise them to the local context.[12] For example, the Avoid-Shift-Improve Framework[i] can offer a structured approach to reducing carbon-intensive transport activities and their inducers, as well as to integrating public transport, walking and cycling solutions.[13] Applying such frameworks consistently across planning, financing and procurement can help phase out fossil fuel subsidies and align financial mechanisms – such as taxes, costs and prices – to support integrated public transport, walking and cycling.[14]

Experts from different fields, government departments and levels of government should contribute their respective priorities (e.g., health, welfare, job creation, equity, etc.) to the systemic, integrated vision for sustainable, low-carbon land transport. This, in turn, will support the development of more robust sustainability criteria (Recommendation 4).

RECOMMENDATION 2

Standardise comprehensive and integrated economic appraisal approaches and tools

It is recommended to standardise the approach and tools used for integrating broad sustainability criteria in an economic appraisal, beyond conventional approaches. This can be achieved by: 1) defining challenges, 2) identifying opportunities and 3) determining social, economic, and environmental outcomes, for different stakeholders over time. Examples and guidance materials are presented in Box 2.

i The Avoid-Shift-Improve framework has been central to sustainable, low-carbon transport for more than a decade and it follows an implicit hierarchy, with appropriate and context-sensitive Avoid measures (that avoid and reduce the need for motorised travel) intended to be implemented first, followed by Shift measures (that shift to more sustainable modes) and finally by Improve measures (that improve transport modes). More information is available at https://slocat.net/asi/.
Original source: H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport - A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf

Box 2. Illustrative example of how to evolve conventional economic appraisals

- **Focus on people and goods instead of vehicles.**
- **Focus on the transport system instead of on infrastructure**.

To respond to the Avoid-Shift-Improve Framework, the set of indicators used in economic appraisals for land transport projects needs to capture, where relevant, aspects such as the following:

Indicators to measure *Avoid*

- Improvements in proximity planning:
  - Urban population density (people per square kilometre)
  - Distance to services
- Impact on transport demand: passenger-kilometre, tonne-kilometre, vehicle-kilometre
- Changes in motorisation: vehicle ownership rates
- Walking and cycling activity: distance and time spent walking and/or cycling
- Improvements of access to opportunities (via catchment areas or travel time): access to markets, education and jobs, employment opportunities directly through the project

Indicators to measure *Shift*

- Impacts on modal split:
  - % of trips by collective transport, walking and cycling
  - % of goods transported by rail or waterways
- Access to public transport and active mobility: % of population that has convenient access to public transport and to safe and convenient walking and cycling infrastructure
- Travel time changes: average time of travel per day
- Attractiveness of collective transport:
  - Number of people transported
  - % of women feeling safe using collective transport
  - % of vehicle fleet/stops and stations that are accessible to people with disabilities
- Impacts on costs:
  - Changes in transport expenses for households
  - Changes in the freight transport costs for operators
- Access to all-weather roads in rural areas: % of the rural population who live within 2 kilometres of an all-season road

Indicators to measure *Improve*

- Uptake of fleet electrification: % of fleet that is/can be electrified
- Improvements in efficiency:
  - People and goods transported on corridor per hour
  - Fleet energy consumption in megajoules per kilometre
- Renewable energy uptake:
  - % of energy provided through renewable electricity
  - Volume of advanced biofuels
- Road safety-focused infrastructure and service improvements: number of traffic fatalities and injuries compared to exposure (volume of different mobility modes)

Additional overarching indicators

- Avoided fuel use: barrels of oil avoided
- Greenhouse gas emissions avoided or reduced: absolute emissions in tonnes of CO2-equivalent and well-to-wheel transport emissions in grams of CO2 per kilometre
- Improvements to air quality: particulate matter (PM10 and PM2.5) pollution levels
- Improvements in mobility-related noise levels: % of population exposed to mobility-related noise over specific decibel (dB(A)) levels
- Increase of physical activity: minutes of moderate-intensity physical activity per week
- Improvements in adaptation and resilience:
  - Infrastructure resilience
  - Transport adaptation towards extreme weather events
- Enhancement of just transition: number of new jobs created and people trained, % of women in the workforce
- Improvement of gender responsiveness:
  - % of women feeling safe commuting/travelling
  - % of women employed in the project
  - Access of women through the project

To fully capture the social, economic and environmental impacts of sustainable, low-carbon land transport projects, it is essential to use several methods and to develop a diverse set of models. No single model offers a complete overview of all relevant indicators. For example, the SAVi methodology uses systems thinking, system dynamics simulation, spatial modelling, and project finance modelling, all integrated into a single analytical framework. Cost-benefit analysis and cost-effectiveness analysis, together with multi-criteria analysis, can be used to assess the economic viability of a project:

- **Cost-benefit analysis** provides information on the financial and economic (i.e., societal) viability of the investment.
- **Cost-effectiveness analysis** determines value for money when a specific target needs to be realised.
- **Multi-criteria analysis** allows for the use of an integrated set of indicators in the analysis, even if some of these cannot be quantified.

Ideally, the methods and tools used should be open-source

and easily accessible. Otherwise, stakeholders with limited resources may find it difficult to apply them.

Appraisal criteria and perspectives are always influenced by normative and political choices on which criteria to include and what weight to attach to each of them. Additionally, any appraisal relies on input data, which may be biased or not fully representative of all relevant aspects. Therefore, it is crucial to raise decision makers' awareness of the limitations. This will ensure the long-term impact and effective adoption of evolved economic appraisals for land transport.

RECOMMENDATION 3

Build multi-stakeholder engagement in the economic appraisal process

The economic appraisal process should ensure the inclusive, transparent and participatory engagement of all relevant stakeholders. This includes municipal, regional, and national governments, private sector actors, non-governmental organisations, local communities and civil society.[15]

Engaging with these diverse actors enables better identification of issues and solutions, and thus of the key performance indicators to include in the economic appraisal and assessment. It also supports the creation of a broad and representative support base for the project, countering and challenging the leverage that lobbies would normally be able to exert on decision makers. The economic appraisal process is even more robust if the key performance indicators of different officers and departments include the existence of such a broad and representative support base.

The local knowledge provided by relevant multi-stakeholder groups can also support the collection and interpretation of data. This can reduce reliance on assumptions based on secondary data, and hence improve the reliability of the overall assessment performed. It ensures that the local context is adequately reflected, avoiding generalisations based on standardised assumptions that would otherwise lead to sub-optimal planning.

RECOMMENDATION 4

Quantify and monetise all costs and benefits

Planners, engineers and policy makers should avoid using only conventional methods, such as cost-benefit analysis, when appraising and assessing sustainable, low-carbon land transport projects. This is especially the case when decision makers are limited to financial indicators that consider solely the direct costs and benefits of a project and only scratch the surface of its full sustainability and decarbonisation potential.

In sustainable, low-carbon land transport projects, the economic and social impacts are often more prominent than the revenues collected and budgets invested. Therefore, it is crucial to identify, quantify and analyse (e.g. via economic valuation) all impacts surrounding a project, including the social and environmental impacts.[16] The lack of data should not prevent the creation of a comprehensive assessment. Methods and models exist to facilitate this analysis, including to assess the variability of results under different assumptions using the Health Economic Assessment Tool (HEAT) for walking and cycling.[17]

An evolved cost-benefit analysis should consider:

- **Financial performance** – using cash flows directly related to the project.
- **Holistic economic performance** – adding the economic valuation of all social and environmental impacts to determine the broad societal contribution of the project.
- **Financial and economic returns by economic actors** – including the private sector, government and civil society.[18]

These considerations determine the:

- **Financial sustainability** – the sustainability of the project for the investor.
- **Economic sustainability, including all costs and benefits** – the contribution of the project to sustainable human development and prosperity.
- **Formulation of the most adequate financing strategy** – whether the project generates sufficient positive impacts for all beneficiaries.

Using a systemic or societal approach, especially when interpreting the results of the cost-benefit analysis, allows for more explicit consideration of important concepts related to sustainable development. This includes concepts such as transport poverty – that is, the lack of adequate transport services necessary to access general services and work, or the inability to pay for these transport services.[19]

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SPOTLIGHT

Improving Access to Climate Finance for Transport in Low- and Middle-Income Countries

This spotlight draws on the findings of the project Improving Access to Climate Finance for Transport Projects in Low and Middle-Income Countries, carried out in the framework of the High Volume Transport (HVT) Applied Research Programme and funded by UKAID through the UK Foreign, Commonwealth & Development Office (FCDO).[1]

KEY FINDINGS

What is climate finance for transport?

- The UN Framework Convention on Climate Change (UNFCCC) defines climate finance as financial resources, whether from public, private or alternative sources, aimed at supporting actions to mitigate and adapt to climate change.

Climate finance falls short of meeting transport needs

- Global climate finance nearly doubled between 2010 and 2020, to account for 2% of global gross domestic product (GDP) in 2023; however, it remains largely insufficient as well as inconsistent across regions. Overall, global climate finance in 2023 totalled USD 1.9 trillion, and 79% was directed to East Asia and the Pacific, North America and Western Europe. Only 3% or USD 20 billion of total global climate finance was directed to the least developed countries, where it is most needed, and 15% to emerging markets and developing economies (excluding China). Notably, the 10 countries most affected by climate change between 2000 and 2019 received less than USD 23 billion, or under 2% of the global total.

- As one of the most capital-intensive sectors, transport received around 29% of climate finance in 2023 but faces the largest investment gap of any sector. In 2023, the sector received around USD 545 billion from public and private sources for climate mitigation activities - seven times below the estimated USD 2.7 trillion needed each year by 2050 to align with global transport climate action targets. Adaptation financing for transport totalled USD 1.8 billion in 2023, or only around 3% of the overall annual global adaptation financing of USD 65 billion on average.

- The investment gap is particularly acute in LMICs because their transport systems are still developing. To support the development of the transport sector, annual transport investment in LMICs (excluding China) must reach an estimated USD 575 billion by 2030. However, in 2023, half of the USD 545 billion in transport-related climate finance went to high-income countries, and the majority (77%) went to road transport, followed by rail and public transport (18%).

- LMICs struggle to attract international climate finance due to unstable macroeconomic and political landscapes, high interest rates, growing levels of debt, and insufficient understanding and technical capacity to develop bankable projects. As a result, significant investment gaps in transport infrastructure are projected for 2040, amounting to an estimated USD 0.8 trillion for Africa and USD 1.6 trillion for Asia.



- Meeting climate targets in transport will require greatly scaling up climate finance for developing economies and leveraging these funds to attract additional investment. Against this backdrop, the 2024 UN Climate Change Conference (COP 29), held in Baku, Azerbaijan, was a missed opportunity for setting a new ambitious climate finance target.

- Because the climate finance decisions made today will shape transport infrastructure and systems for decades to come, investing in sustainable transport must be part of the solution. This is especially important as the global community works on the Baku to Belém Roadmap for 1.3T, which aims to mobilise USD 1.3 trillion annually by 2035 to address multiple priorities in climate action for LMICs.

KEY FINDINGS

Challenges to accessing climate finance for transport

- Project sponsors and policy makers often encounter significant barriers – financial, institutional, informational and technological – that impede their ability to access climate finance effectively.
- Financial barriers typically take the form of inadequate financing sources, difficulty in accessing suitable financing sources, and challenges in identifying accompanying private investors and financeable projects.
- Institutional barriers often relate to inadequate policy and regulatory frameworks and limited institutional and technical capacities to develop bankable project proposals, conduct feasibility studies, and implement and monitor projects.
- Informational barriers include a lack of understanding of the importance of sustainable transport measures, such as electric mobility and active mobility (cycling and walking).
- Technological barriers, such as technical limitations of new and emerging technologies, are particularly evident in electric mobility projects.
- The project Improving Access to Climate Finance for Transport Projects in Low- and Middle-Income Countries identified that the key challenges revolve around the difficulty of securing adequate climate finance for transport and the capacity to effectively use available funds. These challenges are intertwined and compound one another.
- In addition, research has identified five key barriers to accessing climate finance for transport, namely: 1) the lack of enabling policy and regulatory frameworks, 2) limited capacity for project preparation and implementation, 3) high upfront costs and long life cycles of sustainable transport infrastructure, 4) high risk perception and low potential for returns, and 5) inadequate quantity and quality of climate finance and its complex nature. These five barriers are nested within financial, institutional, informational and technological contexts.

Four steps to facilitating access to climate finance for transport in LMICs

- With these barriers and operating contexts in mind, the project Improving Access to Climate Finance for Transport Projects in Low- and Middle-Income Countries elaborates a step-by-step guide that targets primarily project sponsors but also has great relevance for national and sub-national governments in LMICs.
- **STEP 1**
  Secure the necessary enabling environments
  - The creation of an enabling policy and financial environment that supports climate action in transport is an important preliminary step for project sponsors, in close dialogue with national and sub-national governments in LMICs. It enhances the appeal of projects for climate finance; it secures financial incentives for implementation (e.g., subsidies or tax breaks for electric vehicles); and ultimately ensures the project's compliance with the high environmental standards typically required by climate finance providers.
- **STEP 2**
  Develop capacity on sustainable, low-carbon transport
  - The next step is to raise capacity on sustainable, low-carbon transport. LMICs often face gaps in institutional arrangements, expertise and mandates for the required roles to implement climate finance-backed projects.
  - To demonstrate a project's eligibility for the requirements set by financing entities, and to strengthen its business case while garnering local community support, it is essential to build capacity to adapt the evaluation models and cost-benefit analyses to reflect broader benefits. Such benefits may include improved air quality, accessibility, safety, reduced travel time, congestion and job creation.
  - Raising awareness and addressing informational barriers of sustainable transport projects and initiatives is equally important.
  - Leveraging data and technology solutions can play a key role in addressing the issue of high upfront costs of low-carbon technologies.
- **STEP 3**
  Develop capacity on climate finance mechanisms
  - Almost in parallel with step 2, it is important to raise capacity on accessing climate finance. This step is central to providing clarity on the climate finance landscape and best approaches to accessing it in the country concerned. Once capacity has been built, stakeholders should be able to develop financing strategies, identify priority projects and mobilise finance.

KEY FINDINGS

- Project preparation facilities (PPFs) are important avenues through which many financial institutions provide grants, loans and technical assistance for all transport modes.
- Multilateral development banks and development finance institutions are another key source of capacity building support.
- The capacity of project sponsors to make smart use of financial instruments also needs to be enhanced.
- Not least, capacity building should focus on ways to attract private investments through the use of de-risking instruments.

STEP 4

Design suitable and impactful projects

- With the right tools and knowledge on climate finance and transport, the final step is to design and implement impactful projects.
- Climate finance for transport serves as a catalyst for systematic transformations within the sector. The current funding volumes are insufficient to fully develop a country's transport sector, nor is that the primary aim of climate finance. Instead, in the transport sector, climate finance acts as a driver for creating new markets and piloting innovative projects.
- This step includes both the development of bankable projects and the improvement of project implementation.
- Improving pipeline development and project design, however, will necessitate engaging policy makers to secure improved policy alignment between Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement, and national policies.



Drawing on the findings of the project Improving Access to Climate Finance for Transport Projects in Low and Middle-Income Countries, carried out in the framework of the High Volume Transport (HVT) Applied Research Programme and funded by UKAID through the UK Foreign, Commonwealth & Development Office (FCDO), this spotlight shares the actionable guidance that was developed through the project. It outlines key solutions to barriers to accessing climate finance for transport in a variety of contexts: financial, institutional, informational and technological.[2]

What is climate finance for transport?

The UN Framework Convention on Climate Change (UNFCCC) defines climate finance as financial resources, whether from public, private or alternative sources, aimed at supporting actions to mitigate and adapt to climate change. Global climate finance involves providing transnational funding to countries, particularly LMICs, to address the challenges posed by climate change. A growing body of financing entities and instruments provide climate finance specifically for the transport sector.

Although eligibility criteria may vary, climate finance for mitigation in the transport sector typically refers to resources allocated to activities that fall within the scope of the so-called Avoid-Shift-Improve (A-S-I) framework[i]. The A-S-I framework follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures intended to be implemented first, followed by "Shift" measures and finally by "Improve" measures. Practical examples of relevant climate finance include investments targeting improved land use practices and urban design to avoid or reduce unnecessary motorised trips (Avoid); efforts to shift goods and passenger traffic towards more environmentally efficient modes such as railways, walking and cycling (Shift); and, not least, measures to improve efficiency and performance, such as through electrification (Improve).[3]

In the area of adaptation and resilience, climate finance activities tend to focus on reinforcing transport assets as well as strengthening the ability of infrastructure and transport systems to withstand, adapt and recover from extreme weather events and the impacts of a changing climate. In addition to efforts targeting the physical resilience of infrastructure assets, an example of adaptation and resilience-related climate finance is activities aimed at improving operational and organisational resilience – for example, offering redundancy and diversity of mode choice for communities with differing income levels and geographies.

Typically, climate finance provided by domestic or international public entities takes the form of grants (which are scarce) and loans (which make up the majority). In contrast, once private sector entities become involved, a broader suite of financing instruments is used (for example, equity, blended finance, structured finance products, innovative bond structures, etc.).


Jashim Salam

i The Avoid-Shift-Improve framework has been central to sustainable, low carbon transport for more than a decade. It follows an implicit hierarchy, with appropriate and context-sensitive "Avoid" measures (which avoid and reduce the need for motorised travel) intended to be implemented first, followed by "Shift" measures (which shift to more sustainable modes) and finally by "Improve" measures (which improve transport modes). See https://slocat.net/asi and H. Dalkmann and C. Brannigan (2007), Transport and Climate Change, Module 5e: Sustainable Transport – A Sourcebook for Policy-Makers in Developing Cities, GIZ GmbH, https://changing-transport.org/wp-content/uploads/2007_dalkmann_brannigan_transportandclimatechange.pdf.

Climate finance falls short of meeting transport needs

Global climate finance nearly doubled between 2010 and 2020, to account for 2% of global gross domestic product (GDP) in 2023; however, it remains largely insufficient as well as inconsistent across regions.[4] Overall, global climate finance in 2023 totalled USD 1.9 trillion, and 79% was directed to East Asia and the Pacific, North America and Western Europe.5 Only 3% or USD 20 billion of total global climate finance was directed to the least developed countries, where it is most needed, and 15% to emerging markets and developing economies (excluding China).[6] Notably, the 10 countries most affected by climate change between 2000 and 2019 received less than USD 23 billion, or under 2% of the global total.[7]

As one of the most capital-intensive sectors, transport received around 29% of climate finance in 2023 but faces the largest investment gap of any sector.[8] In 2023, the sector received around USD 545 billion from public and private sources for climate mitigation activities - seven times below the estimated USD 2.7 trillion needed each year by 2050 to align with global transport climate action targets.[9] Adaptation financing for transport totalled USD 1.8 billion in 2023, or only around 3% of the overall annual global adaptation financing of USD 65 billion on average.[10]

If the critical financing needs linked to workforce development are factored in, the magnitude of the climate finance shortfall is likely far greater. Moreover, most estimates exclude adaptation and resilience needs, focusing solely on emission reduction efforts. Accounting for the financial costs related to climate-proofing transport infrastructure assets, along with the financial costs of loss and damage from extreme weather events (such as reconstructing rail infrastructure after flooding), will result in a much larger climate finance gap. Climate-induced disasters and extreme weather events already inflict an estimated USD 15 billion in direct damage to transport systems annually, with LMICs bearing a disproportionate high share: around USD 8 billion, the highest costs relative to their GDP.[11]

The investment gap is particularly acute in LMICs because their transport systems are still developing. To support the development of the transport sector, annual transport investment in LMICs (excluding China) must reach an estimated USD 575 billion by 2030.[12] However, in 2023, half of the USD 545 billion in transport-related climate finance went to high-income countries, and the majority (77%) went to road transport, followed by rail and public transport (18%).[13]

LMICs struggle to attract international climate finance due to unstable macroeconomic and political landscapes,



high interest rates, growing levels of debt, and insufficient understanding and technical capacity to develop bankable projects. As a result, significant investment gaps in transport infrastructure are projected for 2040, amounting to an estimated USD 0.8 trillion for Africa and USD 1.6 trillion for Asia.[14]

Meeting climate targets in transport will require greatly scaling up climate finance for developing economies and leveraging these funds to attract additional investment. Against this backdrop, the 2024 UN Climate Change Conference (COP 29), held in Baku, Azerbaijan, was a missed opportunity for setting a new ambitious climate finance target. High-income countries pledged to contribute USD 300 billion by 2035 to LMICs, starting in 2026.[15] In addition, all actors are supposed to scale up financing from public and private sources and alternative sources, amounting to at least USD 1.3 trillion per year by 2035. [16] Despite tripling climate finance to developing countries (from the previous goal of USD 100 billion annually), the newly agreed climate finance goal falls well short of meeting LMICs' calls for the trillions required.[17] As a result, the majority of the financing agreed at COP 29 will rely on private investment and alternative sources, both of which carry uncertainties in realisation.[18] (See 6.1 Financing Sustainable Transport in Times of Constrained Public Budgets.)

The climate finance goal also has attracted criticism regarding its qualitative criteria. The new goal is not accompanied by minimum allocation floors for sub-groups of LMICs (e.g., small island developing states), nor does it set sub-targets for mitigation, adaptation, and loss and damage. Moreover, there are no obligations to prioritise grants over loans, and no safeguards are established to preclude investments in fossil fuel infrastructure from being classified as "climate finance". The combination of these factors results in little guarantee that

the much-needed finance for the transition to sustainable and low-carbon transport will be delivered at the speed required to meet the Paris Agreement and the Sustainable Development Goals (SDGs).

Because the climate finance decisions made today will shape transport infrastructure and systems for decades to come, investing in sustainable transport must be part of the solution. This is especially important as the global community works on the Baku to Belém Roadmap for 1.3T, which aims to mobilise USD 1.3 trillion annually by 2035 to address multiple priorities in climate action for LMICs.[19]

Read more about the outcomes of COP 29 and what these mean for the transport sector in **SLOCAT's Transport in COP 29 Outcomes Analysis.**[20]

Challenges to accessing climate finance for transport

Project sponsors and policy makers often encounter significant barriers – financial, institutional, informational and technological – that impede their ability to access climate finance effectively (Figure 1).[21] The specific challenges vary depending on a country's circumstances and available funding sources.

Financial barriers typically take the form of inadequate financing sources, difficulty in accessing suitable financing sources, and challenges in identifying accompanying private investors and financeable projects. The long-term nature of transport infrastructure projects implies that the cost recovery is distributed across many years and is subject to future unpredictability and delays, which complicate investment decisions.[22]

Institutional barriers often relate to inadequate policy and regulatory frameworks and limited institutional and technical capacities to develop bankable project proposals, conduct feasibility studies, and implement and monitor projects. The absence of stable policy frameworks and clear signals increases the investment risk, particularly in nascent markets that lack regulation and an enabling environment for private sector entry. Weak governance, organisational silos, and overlapping or unclear responsibilities of government authorities can impede access to financing and hinder project planning and implementation. Project sponsors in LMICs often lack sufficient understanding of climate-related risks and the technical capacity to develop bankable projects.[23] (For more on capacity challenges and solutions, see 6.2 Capacity Building for Transport Transformations.)

Informational barriers include a lack of understanding of the importance of sustainable transport measures, such as electric mobility and active mobility (cycling and walking). International practices indicate that promoting awareness of electric vehicles and their benefits among customers and businesses is positively linked to higher deployment.[24] Informational barriers often arise from a lack of data and the ability to measure, verify and communicate the impacts of transport projects.

Technological barriers, such as technical limitations of new and emerging technologies, are particularly evident in electric mobility projects. These markets and funding streams are relatively new, making returns from related projects less well-established. This is exacerbated by the scarcer availability of knowledge on technical issues, such as battery range and charging technology.

The project Improving Access to Climate Finance for Transport Projects in Low- and Middle-Income Countries identified that the key challenges revolve around the difficulty of securing adequate climate finance for transport and the capacity to effectively use available funds. These challenges are intertwined and compound one another.[25]

In addition, research has identified five key barriers to accessing climate finance for transport, namely: 1) the lack of enabling policy and regulatory frameworks, 2) limited capacity for project preparation and implementation, 3) high upfront costs and long life cycles of sustainable transport infrastructure, 4) high risk perception and low potential for returns, and 5) inadequate quantity and quality of climate finance and its complex nature. These five barriers are nested within financial, institutional, informational and technological contexts. The key barriers can be broken down into detailed barriers and solutions framed within each of these areas of the operating context.

Four steps to facilitating access to climate finance for transport in LMICs

With these barriers and operating contexts in mind, the project Improving Access to Climate Finance for Transport Projects in Low- and Middle-Income Countries elaborates a step-by-step guide that targets primarily project sponsors but also has great relevance for national and sub-national governments in LMICs. The guide identifies key challenges and potential solutions and puts them in a step-by-step guide. By leveraging tools such as the A-S-I framework, collecting key resources and materials, and profiling climate finance mechanisms, the guide equips project sponsors and other relevant stakeholders with the knowledge to design impactful,



bankable transport projects. A summary of its key steps is provided below.

Read the **Policy Guide to Improving Access to Climate Finance for Transport** for holistic, high-level recommendations supported by pointers to case studies, guidance documents and other relevant material with a focus on LMICs.[26]

STEP 1

Secure the necessary enabling environments

Embedding a transport project within an enabling regulatory framework is crucial to ensuring the project's alignment with climate plans (e.g., Nationally Determined Contributions and Long-Term Strategies), while demonstrating to prospective funders that it is part of a well-governed and conducive ecosystem. This reduces the project's perceived risks.

The creation of an enabling policy and financial environment that supports climate action in transport is an important preliminary step for project sponsors, in close dialogue with national and sub-national governments in LMICs. It enhances the appeal of projects for climate finance; it secures financial incentives for implementation (e.g., subsidies or tax breaks for electric vehicles); and ultimately ensures the project's compliance with the high environmental standards typically required by climate finance providers.

By engaging actively with national and regional governments, private actors, and other relevant stakeholders, project sponsors can help bring about a conducive regulatory and financial environment. Any institutional and regulatory reform often takes time and is best supported by a series of projects.

For more on how to boost ambition for transport mitigation, adaptation, and resilience in Nationally Determined Contributions and National Adaptation Plans, see the Spotlights on Transport Ambition in NDCs 3.0 *and* Transport in National Adaptation Plans*, in Module 2.*

STEP 2

Develop capacity on sustainable, low-carbon transport

The next step is to raise capacity on sustainable, low-carbon transport. LMICs often face gaps in institutional arrangements, expertise and mandates for the required roles to implement climate finance-backed projects.[27]

To demonstrate a project's eligibility for the requirements set by financing entities, and to strengthen its business case while garnering local community support, it is essential to build capacity to adapt the evaluation models and cost-benefit analyses to reflect broader benefits. Such benefits may include improved air quality, accessibility, safety, reduced travel time, congestion and job creation.

Raising awareness and addressing informational barriers of sustainable transport projects and initiatives is equally important.

Leveraging data and technology solutions can play a key role in addressing the issue of high upfront costs of low-carbon technologies. For example, in the informal transport sector, tracking operators' daily revenue can provide evidence of the stable income of drivers and change the negative "high-risk" perceptions linked to informal transport that result in unfavourable payment and financing terms.

See the **Transport Decarbonisation Index (TDI) Benchmarking Report** to learn about the TDI's diagnostic toolkit, which seeks to enable policy makers in LMICs to evaluate the current state of their transport sectors, identify their respective strengths and gaps, and undertake high-impact policy and financing actions towards a decarbonisation pathway.[28]

STEP 3

Develop capacity on climate finance mechanisms

Almost in parallel with step 2, it is important to raise capacity on accessing climate finance. This step is central to providing clarity on the climate finance landscape and best approaches to accessing it in the country concerned. Once capacity has been built, stakeholders should be able to develop financing strategies, identify priority projects and mobilise finance. Given that project preparation takes place within a certain regulatory and institutional ecosystem, project sponsors must engage with governments and private entities, with the extent of collaboration varying based on the project approach.

Project preparation facilities (PPFs) are important avenues through which many financial institutions provide grants, loans and technical assistance for all transport modes. They can enhance capacity on important elements, such as the drafting of feasibility studies and the development of financing strategies.

Multilateral development banks and development finance institutions are another key source of capacity building support – including in preparing robust project pipelines, enhancing managerial and technical capacity for project implementation, and facilitating monitoring and reporting.

The capacity of project sponsors to make smart use of financial instruments also needs to be enhanced. Examples include the establishment of innovative financing mechanisms – such as separating bus ownership from bus operations with a view to lowering costs and facilitating the wider adoption of electro-mobility. Other mechanisms include combining the use of grants and development loans to cushion initial costs, using guarantees to lower interest rates and mitigate risks, and introducing de-risking measures to mobilise private capital for innovation.

Not least, capacity building should focus on ways to attract private investments through the use of de-risking instruments. This can be achieved through tailored initiatives and innovative finance mechanisms, and the use of grants and concessional financing with attractive terms to avoid increasing countries' debt stress, closing financial viability gaps, and achieving project bankability, among others.

STEP 4

Design suitable and impactful projects

With the right tools and knowledge on climate finance and transport, the final step is to design and implement impactful projects.

Climate finance for transport serves as a catalyst for systematic transformations within the sector. The current funding volumes are insufficient to fully develop a country's transport sector, nor is that the primary aim of climate finance. Instead, in the transport sector, climate finance acts as a driver for creating new markets (such as for transport electrification and shared mobility) **and piloting innovative projects** (for example, the first public transport service or high-speed rail system). The project design in this step should make use of a pool of actions on sustainable, low-carbon transport.

This step includes both the development of bankable projects and the improvement of project implementation. These can be achieved by deepening project sponsors' understanding of the bankability and eligibility criteria for funding proposals, identifying experts with relevant experience in the chosen climate finance mechanism to support the application process, and implementing projects under public-private partnership models to overcome financial barriers and minimise operational risks for the private sector, among others.

Improving pipeline development and project design, however, will necessitate engaging policy makers to secure improved policy alignment between Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement, and national policies. This will aid the incorporation of more transport projects in such plans, while demonstrating commitment to climate objectives and increasing the chances of accessing climate finance.

MODULE 6 | 6.2

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Capacity Building for Transport Transformation



KEY FINDINGS



- Capacity development is a foundational element of broader social, economic and institutional transformation.
- Capacity development and skills play a dual role as both enablers of economic and social change and as a protective buffer for transport professionals and workers against the impacts of socio-economic, technical, climate and environmental change.
- Between 2018 and 2023, public transport operators reported a 15% increase in engineering and maintenance roles, a 13% increase in drivers, and a 34% increase in management positions, reflecting expanded training needs across rail and bus systems.
- Transport service providers and infrastructure operators also require well-trained professionals in light of the large-scale investments needed in sustainable transport – such as railway systems, multi-modal logistics, intelligent transport systems, and transport planning and data.
- A key enabling factor for countries to be able to set and meet climate and sustainability targets is improving or developing the abilities of national-level and sub-national authorities. Realising climate and sustainability goals relies on the ability of professionals in both the public sector (e.g., institutions and communities) and the private sector (e.g., shippers, carriers, logistics service providers) to bring the needed capacities to implement ambitious national strategies.
- Although definitions vary, capacity is defined here as "the ability of people, organisations and society as a whole to manage their affairs successfully", while capacity development is understood as "the process whereby people, organisations and society as a whole unleash, strengthen, create, adapt, and maintain capacity over time, in order to achieve development results."
- Capacity development activities vary in format and duration. Recent research investigating capacity building activities in low- and medium-income countries in Africa and in South Asia identified 14 capacity development formats, ranging from seminars and workshops to customised knowledge reports and open-access data portals.
- Capacity building formats with short durations (usually taking less than a month) include workshops, seminars, trainings, conferences and study tours. In contrast, activities such as scholarships and formal education programmes can extend up to several years.

Identifying capacity gaps

- The formulation of capacity development programmes is ideally preceded by an assessment of existing capacity assets and needs. This ensures that the designed programme is both relevant to the transport institution's defined capacities and responsive to the identified gaps.
- Despite broad expert agreement on the importance of conducting such capacity needs assessments, practice across transport entities does not always reflect this ideal. The approach to capacity development in many transport bodies tends to be *reactive* rather than *proactive*.
- A 2025 study by the Transformative Urban Mobility Initiative (TUMI) included a capacity gap analysis conducted across the three levels of capacity: individual, institutional and societal. Participating transport stakeholders were asked to rate the importance of specific capacities in enabling low-carbon transport in their local context, compared to their current levels of capacity. In doing so, the study was able to identify the three largest capacity gaps currently faced by transport stakeholders: sustainability within educational programmes, enabling societal frameworks, and number of staff.

KEY FINDINGS

Lack of sustainability within educational programmes

- Although education is increasingly acknowledged in international climate and sustainability policy, investment in climate and sustainability education has not matched the urgency of the current climate crisis. The 2025 TUMI study highlighted that the largest capacity gap identified across the different capacity levels was the lack of sustainability within formal educational programmes.
- The study's thematic analysis revealed that the most prevalent disciplines addressing transport in formal education are transport engineering, urban planning and architecture, transport economics, and transport logistics and supply chain management. It points to the under-representation of sustainability and climate change themes within existing transport curricula.
- A key implication of the gap in sustainability within educational programmes is that transport stakeholders struggle to hire qualified personnel. Existing staff members at transport entities often face challenges in carrying out their responsibilities due to both technical and functional capacity gaps.
- Trends such as digital transformation, electrification, and platform-based mobility and logistics services, along with the transformational needs and growing complexities of urban and mobility planning (such as adaptation and resilience to the impacts of climate change, shocks and crises), require a wide range of transport professions and jobs to acquire new skills.
- Promoting learning and professional development of employees is one of the cornerstones of staff attraction and retention policies. In such settings, the costs and risks associated with developing the educational and technical backgrounds of employees are either fully borne by the employer, or shared between the employer and employee.
- Transport stakeholders do not always have dedicated resources and/or policies in place to support individual employees to continue their professional development. Consequently, staff members are often forced to self-fund and self-manage their time to pursue external educational programmes. In other cases, employees may take an (unpaid) leave of absence, particularly when the educational programme mandates in-person (synchronous) engagement.
- Without institutionalised policies and budgets for continuing professional development, employees may struggle to engage in further learning, leading to bigger institutional knowledge gaps.
- Educational opportunities abroad can bring valuable exposure to global practices and networks, but reliance on them for professional development carries important implications and raises questions around accessibility, equity and scalability.
- If individuals seek educational programmes abroad to address the local sustainable educational gap, a potential outcome is brain drain, or the migration of skilled professionals from low- and middle-income countries to high-income countries.
- Alternatively, ensuring that the knowledge and skills for climate and sustainability action in transport are locally taught and nurtured can support lasting and scalable human and economic development in a given region, country or city.



KEY FINDINGS

Addressing the gap in sustainability in educational programmes

- The international transport community provides a variety of capacity building activities aimed at addressing the gaps around sustainability within educational programmes.
- International organisations, non-governmental organisations and foundations are collaborating with local organisations and universities to offer capacity development opportunities that range from in-depth multi-year university-level degrees and curricula development, to specialised executive education and graduate diploma programmes, to shorter term certified courses.
- Some capacity development programmes promote the inclusion and participation of applicants from low- and middle-income countries and of women by offering scholarships or reduced tuition fees.

Way forward

- Education remains an undervalued instrument in formulating and implementing emission mitigation, adaptation, resilience and broader sustainability solutions in transport. A significant structural gap in current curricula and institutional arrangements prevails, particularly the lack of systemic integration of sustainability into education and the persistent disconnect between theoretical research and its application in practice.
- This disconnect is symptomatic of broader global challenges in ensuring equitable access to quality, relevant, and actionable education and knowledge and effective knowledge transfer, particularly in low- and middle-income countries. Such inequality deepens disparities in how regions can respond to transport, climate and sustainability challenges. In response, various international organisations and institutions have support capacity through international development co-operation and official development assistance (ODA).
- A geographically balanced design of capacity development programmes is essential, as many current initiatives remain concentrated in capital cities or national-level agencies, often leaving sub-national and local authorities underserved.
- Successful capacity building initiatives demonstrate that multi-stakeholder collaboration can bridge these gaps.
- Sustainable, long-term strategies should prioritise structural changes in higher education curricula, and foster collaboration among local universities, global institutions, the transport sector and development co-operation actors.
- To ensure that these structural reforms and partnerships are effective over time, it is essential to implement continuous monitoring and evaluation systems.
- In the near term, one option could be to create a globally supported scholarship fund dedicated to studies in sustainable transport, backed by stakeholders across the international transport sector.
- Investing in stronger academic collaboration between universities in the Global North and the Global South presents a strategic opportunity for capacity building in the transport sector. ODA funding could be effectively channelled to support such partnerships, particularly by engaging second-tier universities that serve broader societal segments beyond economically privileged groups.
- By promoting equitable and sustainable access to specialised education and ensuring its relevance to practice, the international transport community can accelerate the transition to sustainable transport systems and services.

Context, challenges and opportunities

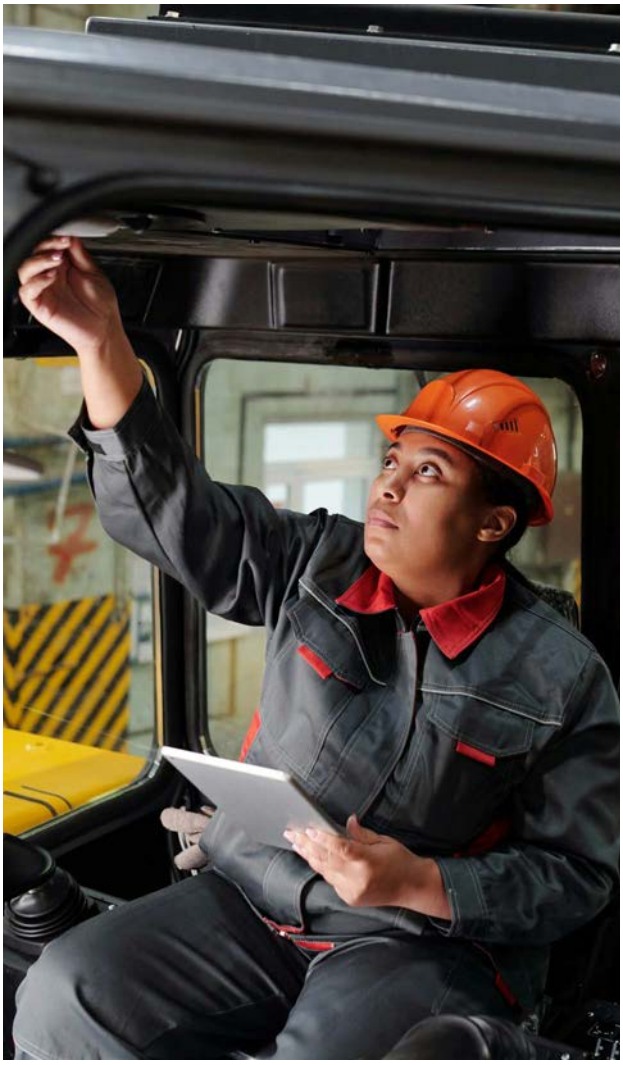
Capacity development[i] is a foundational element of broader social, economic and institutional transformation. Labour markets are being reshaped, new types of jobs are emerging, and existing roles are being redefined. These structural shifts require long-term strategies for education, training, workforce development and institutional transformation.

Capacity development and skills play a dual role as both enablers of economic and social change and as a protective buffer for transport professionals and workers against the impacts of socio-economic, technical, climate and environmental change. This broader framing is particularly important in the context of the transitions required towards sustainable passenger and freight transport.

Between 2018 and 2023, public transport operators reported a 15% increase in engineering and maintenance roles, a 13% increase in drivers, and a 34% increase in management positions, reflecting expanded training needs across rail and bus systems.[1] Some metro systems, as in Chile, have introduced automation with negotiated transitions where new employees directly enter automated roles, while existing workers may voluntarily transfer with wage incentives.[2] Technical upskilling, particularly for electric buses and automated metro lines, is being implemented through dedicated training centres (e.g., in Ireland) and pipeline programmes (e.g., the bus captain school focused on women in Jakarta, Indonesia).[3]

Despite this, older workers in metro systems face adaptation challenges, and shortages remain in technical roles such as electric vehicle maintenance, signalling a continued need for structured training investment.[4] For the rail sector, recruiting young talent, strengthening rail freight transport, and increasing capacity are key actions deemed essential to making railway technology fit for the transport transition.[5]

Transport service providers and infrastructure operators also require well-trained professionals in light of the large-scale investments needed in sustainable transport – such as railway systems, multi-modal logistics, intelligent transport systems, and transport planning and data. In the freight sector, emerging research shows that logistics managers will need new competencies to drive decarbonisation efforts, including an understanding of climate science, greenhouse gas auditing, and familiarity with evolving policy frameworks and technologies.[6] This need also extends to the construction



of climate-resilient transport infrastructure, including roads, both within and outside urban areas, highlighting the importance of skills in construction engineering, sustainable transport planning and street design.

A key enabling factor for countries to be able to set and meet climate and sustainability targets is improving or developing the abilities of national-level and sub-national authorities.[7] **Realising climate and sustainability goals relies on the ability of professionals in both the public sector (e.g., institutions and communities) and the private sector (e.g., shippers, carriers, logistics service providers) to bring the needed capacities to implement ambitious national strategies.**[8] Key strategies include Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs), Long-Term Strategies for Low-Emission Development (LT-LEDS) and the Voluntary National Reviews (VNRs) of the Sustainable

i In this section, "capacity building", "capacity development" and "capacity enhancement" are used synonymously. For the nuances behind these terms, see (Mizrahi, 2004), Capacity Enhancement Indicators: Review of the Literature, https://documents1.worldbank.org/curated/en/117111468763494462/pdf/286140Capacity0enhancement0WBI0WP.pdf

Development Goals (see 2.1 National Transport Pathways to Reach Climate and Sustainability Goals). Researchers have highlighted a widening disconnect between global climate commitments aimed at limiting global warming to 1.5 degrees Celsius (°C), and the actual policies and actions that countries are implementing.[9]

The previous edition of the SLOCAT Global Status Report (GSR) highlighted the need for an overview of existing (and missing) capacity development programmes and activities. It found that information on capacity gaps remains fragmented, sporadic and unquantified at the regional and international levels. As a first step, the third edition of the GSR called for a global stocktake to assess current training programmes, identify institutional and professional skills gaps, promote best practices and strengthen international co-operation to accelerate sustainable transport implementation. It outlined 6 capacity development formats, which have been further expanded into 14 in this edition.

Moreover, the GSR emphasised the need for better data to support planning and evaluation of capacity development activities, and proposed a range of data dimensions to guide more effective capacity development efforts. Three main action areas were identified: standards and guidelines, professional associations, and education.[10]

This fourth edition of the GSR explores recent research trends and developments in capacity development for sustainable transport and mobility transformations. It draws on the findings of two recent studies, conducted on behalf of the High Volume Transport (HVT) Applied Research Programme, and of the Transformative Urban Mobility Initiative (TUMI)[ii].[11]

Capacity development extends beyond training individuals

Although definitions vary, capacity is defined here as "the ability of people, organisations and society as a whole to manage their affairs successfully", while capacity development is understood as "the process whereby people, organisations and society as a whole unleash, strengthen, create, adapt, and maintain capacity over time, in order to achieve development results."[12] In other words, capacity development entails the conscious decision of stakeholders to assess and change the status quo to achieve better outcomes (Box 1).[13]

Box 1. Capacity development levels

International organisations and researchers agree that capacities can be developed across three distinct, but interrelated and mutually reinforcing, analytic levels: individual, institutional and societal (Figure 1). The distinction between these three levels serves to provide a holistic overview of capacity development as a concept, while also identifying the different objectives and skills implied for each capacity level.

Capacity development on the individual level has the objective to improve the knowledge, skills and competences of individuals. Therefore, the focus is on the workforce (its size and educational backgrounds) as well as on the existing educational programmes (both academic and non-academic).

Capacity development on the institutional level is geared towards institutional learning and change management processes to enhance organisational performance. Three sub-capacities are included on the institutional level:

- Governance capacity, which refers to an institution's legal and political authority to plan, finance and implement projects.
- Planning capacity, which reflects the presence of effective plans and procedures to manage projects efficiently; and
- Technical capacity, which indicates the staff's ability to plan and implement projects as desired without significant delays.

Capacity development on the societal level targets the broader context in which individuals and institutions operate, aiming to create conditions that enable and support effective actions. This involves strengthening two key components:

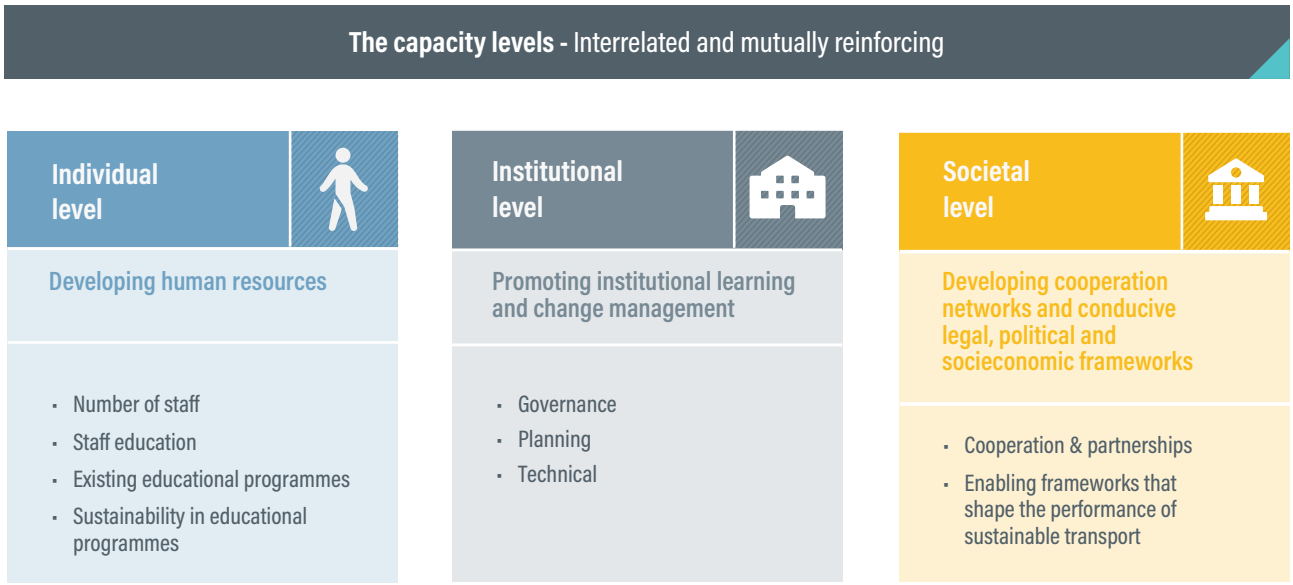
- Enabling environments, which refer to the development of supportive legal, political and socio-economic frameworks; and
- Co-operation partnerships, which focus on building and enhancing collaboration between institutions and individuals to improve co-ordination, knowledge exchange and joint action.

Some scholars further distinguish the definition of capacity based on the levels, where competence is defined as an individual attribute, capability as an organisational attribute and capacity as the combination of both competencies and capabilities.

Source: See endnote 13 for this section.

ii Both studies focused on the capacities of transport institutions without delving into the specific capacities of transport workers. For a good overview of the capacities and needs of transport workers, especially working conditions, see International Transport Workers Federation (2022), A Just Transition for Urban Transport Workers, and see 1.6 A Just Transition in Transport: A Double Challenge

FIGURE 1. Overview of capacity development levels



Capacity development support for stakeholders in passenger and freight transport

Capacity development activities vary in format and duration.[14] **Recent research investigating capacity building activities in low- and medium-income countries in Africa and in South Asia identified 14 capacity development formats, ranging from seminars and workshops to customised knowledge reports and open-access data portals.**[15] Capacity development support for (public) transport stakeholders is provided by thematic experts[iii], including financing institutions, global associations, partnerships, initiatives, think tanks and non-governmental organisations, as well as academic and private sector representatives.

Capacity building formats with short durations (usually taking less than a month) include workshops, seminars, trainings, conferences and study tours (Figure 2).[16] **In contrast, activities such as scholarships and formal education programmes can extend up to several years.** Some capacity building activities – such as the provision of knowledge resources like reports, data portals and libraries – are continuously available, making them an unlimited source of information and capacity building for stakeholders in passenger and freight transport.

Each of these capacity development formats has its strengths and weaknesses, which may be assessed through factors grouped under three main themes: content (thematic focus, profile of experts, context and practice components); target audience (language, profile of partners, incentives and accessibility); and logistics (setting, pace, duration, frequency and co-operation).

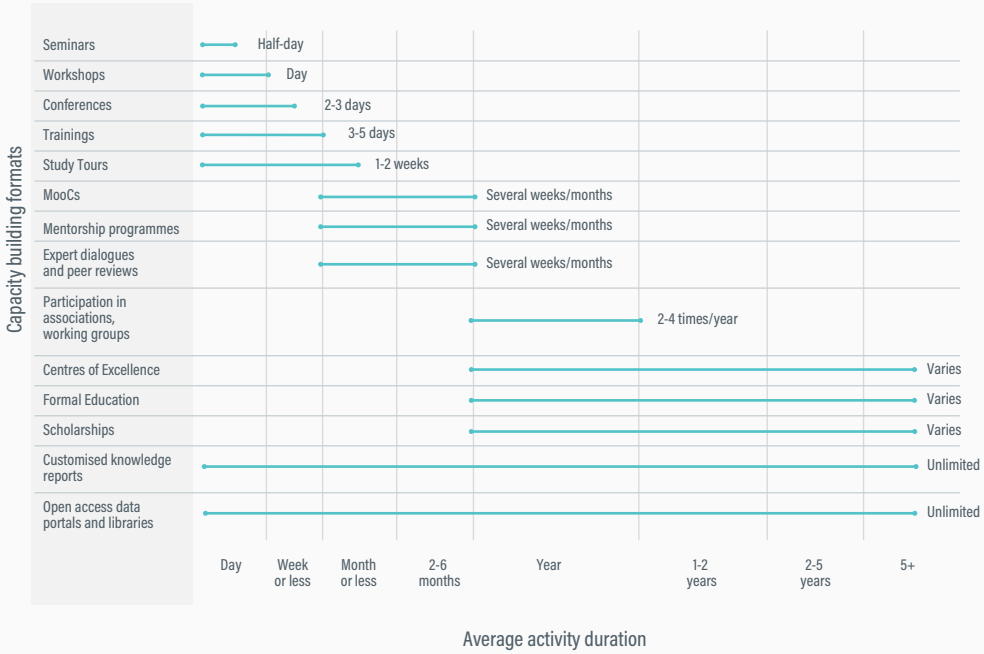
Identifying capacity gaps

The formulation of capacity development programmes is ideally preceded by an assessment of existing capacity assets and needs.[17] **This ensures that the designed programme is both relevant to the transport institution's defined capacities and responsive to the identified gaps.** Some transport authorities have embedded assessment processes and capacity building strategies in place, which

iii Capacity development activities are often organised under the umbrella of international development co-operation and technical assistance.

FIGURE 2. Comparison of average durations of the identified 14 capacity building formats

Comparison of average durations of the identified 14 capacity building formats



A wide range of capacity building formats is available, varying in duration and intensity

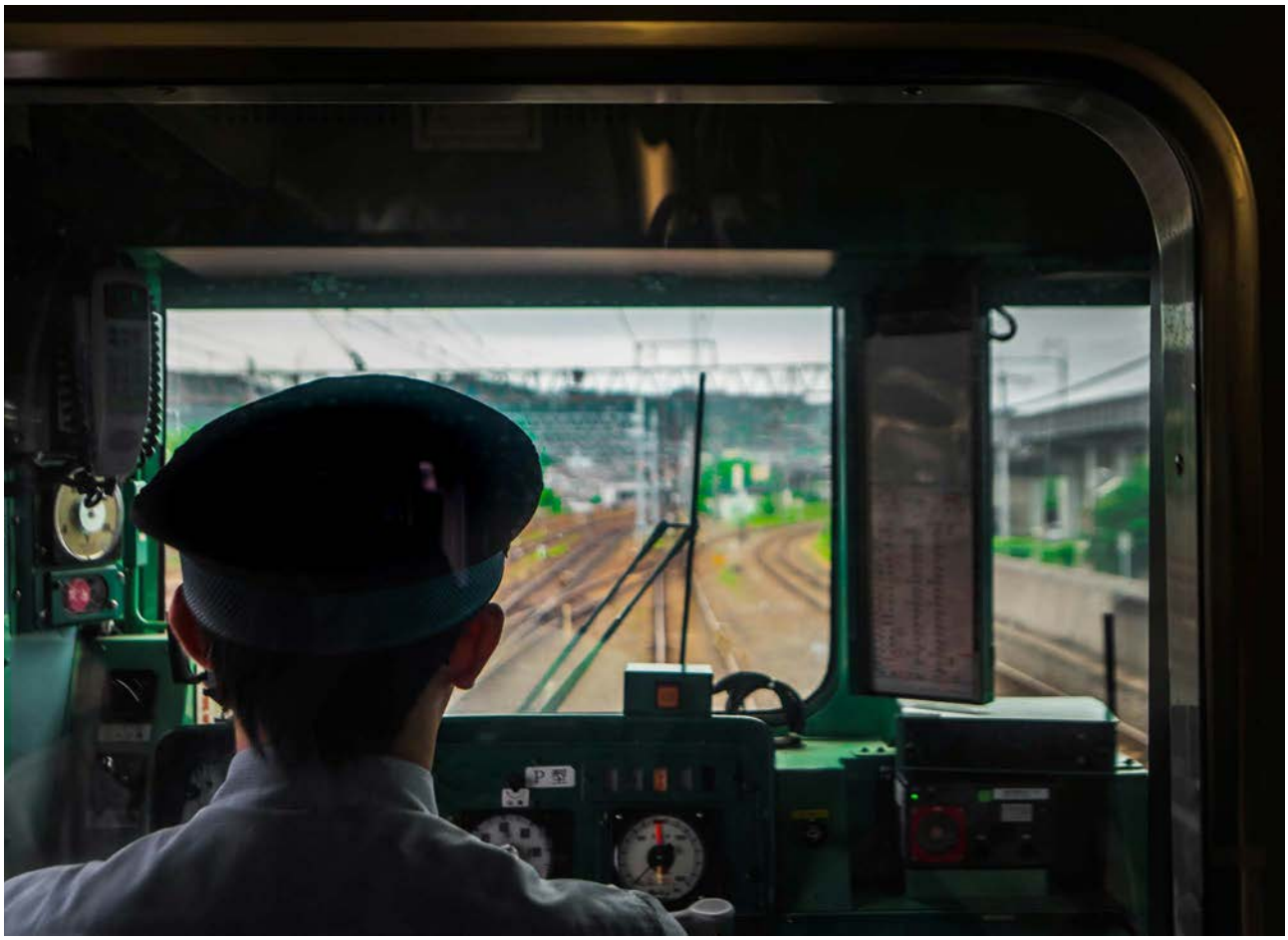
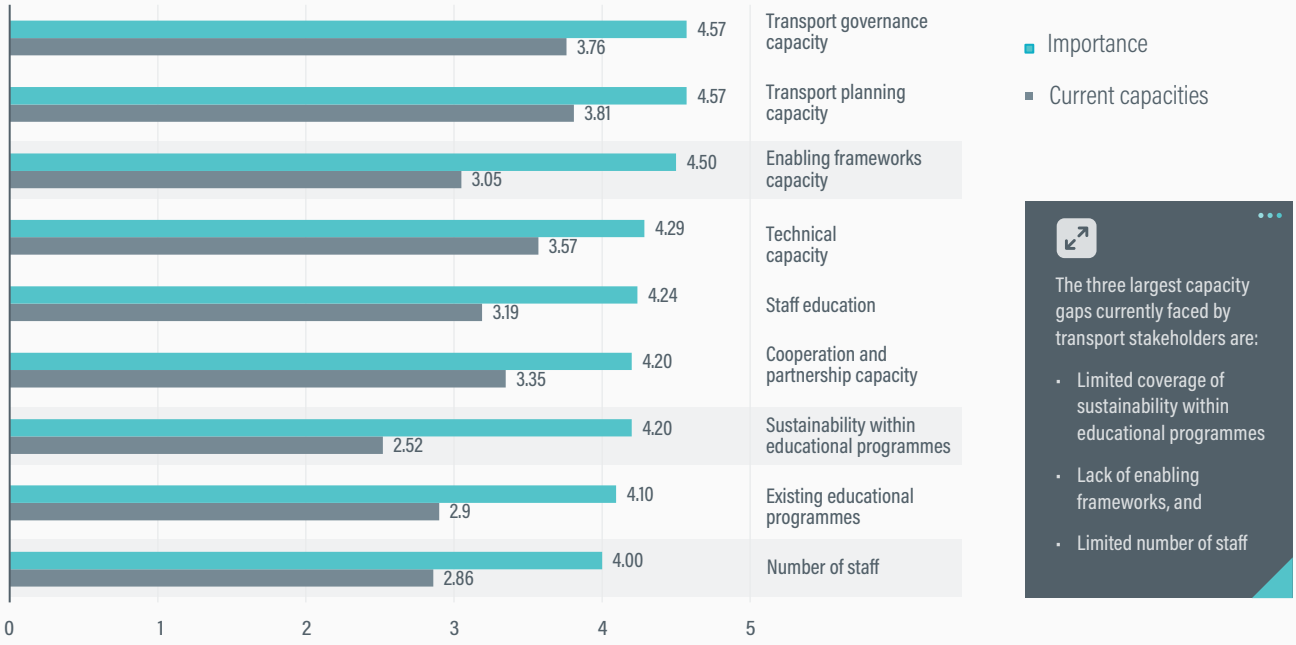


FIGURE 3. Average capacity gaps identified in 21 transport entities across 20 cities



Source: See endnote 26 for this section.

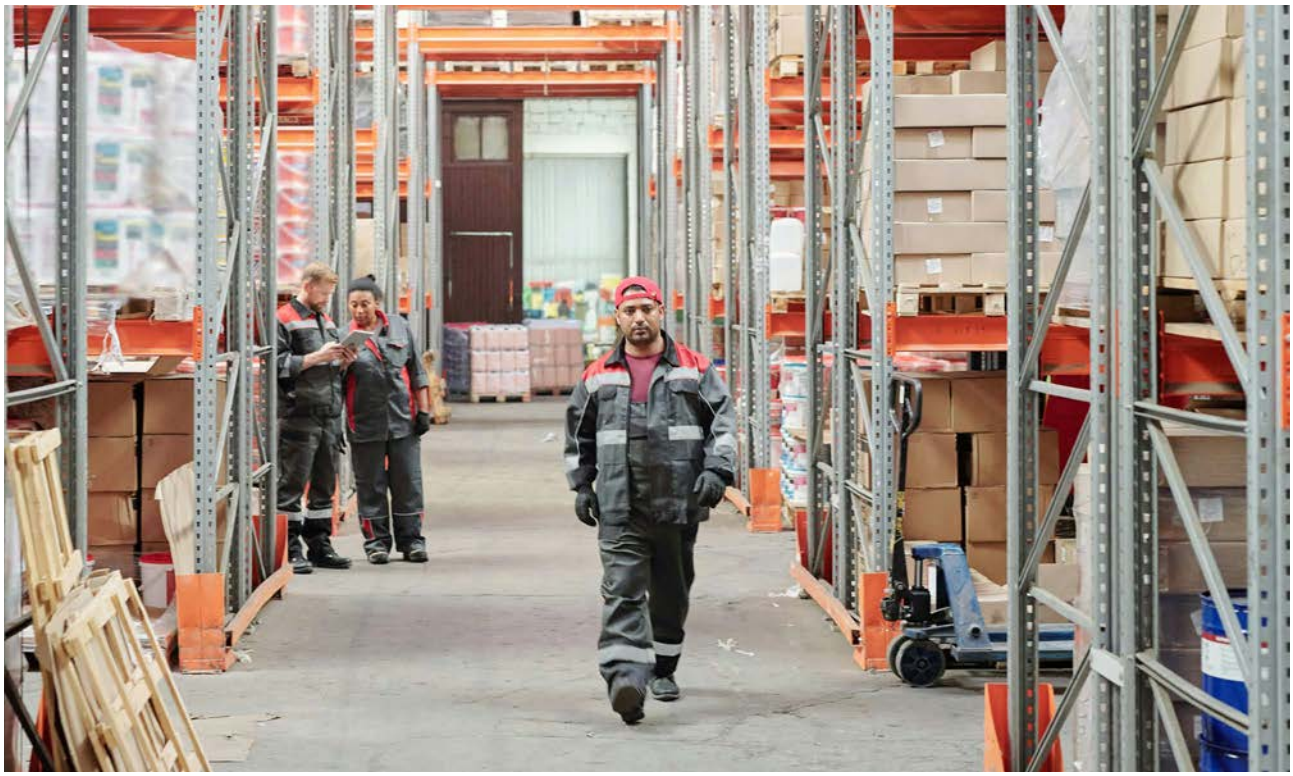
they often operationalise through institutionalised learning management systems. In Nigeria, the Lagos Metropolitan Area Transport Authority (LAMATA) conducts a comprehensive training needs assessment across departments to identify knowledge gaps and skills deficiencies.[18] This assessment is based on feedback from department heads, employee self-assessments and performance reviews.[19]

Despite broad expert agreement on the importance of conducting such capacity needs assessments, practice across transport entities does not always reflect this ideal.[20] **The approach to capacity development in many transport bodies tends to be *reactive* rather than *proactive*.**[21] This is because, in many cases, capacity assessment processes are not embedded within the internal procedures of passenger and freight transport stakeholders; instead, they are often ad-hoc exercises.[22]

A 2025 study by the Transformative Urban Mobility Initiative (TUMI) included a capacity gap analysis conducted across the three levels of capacity: individual, institutional and societal. Participating transport stakeholders were asked to rate the importance of specific capacities in enabling low-carbon transport in their local context, compared to their current levels of capacity. In doing so, the study was able to identify the three largest capacity gaps currently faced by transport stakeholders (Figure 3)**:**[23]

- **Sustainability within educational programmes:** The existing educational programmes do not sufficiently cover sustainable mobility and thus do not equip graduates with the knowledge and skills needed to support the transition to new systems of sustainable transport. In the context of the study, formal education refers to academic and non-academic programmes offered by higher education institutions and local training centres: from university programmes for future transport and logistics managers and decision makers, to professional or executive education programmes and specialised courses and trainings. The definition, however, does not include technical and vocational education provided via apprenticeships, for example.
- **Enabling societal frameworks:** The lack of enabling legal, political and socio-economic factors can hinder actions towards sustainable transport. The transport stakeholders reported significant challenges such as fragmented governance structure, complex approval processes, funding constraints, and the shift in political will and priorities.
- **Number of staff:** The transport stakeholders reported a significant workforce shortage, where they would require nearly double the current number of staff across different departments[iv], covering both technical and functional capacities.

iv The departments included in the study are those focusing on procurement, regulation, marketing and customer management, operations and maintenance, planning, budgeting and construction.



Lack of sustainability within educational programmes

Although education is increasingly acknowledged in international climate and sustainability policy, investment in climate and sustainability education has not matched the urgency of the current climate crisis.[24] **The 2025 TUMI study highlighted that the largest capacity gap identified across the different capacity levels was the lack of sustainability within formal educational programmes.**[25] Transport stakeholders surveyed reported that most educational programmes offered within and outside of universities at the national or sub-national levels provide only a foundational understanding of transport.

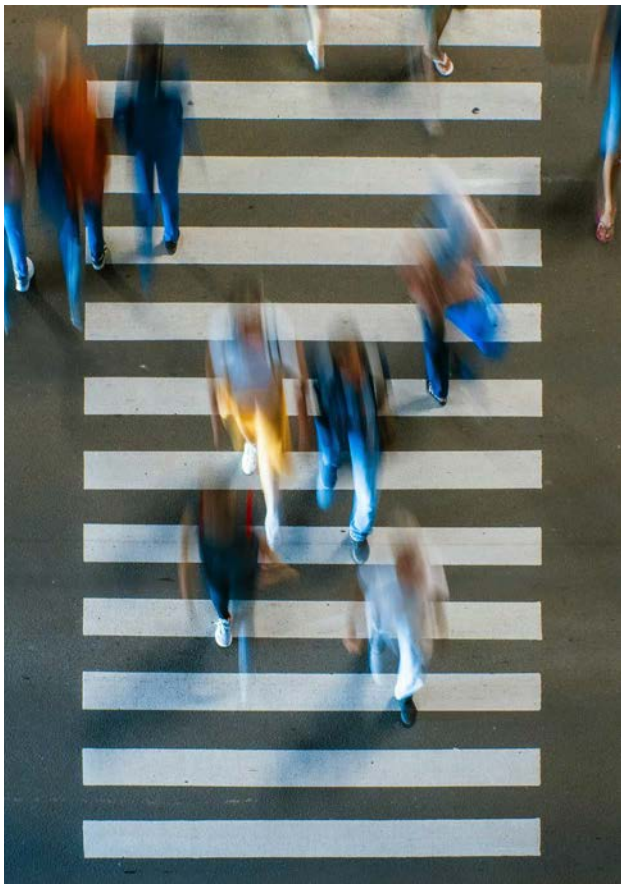
The study's thematic analysis revealed that the most prevalent disciplines addressing transport in formal education are transport engineering, urban planning and architecture, transport economics, and transport logistics and supply chain management. It points to the under-representation of sustainability and climate change themes within existing transport curricula. These themes are most often covered within stand-alone courses, or as modules within an existing course, although a few examples do exist of specialised programmes on sustainable mobility. However, the study was not exhaustive and did not cover all educational programmes in the surveyed countries.

Implications of the gap in sustainability within educational programmes

A key implication of the gap in sustainability within educational programmes is that transport stakeholders struggle to hire qualified personnel. If applicants do not have the right educational background covering sustainable transport and mobility, transport stakeholders may need to undertake a longer and costlier process to allocate the human resources required to successfully plan and implement sustainable transport projects and services within their cities and districts.

Existing staff members at transport entities often face challenges in carrying out their responsibilities due to both technical and functional capacity gaps. On the technical side, staff members may not be equipped with the (up-to-date) knowledge in areas such as sustainable mobility, or integrating climate considerations into transport policies. On a functional level, staff may struggle with cross-departmental co-ordination, budgeting, and project management, which are important in completing day-to-day tasks. These gaps can lead to delays, inefficiencies and poor outcomes in service delivery.

Trends such as digital transformation, electrification, and platform-based mobility and logistics services, along with the transformational needs and growing complexities of urban and mobility planning (such as adaptation and resilience to the impacts of climate change, shocks and crises), require a wide range of transport professions and jobs to acquire new skills. These new requirements



also impact professional education curricula, calling for the adjustment of existing programmes, the development of new ones and the emergence of new professions.

Transport stakeholders that have policies for continuing professional development

Promoting learning and professional development of employees is one of the cornerstones of staff attraction and retention policies.[26] Some employers provide continuous learning opportunities through partnerships with local and national academic institutions and research centres, or by providing trainings and generally supporting employees in attending courses in their field of work.[27] Some transport entities have dedicated person-days and budgets allocated for staff professional development.

In such settings, the costs and risks associated with developing the educational and technical backgrounds of employees are either fully borne by the employer, or shared between the employer and employee. Under a typical employer initiative, the employer assigns individual staff members to pursue short- or long-term educational programmes as part of their daily work arrangements (Box 2).[28] This can be done based on the findings of a capacity and/or training needs assessment conducted by human resources, strategy or other relevant departments.

Box 2. Employer initiative: capacity development process at Liberia's Ministry of Transport

In Liberia, the Ministry of Transport is responsible for developing the capacity of its staff in line with national service training policies. It must designate a training co-ordinator to co-ordinate with the Civil Society Agency and the Liberia Institute of Public Administration, prepare biennial training plans and ensure that all staff have individual development plans that align with their job profiles. Staff are also encouraged to undertake learning opportunities.

Although no formalised procedure exists for obtaining training leave, requests are usually approved and granted as normal working hours or paid leave, especially when aligned with annual capacity needs assessments. Staff members are then required to submit a post-training report by documenting insights and outcomes to ensure knowledge sharing and to contribute to the institutional memory by creating a record of relevant learnings that supports future staff development. This reflects an enabling approach that positions the Ministry as an active supporter of continuous capacity development, on both the individual and institutional levels.

Source: See endnote 29 for this section.

Under a typical employee initiative, individual staff members may put in a request to attend and/or participate in an educational programme, which they may deem as helpful for the delivery of their professional responsibilities (Box 3).[29] Their managers, human resources or other relevant departments would then assess the request based on the need and available resources, etc.

Box 3. Employee initiative: capacity development process at the African Union

At the African Union, learning opportunities, when officially approved, are treated as paid training leave, and in some cases, staff may receive a training allowance. Staff members are required to report on the outcomes of the training to ensure accountability and knowledge sharing, to help integrate new learnings into departmental practices.

In addition to supporting individually initiated opportunities, the African Union's training department pro-actively organises sessions on functional capacities such as leadership and management, inviting departments to nominate staff members to participate. This is complemented by an annual staff appraisal system, which allows supervisors to assess performance and carry out a basic training needs assessment, helping to identify relevant development opportunities for the upcoming year.

Source: See endnote 30 for this section.

Participation in educational programmes may be fully or

partially funded by the employer through concepts such as paid training leave or training allowance. Other models may fully fund the programme but require employees to sign an agreement stating they will return to the workplace after successful completion and mandate their stay within the transport institution for a minimum number of years. Such arrangements are often used to avoid losing qualified personnel in whom the employers have invested.

Transport stakeholders that do not have policies for continuing professional development

Transport stakeholders do not always have dedicated resources and/or policies in place to support individual employees to continue their professional development. Consequently, staff members are often forced to self-fund and self-manage their time to pursue external educational programmes.[30] In some cases, staff members engage in short-term, hybrid programmes that take place on weekends and/or allow asynchronous (flexible) participation. This way, employees may complete the educational programme outside of regular working hours, without needing to step away from their positions.

In other cases, employees may take an (unpaid) leave of absence, particularly when the educational programme mandates in-person (synchronous) engagement. Employees step away from their positions in pursuit of the degree, which would allow them to better perform their jobs upon return. Some workplaces may ensure keeping the employee's position and return after successful programme completion, while others may not. Thus, the employee not only carries the risk of funding the programme and giving up their income channel in the meantime, but also risks not having a job to return to.

Both scenarios show that when the workplace does not value continuing professional development, employees fully carry the direct and indirect costs associated with pursuing educational programmes.

Without institutionalised policies and budgets for continuing professional development, employees may struggle to engage in further learning, leading to bigger institutional knowledge gaps. In cases where existing educational programmes do not sufficiently address the needs of the market, individuals working at transport entities (staff members) and those wishing to be hired (potential staff members) may look outside their countries for educational programmes focused on sustainable transport and mobility.

Educational opportunities abroad can bring valuable exposure to global practices and networks, but reliance on them for professional development carries important implications and raises questions around accessibility, equity and scalability. Educational opportunities abroad are often only accessible to individuals who have the financial and non-financial means to take leave from their jobs and to travel to pursue the programmes. Moreover, the acquired knowledge abroad may not always align with the contextual realities of a local institution's transport environment.

If individuals seek educational programmes abroad to address the local sustainable educational gap, a potential outcome is brain drain, or the migration of skilled professionals from low- and middle-income countries to high-income countries. Research suggests that studying abroad – whether at the beginning of one's professional trajectory or in the middle of it – may increase the likelihood of professionals choosing to stay and/or move to a country different from their own upon programme completion.[31]

Alternatively, ensuring that the knowledge and skills for climate and sustainability action in transport are locally taught and nurtured can support lasting and scalable human and economic development in a given region, country or city.

Addressing the gap in sustainability in educational programmes

The international transport community provides a variety of capacity building activities aimed at addressing the gaps around sustainability within educational programmes. International organisations, non-governmental organisations and foundations are collaborating with local organisations and universities to offer capacity development opportunities that range from in-depth multi-year university-level degrees and curricula development (Boxes 4-8)**, to specialised executive education and graduate diploma programmes** (Boxes 9-10)**, to shorter term certified courses** (Boxes 11-17).[32]

Some capacity development programmes promote the inclusion and participation of applicants from low- and middle-income countries and of women by offering scholarships or reduced tuition fees. Beyond offering scholarships or fee reductions, capacity building programmes must be intentionally designed to integrate gender equality and care responsibilities. Aligning these programmes with broader gender and care agendas not only enhances participation but also increases the transformative impact of mobility policies, making them more responsive to the lived realities of diverse populations.



University degrees and curricula development

Box 4. Post-graduate degrees at the Regional Transport Research and Education Centre in Kumasi, Ghana (TRECK)

TRECK was launched by the Kwame Nkrumah University of Science and Technology (KNUST) in 2018 and is dedicated to strengthening post-graduate education, applied research and professional training in transport. Established as part of the World Bank-funded African Higher Education Centres of Excellence (ACE) programme, TRECK aims to expand the academic-industry collaboration in West Africa, specifically in transport interdisciplinary fields.

LOCATION: Kumasi (Ghana)

FREQUENCY: Annual intake of MSc and MPhil students; short courses offered periodically based on demand

FORMAT: In-person higher education programmes (MSc, MPhil, PhD and short courses)

LANGUAGE: English

INCENTIVES: Dual accreditation by the Ghana Tertiary Education Commission (GTEC) and internationally by the Agency for Quality Assurance through Accreditation of Study Programmes (AQAS) in Germany

COST: Paid tuition fees apply for all programmes; limited scholarships available

TARGET AUDIENCE: Students and public sector transport practitioners

PARTNERS:

- Regional academic partners: Nigeria Building and Road Research Institute, Fourah Bay College (Sierra Leone), University of Sierra Leone, University of Liberia
- National academic partners: Takoradi Technical University, Kumasi Technical University, Building and Road Research Institute (BRRI) in Kumasi, Regional Maritime University
- Government partners: Ministry of Transport, Ghana Highway Authority, Kumasi Metropolitan Assembly
- International partners: World Bank

Box 5. Master in Transport and Sustainable Urban Mobility in Africa by Codatu in Lomé, Togo

The master programme "Transport and Sustainable Urban Mobility in Africa" (*Transport et mobilité urbaine durable en Afrique*) covers the fundamentals of urban mobility in African cities, including global dynamics, mobility demand, transport planning, urban mobility governance, multi-modal transport offer, road management, transport operations, environment and social affairs.

LOCATION: Lomé (Togo)

DURATION: 18 to 24 months

FREQUENCY: Recurring annually since 2015, but paused since COVID-19

FORMAT: Synchronous master programme that includes a 2-3 month internship with a transport authority/operator/consultancy and the preparation of a master's thesis

LANGUAGE: French

COST: Paid fees (USD 3933 or EUR 3,800), with possible support through partial or full scholarships

TARGET AUDIENCE: Students who already have a first master's in a related area, or practitioners who decide to continue their education (in some cases with the encouragement of their employer). EAMAU is affiliated with the West African Economic and Monetary Union (UEMOA), so students are recruited within the region, and part of the cohort did their internship in France.

PARTNERS:

- Université Senghor: delivering the degree
- Ecole Africaine des Métiers de l'Architecture et de l'Urbanisme (EAMAU): hosting the programme
- Codatu: preparing the curriculum, identifying experts beyond the local partners, internships and funding opportunities for scholarships

Box 6. Master in Transport and Sustainable Urban Mobility by Codatu in Rabat, Morocco

The master programme "Transport and Sustainable Urban Mobility" (*Transport et mobilité urbaine durable*) covers sustainable urban mobility, urban mobility planning, governance, financing, transport demand, conducting and implementing public transport projects, developing and operating public transport networks, transport demand and fare policy, and traffic engineering and management.

LOCATION: Rabat (Morocco)

DURATION: 16 months

FREQUENCY: Recurring training since 2017, with four cohorts in 2017, 2018, 2021 and 2023

FORMAT: In-person continuous training for professionals including an internship and the preparation of a master's thesis. Lectures traditionally take place over the weekend every second week to accommodate the schedule of the participating professionals.

LANGUAGE: French

COST: Paid fees (USD 4140 or EUR 4,000), with the possibility of getting a full or partial scholarship

TARGET AUDIENCE: Professionals already appointed, mainly in the Agences d'Urbanisme of various cities in Morocco, experts and consultants, practitioners from local and national authorities.

PARTNERS:

- University Senghor: delivers the degree
- Institut National d'Aménagement et d'Urbanisme (INAU): hosts the programme
- Codatu: conceives the curriculum, identifies external experts, and internship and scholarships opportunities.

Box 7. Master in Sustainable Management and Operations at Kühne Logistics University

Founded in 2010, Kühne Logistics University (KLU) has campuses in Hamburg (Germany) and Saigon (Viet Nam) offering bachelor's, master's, MBA, Ph.D, and executive education programmes in business and management, administration, supply chain management and global logistics. Sustainability is a key competence area within the university and is tackled within the different programmes as part of lectures, dedicated courses and entire study programmes. An example is the part-time Master in Sustainable Management and Operations (SuMO).

LOCATION: Hamburg (Germany)

DURATION: 12 to 18 months

FREQUENCY: Annual intake

FORMAT: Part-time, in-person master's (with a thesis) or a certificate (no thesis); both tracks are required to apply the acquired sustainability concepts directly to a workplace or industry challenge through "Impact Projects"

LANGUAGE: English

COST: Paid tuition fees are required per semester, with the availability of 50% scholarships for applicants from low-and middle-income countries, female executives and staff working in the humanitarian sectors

TARGET AUDIENCE: The programme is offered in part-time format to target professionals with a two-year work experience as a minimum key requirement for admission.

PARTNERS:

- Main donor of KLU is the Kühne Foundation

Box 8. Catalysing Curriculum Change via the VREF Mobility and Access in African Cities (MAC) programme

The Mobility and Access in African Cities (MAC) programme aims to strengthen research and educational capacity on urban access and mobility in sub-Saharan African cities. It focuses on building academic capacity while ensuring that its knowledge outputs reach decision makers, business leaders, civil society, students and other key actors.

In education, MAC has initiated Catalysing Curriculum Change at universities in sub-Saharan Africa to encourage developing and implementing new, research-based postgraduate courses and online learning resources. A scoping study in 2020-2021 identified gaps in transport education, leading to this targeted call for curriculum development rooted in African contexts.

LOCATION: Sub-Saharan Africa (focus on Anglophone regions in Western, Eastern and Southern Africa)

FREQUENCY: Ongoing programme with periodic calls for proposals, workshops, short courses and educational initiatives

FORMAT: Academic capacity building, research funding, study visit grants, curriculum development, workshops, online learning resources and dissemination platforms

LANGUAGE: English

TARGET AUDIENCE: Academic researchers, early-career scholars, sub-Saharan African universities, and institutions engaged in mobility and access research

Executive education and diploma programmes

Box 9. Leading Transport Transitions Programme for city leaders transforming urban mobility

The Leading Transport Transitions programme is an executive education programme focused on equipping urban transport leaders with the policy tools and leadership strategies necessary to drive sustainable mobility transitions in emerging economy cities. Thematically, it addresses critical issues such as rising motorisation, persistent congestion, social exclusion and carbon-intensive transport systems.

LOCATION: Online and in London (United Kingdom)

FORMAT: Hybrid, with online asynchronous and synchronous sessions plus an in-person module with three-day intensive sessions in London (study tour)

LANGUAGE: English

COST: Funded by the German Federal Ministry for Economic Cooperation and Development (BMZ)

TARGET AUDIENCE: Mayors and high-level transport leaders

PARTNERS:

- Transformative Urban Mobility Initiative (TUMI)
- C40 Cities Climate Leadership Group
- LSE Cities at the London School of Economics and Political Science
- BMZ (German Federal Ministry for Economic Cooperation and Development)

Box 10. UITP and TUM Asia Graduate Diploma in Transportation Engineering

The International Association of Public Transport (UITP) is collaborating with the Technical University of Munich Asia (TUM Asia) to bring public transport industry case studies to academia. Targeting mid-level transport professionals with at least five years of experience in the public transport sector, the Graduate Diploma aims to equip participants with the relevant knowledge from the focus areas of Traffic Engineering, Transportation Planning, and Road and Rail Infrastructure Design and Development.

LOCATION: Singapore

DURATION: One module spans 10 half-days on average

FREQUENCY: To be launched in September 2025

FORMAT: In-person block teaching

LANGUAGE: English

INCENTIVES: Upon successful completion of the six modules and passing the exams, participants are awarded the Graduate Diploma in Transportation Engineering

COST: Paid, with preferential pricing for UITP members and for those signing up to multiple modules

TARGET AUDIENCE: Transport professionals based in Singapore and in Asia

Specialised courses and training programmes

Box 11. UITP Academy's Public Transport Fundamentals Training Programme

The UITP Academy offers a large training portfolio focused on diverse aspects of public transport. The programmes address functional capacities such as marketing and communication, but more so technical capacities focusing on the Fundamentals of Public Transport, Planning, Operations and Infrastructure, New Mobility Services, as well as Policy, Planning, Funding and Regulation, etc. The courses are recurring and can follow both an online distance-based learning format, and an in-person classroom-style format.

The Public Transport Fundamentals Training Programme targets professionals who have been in the transport field for less than two years. The learning objective of this long-standing training programme is to provide participants with fundamental knowledge on public transport and sustainable urban mobility through expert-led interactive online sessions.

LOCATION: Varies

DURATION: About 2 weeks

FREQUENCY: Recurring since 2002

FORMAT: Eight interactive online modules (previously in-person)

PACE: Synchronous

LANGUAGE: English

INCENTIVES: Participants receive certification upon successful completion

COST: Paid, with preferential pricing for UITP members and participants from developing countries

TARGET AUDIENCE: Junior transport professionals

Box 12. International Road Federation Road Safety Auditor Training and Certification Programme

This programme aims to enhance road safety by building standardised auditing capacities. It focuses on developing technical skills and competencies necessary for conducting road safety audits, in line with international best practices.

LOCATION: Dar es Salaam (Tanzania), Kampala (Uganda), New Delhi (India)

DURATION: 10 days

FREQUENCY: Recurring annually over a three-year period since 2024

FORMAT: Training course including practical field exercises and a final exam

PACE: Synchronous

LANGUAGE: English

Incentives: Participants receive certification upon successful completion, qualifying them for inclusion in the International Registry of Road Safety Auditors as Road Safety Observers

COST: None; fully funded by the TotalEnergies Foundation

TARGET AUDIENCE: Consulting firms, ministries, national road agencies, private sector engineers and consultants

PARTNERS:

- International Road Federation (IRF): Organiser and content provider
- TotalEnergies Foundation: Funding

Box 13. International Road Assessment Programme training and accreditation: Road Infrastructure Safety and Safest Route Planning

The activities offered within the International Road Assessment Programme (iRAP) focus on the role of safer road infrastructure in improving road safety outcomes. It equips participants with the skills to undertake iRAP assessments and promotes awareness among fleets and logistics stakeholders about road safety risks and safest route planning.

LOCATION: Global

FREQUENCY: Recurring

FORMAT: iRAP training courses, in-person workshops, webinars, conferences, regional workshops and participation in the annual iRAP Innovation Workshop

LANGUAGES: Training and resources are offered in English, Spanish, Portuguese, French, Bahasa Indonesia, Vietnamese, Russian and Hindi.

COST: Most activities, especially webinars and knowledge sessions, are free of charge due to support from the FIA Foundation and other donors

INCENTIVES: The core iRAP training includes full learning management principles suitable for credit hours and associated accreditation and certificates of qualification

TARGET AUDIENCE: Government staff, road industry professionals, iRAP-accredited suppliers, World Bank, UN and regional development banks, investors, non-governmental organisations, youth groups, and fleet managers through the Network of Employers for Traffic Safety (NETS).

IMPACT: Over 1,300 courses and/or capacity building activities completed with more than 75,000 participants worldwide.

PARTNERS:

- Key donors: the FIA Foundation (main donor), Aleatica Foundation, FedEx, 3M and Prudential PLC.
- Strategic partners: United Nations Road Safety Fund, Millennium Challenge Corporation, Global Road Safety Facility, regional development banks and national/sub-national governments.

Box 14. Ochenuel Mobility Solutions' Africa Sustainable Urban Mobility course

The Africa Sustainable Urban Mobility Course focuses on diverse aspects of sustainable urban transport including a dedicated module on urban freight. The urban freight module is usually tailored to the needs of the audience each time the course is delivered in a city.

LOCATION: Varies, notably in: Lagos, Abuja and Benin City (Nigeria), Accra (Ghana), Addis Ababa (Ethiopia), Cairo (Egypt)

DURATION: 3-5 days

FREQUENCY: Conducted 14 times in six African cities since its inception in 2019

FORMAT: In-person workshops and trainings

LANGUAGE: Primarily English, with occasional French translation

INCENTIVES: Offers certification in urban mobility

COST: When supported by an international partner, the course is offered free of charge; otherwise, the hosting institution covers costs on a non-profit basis

TARGET AUDIENCE: City representatives, transport departments and traffic agencies

IMPACT: Since the first edition in Abuja, Nigeria (2019), the course has trained 1,025 participants from 42 African countries

PARTNERS:

- International organisations fund participation, provide expert trainers, or cover costs (e.g., UN-Habitat, UN Environment, GIZ, TUMI, Federal Ministry of Transportation Nigeria, French Development Agency)
- Academic partners support in preparing course content, sharing resources and providing expert trainers (e.g., National Open University of Nigeria Abuja, (Nigeria), Centre for Multi Modal Transport in University of Lagos, (Nigeria), Transport Research and Educational Center, Kwame Nkrumah University of Science and Technology Kumasi (Ghana)

Box 15. Smart Freight Centre Academy's Introduction to Road Freight Electrification

The Smart Freight Centre Academy is a knowledge and learning hub for freight and logistics decarbonisation. Hosted by the international non-profit Smart Freight Centre (SFC), the Academy delivers a wide range of self-paced and live virtual courses designed to build capacity across the logistics value chain – from emissions accounting and sustainable procurement to road freight electrification.

The Introduction to Road Freight Electrification course is designed for stakeholders participating in road freight electrification. Participants explore the urgency and importance of electrifying logistics, the role of road freight in supply chain decarbonisation and the socio-technical aspects of electrifying fleets. The course covers critical decision-making factors for prioritising which operations to electrify and the required groundwork, including vehicle and charging infrastructure.

DURATION: 3-4 hours

FORMAT: Online

PACE: Asynchronous self-paced course (MooC)

LANGUAGE: English

INCENTIVES: Participants earn a certificate of completion after completing the course

TARGET AUDIENCE: Sustainability professionals, logistics managers, procurement officers and corporate teams

Box 16. World Bank Leaders in Urban Transport Planning Workshop

The Leaders in Urban Transport Planning (LUTP) programme empowers policy makers and practitioners with the knowledge and skills needed to diagnose urban mobility challenges and craft effective strategies to promote more liveable, more sustainable cities.

LOCATION: Varies, most recently in: Kathmandu (Nepal), Arusha (Tanzania), Quito (Ecuador)

DURATION: 6-7 days

FREQUENCY: Recurring annually since 2012

FORMAT: In-person and self-study

PACE: Asynchronous self-study modules and in-person interactive training workshop

INCENTIVES: Case studies developed by the Harvard Kennedy School Case Programme, site visits, and certificate of completion upon full attendance and participation in group work

TARGET AUDIENCE: Mid-to senior-level managers and policy makers who occupy or will occupy leadership positions in urban transport planning, governance, management and operations in developing countries

IMPACT: The LUTP programme has trained more than 2,600 practitioners from 105 countries through 81 different workshops

PARTNERS:

- Korean Green Growth Trust Fund (KGGTF): financial partner
- Public-Private Infrastructure Advisory Facility (PPIAF): financial partner
- Partnership Fund for the Sustainable Development Goals: financial partner
- Africa Transport Policy Programme (SSATP): educational partner
- World Resources Institute (WRI): educational partner

Box 17. TUMI training and e-learning courses

The Transformative Urban Mobility Initiative (TUMI), implemented by GIZ and funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), offers several specialised courses on its e-learning platform. From courses focusing on transport planning for sustainable cities to zero-emission vehicles deployment and data management for sustainable cities, the courses are recurring, free of charge and can be followed synchronously (live moderation) or asynchronously (self-paced via recorded sessions).

DURATION: 9 weeks

FORMAT: MooC

PACE: Asynchronous self-study modules

LANGUAGE: English

COST: None

INCENTIVES: Participants can obtain an optional certificate upon completion by subscribing to FutureLearn

TARGET AUDIENCE: Transport and city planning practitioners in the Global South, academics, researchers, students, national and city authorities, consultancies and civil society

IMPACT: Over 4,000 participants registered in this course as of July 2025

PARTNERS:

- UCL: course co-development and trainers
- FutureLearn Platform: hosts the MooC and provides the certificates

Way forward

Education remains an undervalued instrument in formulating and implementing emission mitigation, adaptation, resilience and broader sustainability solutions in transport.[33] A significant structural gap in current curricula and institutional arrangements prevails, particularly the lack of systemic integration of sustainability into education and the persistent disconnect between theoretical research and its application in practice.[34]

This disconnect is symptomatic of broader global challenges in ensuring equitable access to quality, relevant, and actionable education and knowledge and effective knowledge transfer, particularly in low- and middle-income countries. Such inequality deepens disparities in how regions can respond to transport, climate and sustainability challenges. In response, various international organisations and institutions have support capacity through international development co-operation and official development assistance (ODA).

Moreover, the persistent phenomenon of brain drain further weakens the local capacity of transport and mobility sectors. Talented individuals often leave their home countries due to limited opportunities for advanced study and professional development, exacerbating human resource shortages in key public and private institutions.

A geographically balanced design of capacity development programmes is essential, as many current initiatives remain concentrated in capital cities or national-level agencies, often leaving sub-national and local authorities underserved. Expanding outreach and tailoring content to smaller cities and rural areas is key to ensuring inclusive and context-relevant mobility transitions.

The interdisciplinary nature of sustainable transport and the multi-disciplinary competencies needed for transformative action in transport governance complicates these dynamics. Beyond traditional fields such as engineering and architecture, the transport sector depends on expertise from other multi-disciplinary areas, such as marketing, workforce development, data analytics, social sciences and political economy. Yet many educational programmes still fail to keep pace with shifting industry needs and market demands.

Successful capacity building initiatives demonstrate that multi-stakeholder collaboration can bridge these gaps. International development agencies, non-governmental organisations, think tanks, academic institutions, private firms and public authorities each bring complementary strengths. Together, they can support various stages of the capacity development project cycle and contribute to sustainable education for transport.

Sustainable, long-term strategies should prioritise structural changes in higher education curricula, and foster collaboration among local universities, global institutions, the transport sector and development co-operation actors. Such collaboration can promote co-developed, interdisciplinary programmes tailored to local contexts, embedding climate and sustainability education into formal qualifications and professional training.

To ensure that these structural reforms and partnerships are effective over time, it is essential to implement continuous monitoring and evaluation systems. These systems can measure not only the quality of capacity building programmes but also the progress in applying acquired knowledge to decision making and sustainable transport management. This approach helps identify gaps between training and real-world practice, enabling adjustments that enhance the transformative impact of education in the sector.

In the near term, one option could be to create a globally supported scholarship fund dedicated to studies in sustainable transport, backed by stakeholders across the international transport sector. This fund could specifically support undergraduate and post-graduate studies in sustainable transport (structured as full-time or part-time programmes). Eligibility criteria could prioritise professionals working in (public) transport institutions with a conditional return-to-origin clause requiring scholarship recipients to contribute to their home countries for a minimum period of time after programme completion.

Investing in stronger academic collaboration between universities in the Global North and the Global South presents a strategic opportunity for capacity building in the transport sector. ODA funding could be effectively channelled to support such partnerships, particularly by engaging second-tier universities that serve broader societal segments beyond economically privileged groups. An example is the Mexican Academic Network for Public Transport, an initiative in its initial phase with support from GIZ.[35] Likewise, the institutionalisation of post-monitoring and evaluation tools – such as impact surveys, institutional performance assessments and alumni networks – can strengthen the continuity and scalability of capacity development initiatives.

By promoting equitable and sustainable access to specialised education and ensuring its relevance to practice, the international transport community can accelerate the transition to sustainable transport systems and services. The range of potential initiatives would not only strengthen institutional capacity but also address the underlying causes of talent loss and skills mismatch.

LIST OF ABBREVIATIONS

A-S-I Avoid-Shift-Improve
A-S-I-F Activity–Structure–Intensity–Factor
A2Z Accelerating to Zero Coalition
A4E Airlines For Europe
AAAM African Association of Automotive Manufacturers
ACEA European Automobile Manufacturers Association
ACI Airports Council International Europe
ACT ACT benchmarking methodology
ADA Americans with Disabilities
ADB Asian Development Bank
AfCFTA African Continental Free Trade Area
AFD Agence Française de Développement
AfDB African Development Bank
AFIR Alternative Fuels Infrastructure Regulation (EU)
AI Artificial intelligence
ALICE Alliance for Logistics Innovation through Collaboration in Europe
ALP Asia LEDS Partnership
ANWAC African Network for Walking and Cycling
APS Announced Pledges Scenario
ARENA Australian Renewable Energy Agency
ARTC Australian Rail Track Corporation
ASEAN Association of Southeast Asian Nations
AVERE European Association for Electromobility
B10 / B30 / B100 10% / 30% / 100% biofuel blend
BAU Business as usual
BEV Battery electric vehicle
BMZ German Ministry for Economic Cooperation and Development
BRT Bus rapid transit
BTR Biennial transparency reports of the Paris Agreement
BS Bharat Stage
C40 C40 Cities Climate Leadership Group
CAF Development Bank of Latin America
CAFE Corporate Average Fuel Economy
CARB California Air Resources Board
CBI Confederation of British Industry
CCF Corporate Carbon Footprint
CDP Carbon Disclosure Project
CDR Carbon Dioxide Removal
CDRI Coalition for Disaster Resilient Infrastructure
CEVA Corporate Electric Vehicle alliance
CH_4 Methane
CII Carbon Intensity Indicator (ship operational efficiency)
CITA International Motor Vehicles Inspection Committee
CLEPA European Association of Automotive Suppliers
CLG Corporate Leaders Group
CNAM National Conservatory of Art and Crafts of Paris
CNG Compressed natural gas
CO_2 Carbon dioxide
CO_2eq Carbon dioxide equivalent
COP Conference of the Parties to the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC)
CORSIA Carbon Offsetting and Reduction Scheme for International Aviation
CountEmissionsEU Proposed EU regulation setting a common method to calculate/report GHG emissions from transport services
CRS (OECD) Creditor Reporting System
CUTRIC Canadian Urban Transit Research & Innovation Consortium
DAC (OECD) Development Assistance Committee
DACCS Direct Air Carbon Capture and Storage
DFI(s) Development finance institution(s)
DRC Democratic Republic of the Congo
DT4A Digital Transport for Africa
DWT Deadweight tonnage
e-bike Electric bike
e-scooter Electric scooter
EAMAU African School of Architecture and Urban Planning
ECA Export Credit Agency
ECF European Cyclists' Federation
ECOWAS Economic Community of West African States
EDGAR Emissions Database for Global Atmospheric Research
EEA European Economic Area
EEDI Energy Efficiency Design Index
EEXI Energy Efficiency Existing Ship Index
EIB European Investment Bank
EIE Environmental Insights Explorer
EIT Climate-KIC EIT Climate Knowledge & Innovation Community
EJ Exajoule
ERA European Regions Airline Association
ERPS European Parliamentary Research Service
ERRAC European Rail Research Advisory Council
ERT European Round Table for Industry
ESCAP Economic and Social Commission for Asia and the Pacific
EST Forum Environmentally Sustainable Transport Forum (Asia)
ETERC European Transport and Energy Research Centre
ETF Enhanced Transparency Framework of the Paris Agreement
ETS Emission Trading System
EU European Union
EUR Euro
Euro 7 Latest EU road-vehicle pollutant emission standard
EV Electric vehicle
EVE France's voluntary public-private environmental initiative for freight and logistics ("Programme EVE")
FAME Faster Adoptions and Manufacturing of Hybrid and Electric Vehicles
FCDO UK Foreign, Commonwealth & Development Office
FCEV Fuel cell electric vehicle
FDI Foreign direct investment
FI(s) Financial institution(s)
G7 / G20 Group of Seven / Group of Twenty
GAME Global Alliance for Maritime Electrification
GBP British pound sterling
GCF Green Climate Fund
gCO2/kWh grams of CO2 per kilowatt-hour
GDP Gross domestic product
GEF Global Environment Facility
GFDT Global Facility to Decarbonize Transport
GFEI Global Fuel Economy Initiative
Gg Gigagrams
GHG Greenhouse gas
GIZ Deutsche Gesellschaft für Internationale Zusammenarbeit
GLEC Global Logistics Emission Council
GMAC Green Maritime Africa Coalition
GSR SLOCAT Transport, Climate and Sustainability Global Status Report
GST Global Stocktake of the Paris Agreement
GVCs Global value chains
GW Gigawatts
HAG High Ambition Group
HCN Health and Climate Network
HDM Highway Development and Management Model
HDV Heavy-duty vehicle
HEAT Health Economic Assessment Tool
HICs High-income countries
HVT High-Volume Transport Applied Research Programme
IATA International Air Transport Association
ICAO International Civil Aviation Organization
ICCT International Council on Clean Transportation
ICE Internal combustion engine
ICLEI Local Governments for Sustainability
IDB Inter-American Development Bank
IDDRI Institute for Sustainable Development and International Relations
IEA International Energy Agency
IFIEC International Federation of Industrial Energy Consumers
IISD International Institute for Sustainable Development
IKI International Climate Initiative
ILO International Labour Organization
IMF International Monetary Fund
IMO International Maritime Organization
InnovFin EU "Finance for Innovators" initiative

InvestEU European Commission–backed investment programme
IPCC Intergovernmental Panel on Climate Change
IRA Inflation Reduction Act (US)
IRAP International Road Assessment Programme
IRENA International Renewable Energy Agency
IRF International Road Federation
ISM Informal and Shared Mobility in Low-and Middle-Income Countries
ISO International Organization for Standardization
IsDB Islamic Development Bank
ISSB International Sustainability Standards Board
ITDP Institute for Transport and Development Policy
ITF International Transport Forum (OECD)
ITS Institute of Transport Studies
ITS-Davis Institute of Transportation Studies, University of California, Davis
JETPs Just Energy Transition Partnerships
JRC Joint Research Centre (European Commission)
km kilometre
km/lpe Kilometres per litre of petrol equivalent (efficiency unit)
kWh Kilowatt-Hour
l/100 km Litres per 100 kilometres (fuel-consumption unit)
LAC Latin America and the Caribbean
LAMAT Locally Adapted Modified and Advanced Transport
LAMATA Lagos Metropolitan Area Transport Authority
LDCs Least developed countries
LDV Light-duty vehicle
LEAP Leapfrogging to E-mobility Acceleration Partnership (LEAP Fund)
LEDS Low-emission development strategy
LEZs Low-emission zones
LG-CTA Leadership Group for Clean Transport in Asia
LIA Labour impact assessment
LMICs Low- and middle-income countries
LNG Liquified natural gas
LPG Liquefied petroleum gas
LRMT Lagos Rail Mass Transit
LT-LEDS Long-Term Low Emission Development Strategy
LTAG Long-Term Global Aspirational Goal
LTS Long Term Strategies
LUTP Leaders in Urban Transport Planning
MaaS Mobility-as-a-service
MAC Mobility and access
MARPOL International Convention for the Prevention of Pollution from Ships
Mbd Million barrels of oil per day
MCS Megawatt Charging System (heavy-duty vehicle fast-charging standard)
MDB Multilateral development bank
MGPCA Marrakech Partnership for Global Climate Action
MJ Megajoule
MNEs Multi-national enterprises
MoU Memorandum of Understanding
mpg Miles per gallon (fuel-economy unit)
MRV Emission monitoring, reporting and verification
MTCC Maritime Technology Cooperation Centre
Mtoe Million tonnes of oil equivalent
N_2O Nitrous oxide
NACTO National Association of City Transportation Officials
NAMA Nationally appropriate mitigation action
NAMATA Nairobi Metropolitan Area Transport Authority
NAPA National adaptation programme of action
NAP National Adaptation Plan
NDC-TIA NDC Transport Initiative for Asia
NDC Nationally Determined Contribution
NEDC New European Driving Cycle
NEM National electricity market
NEV New energy vehicle
NEVI National Electric Vehicle Infrastructure (US) Formula Program for charging networks
NO_2 Nitrogen dioxide
NO_x Nitrogen oxides (shipping/air quality pollutant)
NTS2 Scotland's National Transport Strategy
NUMO New Urban Mobility Alliance
NUMPs National Urban Policy and Investment Programmes
NZ Net Zero
°C Celsius
ODA Official development assistance
OECD Organisation for Economic Co-operation and Development
OEM(s) Original equipment manufacturer(s)
PAAPAM Pan-African Action Plan for Active Mobility
PATH Partnership for Active Travel and Health
PCF Product Carbon Footprint
PCREEE Pacific Centre for Renewable Energy and Energy Efficiency
PDR People's Democratic Republic
PIARC World Road Association
PIEVC Public Infrastructure Engineering Vulnerability Committee
PM Particulate matter
$PM_{2.5}$ Fine particulate matter ≤2.5 µm
PPF(s) Project Preparation Facility(ies)
PPPs Public-private partnerships
PRISM Partnership for Research in Informal and Shared Mobility
PTI Periodical Technical Inspections
R&D Research and development
RAAHI Auto-Rickshaw in Amritsar through Holistic Intervention
RED III EU Renewable Energy Directive (recast)
REN21 Renewable Energy Policy Network for the 21st Century
ROG Reactive Organic Gases
RSI Roadside Inspections
RWP (European Commission's) Roadworthiness Package
SAF Sustainable aviation fuels
SBT Science Based Targets Initiative
SDGs Sustainable Development Goals
sHYpS Sustainable Hydrogen-powered Shipping consortium
SIDS Small island developing states
SLOCAT SLOCAT Partnership on Sustainable, Low Carbon Transport
SMMT Society of Motor Manufacturers and Traders
SOE(s) State-owned enterprise(s)
SOV Service Operation Vessel
SO_2 Sulphur dioxide
SO_x Sulphur oxides
SSATP Africa Transport Policy Program
STEPS Stated Policies Scenario
SULPs Sustainable urban logistics plans
SUMPs Sustainable urban mobility plans
SUV Sport utility vehicles
TAZARA Tanzania-Zambia Railway Authority
T&E Transport & Environment
TDI Transport Decarbonisation Index
TEN-T Trans-European Transport Network
TEU Twenty-foot Equivalent Units
THC Total hydrocarbons
THE PEP Transport, Health and Environment Pan-European Programme
TICCS Infrastructure Company Classification Standard
TUMI Transformative Urban Mobility Initiative
U-KNOW Knowledge-sharing database (UPPER project)
U-TRANSFER Best-practice transfer tool (UPPER project)
UC University of California
UCI Union Cycliste Internationale
UCL University Colleague London
UIC International Union of Railways
UITP International Association of Public Transport
UKAID United Kingdom aid funding (via the UK Foreign, Commonwealth & Development Office)
ULEZs Ultra-low-emission zones
UN United Nations
UNCTAD United Nations Conference on Trade and Development
UNDESA United Nations Department of Economic and Social Affairs
UNDP United Nations Development Program
UNDRR United Nations Office for Disaster Risk Reduction
UNECE United Nations Economic Commission for Europe
UNEP United Nations Environment Programme
UNFCCC United Nations Framework Convention on Climate Change
UNIDO United Nations Industrial Development Organization

UPPER Unleashing the Potential of Public Transport in Europe
USA United States of America
USD United States Dollar
USDN Urban Sustainability Directors Network
V1G Unidirectional "grid-to-vehicle" smart charging
V2G Vehicle-to-grid bidirectional charging
VAT Value-added tax
VDA German Association of the Automotive Industry
VNO-NCW Dutch Employers' Federation
VLR Voluntary local review (of the SDGs)
VNR Voluntary national review (of the SDGs)
VREF Volvo Research and Educational Foundations
WBA World Benchmarking Alliance
WBCSD World Business Council for Sustainable Development
WHO World Health Organization
WRI World Resources Institute
WSC World Shipping Council
ZEB Zero-emission bus
ZEBRA Zero Emission Bus Rapid-deployment Accelerator
ZEMBA Zero Emission Maritime Buyers Alliance
ZEV Zero-emission vehicle
ZEVWISE Zero-Emission Freight Corridors initiative (Drive to Zero/Global Drive to Zero)
ZEZ-F Zero-emission zone for freight
ZEZ Zero-emission zone
ZIPAR Zambia Institute for Policy Analysis and Research

ENDNOTES

1.1
10 YEARS AFTER THE PARIS AGREEMENT AND THE 2030 AGENDA, ON THE PATH TO THE UN DECADE OF SUSTAINABLE TRANSPORT

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1.3
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S1
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1.5
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2.3
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3.1
AFRICA REGIONAL OVERVIEW

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4.3 WALKING

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S1
SECOND-HAND VEHICLES

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SPOTLIGHT ON
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