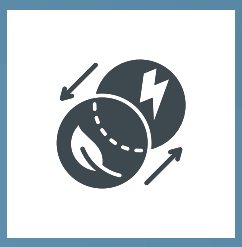


Shaping the Just Transition: Challenges and Opportunities towards Sustainable Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION

MODULE 1

LIST OF FIGURES

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

The Right to Mobility in a Sustainable and Inclusive Society

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

Logistics for Climate Action

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

Driving Gender Equality: Empowering Women and Transforming Transport

A Just Transition in Transport: A Double Challenge

Driving Health Forward: The Critical Link Between Transport and Wellbeing

LIST OF TABLES

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

Logistics for Climate Action

AUTHORS:
Heather Allen, Independent Consultant; Genevivie Ankunda, Maruxa Cardama, Akshay Jamdade, Nikola Medimorec, Jules Vincent, SLOCAT

CONTRIBUTOR:
Holger Dalkmann, Sustain2030

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

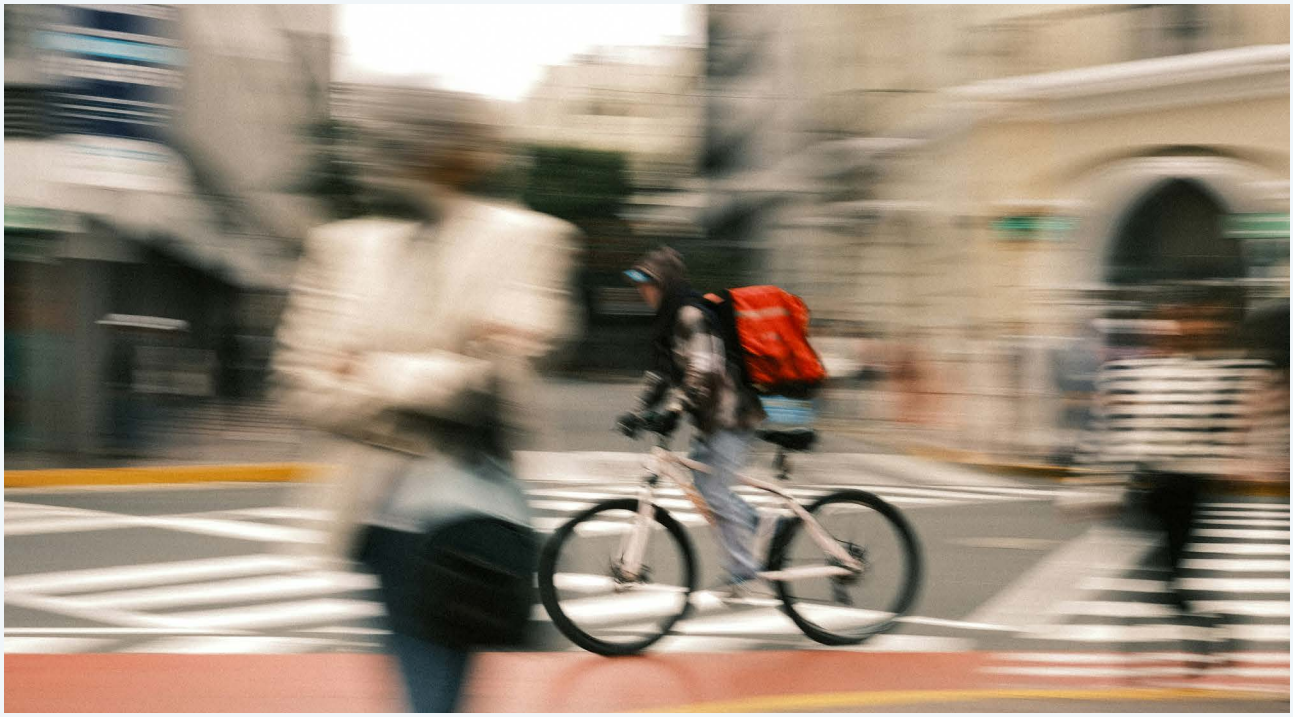
Transport demand, use and access, and sustainability and climate trends in transport

- 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]

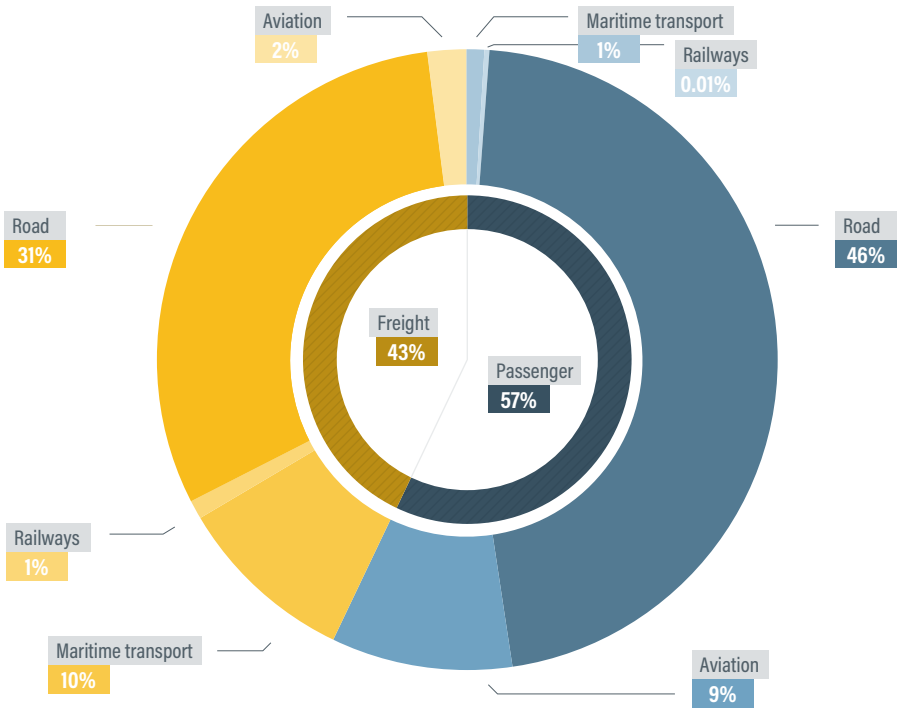
Transport is a significant contributor to greenhouse gas and CO_2 emissions. In 2023, it remained the fastest growing and second largest emission sector (after the power industry sector), responsible for 15.9% of global greenhouse gas emissions and for 21.9% of global CO_2 emissions.[57] Road vehicles 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

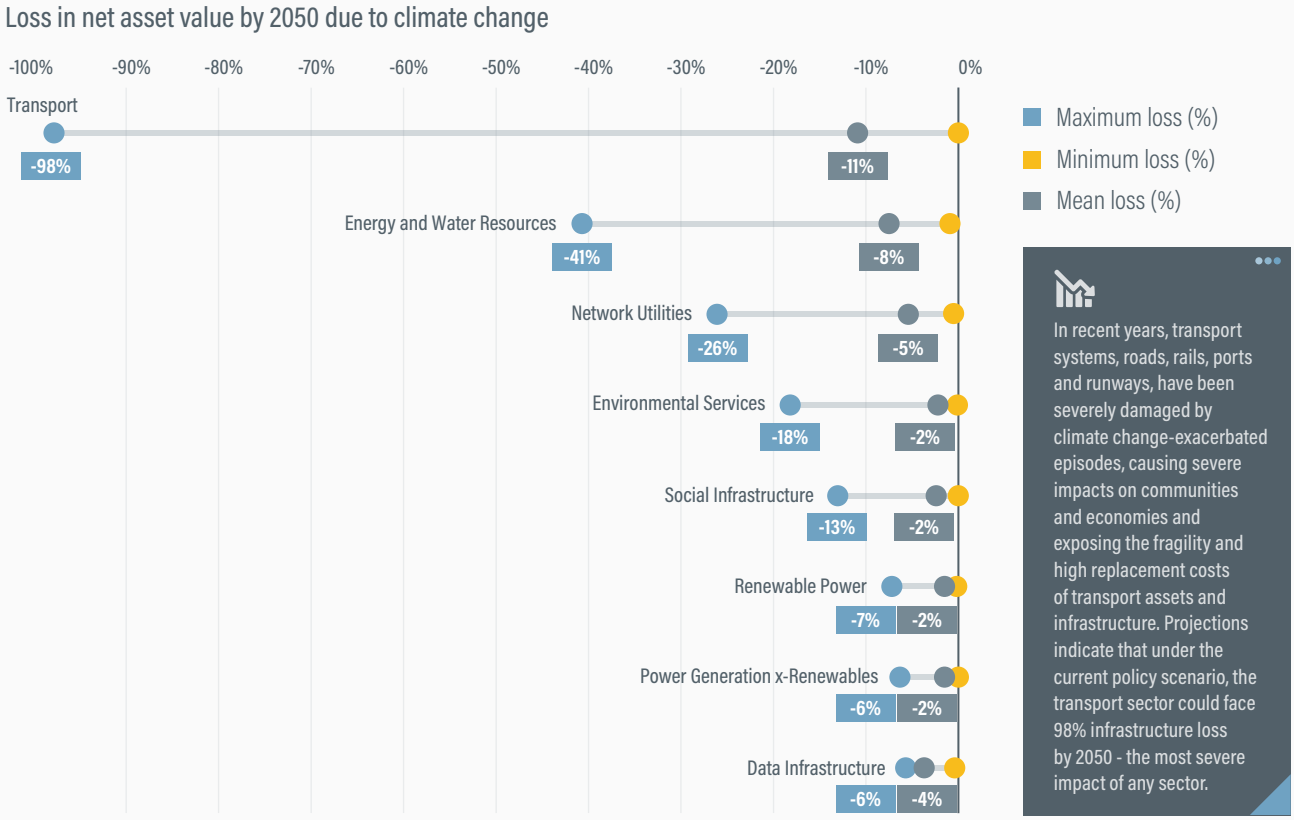
CO_2 emissions from aviation grew 2%, indicating some efficiency gains but still resulting in a net increase in emissions over the period.[82] In 2023, international aviation emitted 498 million tonnes of CO_2 equivalent.[83] Aviation's CO_2 equivalent emissions were expected to surpass their 2019 level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

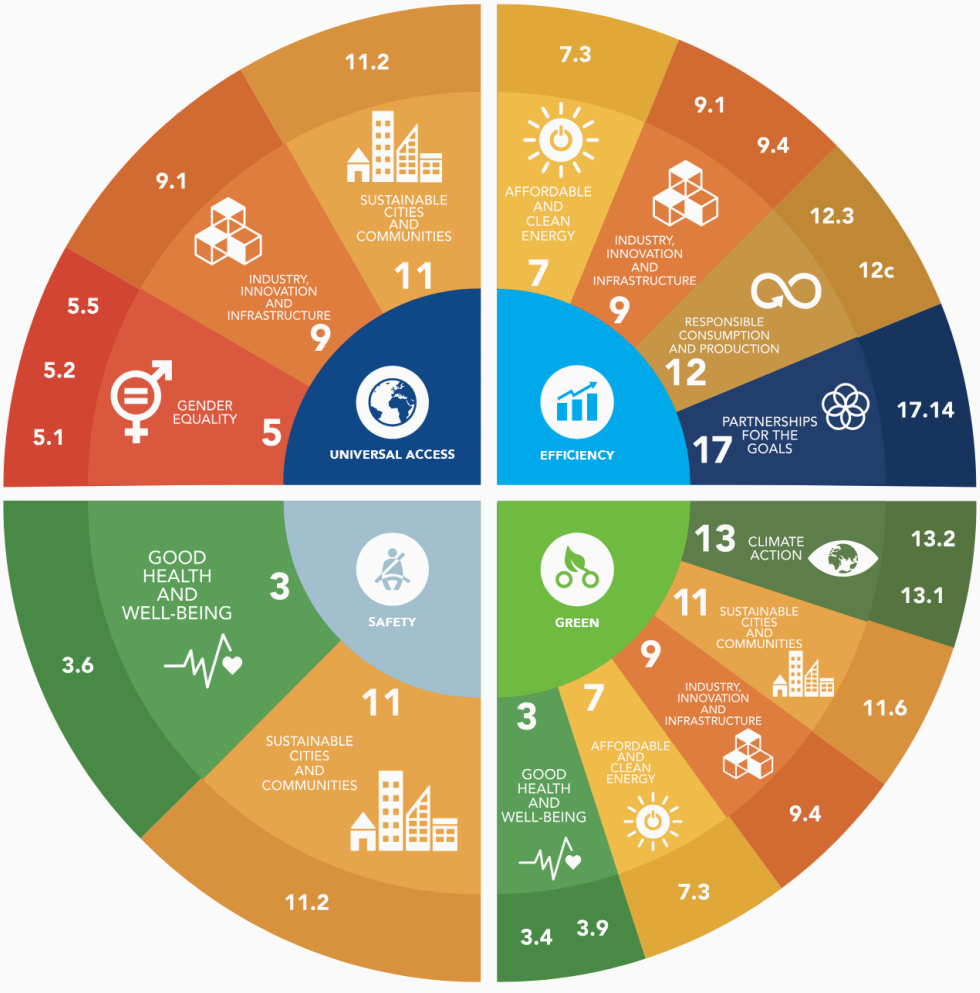
Over the years, the transport dimension of multilateral climate and sustainability processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes. However, current transport policies and investments for climate and 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.)

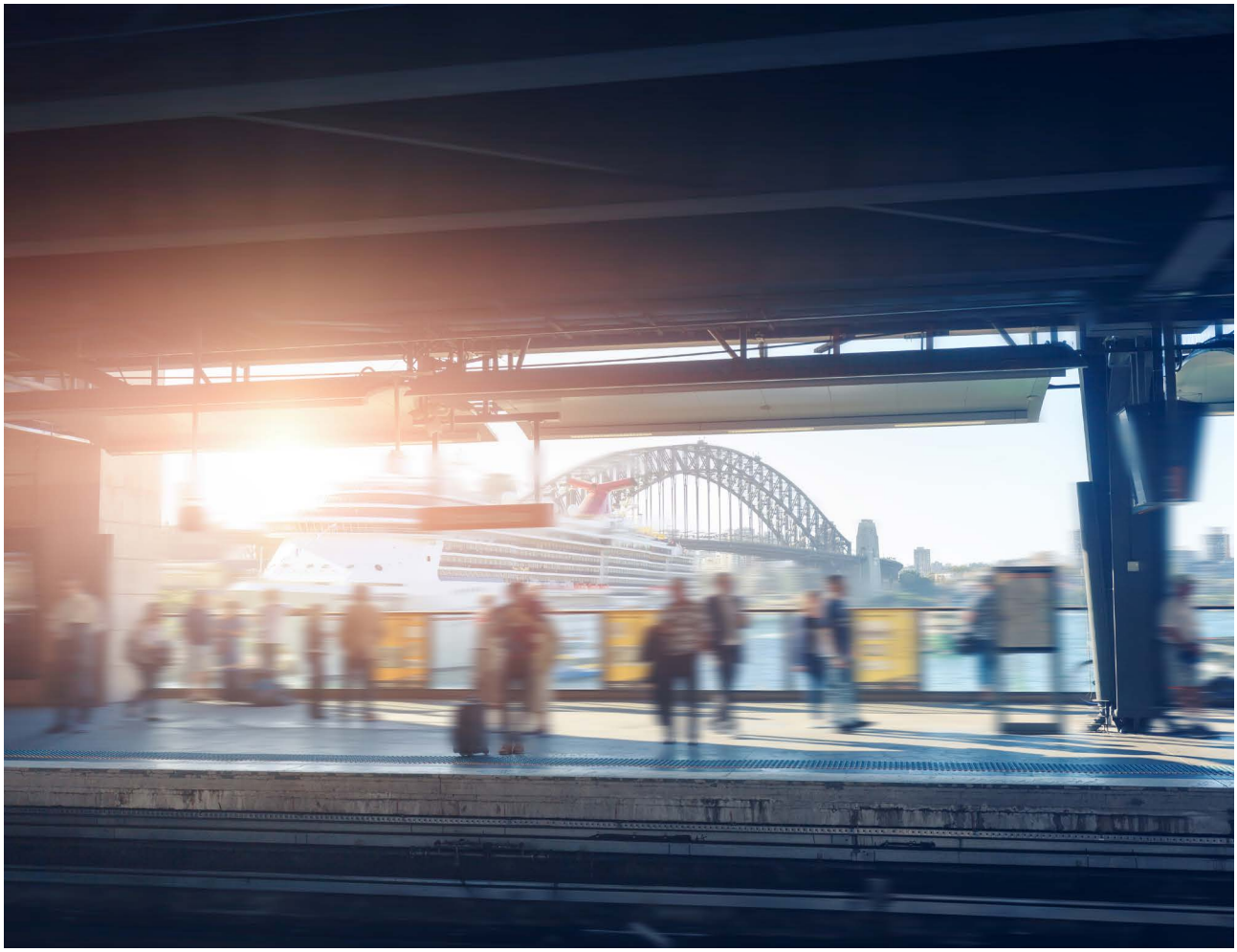
In 2021, Parties established the Mitigation Work Programme (MWP) at the UN Climate Change Conference in Glasgow, United Kingdom (COP 26) to "urgently scale up mitigation ambition and implementation" to help reach the Paris Agreement's 1.5°C goal.[128] At COP 27 in Sharm El-Sheikh (Egypt), Parties further 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.

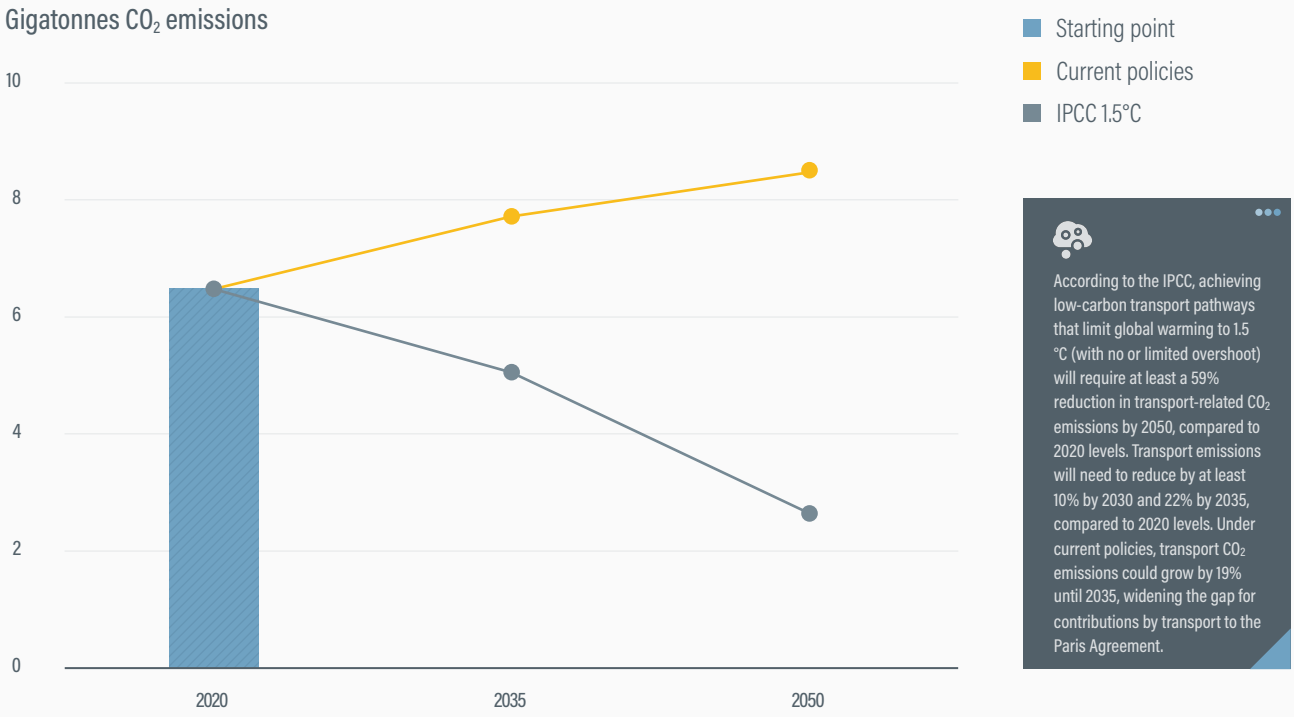
The IPCC has highlighted that total economy-wide greenhouse gas emissions need to peak before 2025 at the latest and to decline 43% by 2030 to limit global warming to 1.5°C (with no or limited overshoot).[152] Because the remaining carbon budget is limited, rapid and deep mitigation of emissions is needed 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]

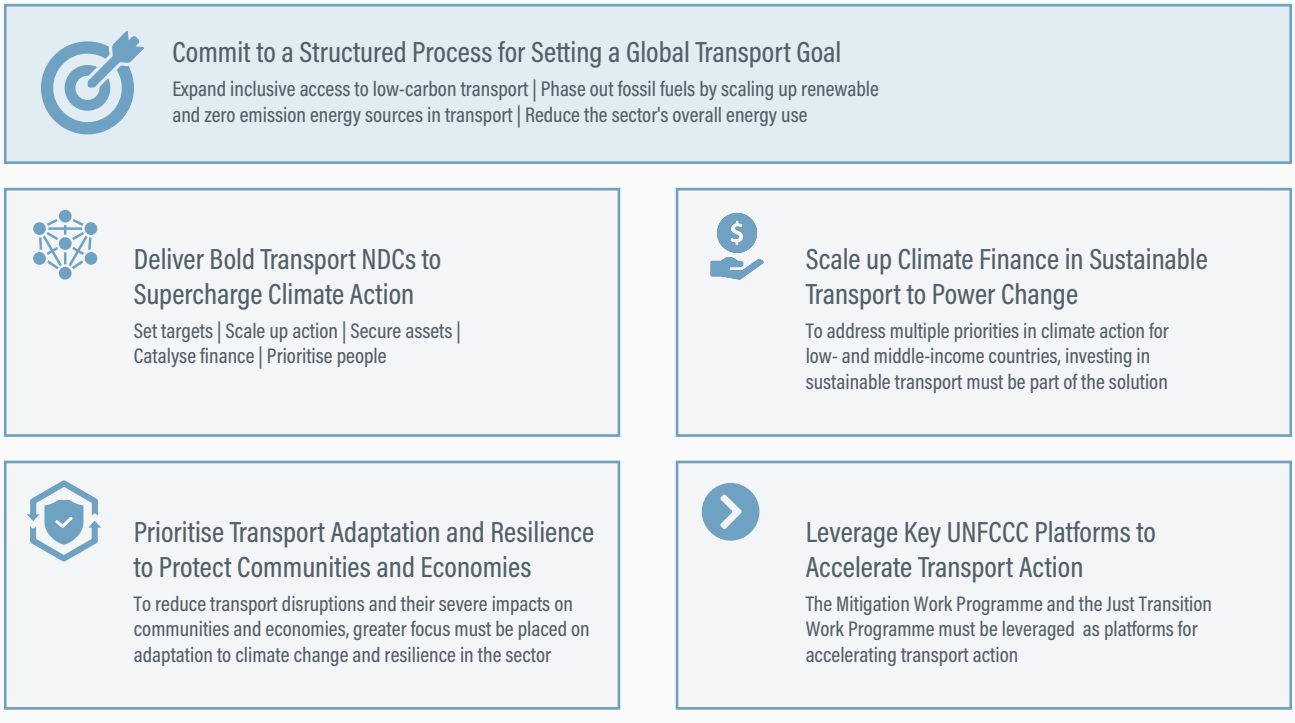
At COP 30, leaders can kick-off a structured process for setting a quantified global goal for the decarbonisation of transport: expanding inclusive access to low-carbon transport, phasing out fossil fuels by scaling up renewable and zero-emission energy sources in transport, and reducing the sector's 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]

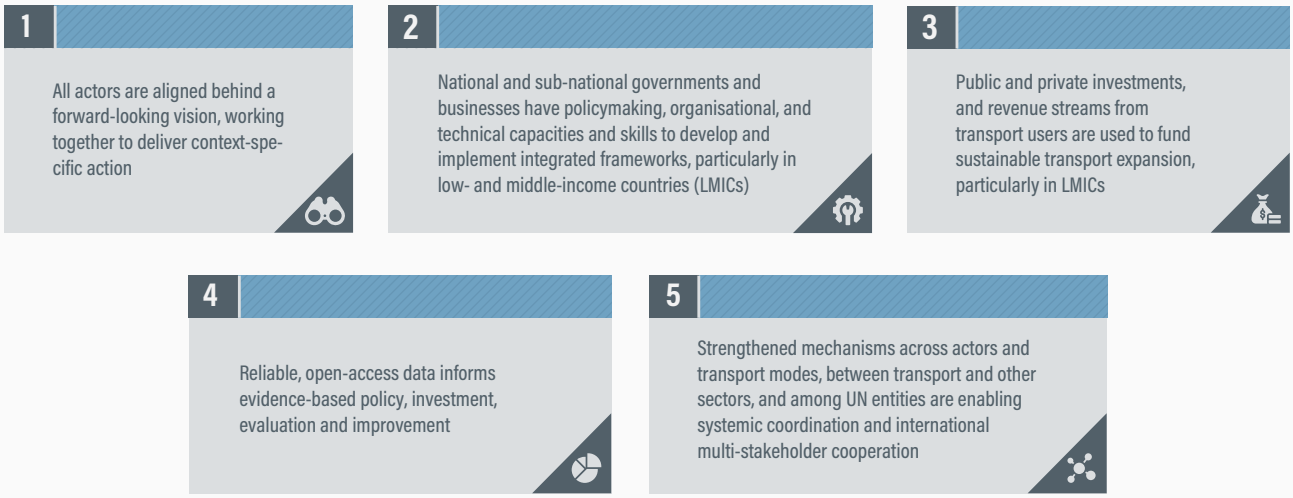
SLOCAT underscores that this UN Decade should serve as a global call to action, encouraging and supporting governments, businesses, users, financiers, civil society and academia to accelerate both individual and collaborative efforts in advancing sustainable transport.[182]

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

AUTHORS:
Jacob Mason, Institute for Transportation and Development Policy (ITDP);
Genevivie Ankunda, SLOCAT

CONTRIBUTORS:
Alyssa Alvarez, ITDP; Maruxa Cardama, SLOCAT

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

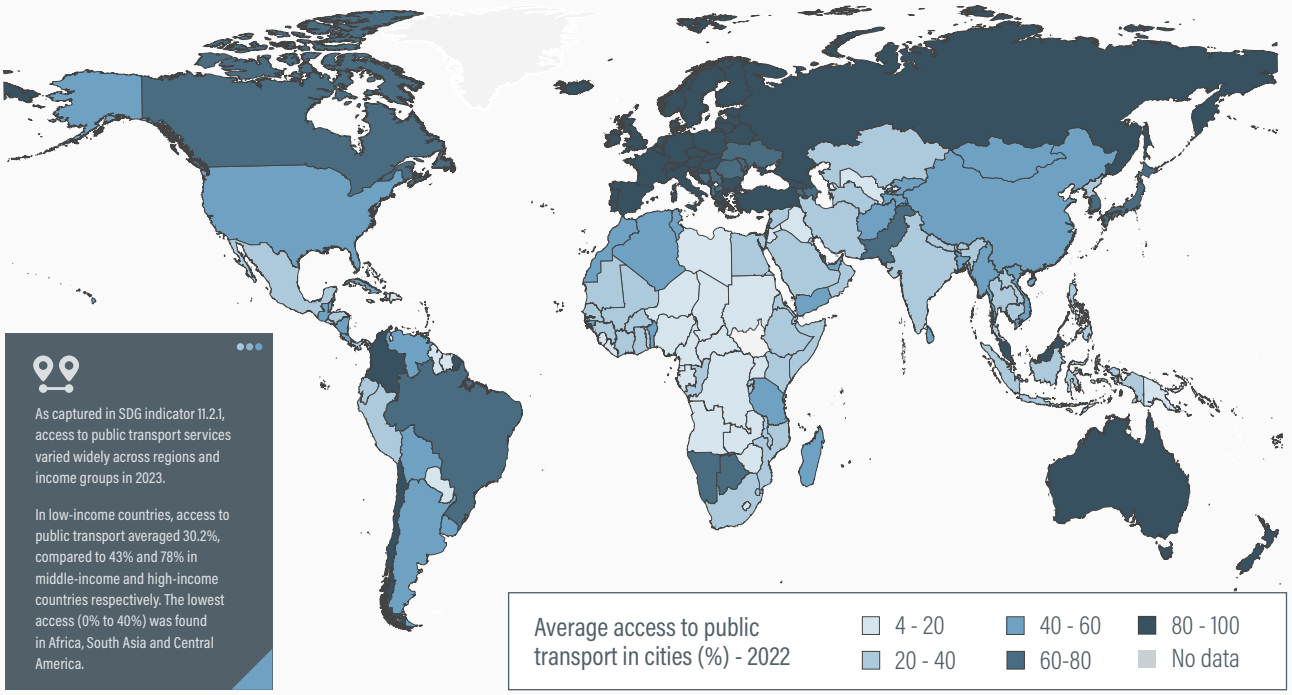
to public transport averaged 30.2%, compared to 43% and 78% in middle-income and high-income countries respectively. The lowest access (0% to 40%) was found in Africa, South Asia and Central America (Figure 1).[13] **In many areas, public transport remains unaffordable for low-income households.** (See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

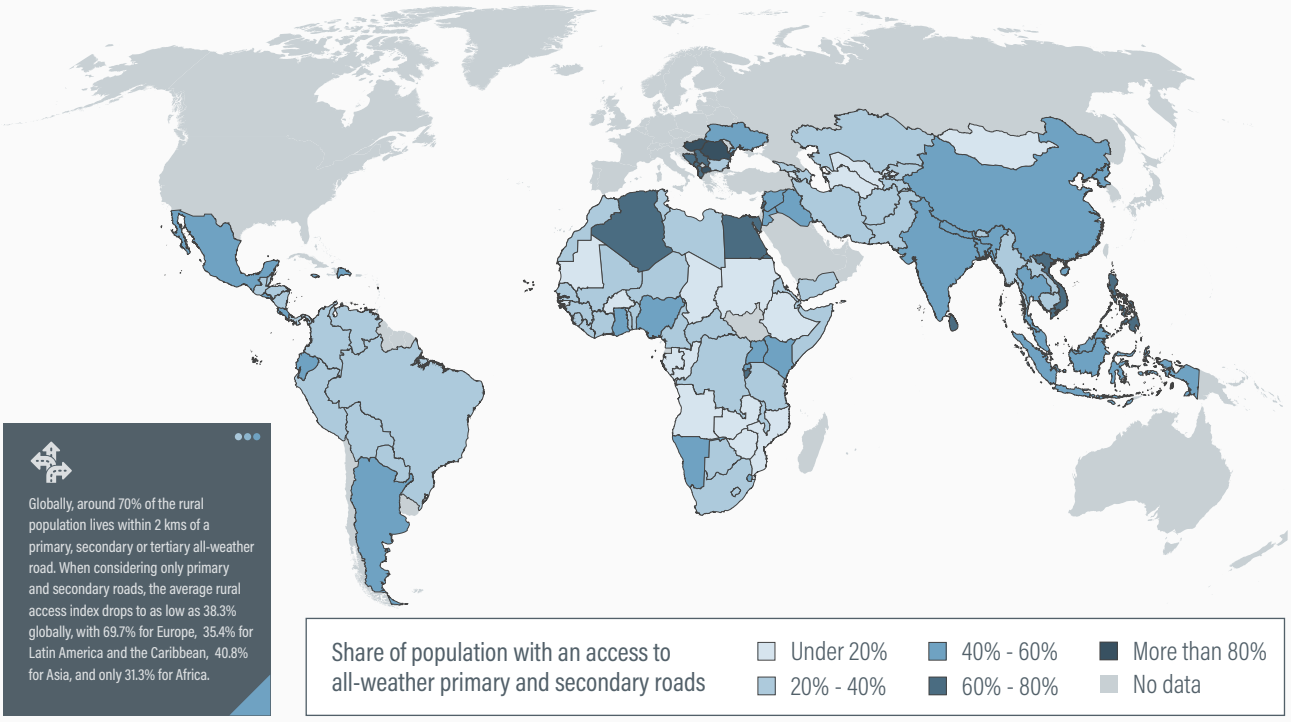
In rural or remote communities, transport availability, accessibility and affordability are often significant challenges. Rural communities typically have higher concentrations of older people with mobility challenges, and the rural population is more likely to have lower incomes. As a result, people 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

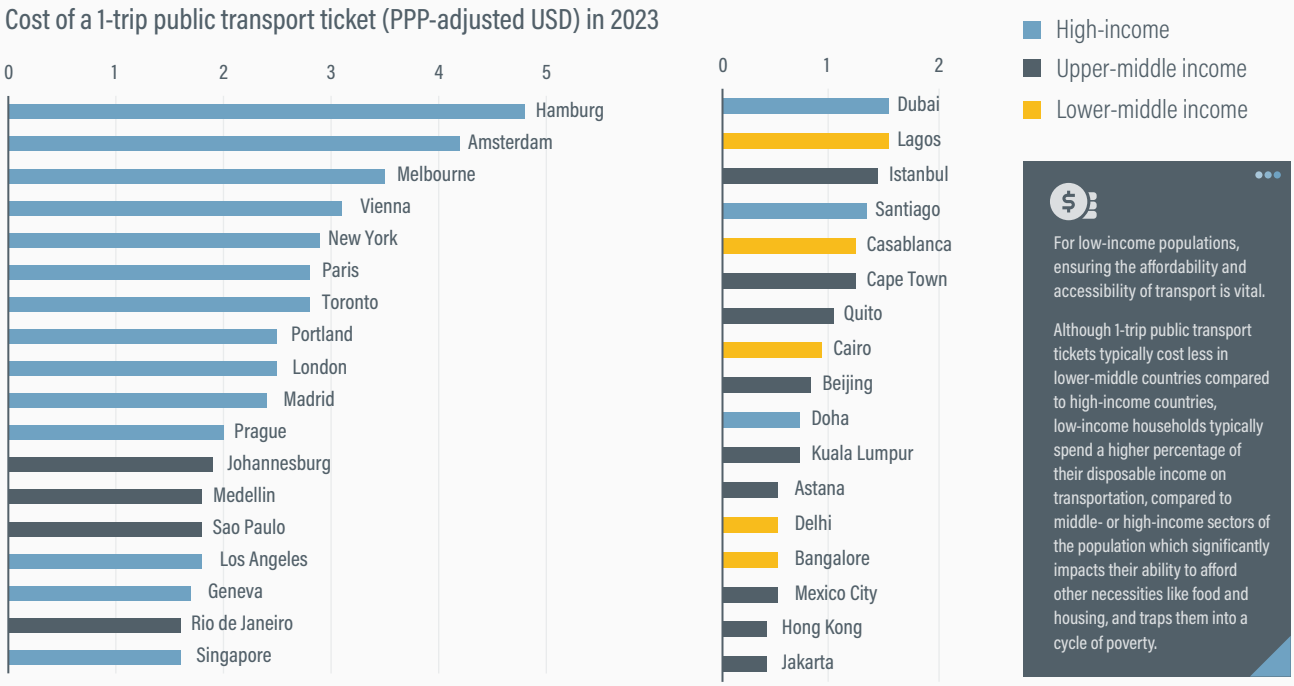
Conventional mobility systems, which tend to rely heavily on cars and fossil fuels, have wide-ranging negative economic, health and environmental impacts.

- 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]

AUTHORS:
Henrik Gudmundsson, CONCITO; Nikola Medimorec, SLOCAT

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.

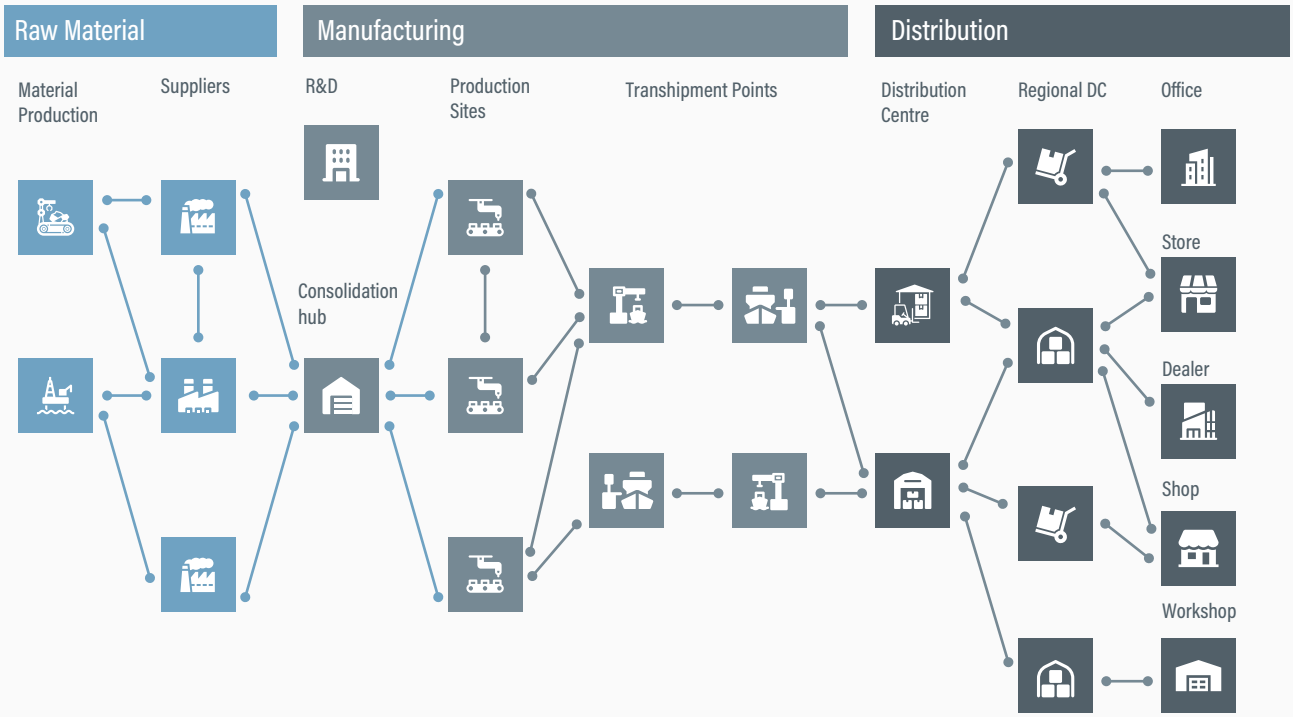
Context, challenges and opportunities

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.

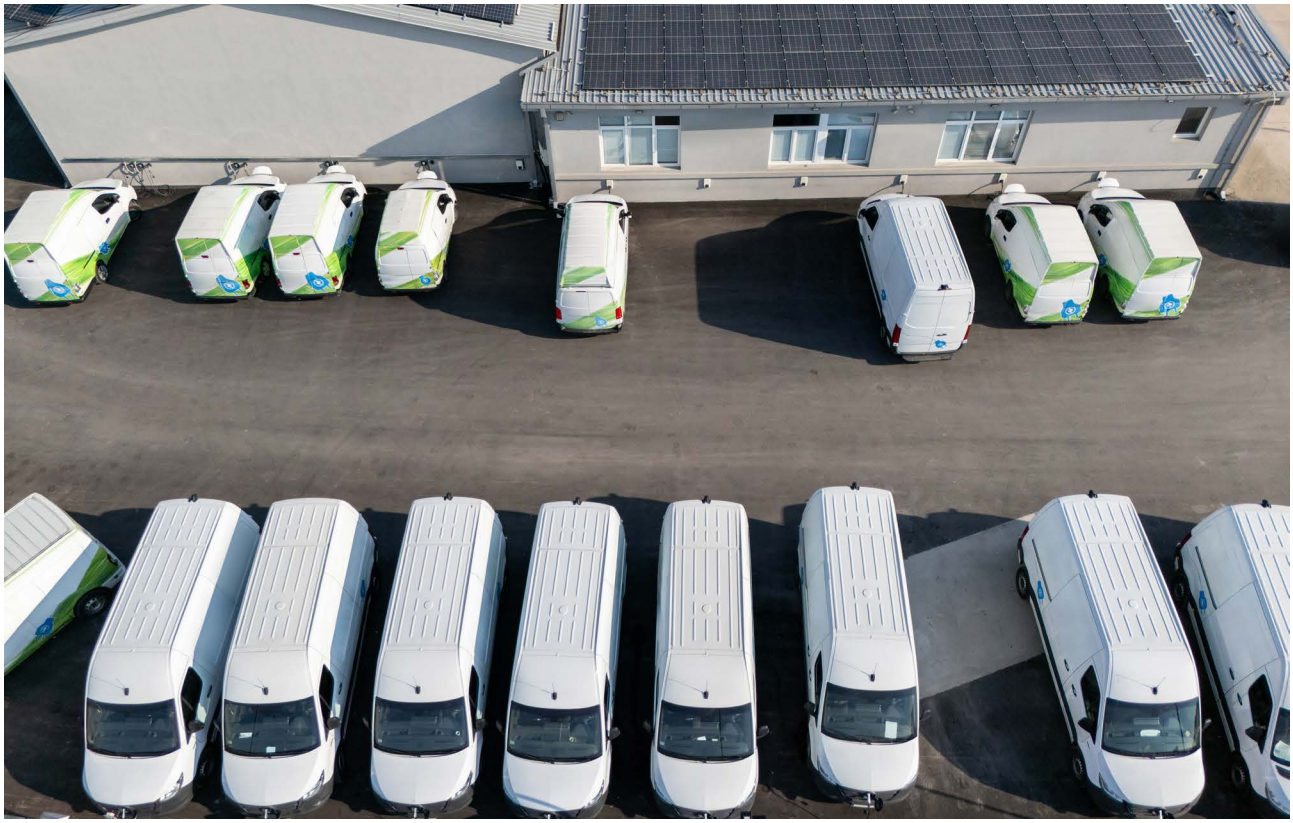
The dual nature of the climate crisis has made this Achilles' heel increasingly evident:

- 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]

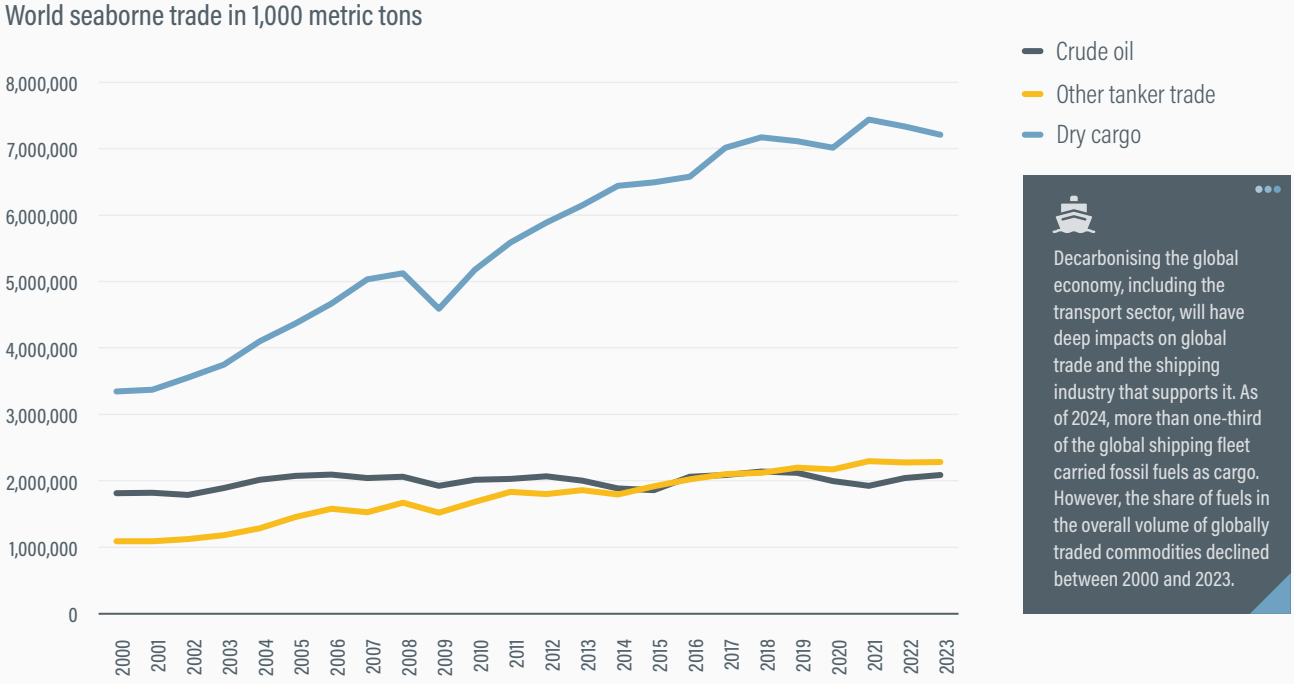
In 2022, the most traded product by value globally was crude petroleum, followed by cars, refined petroleum and integrated computer circuits; China was the biggest overall exporter, and the United States was the biggest importer.[20] **Apart from general trade "imbalances", this points to the high significance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

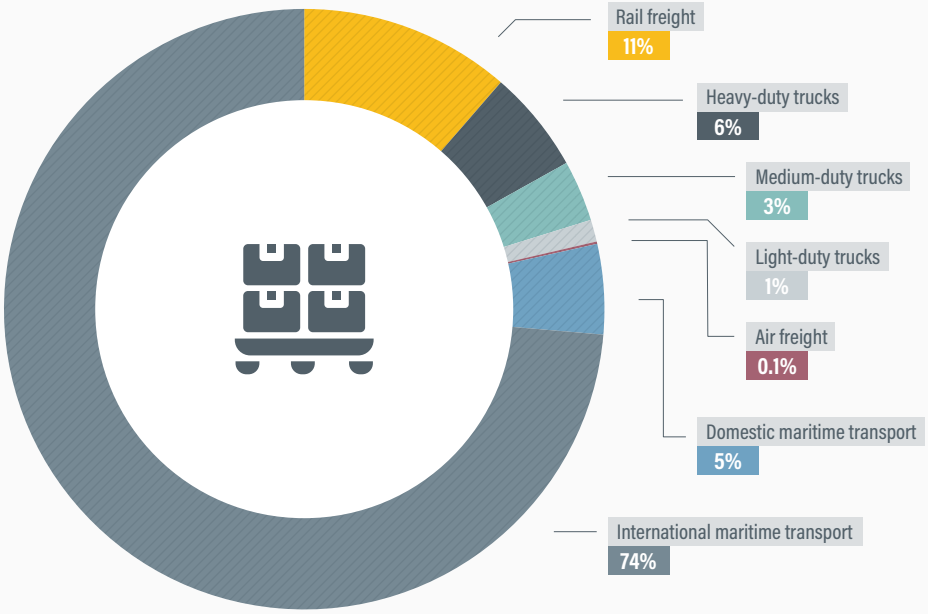


Decarbonising the global economy, including the transport sector, will have deep impacts on global trade and the shipping industry that supports it. As of 2024, more than one-third of the global shipping fleet carried fossil fuels as cargo. However, the share of fuels in the overall volume of globally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

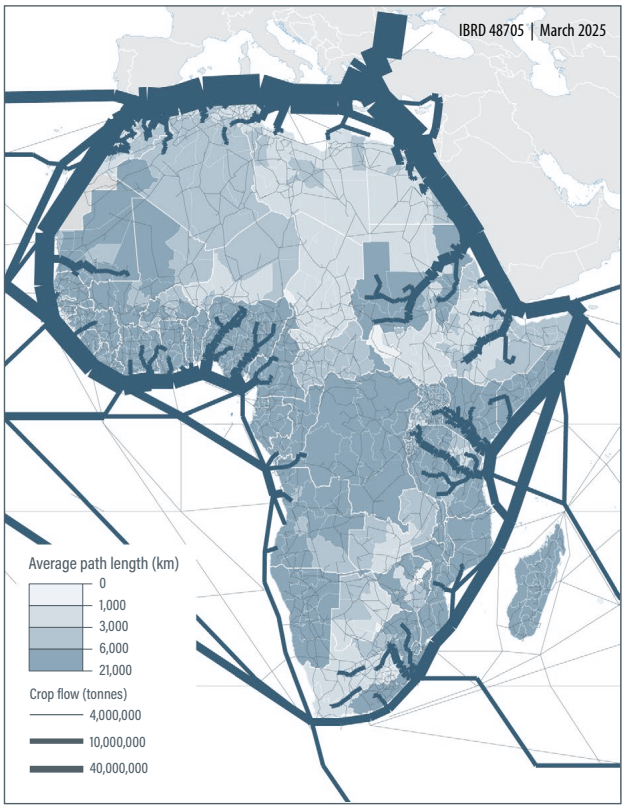
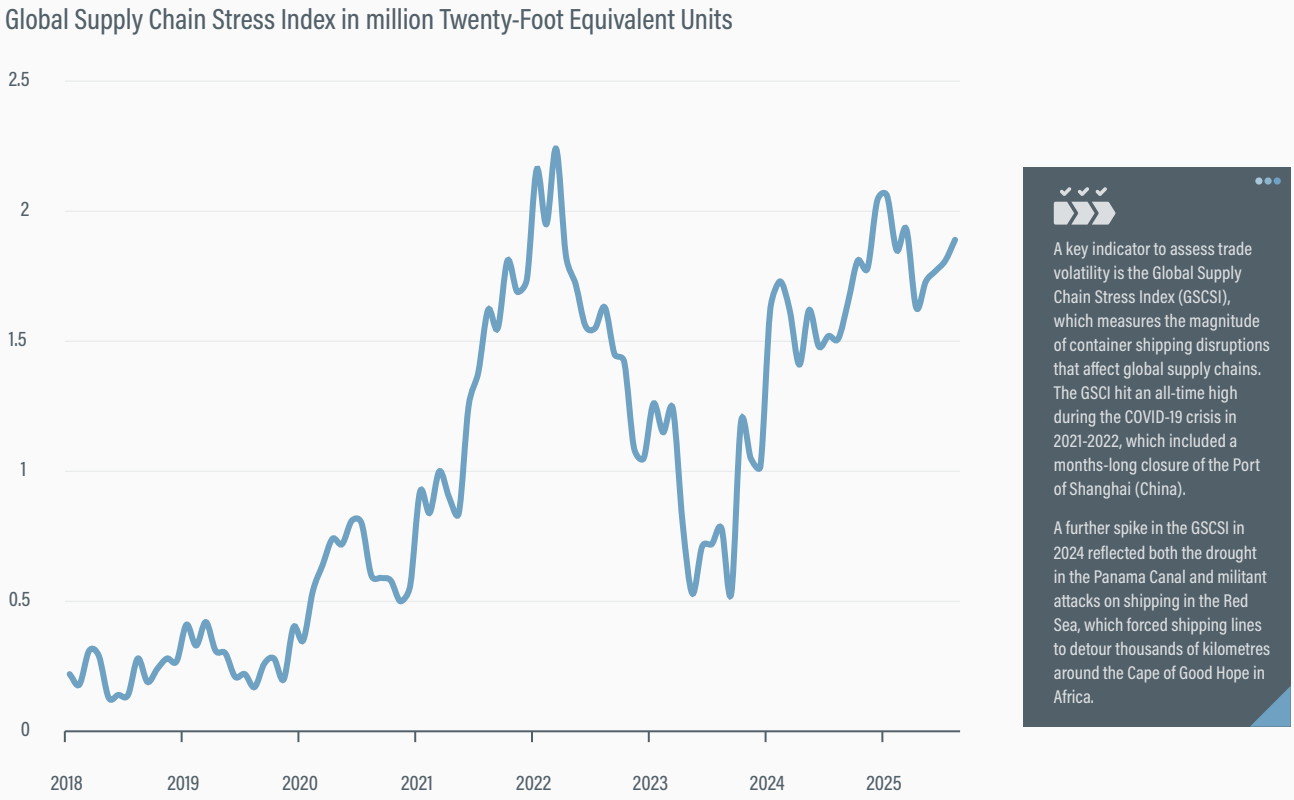


FIGURE 5. Global Supply Chain Stress Index, January 2019 to May 2025



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]

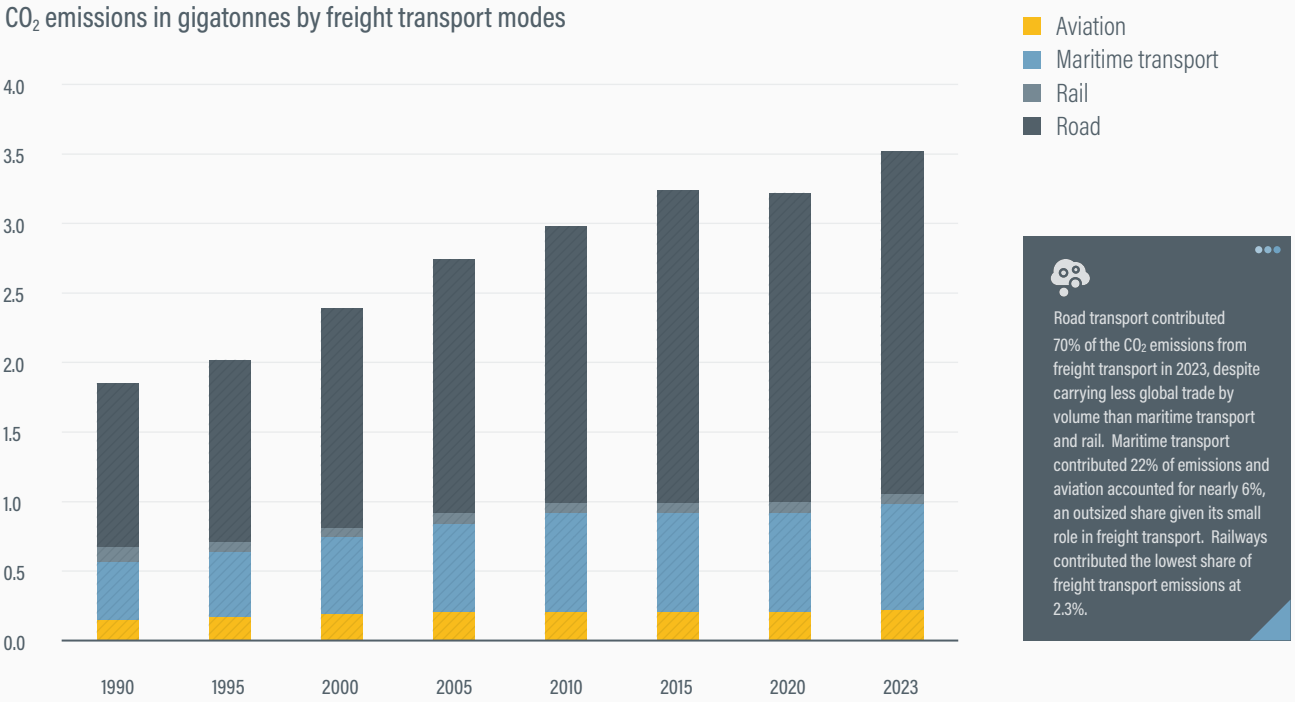
Supply chains both contribute to and are affected by climate change, particularly the impacts of extreme weather events.[48] **Industry leaders have identified hostile weather as the primary risk facing supply chains, causing 27% of supply chain disruptions in 2024 (a share that is predicted to rise).**[49] 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.

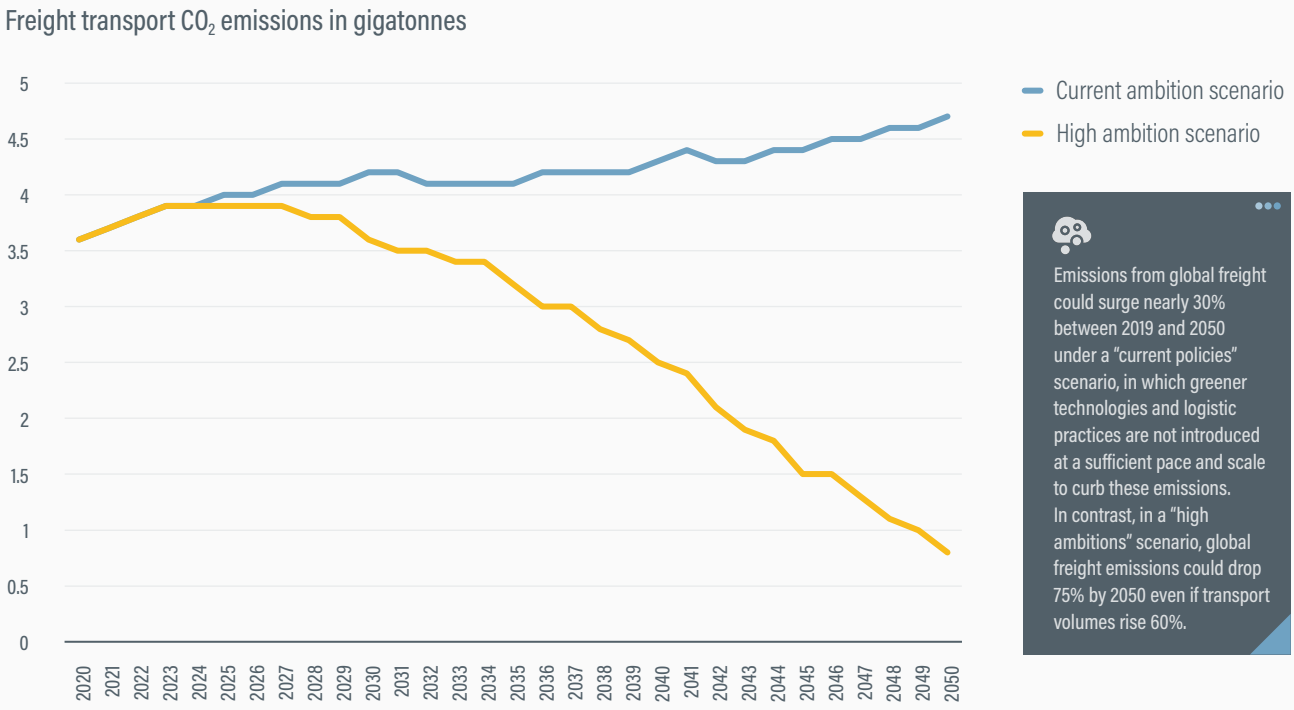
share given its small role in freight transport.[55] **Railways contributed the lowest share of freight transport emissions at 2.3%.**[56]

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



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%.

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.

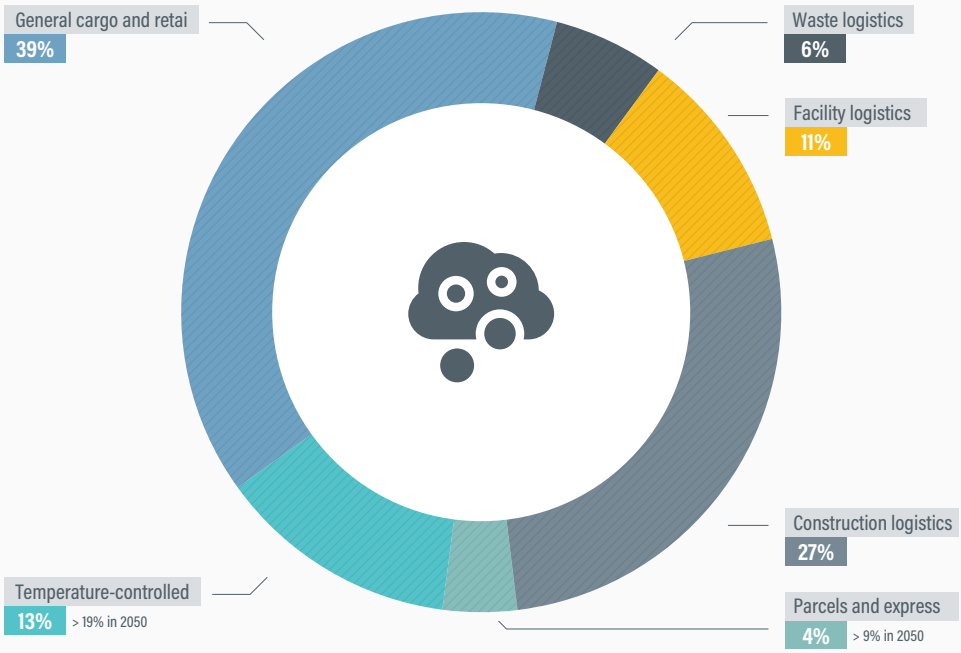
Urban transport contributed an estimated 28% of the total global CO_2 emissions from freight transport in 2023.[67] **Within cities, freight transport typically releases around 20-40% of the greenhouse gas emissions from transport and 30-50% of air pollutants, while also accounting for an estimated 15-25% 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]

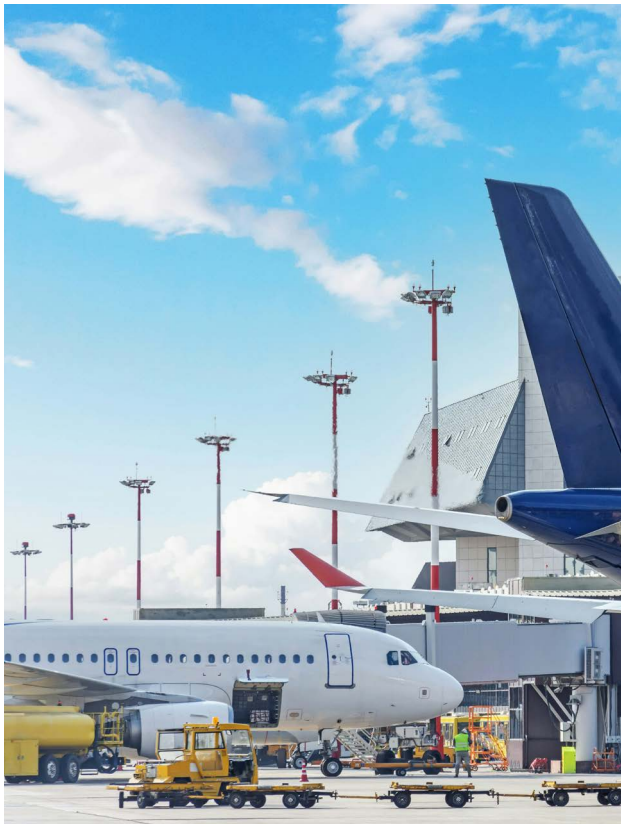
Analysts foresee further substantial increases in e-commerce in the coming years.[84] Drivers of this trend include the enhanced accessibility of cross-border shopping platforms, the proliferation of same-day delivery and free returns, and the expansion of e-commerce into "newer" consumption areas such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

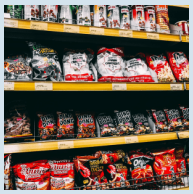
Financing and funding accessible to formal and informal operators

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

AUTHOR:
Akshay Jamdade, SLOCAT

CONTRIBUTORS:
Mark Major, Stefanie Sohm, Kühne Climate Center; Alan C. McKinnon, Kühne Logistics University

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.

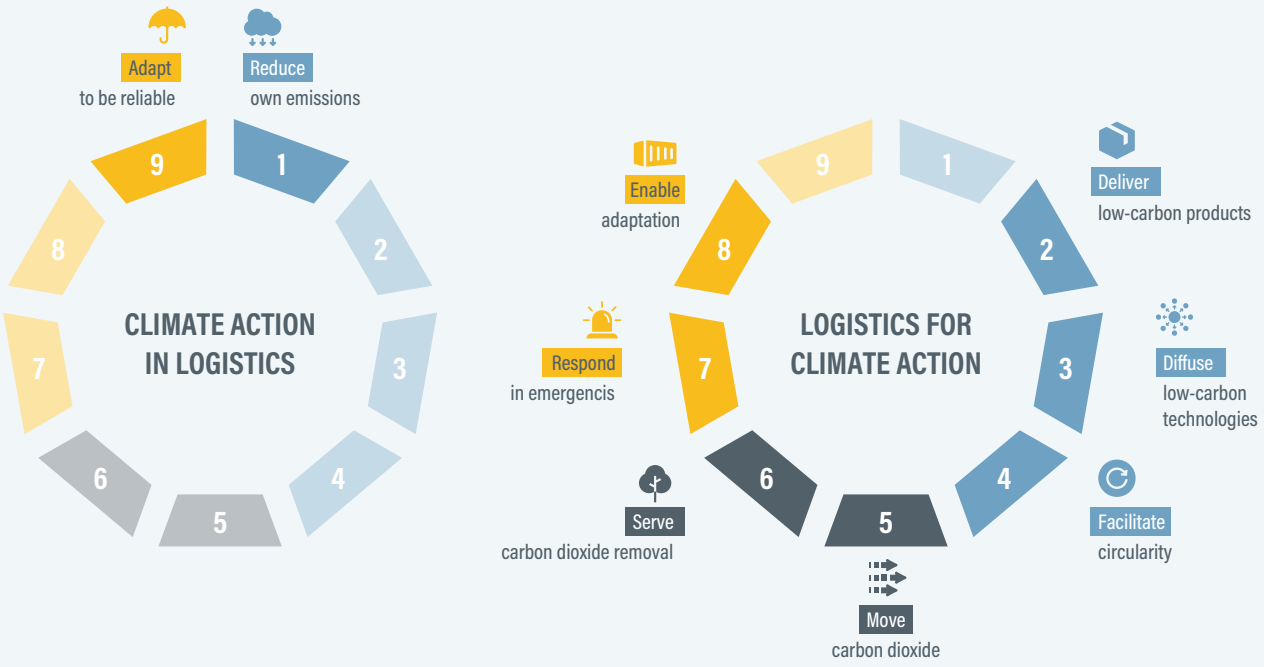
The logistics sector must take action to become low carbon and resilient (climate action in logistics) **as well as having a key role in supporting other sectors to achieve their transition towards equitable, low-carbon and climate-resilient societies** (logistics for climate action).[2] **This dual 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]

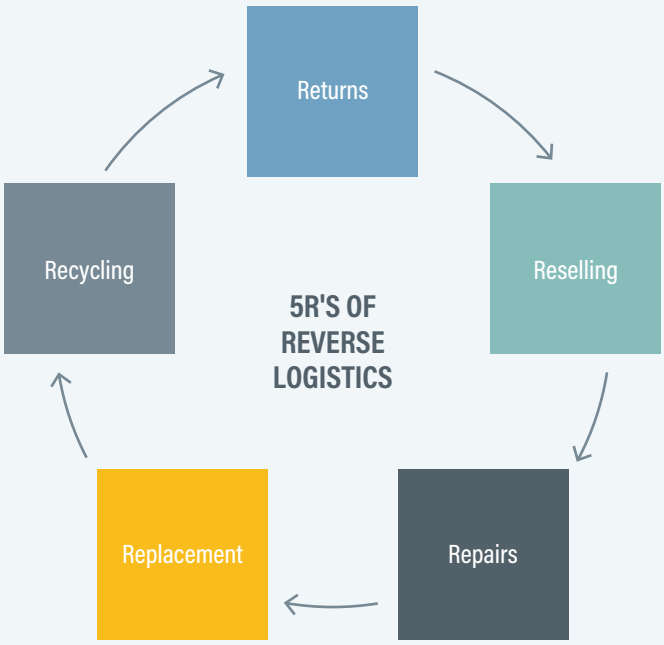
Reverse logistics is central to this approach, as products are collected from users and returned for re-manufacturing, material recovery or responsible disposal (Figure 2)**.**[19]

- 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]

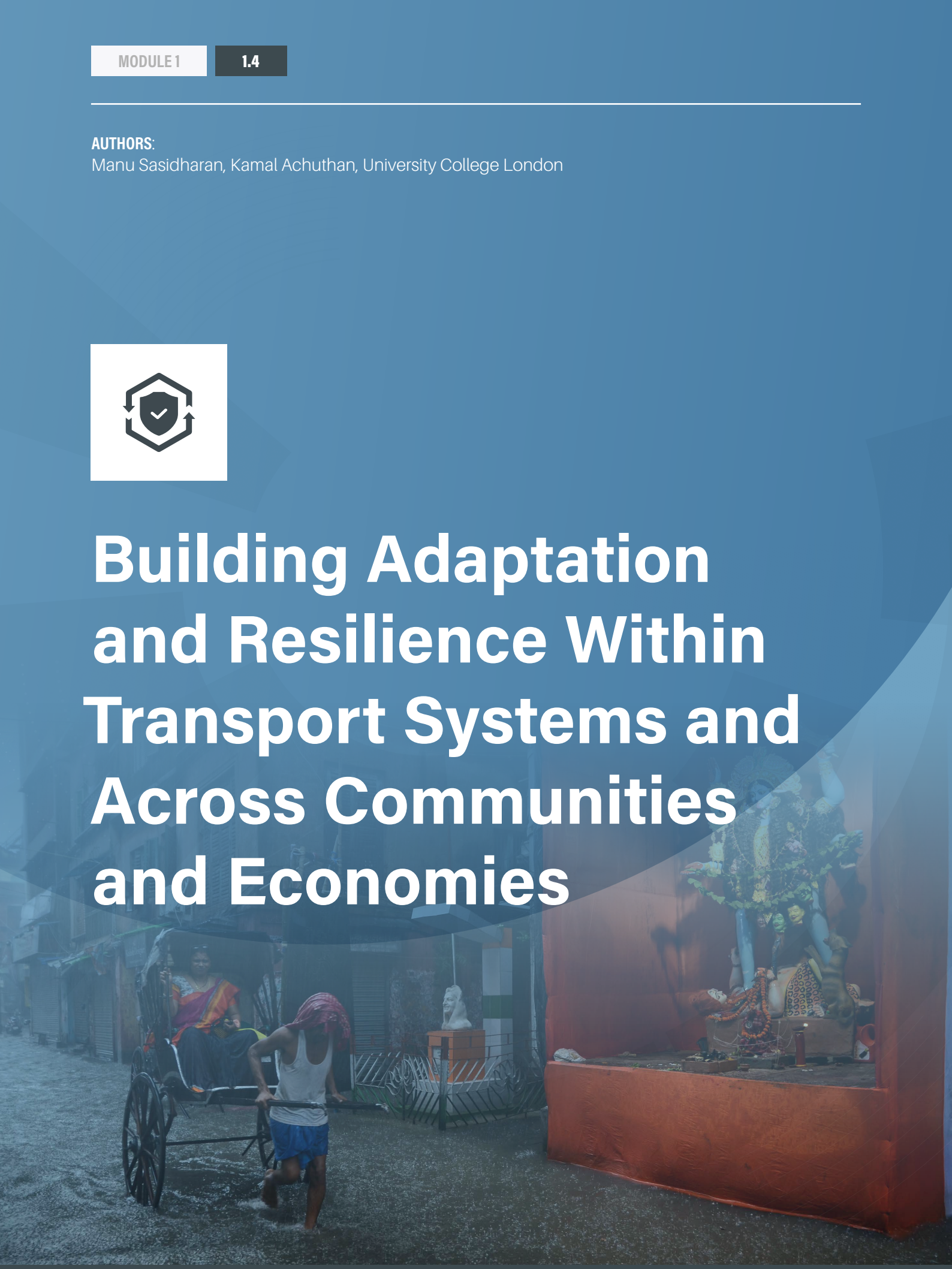
TABLE 1. The dual role of logistics in adapting to a changing climate

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.

AUTHORS:
Manu Sasidharan, Kamal Achuthan, University College London

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,

Cover Photo: Debarshi Mukherjee / Climate Visuals Countdown

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.

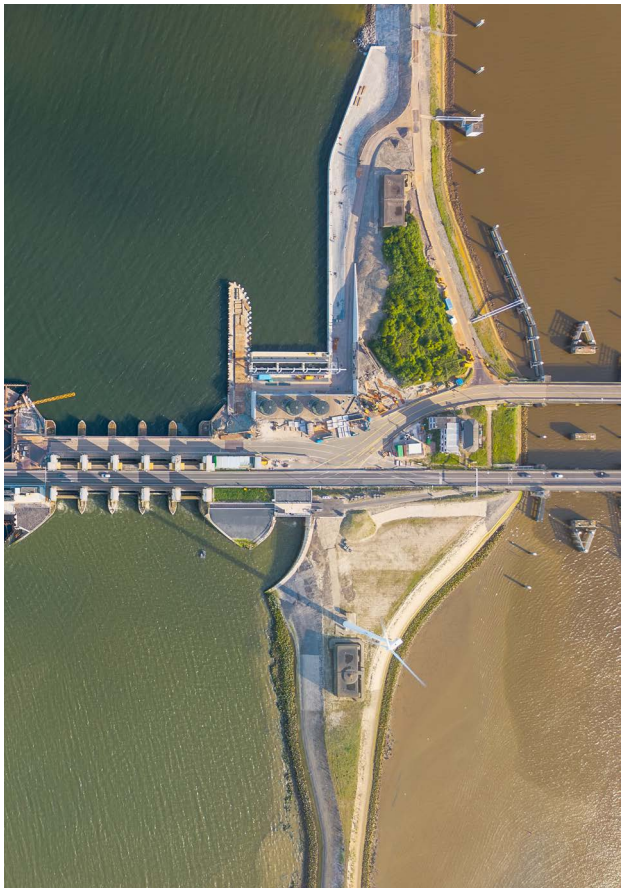
Recent events illustrate that extreme weather disruptions to transport are becoming more frequent and severe. The 2020-25 five-year period has seen some of the hottest years and most damaging storms on record. Transport infrastructure worldwide, much of it ageing and not designed for today's extremes, 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.

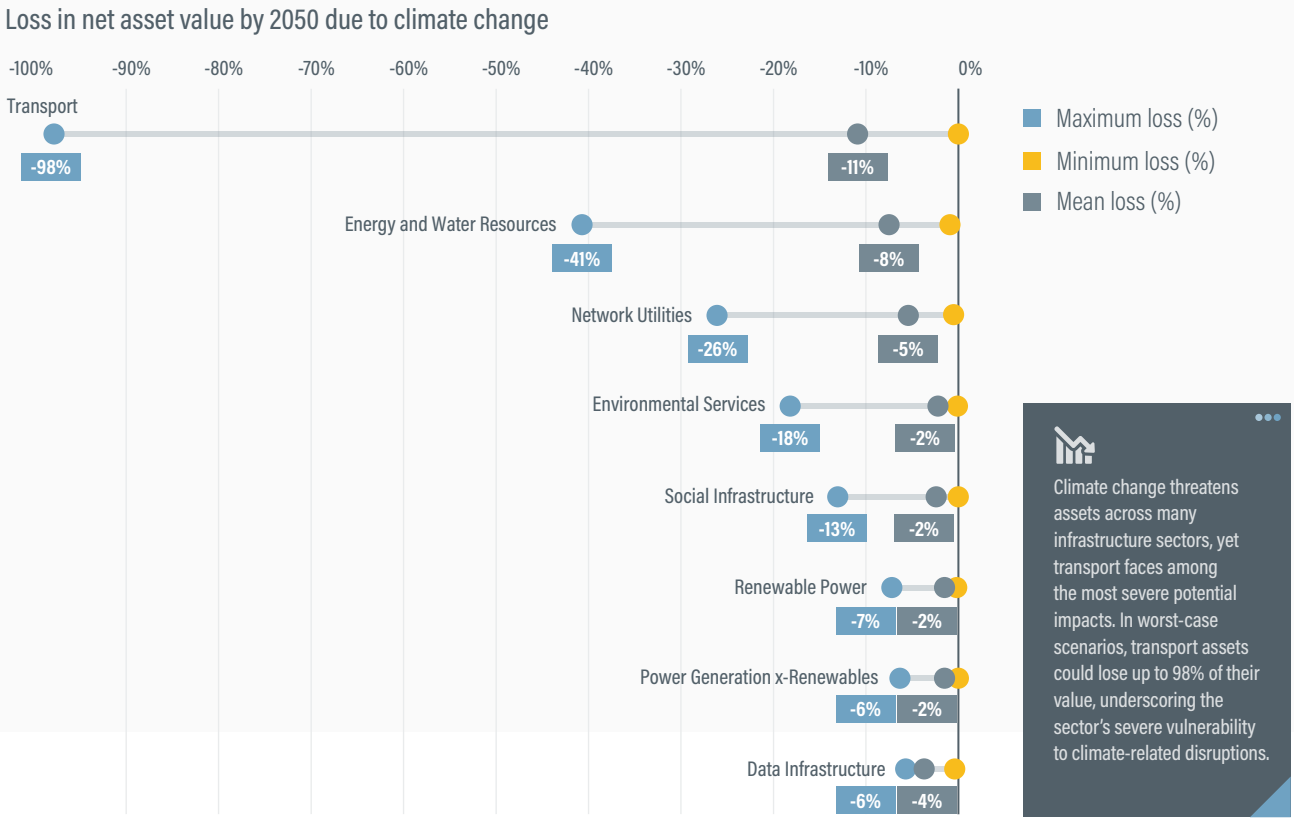
- Resilience of transport systems refers to their capacity to endure, respond to, recover from, and adapt to diverse shocks and stresses, both in the present and over the long term. This encompasses not only the physical robustness of infrastructure but also operational and organisational resilience. 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

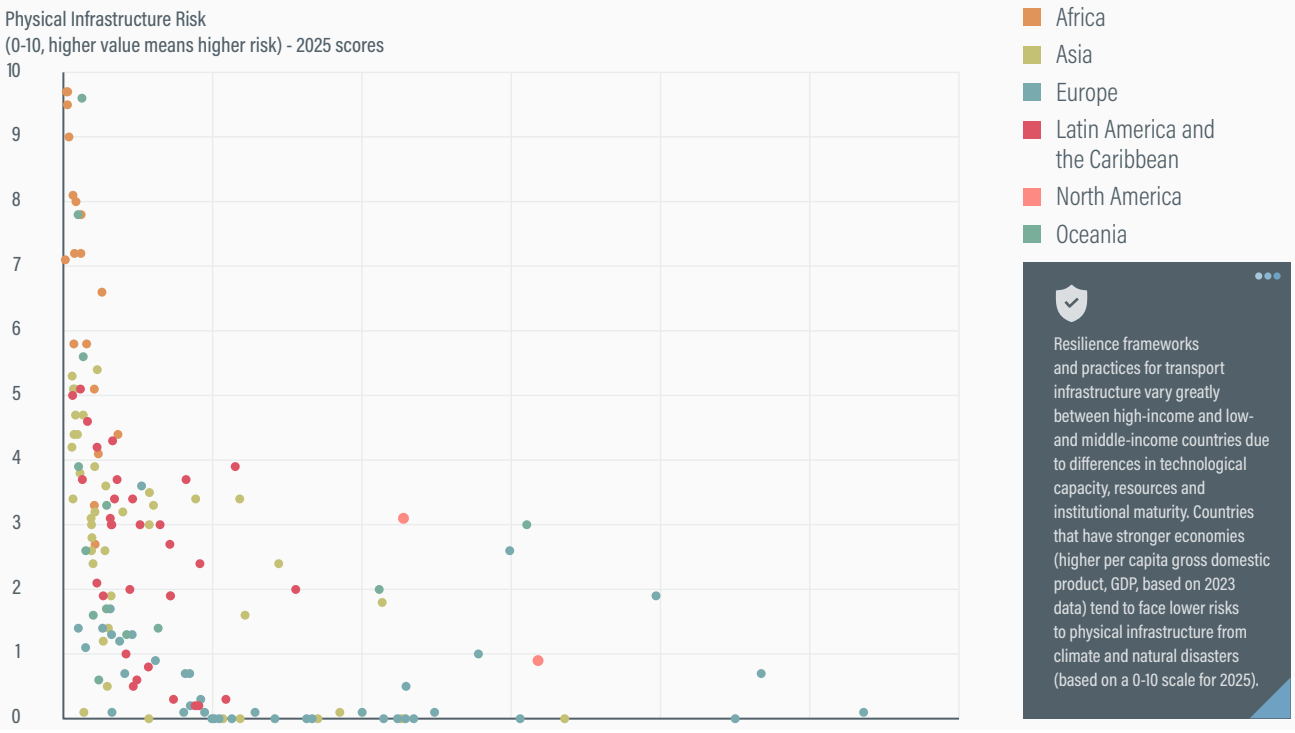
Resilience of transport

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.

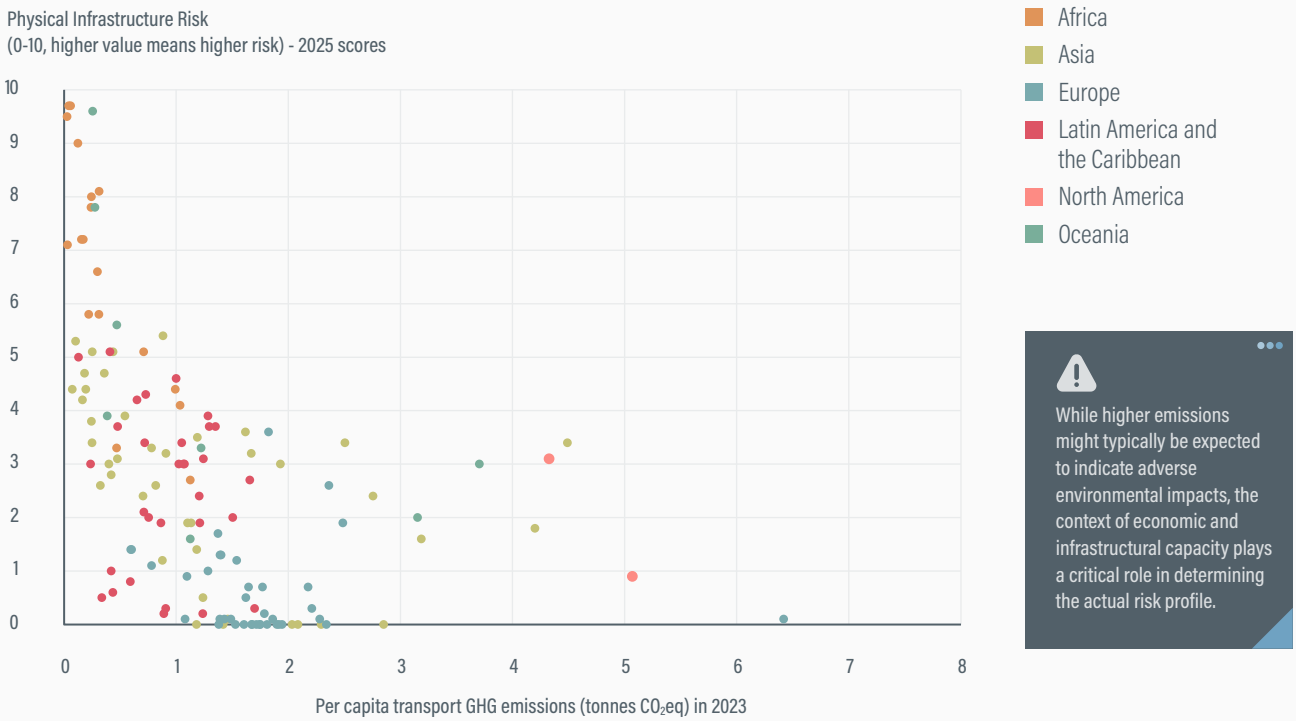
In contrast, many low- and lower-middle-income countries contribute lower emissions because of reduced transport activity, yet suffer from high physical infrastructure risk due to underinvestment and challenges in maintaining existing systems. Resilience efforts in these countries often address vulnerabilities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

AUTHORS:
Kalpana Viswanath, Rithvika Rajiv, Safetipin

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.

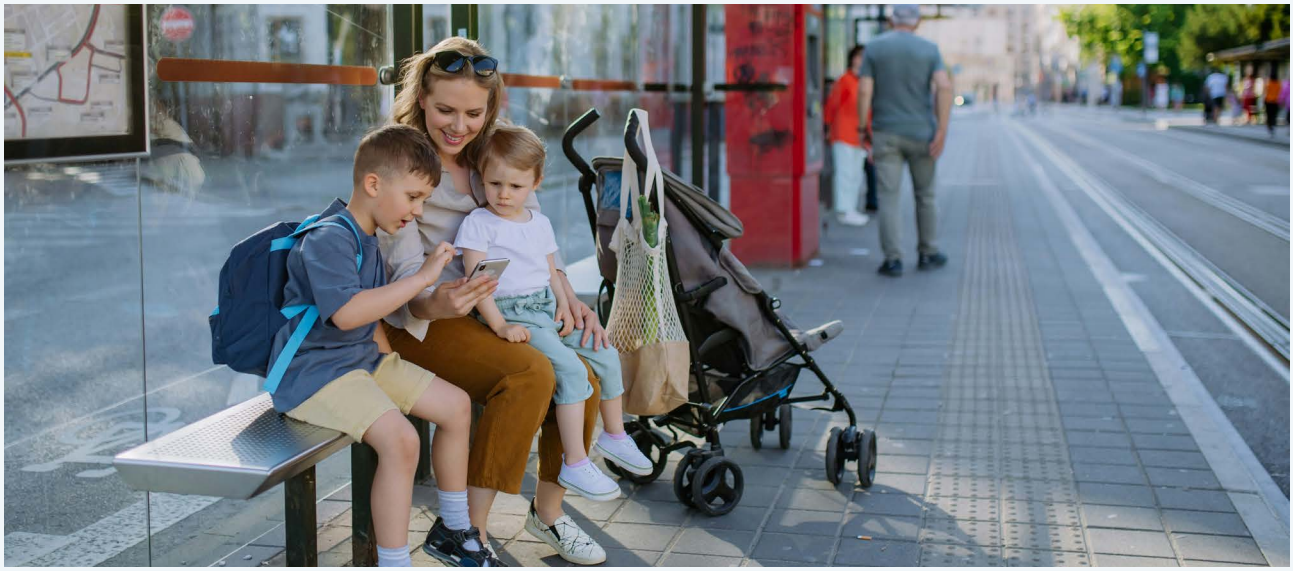
- This design bias is a symptom of a larger structural exclusion. When women are left out of transport planning and decision making, the resulting infrastructure fails to reflect their lived realities.
- Inadequate public transport systems often leave women with no choice but to rely on informal transport 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.

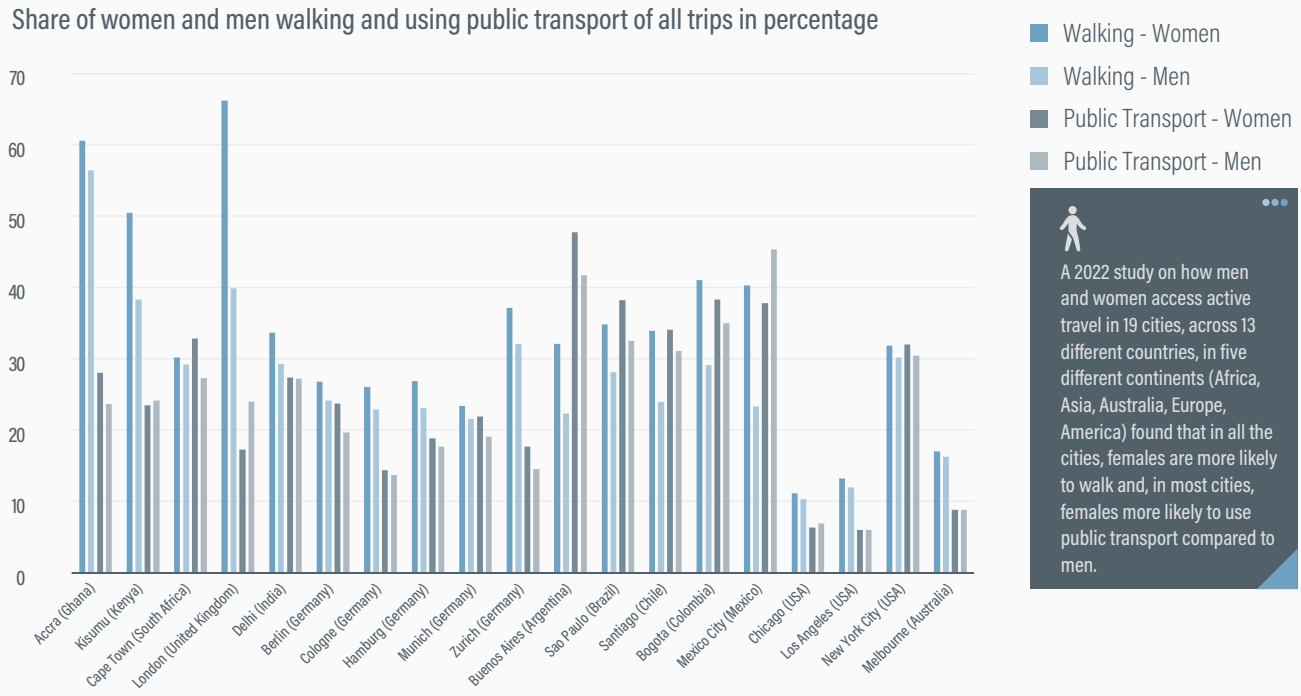
Socio-economic barriers often compel women to rely more on low-carbon transport modes such as walking and public transport, with women accounting for 66% of public transport users globally.[5] Although this dependence places women at the heart of sustainable mobility efforts, it also makes them more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

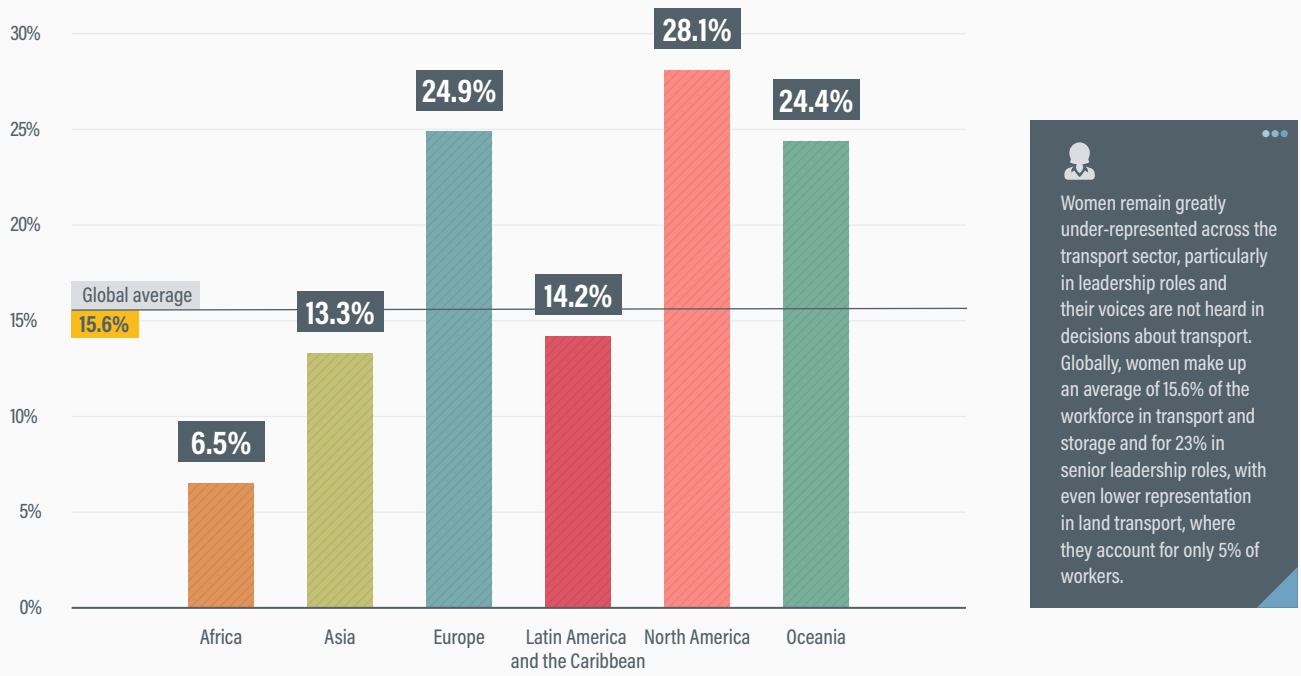
- In Mongolia, 89% of respondents reported witnessing inappropriate behaviour related to sexual harassment on public transport in 2019.[18]
- In 2024, 73% of women in the United States reported having been harassed in a public space, including on mass transport systems (bus, subway, metro, train or plane) 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]

AUTHORS:
Genevivie Ankunda, Nikola Medimorec, Akshay Jamdade, SLOCAT

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.

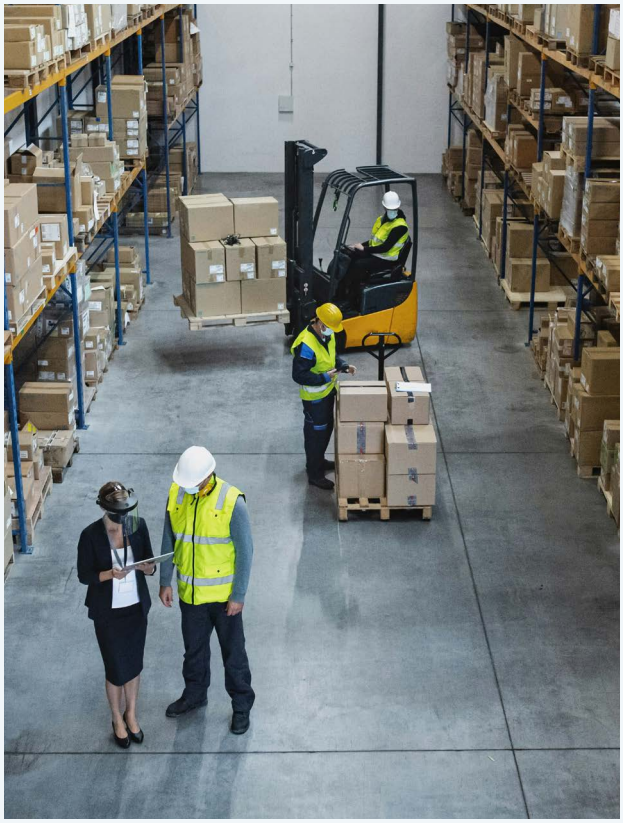
- The International Transport Workers' Federation has a specific working sector on "Women", which advocates for equal rights, representation and opportunities for women in the transport sector.[27] This includes work related to freight transport and logistics, such as warehousing, railways, road transport,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

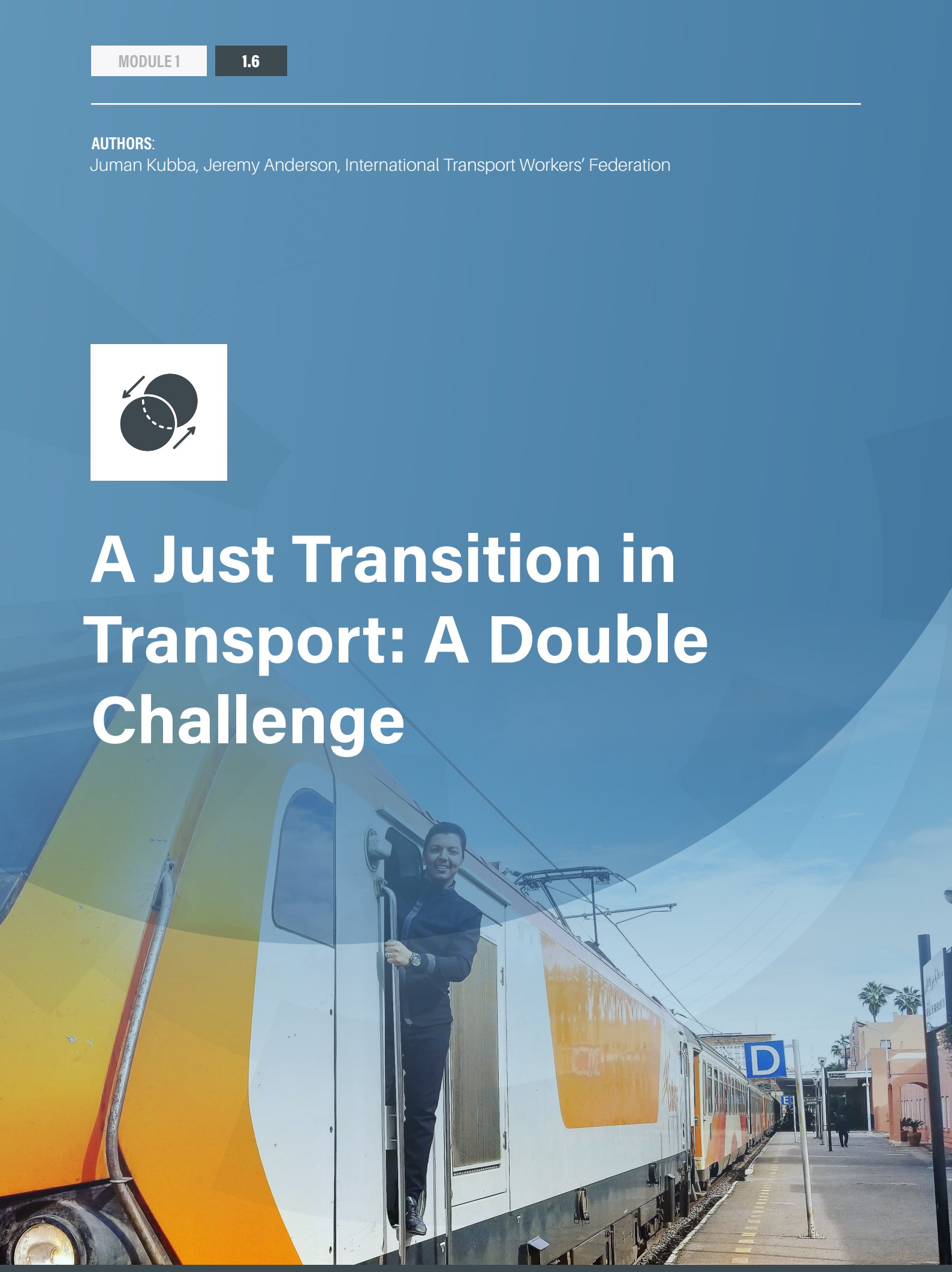


Partnerships in action

- 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.

AUTHORS:
Juman Kubba, Jeremy Anderson, International Transport Workers' Federation

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

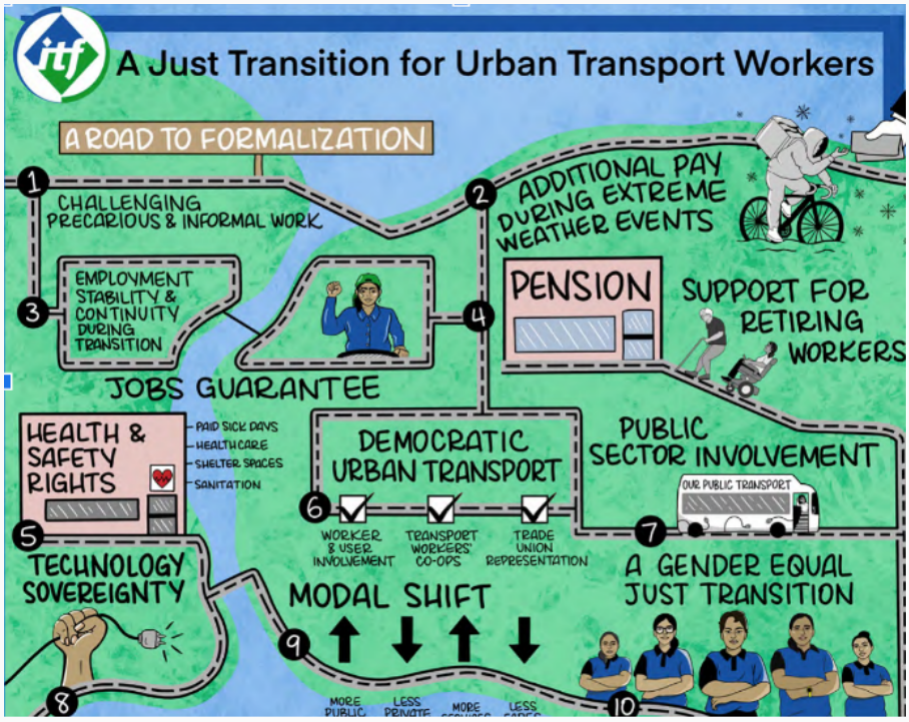
Wholesale transformation of transport is essential to decarbonise and adapt a sector that accounts for 21.9% of carbon dioxide (CO_2) emissions and is particularly exposed to new climate realities. The scale of change needed in the sector creates opportunities and risks for the workers on whom transport 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.

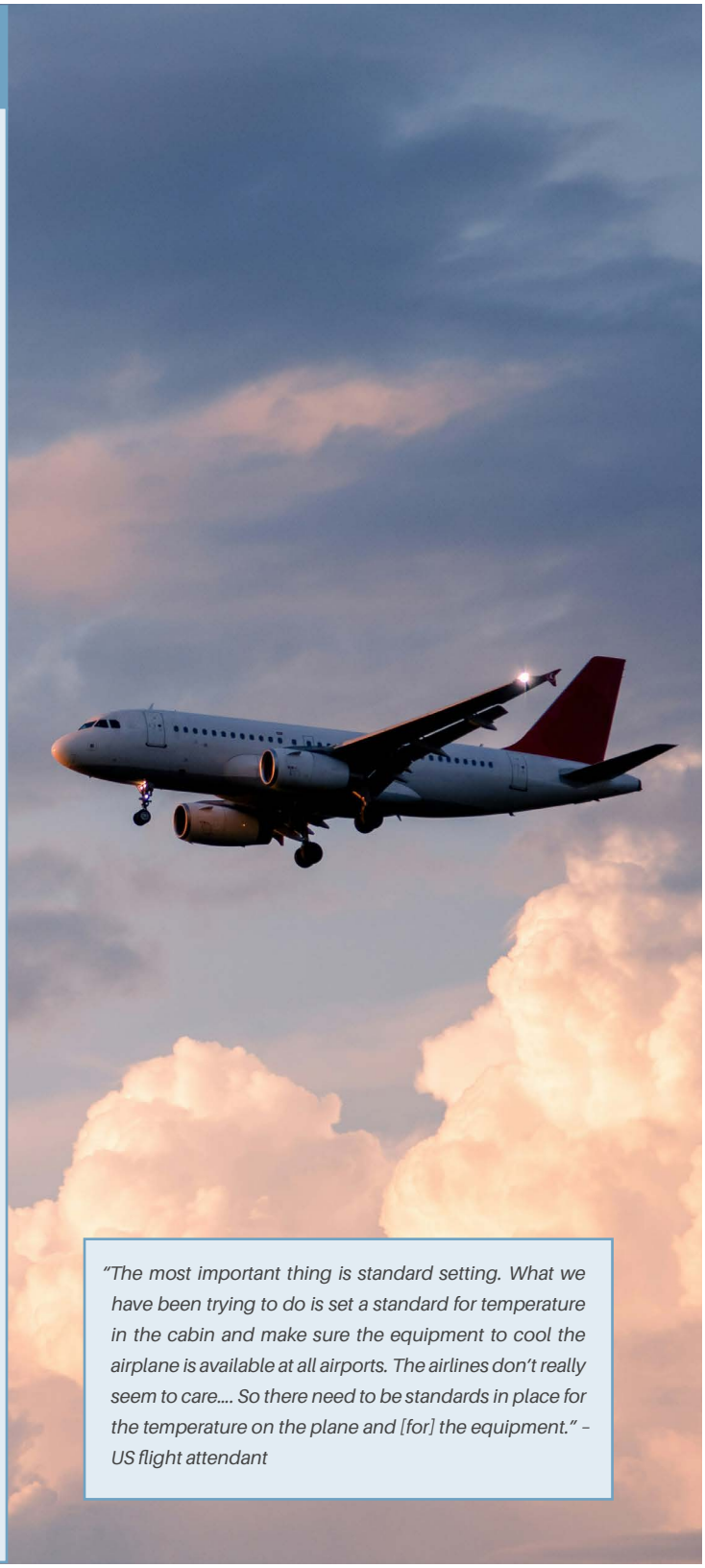
- Transport workers may suffer a physical and mental toll from their direct role in emergency relief, including delivering aid and/or evacuating affected populations.
- Operational disruptions can lead to economic hardship in both the short and long term, as modern supply chain management techniques 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]

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]

MODULE 1 | 1.7

AUTHORS:
Jennifer S. Mindell, University College London; Rob McInerney, International Road Assessment Programme; Dena Kasraian, Eindhoven University of Technology

CONTRIBUTORS:
Genevivie Ankunda, Nikola Medimorec, SLOCAT

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

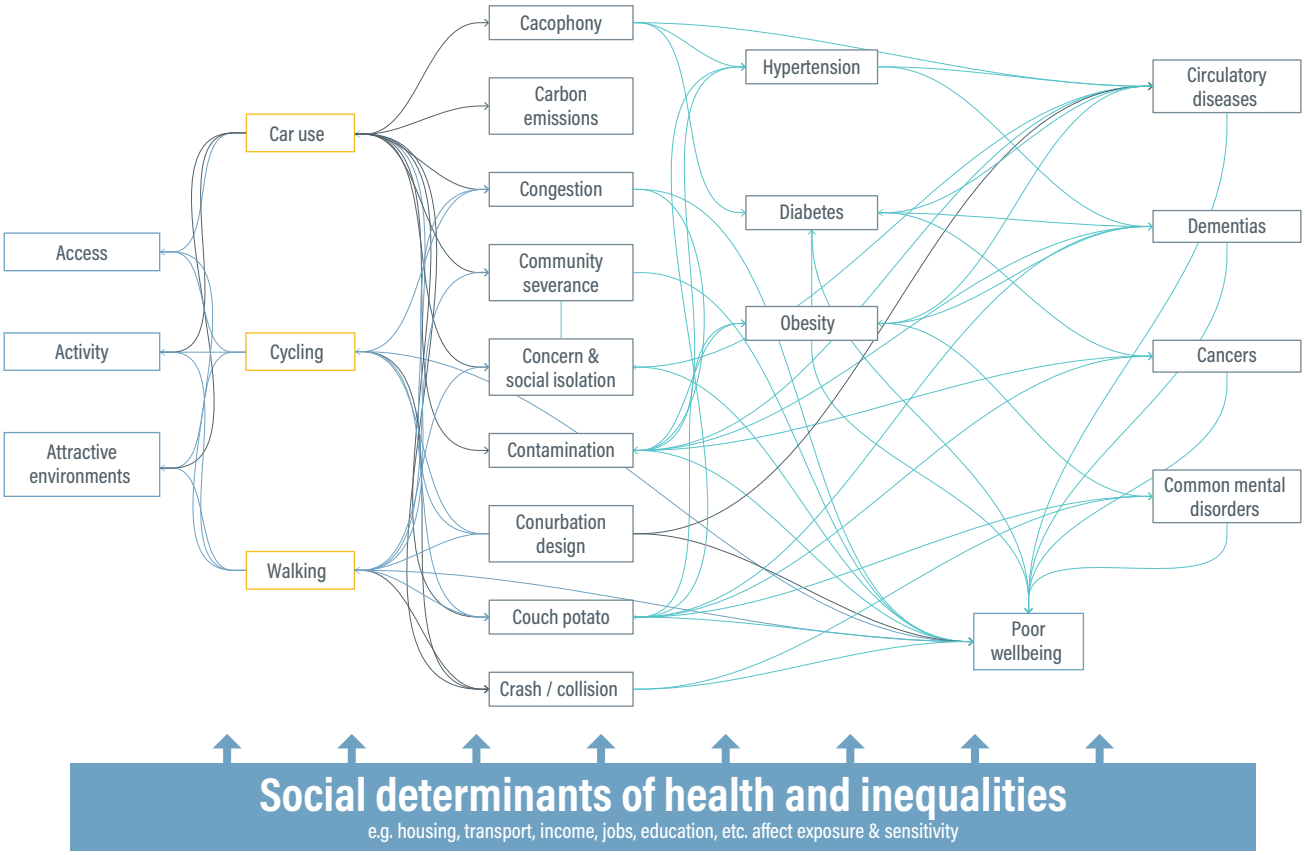
The harms to health provoked by transport - the 9 C's:

- **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).

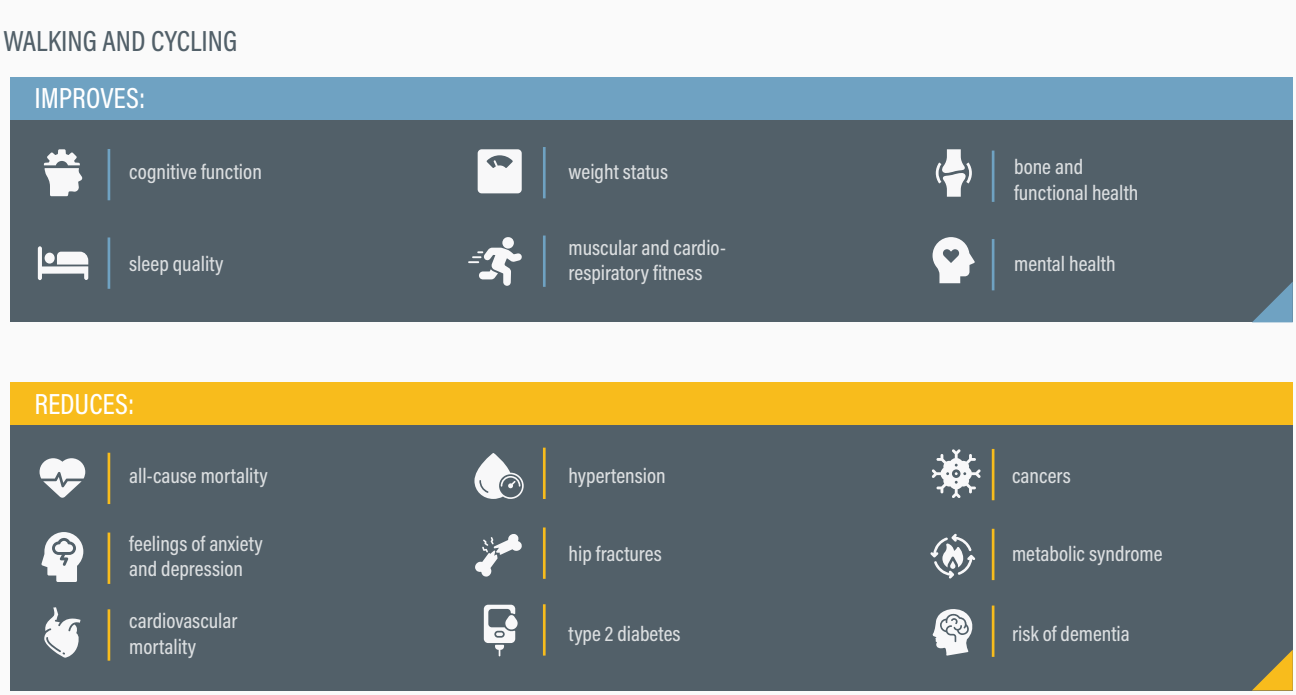
- Cities that have implemented such approaches – recognising that public transport, walking and cycling can greatly reduce transport emissions and create vibrant urban spaces – include Arlington (United States), Curitiba (Brazil), Denver (United States), Hong Kong (China), Melbourne (Australia), Seoul (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.)

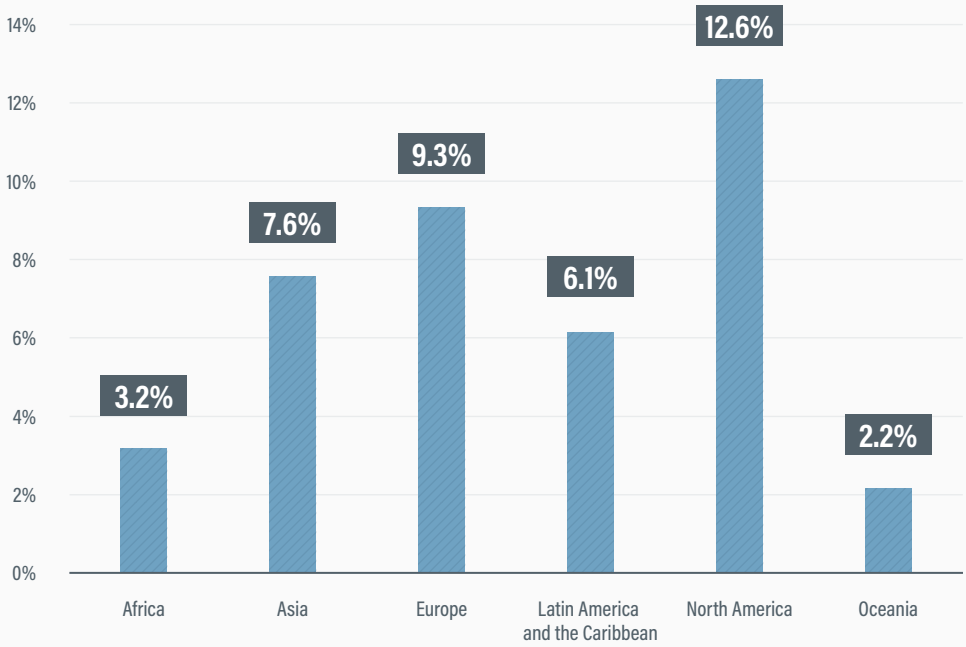
Regions with the most built-up road networks tend to show the highest levels of private motorisation and congestion. As of 2024, three of the world's ten most congested cities were in the United States, which also had the world's highest private motorisation rate at 822 vehicles per 1,000 people, compared 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)

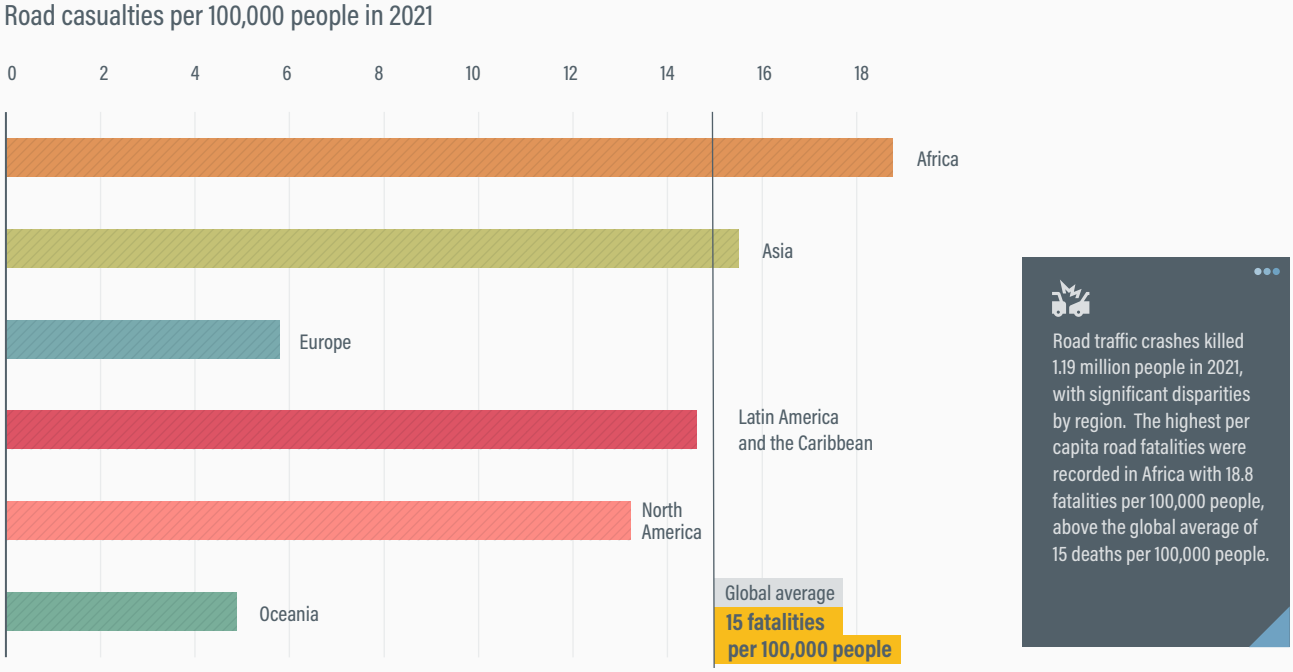
Road traffic crashes killed 1.19 million people in 2021, with large disparities by region (Figure 4).[121] **The highest per capita road fatalities by region were in Africa (18.8 fatalities per 100,000 people, above the global average of 15 deaths per 100,000 people), although small island developing 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]

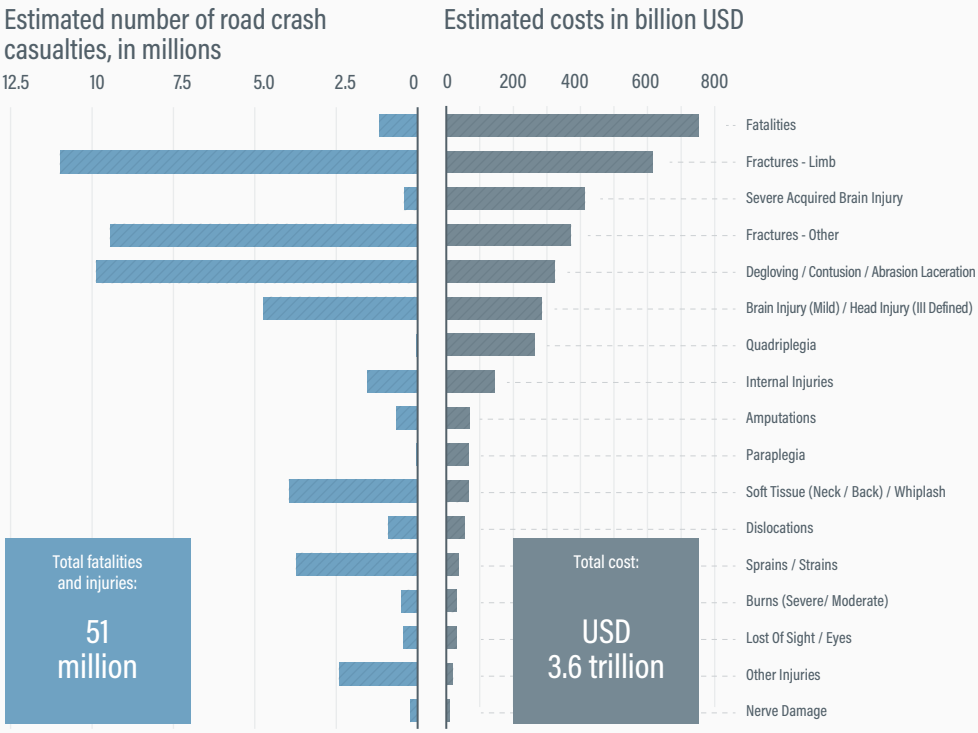
- Freight and construction vehicles kill and injure a disproportionate number of pedestrians and cyclists,

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.

ENDNOTES

1.1
10 YEARS AFTER THE PARIS AGREEMENT AND THE 2030 AGENDA, ON THE PATH TO THE UN DECADE OF SUSTAINABLE TRANSPORT

1 SLOCAT (2025), Seizing the Decade: Reinforcing Sustainable Transport's Central Role in Thriving Communities and Economies, https://slocat.net/wp-content/uploads/2025/06/Seizing-the-Decade_SLOCAT-Contribution-to-UN-Process_May-2025-3.pdf.

2 World Bank (2024), Rural Access Index (RAI), https://datacatalog.worldbank.org/search/dataset/0038250; UNHABITAT (2025), Urban transport, https://data.unhabitat.org/pages/urban-transport; Institute for Transportation and Development Policy (ITDP) and Transformative Urban Mobility Initiative (TUMI) (2024), Access for All Through Universal Accessibility, https://itdp.org/wp-content/uploads/2022/02/Full-Report-jun21.pdf; ITDP (2025), Atlas of Sustainable City Transport, https://atlas.itdp.org/.

3 European Commission Joint Research Commission (JRC) and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

4 IEA (2024), World Energy Outlook, https://www.iea.org/reports/world-energy-outlook-2024.

5 REN21 (2025), Renewables 2025 Global Status Report, https://www.ren21.net/gsr-2025.

6 World Meteorological Organization (2025), State of the Global Climate 2024, WMO-No. 1368, https://library.wmo.int/idurl/4/69455.

7 Ibid.

8 Munich Re (2024), Record thunderstorm losses and deadly earthquakes: the natural disasters of 2023, https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2024/natural-disaster-figures-2023.html. ; Climate Copernicus (2025), The 2024 Annual Climate Summary - Global Climate Highlights 2024, https://climate.copernicus.eu/global-climate-highlights-2024.

9 Van Dijk, A.I.J.M et al, (2025) Global Water Monitor 2024, Summary Report, https://www.globalwater.online/globalwater/wp-content/uploads/2018/09/GWM-Report-2024.pdf.

10 Munich Re (2024), Record thunderstorm losses and deadly earthquakes: the natural disasters of 2023, https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2024/natural-disaster-figures-2023.html.

11 Organisation for Economic Co-operation and Development (OECD) (2017), Investing in Climate, Investing in Growth, https://doi.org/10.1787/9789264273528-en.

12 REN21(2023), Renewables 2023 Global Status Report Collection, Renewables in Energy Demand, https://www.ren21.net/gsr-2023/modules/energy_demand/03_transport_in_focus/; Statista (2025), Logistics industry worldwide – statistics & facts, https://www.statista.com/topics/5691/logistics-industry-worldwide/#topicOverview.

13 N. Limao and A. J. Venables (2001), Infrastructure, Geographical Disadvantage and Transport Costs. World Bank Economic Review 15 (3): 451–79, http://documents.worldbank.org/curated/en/662351468331778084.

14 International Association of Public Transport (UITP) and International Transport Workers' Federation (2025), Global Employment in Urban Public Transport, https://www.itfglobal.org/sites/default/files/node/resources/files/20250616_Global-Employment-in-PT_Report_WEB_0.pdf; IRU (2023), Driver Truck Driver Shortage Report 2024, https://www.iru.org/news-resources/newsroom/global-truck-driver-shortage-double-2028-says-new-iru-report; International Labour Organization (ILO) (2024), Constant turbulence: employment in civil aviation, https://ilostat.ilo.org/blog/constant-turbulence-employment-in-civil-aviation; International Union of Railways (UIC) (2023), UIC Activity Report, https://uic.org/IMG/pdf/uic_activity_report_2023_05jul24_web.pdf; BIMCO and International Chamber of Shipping (2021), Seafarer Workforce Report, https://www.ics-shipping.org/publications/seafarer-workforce-report-2021-edition REN21, Transport in Focus: https://www.ren21.net/gsr-2023/modules/energy_demand/03_transport_in_focus/.

15 Ibid.

16 ILO (2020), Greening the transport sector in the post COVID-19 recovery could create up to 15 million jobs worldwide, https://www.ilo.org/resource/news/greening-transport-sector-post-covid-19-recovery-could-create-15-million

17 ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.

18 Ibid.

19 S. Speizer et al. (2024), Integrated assessment modeling of a zero-emissions global transportation sector, Nature Communications 15, 4439, https://doi.org/10.1038/s41467-024-48424-9; Statista (n.d.), Global passenger mobility demand in 2018 and 2022, by major transportation mode, https://www-statista-com.iclibezp1.cc.ic.ac.uk/statistics/1031444/global-passenger-mobility-demand-transport-mode; International Association of Public Transport (UITP) (2015), Mobility in Cities Database: Synthesis Report, https://cms.uitp.org/wp/wp-content/uploads/2020/06/MCD_2015_synthesis_web_0.pdf.

20 S. Speizer, J. Fuhrman, L. A. Lopez et al. (2024), Integrated assessment modeling of a zero-emissions global transportation sector. Nat Commun 15, 4439. https://doi.org/10.1038/s41467-024-48424-9.

21 Ibid.

22 World Bank (2024), Rural Access Index (RAI), https://datacatalog.worldbank.org/search/dataset/0038250.

23 ITDP (2025), Atlas of Sustainable City Transport, https://atlas.itdp.org.

24 Ibid.

25 UN-Habitat (2025), Urban transport, Urban Indicators Database, https://data.unhabitat.org/pages/urban-transport

26 Ibid.

27 ITDP (2025), Atlas of Sustainable City Transport, https://atlas.itdp.org.

28 Secretariat for the Convention on the Rights of Persons with Disabilities (2015), Accessibility and Disability Inclusion in Urban Development, UN, https://www.un.org/disabilities/documents/2015/accessibility-urbandevelopment.pdf.

29 G. Borker (2024), Understanding the constraints to women's use of urban public transport in developing countries, World Development 180, 106589, https://doi.org/10.1016/j.worlddev.2024.106589; V. Ceccato and A. Loukaitou-Sideris (2022), Fear of sexual harassment and its impact on safety perceptions in transit environments: a global perspective, Violence Against Women, 28/1, 26-48, https://pmc.ncbi.nlm.nih.gov/articles/PMC8564253/pdf/10.1177_1077801221992874.pdf.

30 UITP (2025), MENA Transport Report, https://cms.uitp.org/wp/wp-content/uploads/2025/02/UITP_-_MTR24_26022025_Digital.pdf; B. Welle and A. Kustar (2022), Transport: Toward a More Inclusive, Safer and Cleaner Mobility in African Cities: AfDB Sustainable Urban Development Action Plann (SUDAP), African Development Bank, https://www.afdb.org/sites/default/files/2023/01/18/transport-toward_a_more_inclusive_safer_and_cleaner_mobility_in_african_cities_-_sudap_paper_-_addb_umdf_-_2022.pdf.

31 Ibid.

32 IRF (2024), World Road Statistics 2024, https://datawarehouse.worldroadstatistics.org/

33 Ibid.

34 Ibid.

35 S.R. Manjrekar (2024), Geographic Expansion, Portfolio Diversification, and Vehicle Telematics to Be Strategic Focus Areas in Global Two-wheeler Market in 2024, Frost, https://www.frost.com/growth-opportunity-news/global-two-wheeler-market-in-2024.

36 International Organization of Motor Vehicle Manufacturers (OICA) (2025), Global Sales Statistics 2019-2023, https://www.oica.net/category/sales-statistics.

37 International Energy Agency (IEA) (2024), Global EV Outlook 2024, https://iea.blob.core.windows.net/assets/a9e3544b-0b12-4e15-b407-65f5c-8ce1b5f/GlobalEVOutlook2024.pdf; Snail Truck (2025), The ratio of used-car to new-car sales in developed markets in Europe and the US is stable,https://www.snail-truck.com/new/Industry-news-Stable-sales-ratio.html, accessed June 2025.

38 REN21 (2022), Global Overview: Transport, in Renewables Global Status Report, https://www.ren21.net/gsr-2022/chapters/chapter_01/chapter_01/#sub_5; WHO (n.d.), Environment, Climate Change and Health, Air pollution, https://www.who.int/teams/environment-climate-change-and-health/healthy-urban-environments/transport/health-risks.

39 P.A. Akbar, V. Couture, G. Duranton and A. Storeygard (2023), The Fast, the Slow, and the Congested: Urban Transportation in Rich and Poor Countries, National Bureau of Economic Research, https://www.nber.org/papers/w31642.

40 L. Baertsch (2020), Quantifying the economic benefits of public transportation in Kampala, https://www.theigc.org/publications/quantifying-economic-benefits-public-transportation-kampala.

41 INRIX (2025), INRIX Global Traffic Scorecard, https://www2.inrix.com/l/171932/2025-01-02/71rhrd/171932/1735857445DSlvhZjd/INRIX_2024_Global_Traffic_Scorecard.pdf.

42 European Court of Auditors (2019), Urban mobility in the EU, https://www.eca.europa.eu/lists/ecadocuments/ap19_07/ap_urban_mobility_en.pdf.

43 SLOCAT (2025), Transport, Climate and Sustainability Global Status Report – 4th edition, Regional Overviews: Trends and Policy Development, https://gsr4.slocat.net/modules/regional-overviews/.

44 E.E. McDuffie et al. (2021), Fine Particulate Matter and Global Health: Fuel and Sector Contributions to Ambient PM2.5 and Its Disease Burden Across Multiple Scales, Nature Communications, http://dx.doi.org/10.1038/s41467-021-23853-y ; Health Effects Institute (2024), State of Global Air Report 2024, https://www.stateofglobalair.org/resources/report/state-global-air-report-2024 ; J. Lelieveld et al. (2023), Air pollution deaths attributable to fossil fuels: observational and modelling study, BMJ 2023; 383, https://doi.org/10.1136/bmj-2023-077784.

45 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517; Health Effects Institute (2024), State of Global Air Report 2024, https://www.stateofglobalair.org/resources/report/state-global-air-report-2024; J. Lelieveld et al. (2023), Air pollution deaths attributable to fossil fuels: observational and modelling study, BMJ 2023; 383, https://doi.org/10.1136/bmj-2023-077784.

46 G. Cesaroni et al. (2010), Socioeconomic position and health status of people who live near busy

roads: the Rome Longitudinal Study (RoLS), Environ Health 9, 41, https://doi.org/10.1186/1476-069X-9-41; K. Jiao, M. Xu and M. Liu (2018), Health status and air pollution related socioeconomic concerns in urban China. Int J Equity Health 17, 18, https://doi.org/10.1186/s12939-018-0719-y.

47 SLOCAT (2025), Transport, Climate and Sustainability Global Status Report – 4th edition, Regional Overviews: Trends and Policy Development, https://gsr4.slocat.net/modules/regional-overviews/ ; E.E. McDuffie et al. (2021), Fine Particulate Matter and Global Health: Fuel and Sector Contributions to Ambient PM2.5 and Its Disease Burden Across Multiple Scales, Nature Communications, http://dx.doi.org/10.1038/s41467-021-23853-y.

48 J. Walker, J. Tuniz, L. Bosch and T. Cigut (2022), Walking and Cycling in Africa – Evidence and good practice to inspire action, United Nations Environment Programme and United Nations Human Settlements Programme, https://www.unep.org/resources/report/walking-and-cycling-africa-evidence-and-good-practice-inspire-action.

49 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

50 WHO (2023), Road traffic injuries, https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries ; iRAP (2025), iRAP Safety Insights Explorer, International Road Assessment Program, https://irap.org/safety-insights-explorer/; Institute for Health Metrics and Evaluation (IHME) (2024), Global Burden of Disease 2021: Findings from the GBD 2021 Study, Seattle, United States, https://www.healthdata.org/research-analysis/library/global-burden-disease-2021-findings-gbd-2021-study.

51 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517; iRAP (2025), iRAP Safety Insights Explorer, International Road Assessment Program, https://irap.org/safety-insights-explorer/.

52 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

53 Ibid.

54 European Commission, JRC and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

55 WMO (2023), Greenhouse gas concentrations surge again to new record in 2023, https://wmo.int/news/media-centre/greenhouse-gas-concentrations-surge-again-new-record-2023

56 Ibid

57 European Commission, JRC and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

58 SLOCAT (2025), Transport, Climate and Sustainability Global Status Report – 4th edition, Road Transport, https://gsr4.slocat.net/wp-content/uploads/sites/2/2025/10/4.8-Road-Transport.pdf.

59 European Commission, JRC and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

60 IEA (2024), World Energy Outlook, https://www.iea.org/reports/world-energy-outlook-2024.

61 Ibid.

62 IIbid.

63 CityNews (2023), Energy agency: SUV growth weighs on emissions, batteries, https://toronto.citynews.ca/2023/02/27/energy-agency-suv-growth-weighs-on-emissions-batteries.

64 IEA (2024), World Energy Outlook, https://www.iea.org/reports/world-energy-outlook-2024; REN21 (2025), Renewables 2025 Global Status Report, https://www.ren21.net/gsr-2025.

65 Ibid

66 European Commission, JRC and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

67 Ibid.

68 Ibid.

69 Z. Liu et al. (2025), Carbon monitor, https://carbonmonitor.org/.

70 Dhakal, S.et al (2022) Emissions Trends and Drivers. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter02.pdf.

71 SLOCAT (2021), Tracking Trends in a Time of Change: The Need for Radical Action Towards Sustainable Transport Decarbonisation, Transport and Climate Change Global Status Report – 2nd edition, https://tcc-gsr.com/global-overview/global-transport-and-climate-change/; J.E. Gagnon et al.,(2023), The impact of the COVID-19 pandemic on global GDP growth. doi: 10.1016/j.jjie.2023.101258 https://pmc.ncbi.nlm.nih.gov/articles/PMC10030258/

72 World Bank (2024), GDP (constant 2015 US$), https://data.worldbank.org/indicator/NY.GDP.MKTP.KD ; European Commission, JRC and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

73 Ibid.

74 Figure 1 from Shell (2023), The Energy Security Scenarios, https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

75 Ibid.

76 Ibid.

77 Massachusetts Institute of Technology (MIT) (2023), Freight Transportation, MIT Climate Portal, https://climate.mit.edu/explainers/freight-transportation; Shell (2023), The Energy Security Scenarios, https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

78 European Commission Joint Research Commission (JRC) and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024

79 Ibid.

80 Ibid.

81 Ibid.

82 Ibid.

83 Ibid.

84 T. Lombardo (2025), Tracking Aviation, IEA, https://www.iea.org/energy-system/transport/aviation#tracking.

85 European Commission, JRC and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

86 Ibid.

87 P. Jaramillo et al. (2022), Transport, in: IPCC (2022), Climate Change 2022: Mitigation of Climate Change, https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

88 United Nations Office of Disaster Risk Reduction (UNDRR) (2022) The invisible toll of disasters. https://www.undrr.org/explainer/the-invisible-toll-of-disasters-2022.

89 United Nations Office of Disaster Risk Reduction (UNDRR) (2022) The invisible toll of disasters. https://www.undrr.org/explainer/the-invisible-toll-of-disasters-2022.

90 Figure 2 from N. Amenc (2023), It's getting physical: Some investors in infrastructure could lose more than half of their portfolio to physical climate risks by 2050, EDHEC Infrastructure & Private Assets Research Institute, https://edhecinfraprivateassets.com/paper/its-getting-physical.

91 SLOCAT (2023), Engagement of Transport Stakeholders in the United Nations Framework Convention on Climate Change Process, https://tcc-gsr.com/wp-content/uploads/2023/09/Spotlight-3-Engagement-of-Transport-Stakeholders-in-the-United-Nations-Framework-Convention-on-Climate-Change-Process.pdf.

92 S. Black, A.A. Liu and I.W.H. Parry (2023), IMF Fossil Fuel Subsidies Data: 2023 Update, https://www.imf.org/en/Publications/WP/Issues/2023/08/22/IMF-Fossil-Fuel-Subsidies-Data-2023-Update-537281; D. Benitez and J. Bisbey (2025), Financing Climate Action for Transportation in Developing Countries, World Bank, http://hdl.handle.net/10986/42586 ; OECD (2017), Investing in Climate, Investing in Growth, OECD Publishing, Paris, https://doi.org/10.1787/9789264273528-en .

93 CPI (2025), Global Landscape of Climate Finance 2025, https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2025.

94 Ibid.

95 Ibid.

96 SLOCAT (2023), SLOCAT Key Transformations for Sustainable, Low Carbon Land Transport, https://slocat.net/key-transformations.

97 Sustainable Mobility for All (n.d.), Implementing the SDGs, https://www.sum4all.org/implementing-sdgs.

98 Figure 3 from Ibid.

99 UN (2025), The Sustainable Development Goals Report 2025, https://unstats.un.org/sdgs/report/2025/The-Sustainable-Development-Goals-Report-2025.pdf.

100 Ibid.

101 M.H. Asmare (2023), SDGs data in Africa, https://unstats.un.org/sdgs/files/meetings/vnr-workshop-dec2023/RCa_UN_ECA.pdf.

102 UN (2024), Asia and the Pacific SDG Progress Report 2024, Showcasing Transformative Actions, https://www.unescap.org/sites/default/d8files/event-documents/ESCAP-2024-FS-AP-SDG-Progress.pdf.

103 ATO (2024), Transport and the SDGs: A Comprehensive Review for Asia and the Pacific, https://asiantransportobservatory.org/analytical-outputs/sdgs-in-asia-2024.

104 UN Economic Commission for Latin America and the Caribbean (2024), Regional progress towards the SDG targets, https://agenda2030lac.org/estadisticas/regional-progress-sdg-targets.html.

105 SLOCAT (2025), Transport and Voluntary National Reviews of SDGs Implementation, http://www.slocat.net/vnr.

106 WHO (2025), Decade of Action for Road Safety, https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030.

107 UN Sustainable Development Group (2025), Road safety is everyone's business: Joint Op-Ed, https://unsdg.un.org/latest/announcements/road-safety-everyone's-business-joint-op-ed.

108 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

109 WHO (2024), Road traffic deaths rise in the African region, but down globally, WHO report, https://www.afro.who.int/news/road-traffic-deaths-rise-african-region-down-globally-who-report.

110 WHO (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

111 WHO (2025), Fourth Global Ministerial Conference on Road Safety: https://www.who.int/news-room/

events/detail/2025/02/18/default-calendar/fourth-global-ministerial-conference-on-road-safety; WHO (2025), Marrakech Declaration Fourth Ministerial Conference on Road Safety: One World, One Road, Commit to Life, Marrakech, 18-20 February 2025, https://cdn.who.int/media/docs/default-source/documents/un-road-safety-collaboration/marrakech-declaration-en.pdf?sfvrsn=261f4417_3.

112 World Resources Institute (2015), With Latest Climate Commitments, How Much Will the World Warm? It's Complicated, https://www.wri.org/insights/latest-climate-commitments-how-much-will-world-warm-its-complicated.

113 UNFCCC (2024), Nationally determined contributions under the Paris Agreement, Synthesis report by the secretariat, https://unfccc.int/documents/641792.

114 IDDRI (2025), DDP Report 2025, A Decade of National Climate Action: Stocktake And The Road Ahead. IDDRI, https://ddpinitiative.org/ddp-report-2025/.

115 UNFCCC (2025), FAQ - Implementing the Enhanced Transparency Framework, https://unfccc.int/FAQ-moving-towards-the-ETF.

116 UNFCCC (2021), The Explainer: The Paris Agreement, https://unfccc.int/news/the-explainer-the-paris-agreement.

117 United Nations Framework Convention on Climate Change (UNFCCC) (2025), Paris Agreement, https://unfccc.int/sites/default/files/english_paris_agreement.pdf; UNFCCC (2023), Work programme on just transition pathways referred to in the relevant paragraphs of decision 1/CMA.4, https://unfccc.int/sites/default/files/resource/cma2023_L14E.pdf; UNFCC (2024), Draft Decision, [CMA.5] New Collective Quantified Goal on Climate Finance, https://unfccc.int/documents/643641.

118 GIZ and SLOCAT (2025), NDC Transport Tracker, https://changing-transport.org/tracker.

119 Ibid.

120 Ibid.

121 Ibid.

122 UNFCCC (2023), LT-LEDS Synthesis Report, https://unfccc.int/lt-leds-synthesis-report.

123 Ibid.

124 Ibid.

125 Ibid.

126 UNFCCC (2025), Submitted NAPs from developing country Parties, https://napcentral.org/submitted-naps; UNFCCC (2025), NAPs shared by developed country Parties, https://napcentral.org/developedcountriesnaps.

127 Papua New Guinea (2023), National Adaptation Plan, https://unfccc.int/sites/default/files/resource/NAP-PNG-Finale-2023.pdf.

128 J. Ellis, L. Lo Re and S. Errendal (2023), Making the Mitigation Work Programme fit for purpose: Options for forms, focus and information that would lead to successful implementation, OECD/IEA Climate Change Expert Group Papers, No. 2023/02, https://doi.org/10.1787/26446ffc-en.

129 UNFCCC (2025), Sharm el-Sheikh mitigation ambition and implementation work program, https://unfccc.int/topics/mitigation/workstreams/mitigation-work-programme.

130 UNFCCC (2021), The Glasgow Climate Pact – Key Outcomes from COP26, https://unfccc.int/process-and-meetings/the-paris-agreement/the-glasgow-climate-pact-key-outcomes-from-cop26

131 SLOCAT (2023), A call to double the share of energy efficient and fossil-free forms of land transport by 2030 ,https://slocat.net/call-to-action-on-fossil-fuel-free-land-transport/

132 SLOCAT (2024), A call to double the share of energy efficient and fossil-free forms of land transport by 2030, https://slocat.net/call-to-action-on-fossil-fuel-free-land-transport.

133 UNFCCC (2023), Outcomes of the Dubai Climate Change Conference - Advance Unedited Versions (AUVs) and list of submissions from the sessions in Dubai, https://unfccc.int/cop28/outcomes.

134 Climate High-Level Champions (2025), Breakthroughs, https://www.climatechampions.net/frameworks/breakthroughs.

135 Climate High-Level Champions (2025), Breakthroughs, https://www.climatechampions.net/frameworks/breakthroughs.

136 UNFCCC (2024), Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its fifth session, held in the United Arab Emirates from 30 November to 13 December 2023, https://unfccc.int/sites/default/files/resource/cma2023_16a01E.pdf.

137 Ibid

138 Ibid

139 Ibid

140 United Nations (2024), COP29 climate talks end with $300 billion annual pledge, Guterres calls deal a 'base to build on', https://news.un.org/en/story/2024/11/1157416.

141 United Nations (2024), COP29 climate talks end with $300 billion annual pledge, Guterres calls deal a 'base to build on', https://news.un.org/en/story/2024/11/1157416.

142 SLOCAT (2025), Bridging the Climate Finance Gap for Sustainable Transport: The Crucial Role of the "Baku to Belém Roadmap", https://slocat.net/bridging-the-climate-finance-gap-for-sustainable-transport-the-crucial-role-of-the-baku-to-belem-roadmap/

143 Ibid.

144 Ibid.

145 M. Cardama and A. Yiu (2023), Engagement of Transport Stakeholders in the United Nations Framework Convention on Climate Change Process, Spotlight 3 in SLOCAT Transport, Climate and Sustainability Global Status Report - 3rd edition, https://tcc-gsr.com/wp-content/uploads/2023/09/Spotlight-3-Engagement-of-Transport-Stakeholders-in-the-United-Nations-Framework-Convention-on-Climate-Change-Process.pdf.

146 UNFCCC (n.d.), Marrakech Partnership for Global Climate Action, https://unfccc.int/climate-action/engagement/marrakech-partnership.

147 United Nations (2014), Climate Summit: 'All hands on deck' declares Ban, calling for leadership, concrete action, https://news.un.org/en/story/2014/09/478172.; UNFCCC (2015), The Lima-Paris Action Agenda: Promoting Transformational Climate Action, https://unfccc.int/news/the-lima-paris-action-agenda-promoting-transformational-climate-action.; SLOCAT (2016), Global Climate Action Agenda (GCAA) Transport Initiatives: Stock-take on action on the Implementation of the Paris Agreement on Climate Change and contribution towards the 2030 Global Goals on Sustainable Development, https://slocat.net/wp-content/uploads/2022/04/GCAA-Transport-Initiatives-Report-November-2016-1.pdf.; SLOCAT (2017), Marrakech Partnership for Global Climate Action (MPGCA) Transport Initiatives: Stock-take on action toward implementation of the Paris Agreement and the 2030 Agenda on Sustainable Development, Second Progress Report, https://slocat.net/wp-content/uploads/2022/04/2017-MPGCA-Transport-Initiatives-Report_Final.pdf.

148 SLOCAT (2022), Are Nationally Determined Contributions Aligned with the Commitments and Initiatives on Transport Announced on the Occasion of COP26? A Comparative Analysis by SLOCAT, https://slocat.net/cop26-commitments-ndc-alignment-2022; Accelerating to Zero Coalition (2025), Signatories, https://accelerating-tozero.org/signatories, accessed 14 July 2025; UNFCCC (2025), 2030 Breakthroughs, https://www.climatechampions.net/frameworks/breakthroughs, accessed 14 July 2025; Department for Transport (2023), COP 26: Clydebank Declaration for green shipping corridors, https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors/cop-26-clydebank-declaration-for-green-shipping-corridors; CALSTART (2025), Global Memorandum of Understanding on Zero-emission Medium- and Heavy-duty Vehicles, Global Commercial Vehicle Drive to Zero, https://globaldrivetozero.org/mou-nations, accessed 14 July 2025; UK Department for Transport (2022), COP 26 declaration: International Aviation Climate Ambition Coalition, https://www.gov.uk/government/publications/cop-26-declaration-international-aviation-climate-ambition-coalition/cop-26-declaration-international-aviation-climate-ambition-coalition.

149 SLOCAT (2024), Transport in COP29 outcomes, https://slocat.net/wp-content/uploads/2024/12/Transport-in-COP29-outcomes_Overview.pdf.

150 United Nations Economic Commission for Europe (2025), High-level Meeting on Transport, Health and Environment, https://unece.org/thepep/hlm.; Clean Energy Ministerial (2025), Clean Energy Ministerial, https://www.cleanenergyministerial.org/.

151 ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.

152 P. Jaramillo et al. (2022), Transport, in: IPCC (2022), Climate Change 2022: Mitigation of Climate Change, https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

153 Ibid

154 Ibid

155 **Figure 4** from ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.; P. Jaramillo et al. (2022), Transport, in: IPCC (2022), Climate Change 2022: Mitigation of Climate Change, https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

156 ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.

157 **Figure 5** from SLOCAT (2025), Raising Ambition for Transport in Nationally Determined Contributions, A Five-Point Plan for Transport in New NDCs, https://slocat.net/wp-content/uploads/2025/03/Five-Point-Plan-for-Transport-in-New-NDCs_2025-Recommendations-2.pdf.

158 **Figure 6** from Ibid.

159 UN Economic Commission for Africa (2025), Only 13 of the 195 Parties to the Paris Agreement communicated their NDC 3.0 by the deadline of 10 February 2025, https://www.uneca.org/stories/only-13-of-the-195-parties-to-the-paris-agreement-communicated-their-ndc-3.0-by-the-deadline.

160 GIZ and SLOCAT (2025), NDC Transport Tracker, https://changing-transport.org/tracker/.

161 Ibid.

162 Ibid.

163 Ibid.

164 Ibid.

165 Australian Government (2025), Australia's 2035 Nationally Determined Contribution, Department of Climate Change, Energy, the Environment and Water, Canberra, CC BY 4.0., https://unfccc.int/sites/default/files/2025-09/Australias%20Second%20NDC.pdf.

166 Lesotho (2024), Second Nationally Determined Contributions of Lesotho, https://unfccc.int/sites/default/files/2025-02/Lesotho%20SECOND%20NDC.pdf.

167 Republic of the Marshall Islands (2025) Nationally Determined Contribution 2031-35, https://unfccc.int/sites/default/files/2025-02/Republic%20of%20the%20Marshall%20Islands%20NDC%203.0.pdf.

168 Singapore (2025), Singapore's Second Nationally Determined Contribution (NDC) and Accompanying Information, https://unfccc.int/sites/default/files/2025-02/Singapore%20Second%20Nationally%20Determined%20Contribution.pdf.

169 United Arab Emirates Ministry of Climate Change and Environment (2024), The United Arab Emirates' Third Nationally Determined Contribution (NDC 3.0): Accelerating Action Towards Mission 1.5C, https://unfccc.int/sites/default/files/2024-11/UAE-NDC3.0.pdf.

170 UK Government (2025), United Kingdom of Great Britain and Northern Ireland's 2035 Nationally Determined Contribution, https://unfccc.int/sites/default/files/2025-01/UK%27s%202035%20NDC%20ICTU.pdf.

171 Republic of Uruguay (2024), Tercera Contribución Determinada a nivel Nacional al Acuerdo de París, https://unfccc.int/sites/default/files/2025-01/20241220_Uruguay_NDC3.pdf.

172 **Box 1** from European Commission (2024), Transport poverty: definitions, indicators, determinants, and mitigation strategies - Final Report, https://employment-social-affairs.ec.europa.eu/transport-poverty-definitions-indicators-determinants-and-mitigation-strategies-final-report_en; H. Hook, D. Durán-Rodas, S. Jamal and T. Schwanen (2025), Evaluating initiatives to improve transport justice, Transportation Research Part D: Transport and Environment, Volume 142, https://doi.org/10.1016/j.trd.2025.104719.

173 UN Environment (2024), E-Mobility as a Driver for Change: Towards a gender transformative and just transition to electric mobility, https://sustmob.org/EMOB/pdf/GenderEmobility_Report_August2024.pdf.

174 GIZ and SLOCAT (2025), NDC Transport Tracker, https://changing-transport.org/tracker/.

175 Ibid

176 **Figure 7** from SLOCAT (2025), Five Transport Priorities for Climate and Sustainability Action at COP30, https://slocat.net/wp-content/uploads/2025/09/Five-Transport-Priorities-for-Climate-and-Sustainability-Action-at-COP30-1.pdf.

177 Ibid.

178 UNFCCC (n.d.), Global goal on adaptation, https://unfccc.int/topics/adaptation-and-resilience/workstreams/gga; UNFCCC (n.d.), Fund for responding to Loss and Damage, https://unfccc.int/fund-for-responding-to-loss-and-damage.

179 UN DESA (2025), UN Decade of Sustainable Transport 2026 – 2035, https://sdgs.un.org/un-decade-sustainable-transport-2026-2035.

180 UN DESA (2025), UN Decade of Sustainable Transport 2026 – 2035, https://sdgs.un.org/un-decade-sustainable-transport-2026-2035.

181 Ibid.

182 SLOCAT (2025), Seizing the Decade: Why Sustainable Transport Matters, https://slocat.net/seizing-the-decade-why-sustainable-transport-matters/.

183 **Figure 8** from SLOCAT (2024), UN Decade of Sustainable Transport will start in 2026! https://slocat.net/un-decade-of-sustainable-transport; UN General Assembly (2023), Resolution A/78/148 adopted by the General Assembly on 19 December 2023, https://sdgs.un.org/sites/default/files/2024-10/transport%20to%20achieve%20SDGs.pdf; UN Department of Economic and Social Affairs (2025), UN Decade of Sustainable Transport 2026-2035, https://sdgs.un.org/un-decade-sustainable-transport-2026-2035.

184 H. Dalkmann, J. Leather, S. Gota and A. Meija (2025), Towards effective monitoring for the UN Decade of Sustainable Transport, Asian Development Bank, https://asiantransportobservatory.org/analytical-outputs/towards-effective-monitoring-for-the-un-decade-of-sustainable-transport/.

185 Transport Data Commons (n.d.), Making high quality transport data accessible, https://portal.transport-data.org/.

1.2
THE RIGHT TO MOBILITY IN A SUSTAINABLE AND INCLUSIVE SOCIETY

1 Institute for Transportation and Development Policy (ITDP) and Transformative Urban Mobility Initiative (TUMI) (2024), Access for All Through Universal Accessibility, https://itdp.org/wp-content/uploads/2022/02/Full-Report-jun21.pdf; L. Artieda et al. (2022), Access and Persons with Disabilities in Urban Areas, Access for All Series, ITDP, https://itdp.org/wp-content/uploads/2022/02/Full-Report-jun21.pdf; ITDP and TUMI (2024), Access for All Through Universal Accessibility, Visual Brief, https://itdp.org/wp-content/uploads/2024/10/ITDP-TUMI_Access-for-All-Visual-Brief_Dec-2024.pdf.

2 United Nations (1948), Universal Declaration of Human Rights, https://www.un.org/sites/un2.un.org/files/2021/03/udhr.pdf.

3 World Resources Institute (WRI) (2021), Mexico Adds Fundamental Right to Mobility to Its Constitution, https://www.wri.org/outcomes/mexico-adds-fundamental-right-mobility-its-constitution; Global Alliance of NGOs for Road Safety (2022), Mobility rights in Mexico, https://www.roadsafetyngos.org/events/mobility-rights-in-mexico.

4 World Health Organization (WHO) (2021), Mexico's groundbreaking National Law of Mobility and Road Safety, in Mid-term Results Report: the world needs WHO now more than ever, https://www.who.int/about/accountability/results/who-results-report-2020-mtr/country-story/2021/mexico.

5 Ibid.

6 Ibid.

7 France National Constituent Assembly (2025), The Declaration of the Rights of Man and of the Citizen of 1789, https://www.elysee.fr/en/french-presidency/the-declaration-of-the-rights-of-man-and-of-the-citizen.

8 European Commission Joint Research Centre and International Energy Agency (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

9 Ibid.

10 United Nations (n.d.), Sustainable Development Goals – Goal 11: Make cities inclusive, safe, resilient and sustainable, https://www.un.org/sustainabledevelopment/cities.

11 United Nations (n.d.), Sustainable Development Goals – Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, https://sdgs.un.org/goals/goal9#overview.

12 According to Principle 20 of the European Pillar of Social Rights, everyone has the right to easy-to-use and affordable key services, including water, sanitation, energy, transport, financial services and digital communications. European Commission (2017), The European Pillar of Social Rights in 20 principles, https://employment-social-affairs.ec.europa.eu/policies-and-activities/european-pillar-social-rights-building-fairer-and-more-inclusive-european-union/european-pillar-social-rights-20-principles_en.

13 **Figure 1** from UNHABITAT (2025), Urban transport, https://data.unhabitat.org/pages/urban-transport

14 T. Tammaru et al. (n.d.), Increasing segregation in European cities, https://www.tudelft.nl/en/architecture-and-the-built-environment/research/research-stories/increasing-segregation-in-european-cities.

15 M.J.W.A Vanderschuren and O.A. Nnene (2021), Inclusive planning: African policy inventory and South African mobility case study on the exclusion of persons with disabilities, Health Research Policy and Systems 19, 124, https://doi.org/10.1186/s12961-021-00775-1.

16 Ibid.

17 World Bank (2024), Rural Access Index (RAI), https://datacatalog.worldbank.org/search/dataset/0038250.

18 Ibid.

19 **Figure 2** from Ibid.

20 A. Iimi et al. (2016), New Rural Access Index, Main Determinants and Correlation to Poverty, World Bank, https://documents1.worldbank.org/curated/en/821621478094511356/pdf/WPS7876.pdf.

21 N.R. Velaga et al. (2012), Transport poverty meets the digital divide: accessibility and connectivity in rural communities, Journal of Transport Geography 21, 102-112, https://doi.org/10.1016/j.jtrangeo.2011.12.005.

22 J. Nebrija et al. (2024), A Closer Look at Informal (Popular) Transportation: An Emerging Portrait, United Nations Development Programme (UNDP) and Global Network for Popular Transportation, https://www.undp.org/sites/g/files/zskgke326/files/2024-03/informal_transportation_report_march_2024.pdf.

23 MobiliseYourCity Partnership (2022), Sustainable Urban Mobility Plan (SUMP) of Ambato, Ecuador, https://www.mobiliseyourcity.net/sump-ambato-ecuador-executive-summary; MobiliseYourCityPartnership (2023) Plano Regional de Mobilidade Sustantável e Logística da Baixada Santista, https://www.mobiliseyourcity.net/sites/default/files/2023-07/SUMPBS_Report%20MYC_E00.pdf;MobiliseYourCity; MobiliseYourCityPartnership (2024) Plan de Mobilité Urbaine Durable Dakar, https://www.mobiliseyourcity.net/sites/default/files/2024-07/PMUD-DK_Note%20synth%C3%A8se.pdf; MobiliseYourCityPartnership (2021), Plan de Movilidad Urbano Sostenible de Antofagasta, https://www.mobiliseyourcity.net/sites/default/files/2024-02/Informe%20Final%20PMUS.pdf; MobiliseYourCityPartnership (2025), MobiliseYourCity Global Monitor 2025, Factsheet: Ahmedabad, India, https://www.mobiliseyourcity.net/sites/default/files/2025-05/Ahmedabad%2C%20India.pdf; MobiliseYourCity Partnership (2022), Sustainable Urban Mobility Plan (SUMP) for Medan Metropolitan Area (SUMP Mebidangro), https://www.mobiliseyourcity.net/sites/default/files/2022-12/SUMP%20MEBIDANGRO%20FINAL%20REPORT_DRAFT%206_ENG.pdf, African Urban Mobility Observatory (2021), Role of Informal Paratransit Report, https://transport-links.com/wp-content/uploads/2023/10/africa-urban-mobility-observatory-role-of-informal-paratransit-report-big-data-to-enable-inclusive-low-carbon-mobility.pdf.

24 S. Angel et al. (2021), Densify and expand: a global analysis of recent urban growth, Sustainability 13, 3835, https://doi.org/10.3390/su13073835.

25 **Box 1** from the following sources: WHO (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517; International Road Assessment Programme (2025), iRAP Safety Insights Explorer, https://irap.org/safety-insights-explorer; Health Effects Institute (2024), State of Global Air Report 2024, https://www.stateofglobalair.org/resources/report/state-global-air-report-2024; J. Lelieveld et al. (2023), Air pollution deaths attributable to fossil fuels: observational and modelling study, BMJ 383, https://doi.org/10.1136/bmj-2023-077784; R. Guski, D. Schreckenberg and R. Schuemer (2017), WHO environmental noise guidelines for the European region: a systematic review on environmental noise and annoyance, International Journal of Environmental Research and Public Health 14/12, 1539, https://doi.org/10.3390/ijerph14121539; S. Black, A.A. Liu and I.W.H. Parry (2023), IMF Fossil Fuel Subsidies Data: 2023 Update, International Monetary Fund, https://www.imf.org/en/Publications/WP/Issues/2023/08/22/IMF-Fossil-Fuel-Subsidies-Data-2023-Update-537281.

26 T. Litman (2023), Well Measured: Developing Indicators for Sustainable and Livable Transport Planning, Victoria Transport Policy Institute, https://www.vtpi.org/wellmeas.pdf; WRI (n.d.), Integrated transport, https://www.wri.org/cities/integrated-transport; Designing Buildings (2022), Integrated transport system, https://www.designingbuildings.co.uk/wiki/Integrated_transport_system; UN Economic and Social Commission for Asia and the Pacific (2015), Integrated transport planning, policy formulation and coordination, https://www.unescap.org/sites/default/files/4_Integrated%20Transport%20Planning_ESCAP.pdf; T. Litman (2017), Developing indicators for comprehensive and sustainable transport planning, Transportation Research Record 2017/1, 10-15, https://doi.org/10.3141/2017-02.

27 R. Prieto-Curiel and J.P. Ospina (2024), The ABC of mobility, Environment International 185, https://doi.org/10.1016/j.envint.2024.108541.

28 E. Blomstrom, A. Gauthier and C. Jang (2023), Access and Gender, ITDP and Women's Environment and Development Organization, https://wedo.org/wp-content/uploads/2018/05/access_for_all_series_FINAL-FOR-WEBSITE.pdf.

29 **Figure 3** from UITP (2025), Global Urban Mobility Indicators 2023, https://www.uitp.org/publications/global-urban-mobility-indicators-2023/

30 M. Knipe and S. Krygsman (2024), The opportunity cost of household transport expenditure in South Africa, Journal of Transport and Supply Chain Management 18/0, https://doi.org/10.4102/jtscm.v18i0.1081.

31 Ibid.

32 M. Mohammed and S. Senadheera (2022), Public transport affordability evaluation for Addis Ababa City. Sustainability, 14/11, 6883, https://doi.org/10.3390/su14116883.

33 European Commission (2023), Access to essential services: key challenges for the most vulnerable – report, https://employment-social-affairs.ec.europa.eu/news/access-essential-services-key-challenges-most-vulnerable-report-2023-06-28_en.

34 US Department of Energy (2022), FOTW #1248, July 25, 2022: The Average U.S. Household Spent Nearly $10,000 on Transportation in 2020, https://www.energy.gov/eere/vehicles/articles/fotw-1248-july-25-2022-average-us-household-spent-nearly-10000.

35 European Commission (2025), Report on Access to Essential Services in the EU, Commission Staff Working Document, https://redi-ngo.eu/redi-network/wp-content/uploads/2025/04/report-on-access-to-essential-services-in-the-eu-KE0923154ENN.pdf.

36 ITDP (2024), Better Urban Mobility Starts with Universal Accessibility, https://itdp.org/2024/12/03/better-urban-mobility-starts-with-universal-accessibility; ITDP (2022), Ensuring Access for All Persons with Disabilities, https://itdp.org/2022/06/29/ensuring-access-for-all-persons-with-disabilities; A.M. Gimie et al. (2022), Epidemiology of public transportation use among older adults in the United States, Journal of the American Geriatrics Society 70/12, 3549-3559, https://doi.org/10.1111/jgs.18055.

37 A. Clegg (2025), Navigating public transport and infrastructure to work, Financial Times, https://www.ft.com/content/ebdf55f4-61b8-45ed-8534-866541f29360; Transport for London (2024), Equity in Motion - Our journey to creating a fair, accessible and inclusive transport network (Issue 2), https://content.tfl.gov.uk/equity-in-motion-full.pdf.

38 L. Ribeiro and I. Alfred (2025), From Challenges to Solutions: Building Inclusive Transport for People with Disabilities, TUMI, https://transformative-mobility.org/multimedia/from-challeng-

es-to-solutions-building-inclusive-transport-for-people-with-disabilities; ITDP (2022), From Commuter to Care: Public transport's role in creating the new normal, https://itdp.org/2022/04/19/from-commuter-to-care-public-transports-role-in-creating-the-new-normal.

39 World Bank (2024), Promoting Livable Cities by Investing in Urban Mobility, https://www.worldbank.org/en/results/2024/03/13/promoting-livable-cities-by-investing-in-urban-mobility.

40 ITDP and TUMI (2024), Access for All Through Universal Accessibility, https://itdp.org/wp-content/uploads/2024/10/ITDP-TUMI_Access-for-All-Visual-Brief_Dec-2024.pdf; E. Blomstrom, A. Gauthier and C. Jang (2018), Access and Gender, ITDP, https://itdp.org/wp-content/uploads/2018/05/access_for_all_series_FINAL-FOR-WEBSITE.pdf.

41 ITDP (2022), From Transmilenio to Cycle Networks, Lessons Learned from Bogotá's Comprehensive Urban Mobility Planning, https://itdp.org/wp-content/uploads/2023/05/From-Transmilenio-to-Cycle-Networks-Lessons-Learned-from-Bogotas-Comprehensive-Urban-Mobility-Planning-MAY4.pdf.

42 ITDP (2024), STA 2024 Spotlight: Tianjin, China, From Changing Streets to Systematic Change: Transforming Urban Mobility in Tianjin, https://itdp.org/wp-content/uploads/2024/12/STA-2024-Spotlight-Tianjin-December-2024.pdf.

43 Ibid.

44 A.F. Barata (2024), Social participation and mobility justice in Brazil, Cad. Metropole 26/60, https://doi.org/10.1590/2236-9996.2024-6004.e.

45 ITDP (n.d.), São Paulo, https://itdp.org/city-transformations/sao-paulo.

46 Y. Zhang (2023), Municipality of Niterói, Brazil: Creating Momentum Towards a Walkable and Bikeable City, TUMI Initiative's Transformative Stories, https://www.transformative-mobility.org/wp-content/uploads/2023/03/TUMI_City-profile-and-story-Niteroi-QjKjKD.pdf.

47 UN Sustainable Development Group (n.d.), Human Rights-Based Approach, https://unsdg.un.org/2030-agenda/universal-values/human-rights-based-approach.

48 Transport for London (nd), Diversity & inclusion publications, https://tfl.gov.uk/corporate/publications-and-reports/equality-and-inclusion-publications?intcmp=24542

49 J.C. Mutiganda, M. Skoog and E. Igudia (2023), Understanding the process of improving accessibility and affordability of inter-municipal bus transport system, European Transport Research Review 15, https://doi.org/10.1186/s12544-023-00598-x.

50 Ibid.

51 Queensland Cabinet and Ministerial Directory (2025), A fresh start for Queensland: Queenslanders on Board with the LNP's Permanent 50 Cent Fares, https://statements.qld.gov.au/statements/101980.

52 Ibid.

53 C. Blank et al. (2024), Zero fares on public transport: impacts, challenges and recommendations, WRI, https://www.wribrasil.org.br/noticias/tarifa-zero-transporte-publico-impactos-desafios-recomendacoes.

54 Ibid.

55 Statista (2023), Public transport monthly ticket cost: key cities globally 2023, https://www-statista-com.iclibezp1.cc.ic.ac.uk/statistics/1154432/public-transport-monthly-ticket-cost-selected-cities-worldwide.

56 A. Singh and Nishant (2024), Riding the Justice Route: Assessing the Impact of Free Bus Travel on Progress Toward Gender-Just Public Transport in Delhi, Greenpeace India Society, https://www.greenpeace.org/static/planet4-india-stateless/2024/10/c293ab29-riding-the-justice-route-1-compressed.pdf.

57 Nishant and A. Singh (2025), A Free Ticket Can Be a Ticket to Freedom, The India Forum, https://www.theindiaforum.in/forum/free-ticket-can-be-ticket-freedom.

58 Ibid.

59 N. Kaiser and C.K. Barstow (2022), Rural transportation infrastructure in low- and middle-income countries: a review of impacts, implications, and interventions, Sustainability 14/4, 2149, https://doi.org/10.3390/su14042149.

60 W. Brooks and K. Donovan (2023), Measuring Return on Investment for a Footbridge in Nicaragua and Rwanda, https://bridgestoprosperity.org/wp-content/uploads/2023/11/ROI-Whitepaper_2023.10.20.pdf.

61 J. Hine et al. (2016), Does the extension of the rural road network have a positive impact on poverty reduction and resilience for the rural areas served? If so how, and if not why not, Social Science Research Unit, UCL Institute of Education, University of London, https://assets.publishing.service.gov.uk/media/57a089c2ed915d3cfd0003fe/Extension_of_network_2014_Hine_protocol.pdf; R. Asomani-Boateng, R.J. Fricano and F. Adarkwa (2015), Assessing the socio-economic impacts of rural road improvements in Ghana: a case study of transport sector program support (II), Case Studies on Transport Policy 3/4, 355-366, https://doi.org/10.1016/j.cstp.2015.04.006; J. Hine et al. (2019), Evidence of the impact of rural road investment on poverty reduction and economic development, https://opendocs.ids.ac.uk/articles/report/Evidence_of_the_Impact_of_Rural_Road_Investment_on_Poverty_Reduction_and_Economic_Development/26435254.

62 Ibid.

63 Rwanda Transport Development Agency (2023), Report on Final National Feeder Roads Master Plan, https://bridges.app.box.com/s/12g7mvad30kg3ofcjjmk2myn6cbhdme9.

64 UNDP (2024), Expansion of the Integrated Rural Development of Uzbekistan: Launch of the second phase of the project, https://www.undp.org/uzbekistan/press-releases/expansion-integrated-rural-development-uzbekistan-launch-second-phase-project.

65 **Box 2** from United Nations (2006), Convention on the Rights of Persons with Disabilities and Optional Protocol, https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf.

66 L. Artieda et al. (2022), Access and Persons with Disabilities in Urban Areas, Access for All Series, ITDP, https://itdp.org/wp-content/uploads/2022/02/Full-Report-jun21.pdf.

67 R.D. Clapano (2025), DSWD unveils e-buses for PWDs, https://www.philstar.com/nation/2025/06/18/2451323/dswd-unveils-e-buses-pwds ; Railway Supply (2025), PATH offers 50% discount for riders with disabilities, https://www.railway.supply/path-offers-50-discount-for-riders-with-disabilities/

68 Ramp My City (2018), Equal Access, Equal Opportunities, https://rampmycity.com/

69 European Commission (nd), Passenger Rights, https://transport.ec.europa.eu/transport-themes/passenger-rights_en

70 Ruter (2021), Towards a better normal, https://aarsrapport2021.ruter.no/en/sustainable-movement/public-transport-is-for-everyone.

71 The Urban Catalysts (2024), WE2: She Moves on Electric TwoWheels - Understanding the barriers and opportunities for increasing women's uptake of electric two-wheelers in India, The Urban Catalysts: Mumbai, https://transport-links.com/wp-content/uploads/2025/01/HVT059-Project-Completion-Report_19122024.pdf

72 ITDP (2024), Why Inclusive Transport Matters: In Conversation with TransPeshawar, https://itdp.org/2024/05/10/why-inclusive-transport-matters-in-conversation-with-transpeshawar/

73 Government of Colombia (2025), Conoce las Manzanas del Cuidado, https://sistemadecuidado.gov.co/

74 J. Orozco (2023), Colombia's Women-Led Electric Bus Fleet Is Reshaping Bogotá's Public Transit, CityLab Transportation, https://www.bloomberg.com/news/features/2023-05-08/la-rolita-electric-bus-company-prioritizes-gender-equity.

75 Government of Ireland (2025), National Policy Statement on Shared Mobility and the Provision of Hubs, https://www.gov.ie/en/department-of-transport/publications/policy-statement-on-shared-mobility; Government of Ireland (2025), Minister O'Brien launches National Policy and new Pilot Project for Shared Transport Mobility Hubs, https://www.gov.ie/en/department-of-transport/press-releases/minister-obrien-launches-national-policy-and-new-pilot-project-for-shared-transport-mobility-hubs.

76 European Commission (2023), Passenger Mobility Package: Improved rights and better information for travellers, https://urban-mobility-observatory.transport.ec.europa.eu/news-events/news/passenger-mobility-package-improved-rights-and-better-information-travellers-2023-12-14_en; European Commission (2023), Improved rights and better information for travellers, https://transport.ec.europa.eu/news-events/news/passenger-mobility-package-2023-11-29_en.

77 C40 Cities (n.d.), Zero Emission Bus Rapid-deployment Accelerator (ZEBRA) Partnership, in C40: Scaling up climate action – transportation, https://www.c40.org/what-we-do/scaling-up-climate-action/transportation/zero-emission-rapid-deployment-accelerator-zebra-partnership.

78 Reforma (2024), Ciclotaxis en el Centro Histórico: una norma con vacíos, https://www.reforma.com/ciclotaxis-en-el-centro-historico-una-norma-con-vacios/ar2823489.

79 Câmara Municipal de Lisboa (n.d.), Mexe-te Pela Tua Cidade! https://www.lisboa.pt/temas/mobilidade/escolar/mexe-te-pela-tua-cidade.

80 ITDP (2024), Better Urban Mobility Starts with Universal Accessibility, https://itdp.org/2024/12/03/better-urban-mobility-starts-with-universal-accessibility.

81 Hamburg Sustainability Conference (2024), Hamburg Charter for Inclusive and Just Mobility, https://hamburg-charter.transformative-mobility.org.

82 UPPER (n.d.), About UPPER, https://www.upperproject.eu/about-upper.

83 JUST STREETS (n.d.), About, https://www.just-streets.eu/about.

84 ITDP (2025), Mobility and Access for Babies, Toddlers, and Their Caregivers Course, https://itdp.org/course/mobility-and-access-for-babies-toddlers-and-their-caregivers.

1.3
TRANSPORTING SHARED PROSPERITY: CONNECTING ECONOMIES AND PEOPLE FOR A SUSTAINABLE PLANET

1 Y.K. Dwivedi et al. (2022), Climate change and COP26: Are digital technologies and information management part of the problem or the solution? An editorial reflection and call to action, International Journal of Information Management 63, https://doi.org/10.1016/j.ijinfomgt.2021.102456.

2 **Figure 1** from M. Eriksson (2022), Digital Innovation, Transports and Logistics RISE Mobility and Systems. White Paper RISE Research Institutes of Sweden, https://www.ri.se/en/expertise-areas/expertises/3d-printning-and-just-in-demand-logistik; K. Montevirgen (2025), Comparative advantage, Britannica, https://www.britannica.com/money/comparative-advantage.

3 M. Bartley Johns et al. (2018), Trade and Poverty Reduction: New Evidence of Impacts in Developing Countries, World Bank, http://documents.worldbank.org/curated/en/968461544478747599; World Bank (2023), Trade Has Been a Powerful Driver of Economic Development and Poverty Reduction, https://www.worldbank.org/en/topic/trade/brief/trade-has-been-a-powerful-driver-of-economic-development-and-poverty-reduction.

4 J.P. Rodrique and T. Notteboom (2024), Transportation and economic development, in The Geography of Transport Systems, Sixth Edition, https://doi.org/10.4324/9781003343196.

5 J.J. Rojas-Reyes, L. Rivera-Cadavid and D.L. Peña-Orozco (2024), Disruptions in the food supply chain: a literature review, Heliyon 10/14, https://doi.org/10.1016/j.heliyon.2024.e34730.

6 A.C. McKinnon (2025), Climate Logistics, https://logistics.org.uk/green-mile-homepage/industry-insight/19-05-25/climate-logistics.

7 M. Le Moigne et al. (2024), Greening Ricardo: Environmental comparative advantage and the environmental gains from trade, World Trade Organization (WTO), https://www.wto.org/english/res_e/reser_e/ersd202407_e.pdf.

8 UK Department for Transport (2022), Future of Freight: a long-term plan, https://assets.publishing.service.gov.uk/media/62b9a2e-c8fa8f53572e3db68/future-of-freight-plan.pdf.

9 UN Conference on Trade and Development (UNCTAD) (2025), Key statistics and trends in international trade 2024, https://unctad.org/publication/key-statistics-and-trends-international-trade-2024.

10 International Monetary Fund (IMF) (2008), Globalization: A Brief Overview, https://www.imf.org/external/np/exr/ib/2008/053008.htm; J.P. Rodrique and T. Notteboom (2024), Transportation and Economic Development, in The Geography of Transport Systems, Sixth Edition, https://doi.org/10.4324/9781003343196; Lu et al. (2021), Analysis of factors affecting freight demand based on input-output model, Mathematical Problems in Engineering 2021, https://doi.org/10.1155/2021/5581742; UNCTAD (2025), Global Trade Update (March 2025): The role of tariffs in international trade, https://unctad.org/publication/global-trade-update-march-2025.

11 N. Limao and A.J. Venables (2001), Infrastructure, geographical disadvantage and transport costs, World Bank Economic Review 15/3, 451-479, http://documents.worldbank.org/curated/en/662351468331778084.

12 UNCTAD (2024), The reshaping of global trade: How developing countries can strategize, https://unctad.org/news/reshaping-global-trade-how-developing-countries-can-strategize.

13 Ibid.

14 Ibid.

15 IMF (2001), Global Trade Liberalization and the Developing Countries, https://www.imf.org/external/np/exr/ib/2001/110801.htm; M. Bartley Johns et al. (2018), Trade and Poverty Reduction: New Evidence of Impacts in Developing Countries, World Bank, http://documents.worldbank.org/curated/en/968461544478747599; WTO (2023), World Trade Report 2023, Re-globalization for a secure, inclusive and sustainable future, https://www.wto.org/english/res_e/publications_e/wtr23_e.htm; World Bank (2023), Trade Has Been a Powerful Driver of Economic Development and Poverty Reduction, https://www.worldbank.org/en/topic/trade/brief/trade-has-been-a-powerful-driver-of-economic-development-and-poverty-reduction; G. Felbermayr, S. Peterson and J. Wanner (2025), Trade and the environment, trade policies and environmental policies – how do they interact? Journal of Economic Surveys, https://doi.org/10.1111/joes.12628; United Nations Food and Agriculture Organization (2022), The State of Agricultural Commodity Markets 2022. The negative externalities of trade, https://doi.org/10.4060/cc0471en; Business Continuity Institute (BCI) (2024), BCI Supply Chain Resilience Report 2024, https://www.thebci.org/resource/bci-supply-chain-resilience-report-2024.html.

16 UNCTAD (2025), Global Trade Update (March 2025): The role of tariffs in international trade, https://unctad.org/publication/global-trade-update-march-2025.

17 J. Manners-Bell (2023), The Death of Globalization, Sea Pen Books Ltd.

18 UNCTAD (2024), Trade and Development Report 2024, Rethinking development in the age of discontent, https://unctad.org/publication/trade-and-development-report-2024.

19 S.A. Altman and C.R. Bastian (2023), Don't overestimate shifts from globalization to regionalization: an assessment of trends in trade flows and expectations for the future, UNIDO Industrial Analytics Platform, https://iap.unido.org/articles/dont-overestimate-shifts-globalization-regionalization; P.K. Goldberg and T. Reed (2023), Is the Global Economy Deglobalizing? And If So, Why? And What Is Next? Brookings Papers on Economic Activity 2023/1, 347-423, https://www.nber.org/papers/w31115; E. Yücesan (2025), Does deglobalization imply the end of global supply chains? International Business Review, https://doi.org/10.1016/j.ibusrev.2025.102398.

20 Observatory of Economic Complexity (2025), World, https://oec.world/en/profile/world/wld?selector53id=HS4.

21 M. Fricaudet et al. (2024), Fossil fuel carrying ships and the risk of stranded assets in the transition to a low-carbon economy – Key Findings and Implications for Financiers and Industry Actors, Kühne Climate Centre and UCL, https://www.kuehne-stiftung.org/fileadmin/user_upload/Summary_Fossil_fuel_carrying_ships_and_the_risk_of_stranded_assets.pdf.

22 **Figure 2** from UNCTAD (2025), World seaborne trade by type of cargo, annual (analytical), https://unctadstat.unctad.org/datacentre/dataviewer/US.SeaborneTrade.

23 **Figure 3** from S. Speizer et al. (2024), Integrated assessment modeling of a zero-emissions global transportation sector, Nature Communications 15, 4439, https://doi.org/10.1038/s41467-024-48424-9.

24 Ibid.

25 International Air Transport Association (2024), Global Outlook for Air Transport – A World with Lower Oil Prices? https://www.iata.org/en/iata-repository/publications/economic-reports/global-outlook-for-air-transport-december-2024.

26 World Bank (2022), Container port traffic (TEU: 20 foot equivalent units), https://data.worldbank.org/indicator/IS.SHP.GOOD.TU?view=chart.

27 Organisation for Economic Co-operation and Development (OECD) (2025), Data Explorer, Annual freight transport, https://data-explorer.oecd.org/vis?lc=en&df[ds]=DisseminateFinalDMZ&df[id]=DSD_INDICATORS%40DF_MEASUREMENT&df[ag]=OECD.ITF&df[vs]=1.0&dq=.A...RAIL%2BTOT_INL%2BIWW%2BPIPE%2BROAD...&pd=2000%2C2022&to[TIME_PERIOD]=false&vw=tb, accessed 7 June 2025.

28 Ibid.

29 UNCTAD (2025), Key statistics and trends in international trade 2024, https://unctad.org/publication/key-statistics-and-trends-international-trade-2024.

30 L. Tavasszy et al. (2025), 4.1 Freight Transport and Logistics, in: SLOCAT (2025), Transport, Climate and Sustainability Global Status Report – 4th edition, https://tcc-gsr.com/.

31 **Box 1** from International Transport Forum (ITF) (2025), Transport Network Resilience, https://www.itf-oecd.org/transport-network-resilience.

32 UNCTAD (2025), Key statistics and trends in international trade 2024, https://unctad.org/publication/key-statistics-and-trends-international-trade-2024. **Box 2** from C. Kunaka et al. (2025), Transport Connectivity for Food Security in Africa Strengthening Supply Chains, World Bank, https://hdl.handle.net/10986/43194. **Figure 4** from C. Kunaka et al. (2025), Transport Connectivity for Food Security in Africa Strengthening Supply Chains, World Bank, https://hdl.handle.net/10986/43194

33 World Bank (2025), Global Economy Set for Weakest Run Since 2008 Outside of Recessions, https://www.worldbank.org/en/news/press-release/2025/06/10/global-economic-prospects-june-2025-press-release.

34 UNCTAD (2025), Global Trade Update (March 2025): The role of tariffs in international trade, https://unctad.org/publication/global-trade-update-march-2025.

35 World Bank (2024), A Metric of Global Maritime Supply Chain Disruptions. The Global Supply Chain Stress Index (GSCSI), https://documents1.worldbank.org/curated/en/099746107032431443/pdf/IDU-9447dab5-3757-40b1-93cd-9643f0ab7c10.pdf.

36 **Figure 5** from World Bank (2025), Global Supply Chain Stress Index, https://www.worldbank.org/en/data/interactive/2025/04/08/global-supply-chain-stress-index; SLOCAT Partnership on Sustainable, Low Carbon Transport (2023), Spotlight 4 – Shortening Global Supply Chains as a Key to Decarbonising Transport, Transport, Climate and Sustainability Global Status Report – 3rd Edition, https://tcc-gsr.com/module-1/shortening-global-supply-chains-as-a-key-to-decarbonising-transport.

37 World Bank (2025), Global Supply Chain Stress Index, https://www.worldbank.org/en/data/interactive/2025/04/08/global-supply-chain-stress-index.

38 J. O'Trakoun (2025), How Constrained Are Global Supply Chains? Federal Reserve Bank of Richmond, https://www.richmondfed.org/research/national_economy/macro_minute/2025/how_constrained_are_global_supply_chains.

39 IMF (2025), IMF Data Mapper, https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD.

40 A.C. McKinnon (2018), Decarbonizing Logistics. Distributing goods in a low-carbon world.

41 ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.

42 Ibid.

43 Ibid.

44 Ibid.

45 A.C. McKinnon (2025), Climate Logistics, https://logistics.org.uk/green-mile-homepage/industry-insight/19-05-25/climate-logistics; Shell (2023), The Energy Security Scenarios, https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

46 European Commission Joint Research Centre (JRC) and International Energy Agency (IEA) (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

47 United Nations Environment Programme (2024), Used Heavy-Duty Vehicles and the Environment: A Global Overview of Used Heavy-Duty Vehicles: Flow, Scale and Regulation, https://wedocs.unep.org/handle/20.500.11822/44826.

48 Intergovernmental Panel on Climate Change (IPCC) (2021), Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/sixth-assessment-report-working-group-i.

49 BCI (2024), BCI Supply Chain Resilience Report 2024, https://www.thebci.org/resource/bci-supply-chain-resilience-report-2024.html.

50 A. Tandon (2024), Drought behind Panama Canal's 2023 shipping disruption "unlikely" without El Niño, Carbon Brief, https://www.carbonbrief.org/drought-behind-panama-canals-2023-shipping-disruption-unlikely-without-el-nino.

51 Economist (2024), Climate change's disruptive impact on global supply chains and the urgent call for resilience, https://impact.economist.com/projects/trade-in-transition/climate_change.

52 S. t'Serstevens and M. Major (2025), Logistics in a +2°C world, Kuehne Climate Center, https://www.kuehne-stiftung.org/fileadmin/user_upload/Kuehne_Climate_Center_-_Logistics_in_a_2_Degrees_World.pdf.

53 United Nations Office for Disaster Risk Reduction (2025), Global Assessment Report on Disaster Risk Reduction 2025: Resilience Pays: Financing and Investing for our Future, https://www. undrr.org/gar/gar2025

54 **Figure 6** from S. Speizer et al. (2024), Integrated assessment modeling of a zero-emissions global transportation sector, Nature Communications 15, 4439, https://doi.org/10.1038/s41467-024-48424-9.

55 Ibid.

56 Ibid.

57 UK Department for Energy Security and Net Zero (2024), Research and analysis. Greenhouse gas reporting: conversion factors 2024, https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy.

58 IEA (2024), World Energy Outlook 2024, https://www.iea.org/reports/world-energy-outlook-2024.

59 J. Arthur and D. Singh (2023), Air Freight Operators Soar Toward Climate Change, The Shocking COVID Air Freight Surge That Won't Go Away, Stand-Earth, https://stand.earth/wp-content/uploads/2024/06/Stand-Aviation-Report.pdf.

60 **Figure 7** from ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.

61 Ibid.

62 Ibid.

63 H.B. Rai et al. (2022), "Proximity logistics": Characterizing the development of logistics facilities in dense, mixed-use urban areas around the world, Transportation Research Part A 166, 41-61, https://doi.org/10.1016/j.tra.2022.10.007.

64 United Nations (2018), World Urbanisation Prospects 2018 update, https://population.un.org/wup.

65 T. Fried, B. Welle and S. Avelleda (2020), 80% of goods start or end in cities, it's time we start taking urban freight seriously, The City Fix, https://thecityfix.com/blog/80-of-goods-start-or-end-in-cities-its-time-we-start-taking-urban-freight-seriously.

66 World Economic Forum (WEF) (2024), Transforming Urban Logistics: Sustainable and Efficient Last-Mile Delivery in Cities, https://www.weforum.org/publications/transforming-urban-logistics-a-path-to-sustainable-and-efficient-last-mile-delivery-in-cities; Maersk (2025), Closing the logistics loop with last-mile delivery, https://www.maersk.com/logistics-explained/transportation-and-freight/2025/02/07/last-mile-delivery; L. Ranieri et al. (2018), Review of last mile logistics innovations in an externalities cost reduction vision, Sustainability 10, 782, https://doi.org/10.3390/su10030782; M.G. Gnoni et al. (2025), Assessing sustainability of smart last mile delivery: a simulation-based decision support tool, Sustainable Futures 9, https://doi.org/10.1016/j.sftr.2025.100713; J.C. Pina-Pardo et al. (2022), Design of a two-echelon last-mile delivery model, EURO Journal on Transportation and Logistics 11, https://doi.org/10.1016/j.ejtl.2022.100079.

67 ITF (2023), ITF Transport Outlook 2023, https://www.itf-oecd.org/itf-transport-outlook-2023.

68 H.B. Rai et al. (2022), "Proximity logistics": Characterizing the development of logistics facilities in dense, mixed-use urban areas around the world, Transportation Research Part A 166, 41-61, https://doi.org/10.1016/j.tra.2022.10.007; Expert Group on Urban Mobility (2024), Sustainable urban logistics planning (SULP), Recommendations on Urban Logistics, Expert Group on Urban Mobility, subgroup 4, https://transport.ec.europa.eu/document/download/b818ff86-2463-4949-9413-d3ca559f60b9_en.

69 Expert Group on Urban Mobility (2024), Sustainable urban logistics planning (SULP), Recommendations on Urban Logistics, Expert Group on Urban Mobility, subgroup 4, https://transport.ec.europa.eu/document/download/b818ff86-2463-4949-9413-d3ca559f60b9_en; G. Ayfadopoulou (2018), New cooperative business models and guidance for sustainable city logistics, Novelog project, https://programme2014-20.interreg-central.eu/Content.Node/SULPiTER/03-Georgia-Novelog-SULPITER-meeting.pdf.

70 Trafikanalys (2017), Tunga fordon i urbana miljöer – en kartläggning, Rapport 2017:23, https://www.trafa.se/vagtrafik/tunga-fordon-i-urbana-miljoer---en-kartlaggning-7169.

71 **Figure 8** from E. Den Boer et al. (2017), Outlook City Logistics 2017, Topsector Logistiek, TNO, https://repository.tno.nl/SingleDoc?find=UID%20c1e44ebd-833d-4515-9760-f4a47eddf53a; CE Delft (2016), De omvang van Stadslogistiek, https://ce.nl/wp-content/uploads/2021/03/CE_Delft_4H63_De_omvang_van_stadslogistiek_Def.pdf.

72 E. Den Boer et al. (2017), Outlook City Logistics 2017, Topsector Logistiek, TNO, https://repository.tno.nl/SingleDoc?find=UID%20c1e44ebd-833d-4515-9760-f4a47eddf53a; CE Delft (2016), De omvang van Stadslogistiek, https://ce.nl/wp-content/uploads/2021/03/CE_Delft_4H63_De_omvang_van_stadslogistiek_Def.pdf.

73 Statista (2025), E-commerce as share of total retail sales worldwide 2019-2029, https://www.statista.com/statistics/534123/e-commerce-share-of-retail-sales-worldwide.

74 UNCTAD (2024), Digital Economy Report 2024: Shaping an Environmentally Sustainable and Inclusive Digital Future, https://unctad.org/publication/digital-economy-report-2024.

75 S. Iglesias-Pradas, E. Acquila-Natale and L. Del-Rio-Carazo (2022), Omnichannel retailing: a tale of three sectors, Economic Research-Ekonomska Istraživanja 35/1, https://doi.org/10.1080/1331677X.2021.1991825; H.B. Rai et al. (2022), "Proximity logistics": Characterizing the development of logistics facilities in dense, mixed-use urban areas around the world, Transportation Research Part A, 41-61, https://doi.org/10.1016/j.tra.2022.10.007.

76 J. Alcedo et al. (2025), Back to trend: COVID effects on E-commerce in 44 countries, Journal of Macroeconomics 85, https://doi.org/10.1016/j.jmacro.2025.103682.

77 US Census Bureau (2025), E-Commerce Retail Sales, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/ECOMSA.

78 EUROSTAT (2025), Individuals using the internet for buying goods or services, Data Browser, Digital economy and society, https://ec.europa.eu/eurostat/databrowser/view/tin00096/default/table?lang=en&category=t_isoc.t_isoc_i.t_isoc_iec.

79 UNCTAD (2024), Digital Economy Report 2024: Shaping an Environmentally Sustainable and Inclusive Digital Future, https://unctad.org/publication/digital-economy-report-2024.

80 **Table 2** from the following sources: EUROSTAT (n.d.), E-commerce statistics for individuals online purchases of goods, EU, 2024. (% of individuals who used the internet in the previous 3 months), https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics_for_individuals; A. Buck (2025), Top 9 ecommerce categories fuelling US online shopping growth, Mobiloud, https://www.mobiloud.com/blog/top-ecommerce-categories-in-the-us.

81 EUROSTAT (n.d.), E-commerce statistics for individuals online purchases of goods, EU, 2024. (% of individuals who used the internet in the previous 3 months), https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics_for_individuals.

82 A. Buck (2025), Top 9 ecommerce categories fuelling US online shopping growth, Mobiloud, https://www.mobiloud.com/blog/top-ecommerce-categories-in-the-us.

83 Ibid.

84 Boston Consulting Group (2023), Winning Formulas for E-Commerce Growth, https://www.bcg.com/publications/2023/winning-formulas-for-e-commerce-growth; WEF (2024), Transforming Urban Logistics: Sustainable and Efficient Last-Mile Delivery in Cities, https://www.weforum.org/publications/transforming-urban-logistics-a-path-to-sustainable-and-efficient-last-mile-delivery-in-cities.

85 WEF (2024), Transforming Urban Logistics: Sustainable and Efficient Last-Mile Delivery in Cities, https://www.weforum.org/publications/transforming-urban-logistics-a-path-to-sustainable-and-efficient-last-mile-delivery-in-cities; N. McDonald, Q. Yuan and R. Naumann (2019), Urban freight and road safety in the era of e-commerce, Traffic Injury Prevention 20/7, 764-770, https://doi.org/10.1080/15389588.2019.1651930.

86 E. Den Boer et al. (2017), Outlook City Logistics 2017, Topsector Logistiek, TNO, https://repository.tno.nl/SingleDoc?find=UID%20c1e44ebd-833d-4515-9760-f4a47eddf53a; H. Gudmundsson and S. Krawack (2021), Dekarbonisering af byens logistik, CONCITO, https://concito.dk/files/media/document/Dekarbonisering%20af%20Byens%20Logistik_Endelig-m.engsum.pdf.

87 H. Pålsson, F. Pettersson and L.W. Hiselius (2017), Energy consumption in e-commerce versus conventional trade channels – insights into packaging, the last mile, unsold products and product returns, Journal of Cleaner Production 164, 765-778, https://doi.org/10.1016/j.jclepro.2017.06.242; M. Viu-Roig and E.J. Alvarez-Palau (2020), The impact of e-commerce-related last-mile logistics on cities: a systematic literature review, Sustainability 12/16, 6492, https://doi.org/10.3390/su12166492.

88 I. Kumar and Chidambara (2024), A systematic literature review and bibliometric analysis of last-mile e-commerce delivery in urban areas, Urban, Planning and Transport Research 12/1, https://doi.org/10.1080/21650020.2024.2357577; A. Bjørgen, K.Y. Bjerkan and O.A. Hjelkrem (2021), E-groceries: sustainable last mile distribution in city planning, Research in Transportation Economics 87, https://doi.org/10.1016/j.retrec.2019.100805; R. Sommar and P. Mellander (2018), Signed, Sealed, Delivered – Analysing the Impact of E-Commerce on Urban Areas, Urban Insights, SWECO Group, https://www.swecogroup.com/wp-content/uploads/sites/2/2022/12/urban-insight-report_e-commerce_a4.pdf; L. Hardi and U. Wagner (2019), Grocery delivery or customer pickup – influences on energy consumption and CO2 emissions in Munich, Sustainability 11/3, 641, https://doi.org/10.3390/su11030641.

89 WEF (2024), Transforming Urban Logistics: Sustainable and Efficient Last-Mile Delivery in Cities, https://www.weforum.org/publications/

transforming-urban-logistics-a-path-to-sustainable-and-efficient-last-mile-delivery-in-cities.

90 Ibid.

91 Ibid.

92 L. Dablanc and D. Rakotonarivo (2010), The impacts of logistic sprawl: how does the location of parcel transport terminals affect the energy efficiency of goods' movements in Paris and what can we do about it? in E. Tanguchi and R.G. Thompson (2010), The Sixth International Conference on City Logistics, Procedia – Social and Behavioral Sciences, 2/3, 6087-6096, https://doi.org/10.1016/j.sbspro.2010.04.021.

93 H.B. Rai et al. (2022), "Proximity logistics": Characterizing the development of logistics facilities in dense, mixed-use urban areas around the world, Transportation Research Part A 166, 41-61, https://doi.org/10.1016/j.tra.2022.10.007.

94 S. Michielsen, R. Gevaers and W. Dewulf (2025), A historical overview and analysis of e-commerce's milestones and its growing connection with air transport, Journal of Shipping and Trade 10, 14, https://doi.org/10.1186/s41072-025-00203-5.

95 IEA (n.d.), Tracking Aviation, https://www.iea.org/energy-system/transport/aviation; S. Gössling and A. Humpe (2020), The global scale, distribution and growth of aviation: implications for climate change, Global Environmental Change 65, 102194, https://doi.org/10.1016/j.gloenvcha.2020.102194.

96 ITF (2025), Key Transport Statistics, 2024 Data, https://www.itf-oecd.org/sites/default/files/docs/itf-key-transport-statistics-2025.pdf; Greater London Authority (2025), London Energy and Greenhouse Gas Inventory 2022 (LEGGI), https://data.london.gov.uk/dataset/leggi.

97 WTO (2023), World Trade Report 2023, Re-globalization for a secure, inclusive and sustainable future, https://www.wto.org/english/res_e/publications_e/wtr23_e.htm.

98 Ibid.

99 Ibid.

100 WEF (2024), Transforming Urban Logistics: Sustainable and Efficient Last-Mile Delivery in Cities, https://www.weforum.org/publications/transforming-urban-logistics-a-path-to-sustainable-and-efficient-last-mile-delivery-in-cities; C. Andruetto, J. Mårtensson and A. Pernestål (2023), Categorization of urban logistics concepts according to their sustainability performance, Transportation Research Procedia 72, 2708-2715, https://doi.org/10.1016/j.trpro.2023.11.811.

101 C. Kunaka et al. (2025), Transport Connectivity for Food Security in Africa: Strengthening Supply Chains, International Development in Focus, World Bank, https://openknowledge.worldbank.org/entities/publication/308dc282-90c1-41e4-b4a2-0b19d2309d43.

102 S. Straub et al. (2025), Infrastructure and Poverty Reduction: Innovative Policies for Effective Access, World Bank, https://www.worldbank.org/en/topic/infrastructure/publication/infrastructure-and-poverty-reduction-innovative-policies.

103 Ibid.

104 Sund & Bælt (2025), Kilometer-based tolls for trucks (2025), https://vejafgifter.dk/en.

105 Ibid.

106 Ibid.

107 S. Musa (2025), The Netherlands launches zero-emission zones for urban freight, ZAG Daily, https://zagdaily.com/places/the-netherlands-launches-zero-emission-zones-for-urban-freight.

108 **Box 3** from ITF (2024), Transport System Resilience, https://www.itf-oecd.org/transport-system-resilience and from S. t'Serstevens and M. Major (2025), Logistics in a +2°C world, Kuehne Climate Center, https://www.kuehne-stiftung.org/fileadmin/user_upload/Kuehne_Climate_Center_-_Logistics_in_a_2_Degrees_World.pdf.

109 B. Thakur-Weigold and S. Miroudot (2024), Promoting Resilience and Preparedness in Supply Chains, OECD, https://doi.org/10.1787/be692d01-en.

110 L. Parker et al. (2019), Vulnerability of the agricultural sector to climate change: the development of a pan-tropical Climate Risk Vulnerability Assessment to inform sub-national decision making, PLOS ONE 14/3, e0213641, https://doi.org/10.1371/journal.pone.0213641.

111 SLOCAT and Kuehne Climate Center (2024), Manifesto for intermodal, low-carbon, efficient and resilient freight transport and logistics, https://slocat.net/transforming-freight-transport.

112 **Figure 9** and **Box 4** from SLOCAT and Kuehne Climate Center (2024), Policies and investments for intermodal, low-carbon, efficient and resilient freight transport and logistics, Compendium of interventions to deliver quick wins and initiate long-term transformations, https://slocat.net/policies-and-investments-for-intermodal-low-carbon-efficient-and-resilient-freight-transport-and-logistics.

113 International Climate Initiative (2025), Sino-German Co-Operation on Decarbonising Freight Transport, https://www.international-climate-initiative.com/en/project/sino-german-co-operation-on-decarbonising-freight-transport-24-i-558-chn-g-decarbonising-freight-transport.

114 Decarbonising UK Freight Transport (2023), Who we are, https://decarbonisingfreight.co.uk/who-we-are/

S1
LOGISTICS FOR CLIMATE ACTION

1 A.C. McKinnon (2024), Logistics and climate: an assessment of logistics' multiple roles in the climate crisis, International Journal of Logistics Research and Applications 27/12, 2556-2570, https://doi.org/10.1080/13675567.2024.2367534.

2 Kühne Climate Center (2025), Logistics in a +2°C world, https://www.kuehne-stiftung.org/fileadmin/user_upload/Kuehne_Climate_Center_-_Logistics_in_a_2_Degrees_World.pdf.

3 **Figure 1** from Ibid.

4 Shell (2023), The Energy Security Scenarios, https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html; European Commission Joint Research Centre and International Energy Agency (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

5 A.C. McKinnon (2024), Logistics and climate: an assessment of logistics' multiple roles in the climate crisis, International Journal of Logistics Research and Applications 27/12, 2556-2570, https://doi.org/10.1080/13675567.2024.2367534; Carbon Brief (2024), Guest post: The forgotten role of logistics in achieving net-zero, https://www.carbonbrief.org/guest-post-the-forgotten-role-of-logistics-in-achieving-net-zero.

6 Statista (2025), Logistics industry worldwide – statistics & facts, https://www.statista.com/topics/5691/logistics-industry-worldwide/#topicOverview.

7 Ibid.

8 X. Zhao et al. (2023), International trade and carbon emissions: evaluating the role of trade rule uncertainty, Sustainability 15, 11662, https://doi.org/10.3390/su151511662; A.C. McKinnon (2024), Logistics and climate: an assessment of logistics' multiple roles in the climate crisis, International Journal of Logistics Research and Applications 27/12, 2556-2570, https://doi.org/10.1080/13675567.2024.2367534.

9 Stegra (2025), Our Boden plant, https://stegra.com/the-boden-plant.

10 International Monetary Fund (2022), Chile's Bet on Green Hydrogen, https://www.imf.org/en/Publications/fandd/issues/2022/12/country-case-chile-bet-on-green-hydrogen-Bartlett.

11 Y. Wu et al. (2023), Research on low-carbon technology diffusion among enterprises in networked evolutionary game, Chaos, Solitons & Fractals 174, 113852, https://doi.org/10.1016/j.chaos.2023.113852.

12 DHL (2024), Smart supply chain: what exactly is logistics 4.0 all about? https://www.dhl.com/discover/en-id/logistics-advice/logistics-insights/a-guide-to-industry-4-smart-logistics; DHL (2025), Renewable Energy Logistics, https://www.dhl.com/in-en/home/energy-logistics/renewable-energy-logistics.html.

13 Y. Briand and S. Rothbard (2023), Spotlight 4. Shortening Global Supply Chains as a Key to Decarbonising, in SLOCAT Partnership, Transport, Climate and Sustainability Global Status Report – 3rd edition, https://tcc-gsr.com/wp-content/uploads/2023/06/Spotlight-4-Shortening-Global-Supply-Chains-as-a-Key-to-Decarbonising-Transport.pdf.

14 A.C. McKinnon (2024), Logistics and climate: an assessment of logistics' multiple roles in the climate crisis, International Journal of Logistics Research and Applications 27/12, 2556-2570, https://www.tandfonline.com/doi/full/10.1080/13675567.2024.2367534#d1e445.

15 V. Julianelli et al. (2020), Interplay between reverse logistics and circular economy: critical success factors-based taxonomy and framework, Resources, Conservation and Recycling 158, https://doi.org/10.1016/j.resconrec.2020.104784; H. Sonar et al. (2024), Navigating barriers to reverse logistics adoption in circular economy: an integrated approach for sustainable development, Cleaner Logistics and Supply Chain 12, https://doi.org/10.1016/j.clscn.2024.100165.

16 Dansk Retur System (n.d.), Our deposit return system, https://danskretursystem.dk/en/dansk-retursystem-english; Dansk Retur System (n.d.), Til gavn for miljø og klima, https://danskretursystem.dk/klima-og-miljoe/miljoe-og-klimaaftryk; Via Ritzau (2025), Dansk Retursystem har købt sin sidste fossil-lastbil, https://via.ritzau.dk/pressemeddelelse/14485105/dansk-retursystem-har-kobt-sin-sidste-fossil-lastbil?publisherId=2639941&lang=da.

17 Ibid., all references.

18 Ibid., all references.

19 **Figure 2** from A.A. Shaw (n.d.), 5Rs of Logistics with Examples, SCM Insights, https://scminsight.com/5rs-of-reverse-logistics-with-examples.

20 SK Tes (n.d.), Sustainable technology lifecycle solutions, https://www.sktes.com.

21 Earth5R (2025), Executing Effective E-Waste Collection Drives, https://earth5r.org/executing-effective-e-waste-collection-drives.

22 PRISM (2025), Circular Economy Integration, https://prism.sustainability-directory.com/term/circular-economy-integration.

23 New Leaf (2025), EU exports of used clothing wear out African second-hand markets, https://meta.eeb.org/2025/06/02/eu-exports-of-used-clothing-wear-out-african-second-hand-markets.

24 Ibid.

25 Ibid.

26 A.C. McKinnon (2024), Logistics and climate: an assessment of logistics' multiple roles in the climate crisis, International Journal of Logistics Research and Applications 27/12, 2556-2570, https://doi.org/10.1080/13675567.2024.2367534.

27 Ibid.

28 Ibid.

29 K. Orchard (2019), CO2 transport: the role of CO2 shipping, UK CCS Research Centre, https://ukccsrc.ac.uk/wp-content/uploads/2020/06/The-role-of-CO2-Shipping-KO.pdf.

30 Ibid.; J. Swales (2024), The Role of Logistics in Carbon Capture and Storage, Ti Insights, https://ti-insight.com/briefs/the-role-of-logistics-in-carbon-capture-and-storage.

31 A.C. McKinnon (2024), The Forgotten Role of Logistics in Achieving Net-Zero, Forum on Trade, Environment and the SDGs, https://tessforum.org/latest/the-forgotten-role-of-logistics-in-achieving-net-zero.

32 S. Chatterjee and K.W. Huang (2020), Unrealistic energy and materials requirement for direct air capture in deep mitigation pathways, Nature Communications 11, 3287, https://doi.org/10.1038/s41467-020-17203-7; J. Swales (2024), The Role of Logistics in Carbon Capture and Storage, Ti Insights, https://ti-insight.com/briefs/the-role-of-logistics-in-carbon-capture-and-storage.

33 Kühne Climate Center (2025), Logistics in a +2°C world, https://www.kuehne-stiftung.org/fileadmin/user_upload/Kuehne_Climate_Center_-_Logistics_in_a_2_Degrees_World.pdf.

34 M.A. Kabir, S.A. Khan and G. Kabir (2024), Carbon Capture, Utilization, and Storage Risks from Supply Chain Perspective: A Review of the Literature and Conceptual Framework Development 10, 15, https://doi.org/10.3390/c10010015.

35 F.J. Dickhardt, T.A. Hatton and K.K. Varanasi (2023), Ocean Alkalinity Enhancement, MIT Climate Portal, https://climate.mit.edu/explainers/ocean-alkalinity-enhancement.

36 Munich Re (2024), Record thunderstorm losses and deadly earthquakes: the natural disasters of 2023, https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2024/natural-disaster-figures-2023.html.

37 International Federation of Red Cross and Red Crescent Societies (2019), The Cost of Doing Nothing, The Humanitarian Price of Climate Change and How It Can Be Avoided, https://www.ifrc.org/sites/default/files/2021-07/2019-IFRC-CODN-EN.pdf.

38 Y. Jiang and Y. Yuan (2019), Emergency logistics in a large-scale disaster context: achievements and challenges, International Journal of Environmental Research and Public Health 16/5, 779, https://doi.org/10.3390/ijerph16050779.

39 Fire and Rescue NSW (2025), Drone delivers medicine to isolated community in Northern NSW, https://www.fire.nsw.gov.au/incident.php?record=rech7XEvQhqkFlHor.

40 Kühne Climate Center (2025), Logistics in a +2°C world, https://www.kuehne-stiftung.org/fileadmin/user_upload/Kuehne_Climate_Center_-_Logistics_in_a_2_Degrees_World.pdf.

41 US Agency for International Development (2013), Addressing Climate Change Impacts on Infrastructure, Preparing for Change, https://www.humanitarianlibrary.org/sites/default/files/2018/11/Addressing-Climate-Change-Impacts-on-Infrastructure-report.pdf; A.C. McKinnon (2024), Logistics and climate: an assessment of logistics' multiple roles in the climate crisis, International Journal of Logistics Research and Applications 27/12, 2556-2570, https://doi.org/10.1080/13675567.2024.2367534; Kühne Climate Center (2025), Logistics in a +2°C world, https://www.kuehne-stiftung.org/fileadmin/user_upload/Kuehne_Climate_Center_-_Logistics_in_a_2_Degrees_World.pdf.

42 Port of Rotterdam (2023), Adaptation Strategy for Flood Risk Management, https://www.portofrotterdam.com/sites/default/files/2023-04/adaptation-strategy-for-flood-risk-management-port-of-rotterdam.pdf.

43 M.O. Ha'apio (2021), Nauru, Technology Needs Assessment for Climate Change Adaptation, Barrier Analysis and Enabling Framework, https://tech-action.unepccc.org/wp-content/uploads/sites/2/2021/12/baef-adaptation-nauru.pdf.

44 M. Oppenheimer et al. (2019), Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities, in Intergovernmental Panel on Climate Change, IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities.

1.4
BUILDING ADAPTATION AND RESILIENCE WITHIN TRANSPORT SYSTEMS AND ACROSS COMMUNITIES AND ECONOMIES

1 **Figure 1** from N. Amenc (2023), It's getting physical: Some investors in infrastructure could lose more than half of their portfolio to physical climate risks by 2050, EDHEC Infrastructure & Private Assets Research Institute, https://edhecinfraprivate-assets.com/paper/its-getting-physical.

2 Ibid.

3 Munich Re (2024), Record thunderstorm losses and deadly earthquakes: the natural disasters of 2023, https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2024/natural-disaster-figures-2023.html.

4 United Nations Office of Disaster Risk Reduction (UNDRR) (2022) The invisible toll of disasters. https://www.undrr.org/explainer/the-invisible-toll-of-disasters-2022.

5 M. Sasidharan et al. (2023), A bridge scour risk management approach to deal with uncertain climate future, Transportation Research Part D: Transport and Environment 114, 103567, https://doi.org/10.1016/j.trd.2022.103567.

6 E.E. Koks et al. (2019), A global multi-hazard risk analysis of road and railway infrastructure assets, Nature communications 10/1, 2677, https://doi.org/10.1038/s41467-019-10442-3.

7 Ibid.

8 Ibid.

9 Ibid.

10 N. Dhanesha and B. Jones (2022), It's so hot in Europe that roads are literally buckling, Vox, https://www.vox.com/2022/7/20/23270092/europe-uk-heat-wave-roads-trains-climate-change; A. Jones (2022), Melting A14 closed for hours after heat created "skate park" like ramp, Cambridgeshire Live https://www.cambridge-news.co.uk/news/cambridge-news/melting-a14-closed-hours-after-24529780.

11 Ibid.

12 Ibid.

13 G. Houtven et al. (2022), Act now or pay later: the costs of climate inaction for ports and shipping, Environmental Defense Fund, https://www.edf.org/sites/default/files/press-releases/RTI-EDF%20Act%20Now%20or%20Pay%20Later%20Climate%20Impact%20Shipping.pdf.

14 J. Verschuur et al. (2023), Multi-hazard risk to global port infrastructure and resulting trade and logistics losses, Communications Earth & Environment 4/5), https://doi.org/10.1038/s43247-022-00656-7.

15 E.E. Koks et al. (2022), Brief communication: critical infrastructure impacts of the 2021 mid-July western European flood event, Natural Hazards and Earth System Sciences Discussions, 1-11, https://doi.org/10.5194/nhess-22-3831-2022.

16 Z. Seitz (2025), From Floods to Heatwaves: Strengthening Urban Transport Amidst Changing Climate, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), https://changing-transport.org/wp-content/uploads/2025_From-floods-to-heatwaves_Stregthening-Urban-Transport.pdf.

17 N. Razzaq et al. (2022), Pakistan's floods and their devastating impacts on people, International Journal of Agriculture and Biosciences, https://doi.org/10.47278/journal.ijab/2022.035.

18 Pakistan Ministry of Planning Development & Special Initiatives (2022), Pakistan Floods 2022 Post-Disaster Needs Assessment, https://thedocs.worldbank.org/en/doc/4a0114eb7d1cecbbbf2f-65c5ce0789db-0310012022/original/Pakistan-Floods-2022-PDNA-Main-Report.pdf.

19 H. Reid and N. Banya (2022), South Africa says Durban port functional after flood devastation, Reuters, https://www.reuters.com/world/africa/safrica-says-durban-port-functional-backlog-be-cleared-days-2022-04-19.

20 UN Office for the Coordination of Humanitarian Affairs (2025), West and Central Africa: Flooding Situation 2024 Overview – as of 10 February 2025, https://www.unocha.org/publications/report/chad/west-and-central-africa-flooding-situation-2024-overview-10-february-2025.

21 Reuters (2025), Extreme rain in China caused $2.2 billion in road damage, further straining public purse, https://www.reuters.com/business/environment/extreme-rain-china-caused-22-billion-road-damage-further-straining-public-purse-2025-08-27.

22 S. Brambilla et al. (2025), Modeling the impact of smoke from prescribed fire on road visibility. Environmental Modelling & Software, 106510, https://doi.org/10.1016/j.envsoft.2025.106510.

23 BBC (2018), Japan Typhoon Jebi: Kansai airport evacuated, https://www.bbc.com/news/av/world-asia-45422285.

24 R. Treisman (2022), Damage from hurricane Ian cuts Sanibel Island off from Florida's mainland, NPR, https://www.npr.org/2022/09/30/1126204141/sanibel-causeway-hurricane-ian.

25 Wikipedia (2025), 2025 European and Mediterranean wildfires, https://en.wikipedia.org/wiki/2025_European_and_Mediterranean_wildfires.

26 M. Parraga (2025), Panama Canal traffic fell to 33.7 ships per day in March, authority says, Reuters, https://www.reuters.com/world/americas/panama-canal-traffic-fell-337-ships-per-day-march-authority-says-2025-04-10.

27 E. Thomson (2022), Droughts are creating new supply chain problems. This is what you need to know, Pakistan & Gulf Economist, https://www.pakistangulfeconomist.com/2022/11/28/droughts-are-creating-new-supply-chain-problems-this-is-what-you-need-to-know.

28 T. Suen and D. Stanway (2022), Yangtze tributary runs dry as China faces another month of drought, Reuters https://www.reuters.com/world/china/china-warns-yangtze-drought-could-last-until-sept-it-races-protect-harvests-2022-08-18.

29 International Growth Centre (2020), Impact of COVID-19 on public transport, https://www.theigc.org/blogs/covid-19-and-cities/impact-covid-19-public-transport.

30 International Association of Public Transport (UITP) (2025), Global Metro Figures 2025, https://cms.uitp.org/wp/wp-content/uploads/2025/05/20250506_Global-Metro-Figures_Statistics-Brief_WEB-1.pdf.

31 CBC News (2020), How COVID-19 is affecting public transit use, https://www.cbc.ca/news/canada/coronavirus-covid19-public-transit-1.5509927.

32 Ibid.

33 I. Diouf et al. (2020), Urban Mobility and COVID-19 in Africa, Transport Global Practice, World Bank Group Africa Transport Policy Program, https://www.ssatp.org/sites/default/files/publication/COVID19%20and%20Public%20Transport%20in%20Africa%20-%20FINAL%20-%20Aug2020%20-%20ENGLISH.pdf; World Bank (2024), Diagnostics Study and Reform Guidance for Public Transport in Ulaanbaatar, https://documents1.worldbank.org/curated/en/099121824023250448/pdf/P178172-2a355a6c-0953-41db-a65e-dd71eb9bdc53.pdf.

34 US Federal Transit Administration (2024), National Transit Summaries and Trends (NTST), https://www.transit.dot.gov/ntd/national-transit-summaries-and-trends-ntst.

35 UPPER (2024), 2024 EMTA Barometer with a focus on 5 Upper cities, https://www.upperprojecteu.eu/news/emta-barometer-2024-with-a-focus-on-4-upper-cities.

36 European Metropolitan Transport Authorities (EMTA) (2024), Barometer Report 2024, https://www.upperprojecteu.eu/wp-content/uploads/2024/07/EMTA-Barometer-Report-2024.pdf.

37 Land Transport Authority of Singapore (2025), Statistics, accessed 31 July 2025, https://www.lta.gov.sg/content/ltagov/en/who_we_are/statistics_and_publications/statistics.html.

38 Ibid.

39 J. Verschuur et al. (2024), Modeling the dynamic impacts of maritime network blockage on global supply chains, Transportation Research Part E 175, 102977, https://doi.org/10.1016/j.xinn.2024.100653.

40 Deutsche Welle (2023), Nationwide German transport strike causes major disruptions, https://www.dw.com/en/nationwide-german-transport-strike-causes-major-disruptions/a-65129283.

41 **Figure 2** from World Bank (2025), GDP (constant 2015 US$), https://data.worldbank.org/indicator/NY.GDP.MKTP.KD; INFORM (2025), INFORM Risk Index, https://drmkc.jrc.ec.europa.eu/inform-index.

42 Ibid.

43 Ibid.

44 Ibid.

45 Ibid.

46 Ibid.

47 Ibid.

48 Ibid.

49 Ibid.

50 Ibid.

51 M. Singer, C. Hodge and A. Pennington (2021), Federal Fleet Resilience Planning, US Department of Energy, https://www.energy.gov/sites/default/files/2021-04/federal-fleet-resilience-planning.pdf.

52 U. Jayasinghe (2022), Sri Lanka stops fuel supply to non-essential services as crisis worsens, Reuters, https://www.reuters.com/world/asia-pacific/crisis-hit-sri-lanka-shuts-schools-urges-work-home-save-fuel-2022-06-27.

53 UN Economic and Social Commission for Asia and the Pacific (2025), Enhancing the resilience and sustainability of urban public transport systems in Asia-Pacific cities, Eighty-first session, https://www.unescap.org/sites/default/d8files/event-documents/2500039E.pdf.

54 Asian Transport Observatory (2025), From Breakdowns to Breakthroughs: Climate Resilience of Asia-Pacific's Transport Infrastructure, https://asiantransportobservatory.org/analytical-outputs/transport-asia-resilience; World Bank (2023), Supporting Bangladesh's Delta Plan through strategic partnerships, https://www.worldbank.org/en/news/feature/2023/11/28/supporting-bangladesh-s-delta-plan-through-strategic-partnerships; UNDRR (2025), Bangladesh delta plan 2100 (BDP 2100), https://www.preventionweb.net/publication/bangladesh-delta-plan-2100-bdp-2100.

55 UNDRR and Coalition for Disaster Resilient Infrastructure (CDRI) (2024), Roadmap for Infrastructure Resilience in the Republic of Chile, https://www.undrr.org/media/105606/download?startDownload=20250907.

56 **Box 1** and **Figure 3** from European Commission Joint Research Centre (JRC) and IEA (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024; INFORM (2025), INFORM Risk Index, https://drmkc.jrc.ec.europa.eu/inform-index.

57 INFORM (2025), INFORM Risk Index, https://drmkc.jrc.ec.europa.eu/inform-index.

58 Ibid.

59 Ibid.

60 Ibid.

61 Ibid.

62 Ibid.

63 C. L'Hermitte, L. Wotherspoon and R. Mowll (2024), Keeping goods moving in the wake of a disaster: a qualitative study of intermodal transport, International Journal of Logistics Management 35/1, 210-232, https://doi.org/10.1108/IJLM-02-2022-0075; J. Goentzel and M. Windle (2017), Supply Chain Resilience: Restoring Business Operations After a Hurricane, MIT Center for Transportation & Logistics, https://hdl.handle.net/1721.1/126772.

64 P.J. Palin (2020), Supply chain resilience: push and pull in catastrophes, Journal of Critical Infrastructure Policy 1/2, 17-35, https://doi.org/10.18278/jcip.1.2.3.

65 DHL (2024), The 4 dimensions of supply chain diversification, https://dhl-freight-connections.com/en/solutions/the-4-dimensions-of-supply-chain-diversification.

66 Ibid.

67 US Department of Transportation (2025), National Freight Strategic Plan (NFSP), https://www.transportation.gov/freight/NFSP.

68 Transformative Urban Mobility Initiative (2025), Dealing with Crises in Urban Transport Systems, https://transformative-mobility.org/wp-content/uploads/2025/05/Crisis-Mgmt-Urban-Transport_Slide-Deck_GIZ_TUMI.pdf.

69 Scottish Government (n.d.), Rural and Environment Science and Analytical Services, https://digitalacademy.gov.scot/success_story/resas.

70 N. Kapucu and V. Garayev (2011), Collaborative Decision-Making in Emergency and Disaster Management, International Journal of Public Administration, 34(6), 366–375, https://doi.org/10.1080/01900692.2011.561477.

71 D. Otwori and N. Nyandiko (2024), Challenges against the Achievement of Disaster Risk Reduction Strategies in African States, Journal of the Kenya National Commission for UNESCO, 4(1), https://doi.org/10.62049/jkncu.v4i1.61.

72 Organisation for Economic Co-operation and Development (OECD) (2025), OECD Supply Chain Resilience Review: Navigating Risks, https://doi.org/10.1787/94e3a8ea-en.

73 Administration for Strategic Preparedness and Response (n.d.), Center for the Strategic National Stockpile, https://aspr.hhs.gov/SNS/Pages/default.aspx.

74 B. Gerlach, S. Zarnitz, B. Nitsche and F. Straube (2021), Digital Supply Chain Twins—Conceptual Clarification, Use Cases and Benefits, Logistics, 5, 86, https://doi.org/10.3390/logistics5040086.

75 J. Sagara and M. Ishiwatari (n.d.), CLUSTER 4: Recovery Planning, Infrastructure Rehabilitation, Knowledge Note 4-1, https://www.gfdrr.org/sites/default/files/publication/knowledge-note-japan-earthquake-4-1.pdf.

76 L.C. Blancas, C. Briceño-Garmendia, H.S. Roh and H. Vrenken (2022), Competing with Logistics Clusters: Vignettes from the International Experience, Mobility and Transport Connectivity Series, http://hdl.handle.net/10986/37703.

77 M. Scott (2023), Supply Chain Mapping for Emergency Management Decision-Making, The Sam Houston State University Institute for Homeland Security, https://doi.org/10.17605/OSF.IO/T34EP.

78 World Bank (2023), Colombia Country Climate and Development Report, http://hdl.handle.net/10986/40056; Departamento Nacional de Planeacion (2018), Plan Nacional de Adaptación, Alcambioclimatico, ABC: Adaptación Bases Conceptuales. Marco Conceptual y Lineamientos, https://unfccc.int/sites/default/files/resource/NAP_Colombia_2018.pdf.

79 M. Becoulet et al. (2021), Resilient recovery: How can Nature-Based Solutions improve transport infrastructure resilience? Lessons from Haiti, World Bank, https://blogs.worldbank.org/en/transport/resilient-recovery-how-can-nature-based-solutions-improve-transport-infrastructure.

80 National Portal of India (n.d.), PM Gati Shakti - National Master Plan for Multi-modal Connectivity, https://www.india.gov.in/spotlight/pm-gati-shakti-national-master-plan-multi-modal-connectivity.

81 World Bank and Korea Green Growth Trust Fund (2023), Development of ITS-led Tanzania Railway system strengthening climate resilient infrastructure based on GIS, https://www.wbgkggtf.org/node/3912.

82 Transport Community (n.d.), Green Lanes, https://www.transport-community.org/transport-facilitation/green-lanes.

83 United Nations Economic Commission for Africa (2020), Facilitating cross-border trade through a coordinated African response to COVID-19, https://hdl.handle.net/10855/43789.

84 P. Zsófia (2025), Europe's first electric truck charging corridor inaugurated in France, Trans.Info, https://trans.info/en/electric-truck-charging-399758; SNCF (2025), FLEXY—the road-rail system for small local lines, https://www.groupe-sncf.com/en/innovation/local-mobility/flexy.

85 Concern Worldwide (2020), From Flood Resilience Measurement for Communities (FRMC) to Intervention: Learning brief, https://zcralliance.org/resources/item/from-flood-resilience-measurement-for-communities-frmc-to-intervention-learning-brief.

86 Federal Democratic Republic of Ethiopia (2019), Ethiopia's Climate Resilient Green Economy National Adaptation Plan, https://unfccc.int/sites/default/files/resource/NAP_Ethiopia_2019.pdf.

87 World Bank (2021), Green National Highways Corridor Project, https://projects.worldbank.org/en/projects-operations/project-detail/P167350.

88 E. Meleshkina (2024), The Singapore Model: Integrating Smart Technologies and Sustainability for Urban Excellence, New Polis, https://newpolis.media/the-singapore-model-integrating-smart-technologies-and-sustainability-for-urban-excellence/.

89 Reconstruction Agency (n.d.), Recovery and reconstruction of road networks, 2. Infrastructure Development Including Transportation and Logistics Networks, https://www.reconstruction.go.jp/311kyoukun/pdf/kyokun/hukkou_16-en.pdf.

90 S. Kim et al. (2022), Development of black-ice removal system with latent heat thermal energy storage and solar thermal collectors, Energy, Volume 244, Part A, https://doi.org/10.1016/j.energy.2021.122721; E. Tromp, A. te Nijenhuis and H. Knoeff (2022), The Dutch Flood Protection Programme: Taking Innovations to the Next Level. Water, 14, 1460, https://doi.org/10.3390/w14091460.

91 Department for Environment, Food and Rural Affairs (2023), Third National Adaptation Programme (NAP3), https://www.gov.uk/government/publications/third-national-adaptation-programme-nap3.

92 Transformative Urban Mobility Initiative (2025), Dealing with Crises in Urban Transport Systems, https://transformative-mobility.org/wp-content/uploads/2025/05/Crisis-Mgmt-Urban-Transport_Slide-Deck_GIZ_TUMI.pdf.

93 US Department of Transportation, Federal Highway Administration (2016), Planning for Climate Change: FHWA's Climate Change Resilience Pilot Program, https://www.environment.fhwa.dot.gov/pubs_resources_tools/publications/newsletters/jan16nl.pdf.

94 New Zealand Lifelines (n.d.), New Zealand Lifelines Council, https://www.nzlifelines.org.nz.

95 ISO (2018), ISO 31000:2018(en), Risk management — Guidelines, Online Browsing Platform (OBP) Version 4.41.0, https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en; ISO (2021), ISO 14091:2021, Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment, https://www.iso.org/standard/68508.html; ISO (2017), ISO 22316:2017, Security and resilience — Organizational resilience — Principles and attributes, https://www.iso.org/standard/50053.html.

96 British Standards Institution (2021), BS 8631:2021, Adaptation to climate change. Using adaptation pathways for decision making, Guide, https://knowledge.bsigroup.com/products/adaptation-to-climate-change-using-adaptation-pathways-for-decision-making-guide?version=standard; B.M. Ayyub et al. (2018), Climate-Resilient Infrastructure: Adaptive Design and Risk Management, https://sp360.asce.org/personifyebusiness/Merchandise/Product-Details/productId/244232276; Austroads (n.d.), Pavement, https://austroads.gov.au/publications/pavement/agpt04k/operating-environment/the-physical-environment/climate-and-weather.

97 Adapta Brasil MCTI (2021), Decision Support Tool, https://www.slideshare.net/slideshow/adapta-brasil-mcti-decision-support-tool/250601970; M. Hagenlocher et al. (2018), Climate Risk Assessment for Ecosystem-based Adaptation, A guidebook for planners and practitioners, https://www.adaptationcommunity.net/wp-content/uploads/2018/06/giz-eurac-unu-2018-en-guidebook-climate-risk-asessment-eba.pdf.

98 Environment and Climate Change Canada (2024), Canada's National Adaptation Strategy Building Resilient Communities and a Strong Economy, https://unfccc.int/sites/default/files/resource/NAP-Canada-2024-EN.pdf; Ministry for the Environment (2022), Aotearoa New Zealand's first national adaptation plan, https://unfccc.int/sites/default/files/resource/NAP-New-Zealand-2023.pdf; Department for Environment, Food and Rural Affairs (2023), Third National Adaptation Programme (NAP3), https://www.gov.uk/government/publications/third-national-adaptation-programme-nap3.

99 Public Infrastructure Engineering Vulnerability Committee (n.d.), Resilient infrastructure is crucial to Canada's safety, economy and future, https://pievc.ca.

100 UNFCCC (2023), COP28 Agreement Signals "Beginning of the End" of the Fossil Fuel Era, https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era.

101 M. Pill and G. Hammersley (2024), A climate loss and damage fund that works, Policy Brief https://unfccc.int/sites/default/files/resource/PILL-HAMMERSLEY-Climate-loss-and-damage-fund.pdf.

102 Ibid.

103 UNFCCC (2023), Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation referred to in decision 7/CMA.3, https://unfccc.int/sites/default/files/resource/cma5_auv_8a_gga.pdf.

104 SLOCAT (2024), Transport in COP29 outcomes, https://slocat.net/wp-content/uploads/2024/12/Transport-in-COP29-outcomes_Overview.pdf.

105 GIZ and SLOCAT (2025), NDC Transport Tracker, https://www.changing-transport.org/tracker.

106 Lesotho (2024), Second Nationally Determined Contributions of Lesotho, https://unfccc.int/sites/default/files/2025-02/Lesotho%20SECOND%20NDC.pdf.

107 Government of Nepal (2025), Nationally Determined Contributions (NDC) 3.0, https://unfccc.int/sites/default/files/2025-05/Nepal%20NDC3.pdf.

108 GIZ and SLOCAT (2025), NDC Transport Tracker, https://www.changing-transport.org/tracker.

109 Ibid.

110 Republic of Kenya, Ministry of Environment Climate Change and Forestry (2025), Kenya's Second Nationally Determined Contribution (2031-2035) https://unfccc.int/sites/default/files/2025-05/KENYAS%20SECOND%20NATIONALLY%20DETERMINED%20CONTRIBUTION%202031_2035.pdf.

111 Maldives Ministry of Tourism and Environment (2025), Maldives' Third Nationally Determined Contribution, National Climate Action Plan Towards Resilience and Low-Carbon Development, https://unfccc.int/sites/default/files/2025-02/Maldives%E2%80%99%20Third%20Nationally%20Determined%20Contribution.pdf.

112 Government of the Republic of Moldova (2025), Nationally Determined Contribution 3.0, https://unfccc.int/sites/default/files/2025-05/MD_NDC_3.pdf.

113 UNFCCC (2025), Submitted NAPs from developing country Parties, https://napcentral.org/submitted-naps; UNFCCC (2025), NAPs shared by developed country Parties, https://napcentral.org/developedcountriesnaps.

114 Ibid.

115 S. Greenham et al. (2022), Adaptation for transport resilience to climate change for LICs in Africa and South Asia: state of knowledge report, prepared by the University of Birmingham and TRL, UK, https://transport-links.com/wp-content/uploads/2023/10/state-of-knowledge-report-adaptation-for-transport-resilience-to-climate-change-aftr-cc-for-lics-in-africa-and-south-asia.pdf.

116 Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh (2022), National Adaptation Plan of Bangladesh (2023-2050), https://moef.portal.gov.bd/sites/default/files/files/moef.portal.gov.bd/npfblock/903c6d55_3fa3_4d24_a4e1_0611eaa3cb69/National%20Adaptation%20Plan%20of%20Bangladesh%20%282023-2050%29%20%281%29.pdf.

117 Departamento Nacional de Planeacion (2018), Plan Nacional de Adaptación, Alcambioclimatico, ABC: Adaptación Bases Conceptuales. Marco Conceptual y Lineamientos, https://unfccc.int/sites/default/files/resource/NAP_Colombia_2018.pdf.

118 Federal Democratic Republic of Ethiopia (2019), Ethiopia's Climate Resilient Green Economy, National Adaptation Plan, https://unfccc.int/sites/default/files/resource/NAP_Ethiopia_2019.pdf.

119 Papua New Guinea (2023), National Adaptation Plan, https://unfccc.int/sites/default/files/resource/NAP-PNG-Finale-2023.pdf.

120 Ibid.

121 UNFCCC (2025), Submitted NAPs from developing country Parties, https://napcentral.org/submitted-naps; UNFCCC (2025), NAPs shared by developed country Parties, https://napcentral.org/developedcountriesnaps.

122 Ibid.

123 UNFCCC (2025), NAPs shared by developed country Parties, https://napcentral.org/developedcountriesnaps.

124 Ministry for the Environment (2022), Aotearoa New Zealand's first national adaptation plan, https://unfccc.int/sites/default/files/resource/NAP-New-Zealand-2023.pdf.

125 Department for Environment, Food and Rural Affairs (2023), Third National Adaptation Programme (NAP3), https://www.gov.uk/government/publications/third-national-adaptation-programme-nap3.

126 Climate Policy Initiative (CPI) (2025), Global Landscape of Climate Finance 2025, https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2025.

127 Ibid.

128 Y. Zhang et al. (2024), Access to climate finance in low- and middle-income countries, World Resources Institute, https://transport-links.com/wp-content/uploads/2024/11/WRI24_ClimateFinance_web_noDOI.pdf.

129 European Investment Bank (2024), 2023 Joint Report On Multilateral Development Banks' Climate Finance, https://www.eib.org/attachments/lucalli/20240150_2023_joint_report_on_mdbs_climate_finance_en.pdf.

130 Ibid.

131 Asian Development Bank (ADB) (2024), Climate Change Financing at ADB, https://data.adb.org/dashboard/climate-change-financing-adb.

132 Ibid.

133 World Bank (2024), Climate Finance, https://www.worldbank.org/en/news/factsheet/2024/11/12/climate-finance.

134 C. Brandon et al. (2025), Strengthening the investment case for climate adaptation: a triple dividend approach, World Resources Institute, https://doi.org/10.46830/wriwp.25.00019.

135 Ibid.

136 UNDRR (2023), A systems approach for disaster risk reduction, https://www.undrr.org/media/93132.

1.5
DRIVING GENDER EQUALITY: EMPOWERING WOMEN AND TRANSFORMING TRANSPORT

1 T. Uteng (2021), Gender gaps in urban mobility and transport planning, in R. Pereira and G. Boisjoly, eds., Advances in Transport Policy and Planning 8, 33-69, https://doi.org/10.1016/bs.atpp.2021.07.004.

2 G. Borker (2024), Understanding the constraints to women's use of urban public transport in developing countries, World Development 180, https://doi.org/10.1016/j.worlddev.2024.106589.

3 Asian Development Bank (ADB) (2025), Gender Equality in Transport Toolkit: Moving towards gender transformative transport systems in Asia and the Pacific, https://www.adb.org/sites/default/files/publication/1072231/gender-equality-transport-tool-kit.pdf.

4 D. Mahadevia, S. Lathia and K. Gounder (2024), Enabling gender responsive low-carbon transport in India using SDG5 framework, Sustainable Social Development, https://doi.org/10.54517/ssd.v2i5.2648.

5 Global Labour Institute (2018), Women in Public Transport, https://www.itfglobal.org/sites/default/files/paragraph/pdf-chapters/files/Women_in_Public_Transport_OPT-1.pdf; Organisation for Economic Co-operation and Development (OECD) (2024), Harnessing the Green and Digital Transitions for Gender Equality: Insights from the 2024 OECD Forum on Gender Equality, https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/10/harnessing-the-green-and-digital-transitions-for-gender-equality_c9a0091a/860d0901-en.pdf.

6 **Figure 3.** from Goel, R., Oyebode, O., Foley, L., Tatah, L., Millett, C., & Woodcock, J. (2023). Gender differences in active travel in major cities across the world. Transportation, 50(2), 733–749. https://doi.org/10.1007/s11116-021-10259-4

7 W-S. Ng and A. Acker (2018), Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies, International Transport Forum (ITF), https://www.itf-oecd.org/sites/default/files/docs/urban-travel-behaviour-gender.pdf.

8 R. Goel et al. (2023), Gender differences in active travel in major cities across the world, Transportation 50/2, 733-749, https://doi.org/10.1007/s11116-021-10259-4.

9 I.S. Madariaga (2013), Mobility of care: Introducing new concepts in urban transport, in I.S. Roberts, Fair Shared Cities, Routledge.

10 World Health Organization (WHO) (2024), Fair Share for Health and Care: gender and the undervaluation of health and care work, https://iris.who.int/server/api/core/bitstreams/6387cdb5-63e3-44d1-9cdb-2f01b860d590/content.

11 G. Borker (2022), Constraints to Women's Use of Public Transport in Developing Countries, Part I: High Costs, Limited Access, and Lack of Comfort, World Bank, http://documents1.worldbank.org/curated/en/099550408012242045/pdf/IDU05986e9020f68504b680bc3709f90291733e9.pdf.

12 J. Forman et al. (2019), Automobile injury trends in the contemporary fleet: belted occupants in frontal collisions, Traffic Injury Prevention 20/6, 607-612, https://doi.org/10.1080/15389588.2019.1630825.

13 S. Shah, R.M. Rajiv and A. Lokre (2023), Moving toward gender-equitable transportation in post-COVID-19 urban South Asia, Transportation Research Record 2677/4, 865-879, https://doi.org/10.1177/03611981221111369.

14 M. Moscoso et al. (2020), Las mujeres en el transporte en Bogotá: las cuentas, World Resources Institute Ross Center for Sustainable Cities and despacio, https://www.despacio.org/wp-content/uploads/2020/03/mujeresbogotalascuentas-20200303web.pdf.

15 W-S. Ng and A. Acker (2018), Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies, International Transport Forum (ITF), https://www.itf-oecd.org/sites/default/files/docs/urban-travel-behaviour-gender.pdf.

16 KRPA (2020), Survey on Sexual Harassment in Public Spaces During the Covid-19 Pandemic in Indonesia, https://jakartafeminist.com/portfolio/krpa-survey-on-sexual-harassment-in-public-spaces-during-the-covid-19-pandemic-in-indonesia.

17 L.M. Quinones (2020), Sexual harassment in public transport in Bogotá, Transportation Research Part A: Policy and Practice 139, 54-69, https://doi.org/10.1016/j.tra.2020.06.018; H. Allen et al. (2019), Ella se mueve segura. Un estudio sobre la seguridad personal de las mujeres y el transporte público en tres ciudades de América Latina, CAF and FIA Foundation, https://scioteca.caf.com/handle/123456789/1405.

18 ADB (2019), Baseline Survey Report: Improving Transport Services in Ger Areas, https://www.adb.org/sites/default/files/project-documents/52374/52374-001-pam-en.pdf.

19 S. Wang, M. Elefante and A.T. Bonfert (2024), Ensuring women's safety: data insights on gender-based violence legislation and policies, https://genderdata.worldbank.org/en/data-stories/women-safety

20 C. Harper, R. Marcus, D. Jiménez, T. Rodriguez and E. Tant (2022), Is no space safe? Working to end gender based violence in the public sphere, https://www.alignplatform.org/sites/default/files/2022-11/align_briefing_gbv_in_public_sphere_final.pdf

21 Ibid.

22 World Bank (2024), The Business Case for Gender in the Transport Sector, http://documents1.worldbank.org/curated/en/099317204022435210/pdf/IDU1dba29c311be8114eeb1b4d51a25795ee9e4f.pdf.

23 S. Shah et al. (2017), Women and Transport in Indian Cities, Institute for Transportation and Development Policy (ITDP) and Safetipin, https://itdp.in/wp-content/uploads/2018/01/181202_Women-and-Transport-in-Indian-Cities.pdf.

24 **Figure 2.** from International Labour Organization (ILO) (2025), ILOSTAT data explorer, https://rshiny.ilo.org/dataexplorer45/?lang=enandid=EMP_2EMP_SEX_ECO_NB_A, accessed 26 May 2025; N. Kurshitashvili et al. (2025), Addressing Barriers to Women's Participation in Transport: Global, ECA, and MENA Perspectives, World Bank, https://documents1.worldbank.org/curated/en/099010925132542721/pdf/P506086-86091978-a3ad-4c47-9bd9-942a8efc6448.pdf.

25 Ibid.

26 ILO (2025), ILOSTAT data explorer, https://rshiny.ilo.org/dataexplorer45/?lang=enandid=EMP_2EMP_SEX_ECO_NB_A, accessed 26 May 2025

27 ILO (2025), ILOSTAT data explorer, https://rshiny.ilo.org/dataexplorer45/?lang=enandid=EMP_2EMP_SEX_ECO_NB_A, accessed 26 May 2025; Transport Canada (2024), Transportation in Canada, Overview Report 2023, https://tc.canada.ca/sites/default/files/2024-06/TC_2023_Annual_Report_EN_2024-05-29.pdf.

28 ILO (2025), ILOSTAT data explorer, https://rshiny.ilo.org/dataexplorer45/?lang=enandid=EMP_2EMP_SEX_ECO_NB_A, accessed 26 May 2025.

29 Ibid.

30 Social Development Direct (2020), Addressing Gender-Based Violence and Harassment (GBVH) in the Public Transport Sector, https://www.ifc.org/content/dam/ifc/doc/mgrt/sectorbrief-addressinggbvh-transport-july2020.pdf

31 Sustainable Mobility for All (2023), Gender Imbalance in the Transport sector: A Toolkit for Change, https://www.sum4all.org/data/files/gender_imbalance_in_the_transport_sector_a_toolkit_for_change.pdf.

32 T. Turner (2024), Female truckers are safer drivers, and more are needed, research shows, Auburn University Harbert College of Business, https://harbert.auburn.edu/news/female-truckers-are-safer-drivers-and-more-are-needed-research-shows.html.

33 Ibid.; A. Scott, B. Davis-Sramek and D.J. Ketchen (2024), Men at work...unsafely: gender differences in compliance with safety regulations in the trucking industry, Production and Operations Management 33/4, 995-1013, https://doi.org/10.1177/10591478241235145.

34 N. Kurshitashvili et al. (2025), Addressing Barriers to Women's Participation in Transport: Global, ECA, and MENA Perspectives, World Bank, https://documents1.worldbank.org/curated/en/099010925132542721/pdf/P506086-86091978-a3ad-4c47-9bd9-942a8efc6448.pdf.

35 Ibid.

36 Ibid.

37 Down to Earth (2025), World Environment Day 2025: Why women are the first to suffer in a warming world, https://www.downtoearth.org.in/climate-change/world-environment-day-2025-why-women-are-the-first-to-suffer-in-a-warming-world.

38 WRI India (2025), Breathing unequally: Impact of air pollution on women, https://wri-india.org/perspectives/breathing-unequally-impact-air-pollution-women.

39 Z. Seitz (2025), From Floods to Heatwaves: Strengthening Urban Transport amidst Changing Climate - Experiences from China on Climate-Proofing Urban Mobility Systems, https://changing-transport.org/wp-content/uploads/2025_From-floods-to-heatwaves_Stregthening-Urban-Transport.pdf

40 **Box 2** from the following sources: Y. Beebeejaun (2017), Gender, urban space, and the right to everyday life, Journal of Urban Affairs, 323-334, http://dx.doi.org/10.1080/07352166.2016.1255526; United Nations (1992), Agenda 21. United Nations Conference on Environment and Development, https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf; B. Jones (2018), "A more receptive crowd than before": Explaining the World Bank's gender turn in the 2000s, Progress in Development Studies 18/3, 172-188, https://doi.org/10.1177/1464993418766584; K. Dominguez Gonzalez et al. (2023), Closing gender gaps in transport, World Bank, https://documents1.worldbank.org/curated/en/099512412082314620/pdf/IDU0a9d235b00e11b040f00ad80077fcc4d1ef74.pdf.

41 Y. Glemarec, S. Qayum and M. Olshanskaya (2016), Leveraging co-benefits between gender equality and climate action for sustainable development: mainstreaming gender considerations in climate change projects, UN Women, https://unfccc.int/files/gender_and_climate_change/application/pdf/leveraging_cobenefits.pdf.

42 Philippine Commission on Women (n.d.), FAQ: Republic Act 9710 or the Magna Carta of Women, https://pcw.gov.ph/faq-republic-act-9710-the-magna-carta-of-women; Philippine Commission on Women. (n.d.), FAQ: Republic Act No. 11313: Safe Spaces Act (Bawal Bastos Law), https://pcw.gov.ph/faq-republic-act-no-11313.

43 T.H. Pham and H.M. Nguyen (2015), Gender responsive budgeting in Viet Nam, UN Women, https://asiapacific.unwomen.org/sites/default/files/Field%20Office%20ESEAsia/Docs/Publications/2015/12/GRB-Report-EN.pdf.

44 United Nations Framework Convention on Climate Change (n.d.), Lima Work Programme on Gender (LWPG), https://www4.unfccc.int/sites/NWPStaging/Pages/Lima-Work-Programme-on-Gender.aspx.

45 World Bank (2015), Transport or gender? A holistic approach is critical for achieving the SDGs, https://blogs.worldbank.org/en/transport/trans-

port-or-gender-holistic-approach-critical-achieving-sdgs.

46 World Bank (2022), India – Toolkit for enabling gender responsive urban mobility and public spaces: Volume 1 – The "what-to-do" note for policymakers, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099651410192229435/idu01ef8184c02ec004af50ae850e22d67ee8c62; Asian Development Bank (ADB) (2025), Gender Equality in Transport Toolkit: Moving towards gender transformative transport systems in Asia and the Pacific, https://www.adb.org/sites/default/files/publication/1072231/gender-equality-transport-tool-kit.pdf. ; ITF (2024), ITF Gender Analysis Toolkit for Transport policies, https://gendertoolkit.itf-oecd.org/

47 Flone Initiative (2024), Nakuru public transport code of conduct: popular version, https://floneinitiative.org/nakuru-public-transport-code-of-conduct-popular-version.

48 European Investment Bank and International Union of Public Transport (UITP) (2024), Gender best practices in public transport, https://www.eib.org/files/documents/explore-gender-best-practices-in-public-transport.pdf.

49 H. Jamba, A. Devaraj, and C. Kanuri (2025), Fare-free bus travel scheme for women: Lessons from Delhi, Working Paper, New Delhi: WRI India, https://doi.org/10.46830/wriwp.23.00055

50 A. Hever (2023), How AI is helping to Improve transportation safety on a global scale, Forbes, https://www.forbes.com/councils/forbestechcouncil/2023/05/12/how-ai-is-helping-to-improve-transportation-safety-on-a-global-scale.

51 K. Viswanath, and A. Basu (2015), SafetiPin: an innovative mobile app to collect data on women's safety in Indian cities, Gender and Development, 23, https://doi.org/10.1080/13552074.2015.1013669

52 J. McCurry (2019), 'Stop it!' Japanese women turn to app to stop groping on trains, https://www.theguardian.com/world/2019/may/22/groping-digi-police-app-downloads-japan-train

53 ITF (2024), Improving the quality of walking and cycling in cities, https://www.itf-oecd.org/improving-quality-walking-cycling-cities.

54 W-S. Ng and D. Bassan (2022), Gender Equality and the Role of Women in Decarbonising Transport, ITF and Fia Foundation, https://www.itf-oecd.org/sites/default/files/docs/gender-equality-women-decarbonising-transport.pdf.

55 World Bank (2023), Making Way for Women in Transport and Logistics: Promising Practices in Europe and Central Asia, https://www.worldbank.org/en/news/feature/2023/01/26/making-way-for-women-in-transport-and-logistics-promising-practices-in-europe-and-central-asia

56 ITDP (2023), How this Indian city is empowering women and improving transport connectivity, https://itdp.org/2023/10/05/india-bhubaneswar-empowering-women-improving-transport-connectivity.

57 ITDP (2023), TA 2023 Spotlight: Bhubaneswar, India – Creating Integrated Public Transport Services That Leave No One Behind, https://itdp.org/wp-content/uploads/2023/09/MOBILIZE-BhubaneswarSTA2023-final.pdf.

58 ALOI Global (n.d.), Powering microfinance for informal sector businesses, https://aloi.global.

59 H. Allen, and A. Berlin (2024), E-Mobility as a Driver for Change: Towards a gender transformative and just transition to electric mobility, UNEP, https://sustmob.org/EMOB/pdf/GenderEmobility_Report_August2024.pdf

60 Ibid.

61 Ibid.

62 UNEP (2024), How Colombia's electric buses are countering climate change and creating jobs for women, https://www.unep.org/news-and-stories/story/how-colombias-electric-buses-are-countering-climate-change-and-creating-jobs.

63 H. Allen, and A. Berlin (2024), E-Mobility as a Driver for Change: Towards a gender transformative and just transition to electric mobility, UNEP, https://sustmob.org/EMOB/pdf/GenderEmobility_Report_August2024.pdf

64 C.S.C Tobanda (2025), No One Left Behind: Centering Equity and Inclusion in the UN Decade of Sustainable Transport, Changing Transport, https://changing-transport.org/no-one-left-behind-un-decade-sustainable-transport; Global Alliance for Feminist Transport (2025), Call for Impact to Center Equity and Inclusion in the UN Decade of Sustainable Transport, https://feminist-transport.org/call-for-impact-to-center-equity-inclusion-in-the-un-decade-of-sustainable-transport.

S2
SPOTLIGHT ON GENDER-RESPONSIVE APPROACHES IN FREIGHT TRANSPORT IN ASIA

1 UNIS (n.d.), What is Logistics Ecosystem? https://www.unisco.com/freight-glossary/logistics-ecosystem.

2 International Transport Forum (ITF) (2025), Share of employment in the transport sector, Transport Data Dashboard, https://www.itf-oecd.org/transport-data-dashboard; M. Blix (2017), Structural change and the freight transport labour market, https://www.itf-oecd.org/sites/default/files/docs/structural-change-freight-transport-labour-market.pdf; Gi Group Holding (2023), Logistics: Global HR Trends 2023 Edition, https://www.gigroupholding.com/insights/logistics-global-hr-trends-2023.

3 ITF (2021), Transport Outlook 2021, https://www.itf-oecd.org/itf-transport-outlook-2021; Asian Transport Observatory (2022), Asian Transport 2030 Outlook, https://asiantransportobservatory.org/documents/11/Asian_Transport_2030_Outlook_Nov_2022.pdf; ATO (2024), Bridging the Gap: A Deep Dive into NDCs and Transport Policy Landscapes in Low- and Middle-Income Asian Economies, https://asiantransportobservatory.org/analytical-outputs/ndc-analysis.

4 International Labour Organization (2025), ILOSTAT data explorer, ISIC-Rev.4: H. Transportation and Storage, https://rshiny.ilo.org/dataexplorer45/?lang=en&id=EMP_TEMP_SEX_ECO_NB_A.

5 International Transport Workers' Federation (n.d.), Access to decent work, https://www.itfglobal.org/en/sector/women/women-in-transport/access-decent-work.

6 Ibid.

7 ATO (2024), Bridging the Gap: A Deep Dive into NDCs and Transport Policy Landscapes in Low- and Middle-Income Asian Economies, https://asiantransportobservatory.org/analytical-outputs/ndc-analysis.

8 L. Edirisinghe (2021), Empowering women in freight transport to enhance its sustainability: draft guidelines for ESCAP region, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), https://www.unescap.org/sites/default/d8files/event-documents/Aug17_UNESCAP-Presentation_women_empowerment.pdf; International Transport Workers' Federation (2025), Rising risks from automation, warn global union leaders, https://www.itfglobal.org/en/news/women-metro-workers-face-rising-risks-automation-warn-global-union-leaders; Asian Development Bank (ADB) (2024), Gender Equality and Social Inclusion in Public Water, Sanitation, and Hygiene Facilities in Developing Asia and the Pacific, https://www.adb.org/sites/default/files/publication/1016931/gender-social-inclusion-water-sanitation-hygiene.pdf.

9 N. Kurshitashvili (2025), Addressing Barriers to Women's Participation in Transport: Global, ECA, and MENA Perspectives, World Bank, http://documents.worldbank.org/curated/en/099010925132542721.

10 UNESCAP (2019), Unpaid Work in Asia and the Pacific, Social Development Policy Papers, https://www.unescap.org/sites/default/files/PP_2019-02_Unpaid%20Work.pdf; UNIS (n.d.), What is Logistics Ecosystem? https://www.unisco.com/freight-glossary/logistics-ecosystem.

11 L. Edirisinghe (2024), Promoting a socially inclusive freight transport sector through gender mainstreaming and empowering persons with disabilities, UNESCAP, https://repository.unescap.org/server/api/core/bitstreams/8bd7f23e-02bc-4058-8a75-4b09a18f29fc/content.

12 Ibid.

13 Ibid.; World Bank (2005), Education for All: The Cost of Accessibility, https://documents1.worldbank.org/curated/en/185031468178138911/pdf/388640EdNotes1August2005CostOfAccess12.pdf.

14 The Urban Catalysts (2024), WE2: She Moves on Electric TwoWheels - Understanding the barriers and opportunities for increasing women's uptake of electric two-wheelers in India, The Urban Catalysts: Mumbai, https://transport-links.com/wp-content/uploads/2025/01/HVT059-Project-Completion-Report_19122024.pdf.

15 Ibid.

16 R. Behuria et al. (2025), Gender Transformative Approaches in Infrastructure PPPs: Lessons from the Transport Sector, ADB Institute, https://www.adb.org/sites/default/files/publication/1032711/adbi-gender-transformative-approaches-infrastructure-ppps-lessons-transport-sector.pdf.

17 Sustainable Mobility for All (2023), Gender Imbalance in the Transport Sector: A Toolkit for Change, https://www.sum4all.org/data/files/gender_imbalance_in_the_transport_sector_a_toolkit_for_change.pdf.

18 L. Edirisinghe (2021), Empowering women in freight transport to enhance its sustainability: draft guidelines for ESCAP region, https://www.unescap.org/sites/default/d8files/event-documents/Aug17_UNESCAP-Presentation_women_empowerment.pdf.

19 L. Edirisinghe (2024), Promoting a socially inclusive freight transport sector through gender mainstreaming and empowering persons with disabilities, UNESCAP, https://repository.unescap.org/server/api/core/bitstreams/8bd7f23e-02bc-4058-8a75-4b09a18f29fc/content.

20 Ibid.

21 L. Edirisinghe (2021), Empowering women in freight transport to enhance its sustainability: draft guidelines for ESCAP region, https://www.unescap.org/sites/default/d8files/event-documents/Aug17_UNESCAP-Presentation_women_empowerment.pdf.

22 Baton (2024), Trucking for Equality, https://baton-transport.com/blog/trucking-for-equality.

23 Nasheman News (2023), Baton Transport In Association with The Vega Group Announces initiative to support and empower women drivers in India and provide them with employment opportunities in Eastern European Countries, https://nasheman.in/baton-transport-in-association-with-the-vega-group-announces-initiative-to-support-and-empower-women-drivers-in-india-and-provide-them-with-employment-opportunities-in-eastern-european-countries.

24 S. Dimri (2025), Driving Change Through an Ecosystem Approach, https://www.globalgiving.org/projects/women-on-wheels-india/reports.

25 R. Behuria et al. (2025), Gender Transformative Approaches in Infrastructure PPPs: Lessons from the Transport Sector, ADB Institute, https://www.adb.org/sites/default/files/publication/1032711/adbi-gender-transformative-approaches-infrastructure-ppps-lessons-transport-sector.pdf.

26 International Association of Public Transport (UITP) and ITF (2019), Positive Employer Gender Policy – Joint Recommendations: Strengthening Women's employment and equal opportunities in urban public transport, https://www.itfglobal.org/en/resources/itf-uitp-positive-employer-gender-policy.

27 International Transport Workers' Federation (n.d.), Advocating for equal rights, representation and opportunities for women, https://www.itfglobal.org/en/sector/women.

28 International Transport Workers' Federation (n.d.), Sectors, https://www.itfglobal.org/en/sectors.

29 Women in Trucking (n.d.), Accelerating opportunities for women in trucking, https://www.womenintrucking.org; Sustainable Mobility for All (2023), Gender Imbalance in the Transport Sector: A Toolkit for Change, https://www.sum4all.org/data/files/gender_imbalance_in_the_transport_sector_a_toolkit_for_change.pdf.

30 Sustainable Mobility for All (2023), Gender Imbalance in the Transport Sector: A Toolkit for Change, https://www.sum4all.org/data/files/gender_imbalance_in_the_transport_sector_a_toolkit_for_change.pdf.

31 Ibid.

32 Ibid.; Changeincontent Bureau (2024), India soars high with the highest number of women pilots in the world, https://www.changeincontent.com/highest-number-of-women-pilots-india.

33 L. Edirisinghe (2024), Promoting a socially inclusive freight transport sector through gender mainstreaming and empowering persons with disabilities, UNESCAP, https://repository.unescap.org/server/api/core/bitstreams/8bd7f23e-02bc-4058-8a75-4b09a18f29fc/content.

34 Ibid.

35 NDC Transport Initiative for Asia (2023), The NDC Transport Initiative for Asia (NDC-TIA) aims to facilitate a paradigm shift to zero-emission transport across Asia, https://www.ndctransportinitiativeforasia.org/about

36 Ibid.

37 Ibid.

38 N. Kurshitashvili (2025), Addressing Barriers to Women's Participation in Transport: Global, ECA, and MENA Perspectives, World Bank, https://documents1.worldbank.org/curated/en/099010925132542721/pdf/P506086-86091978-a3ad-4c47-9bd9-942a8efc6448.pdf.

1.6
A JUST TRANSITION IN TRANSPORT: A DOUBLE CHALLENGE

1 International Association of Public Transport (UITP) and International Transport Workers' Federation ITF (2025), Global Employment in Urban Public Transport, https://www.itfglobal.org/sites/default/files/node/resources/files/20250616_Global-Employment-in-PT_Report_WEB_0.pdf; IRU (2023), Driver Truck Driver Shortage Report 2024, https://www.iru.org/news-resources/newsroom/global-truck-driver-shortage-double-2028-says-new-iru-report; International Labour Organization (ILO) (2024), Constant turbulence: employment in civil aviation, https://ilostat.ilo.org/blog/constant-turbulence-employment-in-civil-aviation; International Union of Railways (UIC) (2023), UIC Activity Report, https://uic.org/IMG/pdf/uic_activity_report_2023_05jul24_web.pdf; BIMCO and International Chamber of Shipping (2021), Seafarer Workforce Report, https://www.ics-shipping.org/publications/seafarer-workforce-report-2021-edition REN21, Transport in Focus: https://www.ren21.net/gsr-2023/modules/energy_demand/03_transport_in_focus/.

2 **Figure 1** from International Transport Worker's Federation (2022), A Just Transition for Urban Transport Workers, https://www.itfglobal.org/en/resources/just-transition-urban-transport-workers-0.

3 European Commission Joint Research Centre (JRC) and International Energy Agency (IEA) (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024; REN21 (2025), Renewables 2025 Global Status Report: Global Overview, https://www.ren21.net/gsr-2025.

4 E.A. Mack, S. Agrawal, S. Wang (2021), The impacts of the COVID-19 pandemic on transportation employment: A comparative analysis, Transportation Research Interdisciplinary Perspectives, Volume 12, https://doi.org/10.1016/j.trip.2021.100470.

5 International Transport Worker's Federation (2023), Lessons in Failure: Automation at the Port of Auckland, https://www.itfglobal.org/en/resources/lessons-in-failure-automation-port-auckland.

6 **Box 1** from International Transport Worker's Federation (2022), A Zero-Carbon Future for the Aviation Sector, https://www.itfglobal.org/en/resources/zero-carbon-future-aviation-sector

7 ILO (2024), Ensuring safety and health at work in a changing climate, https://www.ilo.org/publications/ensuring-safety-and-health-work-changing-climate.

8 ILO (2024), Heat at work: Implications for safety and health, https://www.ilo.org/sites/default/files/2024-07/ILO_OSH_Heatstress-R16.pdf; The Lancet (2024), The 2024 Global Report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(24)01822-1/abstract; ANRT (2024), The Technological Issues Involved in Adapting to Climate Change, https://www.anrt.asso.fr/sites/default/files/2025-01/ANRT-The-technological-issues-involved-in-adapting-to-climate-change.11.2024.pdf.

9 Ibid.

10 German Centre for Rail Traffic Research at the Federal Railway Authority (2025), Climate Change Adaptation in Rail Traffic Systems, https://www.dzsf.bund.de/SharedDocs/Downloads/DZSF/Veroeffentlichungen/Whitepaper_Vortraege/2024/2025_02_Tagungsband_CCARTS.pdf; SNCF Group (2024), Planning ahead for high temperatures, https://www.groupe-sncf.com/en/group/behind-the-scenes/traffic-flows/high-temperatures.

11 ILO (2024), Ensuring safety and health at work in a changing climate, https://www.ilo.org/publications/ensuring-safety-and-health-work-changing-climate.

12 International Transport Worker's Federation (2022), Time to step up: Pakistan floods show the urgent need for wealthy countries to follow through on adaptation funding promises, https://www.itfglobal.org/en/news/time-step-pakistan-floods-show-urgent-need-wealthy-countries-follow-through-adaptation-funding.

13 UITP and International Transport Worker's Federation (2025), Global Employment in Urban Public Transport, https://www.itfglobal.org/sites/default/files/node/resources/files/20250616_Global-Employment-in-PT_Report_WEB_0.pdf.

14 International Transport Worker's Federation (2025), We Move the World, https://www.itfglobal.org/en/about-us.

15 Ibid.

16 **Box 2** from Global Labour Institute (2025), Understanding Informal Transport in Africa: Labour impact assessments as tools to improve workers' conditions, https://vref.se/wp-content/uploads/2025/01/Labour-impact-assessment-methodology-report.pdf.

17 **Box 3** from the following sources: United Nations Framework Convention on Climate Change (UNFCCC) (2015), Paris Agreement, https://unfccc.int/sites/default/files/english_paris_agreement.pdf; UNFCCC (2023), Work programme on just transition pathways referred to in the relevant paragraphs of decision 1/CMA.4, https://unfccc.int/sites/default/files/resource/cma2023_L14E.pdf; UNFCCC (2024), Draft Decision, [CMA.5] New Collective Quantified Goal on Climate Finance, https://unfccc.int/documents/643641; ILO (2016), Guidelines for a just transition towards environmentally sustainable economies and societies for all, https://www.ilo.org/publications/guidelines-just-transition-towards-environmentally-sustainable-economies; ILO (2023), Resolution concerning a just transition towards environmentally sustainable economies and societies for all, https://www.ilo.org/resource/ilc/111/resolution-concerning-just-transition-towards-environmentally-sustainable; United Nations, 2015, The 17 Goals, https://sdgs.un.org/goals.

18 International Transport Worker's Federation and SLOCAT (2024), Prioritising just transition for transport in nationally determined contributions, https://www.itfglobal.org/en/resources/prioritising-just-transition-transport-in-nationally-determined-contributions.

19 International Transport Worker's Federation analysis of UNFCCC (2025), NDC Registry, https://unfccc.int/NDCREG.

20 Government of Brazil (2024), Brazil's NDC National Determination to Contribute and Transform, https://unfccc.int/sites/default/files/2024-11/Brazil_Second%20Nationally%20Determined%20Contribution%20%28NDC%29_November2024.pdf.

21 Government of Nepal (2025), Nationally Determined Contributions (NDC) 3.0, https://unfccc.int/sites/default/files/2025-05/Nepal%20NDC3.pdf.

22 UK Government (2025), United Kingdom of Great Britain and Northern Ireland's 2035 Nationally Determined Contribution, https://unfccc.int/sites/default/files/2025-01/UK%27s%202035%20NDC%20ICTU.pdf.

23 International Transport Worker's Federation (2022), Mapping a Maritime Just Transition for Seafarers - Maritime Just Transition Task Force, https://www.itfglobal.org/en/resources/mapping-maritime-just-transition-seafarers-maritime-just-transition-task-force-2022 ; SAFETY4SEA (2023), Maritime Just Transition Task Force: Engaging industry in social dialogue, https://safety4sea.com/cm-maritime-just-transition-task-force-engaging-industry-in-social-dialogue/ ; IMO (2021), Martime Just Transition, https://www.imo.org/en/ourwork/humanelement/pages/maritime-just-transition.aspx .

24 International Chamber of Shipping (2021), The Maritime Just Transition Task Force, https://www.ics-shipping.org/representing-shipping/maritime-just-transition-task-force/.

25 International Transport Worker's Federation (2021), UN Global Compact and shipping industry confirm formation of 'people-centred' Task Force to ensure Just Transition to net-zero, https://www.itfseafarers.org/en/news/un-global-compact-and-shipping-industry-confirm-formation-people-centred-task-force-ensure.

26 SINDMAR (2025), Marítimos aprovam proposta de ACT Norsul e Norsulcargo, https://www.sindmar.org.br/maritimos-aprovam-proposta-de-act-norsul-e-norsulcargo/.

27 ILO (2025), Roadmap development for decent work, social protection in the Philippines, https://www.ilo.org/resource/news/philippines-gains-ground-decent-work-social-protection-roadmap.

28 International Transport Worker's Federation (2024), Technology and Decent Work Charter 2024, https://www.itfglobal.org/sites/default/files/node/resources/files/Technology_and_Decent_Work_Charter_2024.pdf.

29 International Transport Worker's Federation (2022), Just transition through collective bargaining: lessons from Chile, https://www.itfglobal.org/en/tags/cop27; International Transport Worker's Federation (2025), Metro workers win reduced work week with no loss of pay, https://www.itfglobal.org/en/news/metro-workers-win-reduced-work-week-no-loss-pay.

30 Global Labour Institute (2025), Understanding Informal Transport in Africa: Labour impact assessments as tools to improve workers' conditions, https://vref.se/wp-content/uploads/2025/01/Labour-impact-assessment-methodology-report.pdf.

31 International Transport Worker's Federation (2021), UN Global Compact and shipping industry confirm formation of 'people-centred' Task Force to ensure Just Transition to net-zero, https://www.itfseafarers.org/en/news/un-global-compact-and-shipping-industry-confirm-formation-people-centred-task-force-ensure.

32 International Transport Worker's Federation (2025), Global Employment in Urban Public Transport, https://www.itfglobal.org/en/resources/global-employment-in-urban-public-transport.

1.7
DRIVING HEALTH FORWARD: THE CRITICAL LINK BETWEEN TRANSPORT AND WELLBEING

1 A. Glazener et al. (2021), Fourteen pathways between urban transportation and health: a conceptual model and literature review, Journal of Transport & Health 21, 101070, https://doi.org/10.1016/j.jth.2021.101070; J.S. Mindell and S.J. Watkins (2024), Transport, health and inequality: an overview of current evidence, Journal of Transport & Health 38, 101886, https://doi.org/10.1016/j.jth.2024.101886. **Box 1** from idem.

2 M. Kırmızı (2023), Transport inequality in today's cities at the intersection of mobility and inequality, Trafik ve Ulaşım Araştırmaları Dergisi 6/1, 17-43, https://doi.org/10.38002/tuad.1219025; B. Matos and C. Lobo (2023), The barrier effect and pedestrian mobility/accessibility on urban highways: an analysis based on the Belo Horizonte/Minas Gerais/Brazil Ring Road, Sustainability 15/4, 3408, https://doi.org/10.3390/su15043408; E. Pisoni, M. Domínguez-Torreiro and P. Thunis (2022), Inequality in exposure to air pollutants: a new perspective, Environmental Research 212, 113358, https://doi.org/10.1016/j.envres.2022.113358.

3 J.S. Mindell et al. (2014), Transport and clinical practice, Journal of Transport & Health 1/1, 73-80, https://doi.org/10.1016/j.jth.2013.08.001; J.S. Mindell et al. (2025), A meta-review of literature reviews of disability, travel and inequalities, Journal of Transport & Health 41, 101961, https://doi.org/10.1016/j.jth.2024.101961.

4 Ibid., both references.

5 **Figure 1** adapted from J.S. Mindell and S.J. Watkins (2025), Transport, health and inequality: an overview of current evidence, Journal of Transport & Health 38, 101886, https://doi.org/10.1016/j.jth.2024.101886, and from Figure 20.1 in J.S. Mindell and A. Curl (2024), Interactions in Travel and health, Chapter 20 in D. Potoglou and J. Spinney, eds., Handbook of Travel Behaviour, https://doi.org/10.4337/9781839105746.

6 S.A. Clemes et al. (2022), A multicomponent structured health behaviour intervention to improve physical activity in long-distance HGV drivers: the SHIFT cluster RCT, Public Health Research 10, 1-174, https://doi.org/10.3310/PNOY9785; S. Tahernejad et al. (2024), Musculoskeletal disorders among truck drivers: a systematic review and meta-analysis, BMC Public Health 24, 3146, https://doi.org/10.1186/s12889-024-20611-9.

7 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517; Health Effects Institute (2024), State of Global Air Report 2024, https://www.stateofglobalair.org/resources/report/state-global-air-report-2024; J. Lelieveld et al. (2023), Air pollution deaths attributable to fossil fuels: observational and modelling study, BMJ 383, https://www.bmj.com/content/383/bmj-2023-077784.

8 J.S. Mindell et al. (2025), A meta-review of literature reviews of disability, travel and inequalities, Journal of Transport & Health 41, 109161, https://doi.org/10.1016/j.jth.2024.101961.

9 R. Riley and A. de Nazelle (2019), Barriers and enablers of integrating health evidence into transport and urban planning and decision making, Integrating Human Health into Urban and Transport Planning, 641-654, https://doi.org/10.1007/978-3-319-74983-9_31.

10 M. Negev, L. Zea-Reyes and L. Caputo (2022), Barriers and enablers for integrating public health cobenefits in urban climate policy, Annual Review of Public Health 43, https://doi.org/10.1146/annurev-publhealth-052020-010820.

11 After adjusting for other relevant factors. J. Holt-Lunstad et al. (2015), Loneliness and social isolation as risk factors for mortality: a meta-analytic review, Perspectives on Psychological Science 10/2, 227-237, https://doi.org/10.1177/1745691614568352.

12 M. Marmot and J.J. Allen (2014), Social determinants of health equity, American Journal of Public Health 104/S4, S517–S519, https://doi.org/10.2105/AJPH.2014.302200.

13 Institute for Transportation and Development Policy (2025), Atlas of Sustainable City Transport, https://atlas.itdp.org.

14 Ibid.

15 UN-Habitat (2025), Urban transport, Urban Indicators Database, https://data.unhabitat.org/pages/urban-transport, accessed 10 April 2025.

16 D. Stiller et al. (2025), Does formal public transport serve the city well? The importance of semiformal transport for the accessibility in Medellín, Colombia, PLOS One 20/4, e0321691, https://doi.org/10.1371/journal.pone.0321691.

17 H. Ali and M. Abdullah (2023), Exploring the perceptions about public transport and developing a mode choice model for educated disabled people in a developing country, Case Studies on Transport Policy 11, 100937, https://doi.org/10.1016/j.cstp.2022.100937; D. Hernandez and S. Rodriguez (2023), Same network, same access to urban opportunities? Accessibility via public transportation for wheelchair users, Journal of Disability Policy Studies 35/2, https://doi.org/10.1177/10442073231165773.

18 UN-Habitat (2025), Urban transport, Urban Indicators Database, https://data.unhabitat.org/pages/urban-transport, accessed 10 April 2025.

19 M.J.W.A Vanderschuren and O.A. Nnene (2021), Inclusive planning: African policy inventory and South African mobility case study on the exclusion of persons with disabilities, Health Research Policy and Systems 19, 124, https://doi.org/10.1186/s12961-021-00775-1.

20 Australian Bureau of Statistics (2024), Survey of Disability, Ageing and Carers (SDAC), https://www.aihw.gov.au/australias-disability-strategy/outcomes/inclusive-homes-and-communities/public-transport-usability.

21 C. Bartels et al. (2016), Can the use of bus rapid transit lead to a healthier lifestyle in urban South Africa? The SUN Study, Journal of Transport & Health 3/2, 200-210, https://doi.org/10.1016/j.jth.2016.04.003; R. Patterson et al. (2019), Physical activity accrued as part of public transport use in England, Journal of Public Health 41/2, 222-230, https://doi.org/10.1093/pubmed/fdy099; C. Rissel et al. (2012), Physical activity associated with public transport use – a review and modelling of potential benefits, International Journal of Environmental Research and Public Health 9/7, 2454-2478, https://doi.org/10.3390/ijerph9072454.

22 D. Stiller et al. (2025), Does formal public transport serve the city well? The importance of semiformal transport for the accessibility in Medellín, Colombia, PLOS One 20/4, e0321691, https://doi.org/10.1371/journal.pone.0321691.

23 D. Plaza-Herrera and J. Mercadé-Aloy (2025), Inclusive 15-minute cities: an age-sensitive assessment of active accessibility in the metropolitan area of Barcelona, Cities 165, https://doi.org/10.1016/j.cities.2025.106091.

24 Urban Design Lab (2024), Top 10 Successful Transit-Oriented Development Case Studies, https://urbandesignlab.in/top-10-successful-transit-oriented-development-case-studies.

25 C. Bartels et al. (2016), Can the use of bus rapid transit lead to a healthier lifestyle in urban South Africa? The SUN Study, Journal of Transport & Health 3/2, 200-210, https://doi.org/10.1016/j.jth.2016.04.003; R. Patterson et al. (2019), Physical activity accrued as part of public transport use in England, Journal of Public Health 41/2, 222-230, https://doi.org/10.1093/pubmed/fdy099; C. Rissel et al. (2012), Physical activity associated with public transport use—a review and modelling of potential benefits, International Journal of Environmental Research and Public Health 9/7, 2454-2478, https://doi.org/10.3390/ijerph9072454.

26 N. Cavill et al. (2019), Active Travel & Physical Activity Evidence Review, Sport England, https://sportengland-production-files.s3.eu-west-2.amazonaws.com/s3fs-public/active-travel-full-report-evidence-review.pdf.

27 WHO (2022), Physical activity (fact sheets), https://www.who.int/news-room/fact-sheets/detail/physical-activity. **Figure 2** from WHO Regional Office for Europe (2022), Walking and cycling: latest evidence to support policy-making and practice, https://www.who.int/europe/publications/i/item/9789289057882.

28 WHO (2010), Global recommendations on physical activity for health, https://iris.who.int/handle/10665/44399.

29 I. Avila-Palencia et al. (2018), The effects of transport mode use on self-perceived health, mental health, and social contact measures: a cross-sectional and longitudinal study, Environment International 120, 199-206, https://doi.org/10.1016/j.envint.2018.08.002.

30 M. Tainio et al. (2016), Can air pollution negate the health benefits of cycling and walking? Preventive Medicine 87, 233-236, https://doi.org/10.1016/j.ypmed.2016.02.002.

31 K. Chatterjee et al. (2020), Commuting and wellbeing: a critical overview of the literature with implications for policy and future research, Transport Reviews 40/1, 5-34, https://doi.org/10.1080/01441647.2019.1649317; A. Martin, Y. Goryakin and M. Suhrcke (2014), Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey, Preventive Medicine 69, 296-303, https://doi.org/10.1016/j.ypmed.2014.08.023.

32 C. Friel et al. (2024), Health benefits of pedestrian and cyclist commuting: evidence from the Scottish Longitudinal Study, BMJ Public Health 2, e001295, https://doi.org/10.1136/bmjph-2024-001295.

33 C. Brand et al. (2021), The climate change mitigation impacts of active travel: evidence from a longitudinal panel study in seven European cities, Global Environmental Change 67, 102224, https://doi.org/10.1016/j.gloenvcha.2021.102224.

34 L. Besser, and A. Dannenberg (2005), Walking to public transit. steps to help meet physical activity recommendations, American Journal of Preventive Medicine 29, 273-280, https://doi.org/10.1016/j.amepre.2005.06.010; A.A. Laverty et al. (2013), Active travel to work and cardiovascular risk factors in the United Kingdom, American Journal of Preventive Medicine 45, 282-288, https://doi.org/10.1016/j.amepre.2013.04.012; C. Rissel et al. (2012), Physical activity associated with public transport use – a review and modelling of potential benefits, International Journal of Environmental Research and Public Health 9, 2454-2478, https://doi.org/10.3390/ijerph9072454.

35 K. Chatterjee et al. (2020), Commuting and wellbeing: a critical overview of the literature with implications for policy and future research, Transport Reviews 40/1, 5-34, https://doi.org/10.1080/01441647.2019.1649317.

36 A. Martin et al. (2015), Impact of changes in mode of travel to work on changes in body mass index: evidence from the British Household Panel Survey, Journal of Epidemiology and Community Health 69/8, 753, https://doi.org/10.1136/jech-2014-205211.

37 P. Rouxel, E. Webb and T. Chandola (2017), Does public transport use prevent declines in walking speed among older adults living in England? A prospective cohort study, BMJ Open 7/9, e017702, https://doi.org/10.1136/bmjopen-2017-017702.

38 M. Gascon et al. (2015), Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review, International Journal of Environmental Research and Public Health 12/4, 4354-4379, https://doi.org/10.3390/ijerph120404354; R. Wang et al. (2023), Exploring mechanistic pathways linking urban green and blue space to mental wellbeing before and after urban regeneration of a greenway: evidence from the Connswater Community Greenway, Belfast, UK, Landscape and Urban Planning 235, 104739, https://doi.org/10.1016/j.landurbplan.2023.104739.

39 Ibid., both references.

40 M.P. White et al. (2019), Spending at least 120 minutes a week in nature is associated with good health and wellbeing, Scientific Reports 9, 7730, https://doi.org/10.1038/s41598-019-44097-3.

41 Ibid.

42 WHO (2022), Compendium of WHO and other UN guidance on health and environment, 2022 update, https://iris.who.int/bitstream/handle/10665/352844/WHO-HEP-ECH-EHD-22.01-eng.pdf.

43 Sustainable Mobility for All (2023), Global Mobility Report 2022: Tracking Sector Performance, https://www.sum4all.org/data/files/global_mobility_report_2022_04052023_final.pdf.

44 Ibid.

45 R. Guski, D. Schreckenberg and R. Schuemer (2017), WHO environmental noise guidelines for the European region: a systematic review on environmental noise and annoyance, International Journal of Environmental Research and Public Health 14/12, 1539, https://doi.org/10.3390/ijerph14121539; H.A.R. Jensen, B. Rasmussen and O. Ekholm (2018), Neighbour and traffic noise annoyance: a nationwide study of associated mental health and perceived stress, European Journal of Public Health 28/6, 1050-1055, https://doi.org/10.1093/eurpub/cky091.

46 WHO (2022), Compendium of WHO and other UN guidance on health and environment, 2022 update, https://iris.who.int/bitstream/handle/10665/352844/WHO-HEP-ECH-EHD-22.01-eng.pdf.

47 N. Khan et al. (2023), Low educational attainment is associated with higher all-cause and cardiovascular mortality in the United States adult population, BMC Public Health 23, 900, https://doi.org/10.1186/s12889-023-15621-y; J. K. Montez and J. D. Brooks (2021), Educational attainment and adult health, Handbook of Aging and the Social Sciences, 83-98, https://doi.org/10.1016/B978-0-12-815970-5.00006-1.

48 T. Münzel et al. (2024), Transportation noise pollution and cardiovascular health, Circulation Research 134/9, 1113-1135, https://doi.org/10.1161/CIRCRESAHA.123.323584.

49 M. Sørensen et al. (2024), Health position paper and redox perspectives – disease burden by transportation noise, Redox Biology 69, 102995, https://doi.org/10.1016/j.redox.2023.102995.

50 K. Eminson et al. (2023), Does air pollution confound associations between environmental noise and cardiovascular outcomes? A systematic review, Environmental Research 232, 116075, https://doi.org/10.1016/j.envres.2023.116075.

51 S. Stansfeld et al. (2005), Aircraft and road traffic noise and children's cognition and health: a cross-national study, The Lancet 365/9475, 1942-1949, https://doi.org/10.1016/S0140-6736(05)66660-3.

52 Sustainable Mobility for All (2023), Global Mobility Report 2022: Tracking Sector Performance, https://www.sum4all.org/data/files/global_mobility_report_2022_04052023_final.pdf.

53 European Environment Agency(2024), Exposure of Europe's population to environmental noise, https://www.eea.europa.eu/en/analysis/indicators/exposure-of-europe-population-to-noise.

54 L.N.A. Sackey et al. (2024), Assessment of noise levels and perceptions of its health impact at Kejetia Market in Ghana, The Scientific World Journal, https://onlinelibrary.wiley.com/doi/10.1155/2024/7658837; F. Osei and E. Effah (2022), Health effects caused by noise – the case of Africa: evidence in literature from the past 25 years, Asian Journal of Advanced Research and Reports, 19-27, https://hal.science/hal-04162275/document.

55 European Commission Joint Research Centre (JRC) and International Energy Agency (IEA) (2024), EDGAR Community GHG Database, and comprising IEA-EDGAR CO2, EDGAR CH4, EDGAR N2O, EDGAR F-GASES version EDGAR_2024_GHG, https://edgar.jrc.ec.europa.eu/dataset_ghg2024.

56 Ibid.

57 Ibid.

58 M. Romanello (2024), The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action, The Lancet 404/10465, 1847-1896, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(24)01822-1/fulltext.

59 Ibid.

60 L. Bilgili (2023), Operational greenhouse gas emissions of air, rail, road, and sea transport modes in life cycle perspective, in S.K. Sharma et al., eds., Transportation Energy and Dynamics. Energy, Environment, and Sustainability, https://doi.org/10.1007/978-981-99-2150-8_14.

61 T. Ramani et al. (2019), Air quality and health impacts of freight modal shifts: review and assessment, Transportation Research Record: Journal of the Transportation Research Board 2673, 153-164, https://doi.org/10.1177/0361198119834008.

62 H. Ritchie (2023), Which form of transport has the smallest carbon footprint? Our World in Data, https://ourworldindata.org/travel-carbon-footprint; IEA (2019), Energy intensity of passenger transport modes, https://www.iea.org/data-and-statistics/charts/energy-intensity-of-passenger-transport-modes-2018; European Environment Agency (nd), Indicator 20: Energy and CO2 intensity, https://www.eea.europa.eu/en/analysis/publications/envissueno12/page027.html;

63 B. Appleyard and D. Appleyard (2021), Livable streets 2.0, https://www.inspectioncopy.elsevier.com/book/details/9780128160282.

64 P.R. Anciaes (2015), What do we mean by "community severance"? UCL Street Mobility Project, https://www.ucl.ac.uk/iehc/research/epidemiology-public-health/research/hssrg/studies/street-mobility/publications.

65 L. Foley et al. (2017), Effects of living near an urban motorway on the wellbeing of local residents in deprived areas: natural experimental study, PLOS One 12/4, e0174882, https://doi.org/10.1371/journal.pone.0174882.

66 P. R. Anciaes et al. (2019), Perceptions of road traffic conditions along with their reported impacts on walking are associated with wellbeing, Travel Behaviour and Society 15, 88-101, https://doi.org/10.1016/j.tbs.2019.01.006.

67 P. Anciaes and A. Bradbury (2022), Community severance in urban Africa, in R.A. Acheampong et al., eds., Transport and Mobility Futures in Urban Africa, 111-127, https://doi.org/10.1007/978-3-031-17327-1_8.

68 Ibid.

69 P.R. Anciaes et al. (2022), The cost of the wider impacts of road traffic on local communities: 1.6% of Great Britain's GDP, Transportation Research Part A: Policy and Practice 163, 266-87, https://doi.org/10.1016/j.tra.2022.05.016.

70 S.L. Amosun et al. (2007), Are elderly pedestrians allowed enough time at pedestrian crossings in Cape Town, South Africa? Physiotherapy Theory and Practice 23/6, 325-332, https://doi.org/10.1080/09593980701593755; L. Asher et al. (2012), Most older pedestrians are unable to cross the road in time: a cross-sectional study, Age and Ageing 41/5, 690-694, https://doi.org/10.1093/ageing/afs076; E. Duim, M.L. Lebrão and J.L.F. Antunes (2017), Walking speed of older people and pedestrian crossing time, Walking and Walkability: A review of the Evidence on Health 5, 70-76, https://doi.org/10.1016/j.jth.2017.02.001; R. Romero-Ortuno et al. (2010), Do older pedestrians have enough time to cross roads in Dublin? A critique of the Traffic Management Guidelines based on clinical research findings, Age and Ageing 39/1, 80-86, https://doi.org/10.1093/ageing/afp206.

71 S.E. Jackson et al (2019), Social isolation and physical activity mediate associations between free bus travel and wellbeing among older adults in England, Journal of Transport & Health 13, 274-284, https://doi.org/10.1016/j.jth.2019.03.006.

72 R. Vaishya and A. Vaish (2020), Falls in older adults are serious, Indian Journal of Orthopaedics 54/1, 69-74, https://doi.org/10.1007/s43465-019-00037-x.

73 R. Whitley and M. Prince (2005), Fear of crime, mobility and mental health in inner-city London, UK, Social Science & Medicine 61/8, 1678-1688, https://doi.org/10.1016/j.socscimed.2005.03.044.

74 L. Sagaris and L. Baker (2024), New challenges arise from consolidation of gender, health and transport research, Journal of Transport & Health 39, 101902, https://doi.org/10.1016/j.jth.2024.101902.

75 K. Primc et al. (2025), Transport poverty vulnerability index: Making use of standardised databases, Energy Research & Social Science, Volume 123, https://doi.org/10.1016/j.erss.2025.104041.

76 L. Pearson et al. (2022), Adults' self-reported barriers and enablers to riding a bike for transport: a systematic review, Transport Reviews 43/2, 1-29, https://doi.org/10.1080/01441647.2022.2113570.

77 Ibid.

78 K. Clifton and C.D. Muhs (2012), Capturing and representing multimodal trips in travel surveys, Transportation Research Record: Journal of the Transportation Research Board 2285, 74-83, https://doi.org/10.3141/2285-09.

79 UN Women (2024), Progress on the Sustainable Development Goals, The Gender Snapshot 2024, https://www.unwomen.org/sites/default/files/2024-09/progress-on-the-sustainable-development-goals-the-gender-snapshot-2024-en.pdf.

80 Ibid.

81 J. Walker et al. (2022), Walking and Cycling in Africa: Evidence and good practice to inspire action, United Nations Environment Programme (UNEP) and UN-Habitat, https://www.unep.org/resources/report/walking-and-cycling-africa-evidence-and-good-practice-inspire-action.

82 Ibid.

83 H. Nadrian et al. (2020), Public health impacts of urban traffic jam in Sanandaj, Iran: a case study with mixed-method design, Journal of Transport & Health 19, https://doi.org/10.1016/j.jth.2020.100923.

84 K. Zhang and S. Batterman (2013), Air pollution and health risks due to vehicle traffic, Science of the Total Environment 450-451, 307-316, https://doi.org/10.1016/j.scitotenv.2013.01.074.

85 D.C. Melbye et al. (2015), Accessibility, congestion and travel delays in Dar es Salaam – a time–distance perspective, Habitat International 46, 178-186, https://doi.org/10.1016/j.habitatint.2014.12.004.

86 J. Euchi and A. Kallel (2021), Internalization of external congestion and CO2emissions costs related to road transport: the case of Tunisia, Renewable and Sustainable Energy Reviews 142, 110858, https://doi.org/10.1016/j.rser.2021.110858.

87 Ibid.

88 K. Zhang and S. Batterman (2013), Air pollution and health risks due to vehicle traffic, Science of the Total Environment 450-451, 307-316, https://doi.org/10.1016/j.scitotenv.2013.01.074.

89 P. Anciaes, Y. Cheng and S.J. Watkins (2025), Policy measures to reduce road congestion: What worked? Journal of Transport & Health 41, 101984, https://doi.org/10.1016/j.jth.2025.101984.

90 Ibid.

91 INRIX (2025), INRIX Global Traffic Scorecard, https://www2.inrix.com/l/171932/2025-01-02/71rhrd/171932/1735857445DSlvhZjd/INRIX_2024_Global_Traffic_Scorecard.pdf.

92 WHO (2025), The synergies of heat stress and air pollution and their health impacts: technical brief, https://www.who.int/publications/i/item/B09369.

93 Health Effects Institute (2024), State of Global Air Report 2024, https://www.stateofglobalair.org/resources/report/state-global-air-report-2024; J. Lelieveld et al. (2023), Air pollution deaths attributable to fossil fuels: observational and modelling study, BMJ 383, https://doi.org/10.1136/bmj-2023-077784.

94 E.E. McDuffie et al. (2021), Fine particulate matter and global health: fuel and sector contributions to ambient PM2.5 and its disease burden across multiple scales, Nature Communications, http://dx.doi.org/10.1038/s41467-021-23853-y.

95 Health Effects Institute (2024), State of Global Air Report 2024, https://www.stateofglobalair.org/resources/report/state-global-air-report-2024; J. Lelieveld et al. (2023), Air pollution deaths attributable to fossil fuels: observational and modelling study, BMJ 383, https://doi.org/10.1136/bmj-2023-077784.

96 E.E. McDuffie et al. (2021), Fine particulate matter and global health: fuel and sector contributions to ambient PM2.5 and its disease burden across multiple scales, Nature Communications, http://dx.doi.org/10.1038/s41467-021-23853-y.

97 N. Brusselaers, C. Macharis and K. Mommens (2023), The health impact of freight transport-related air pollution on vulnerable population groups, Environmental Pollution 329, 121555, https://doi.org/10.1016/j.envpol.2023.121555.

98 M.V. Corazza, P. Di Mascio and G. Esposito (2022), Airports as sensitive areas to mitigate air pollution: evidence from a case study in Rome, Environments 9, 108, https://doi.org/10.3390/environments9090108.

99 Royal College of Paediatrics and Child Health (2016), Every breath we take: the lifelong impact of air pollution: report of a working party, Royal College of Physicians of London, https://www.rcp.ac.uk/improving-care/resources/every-breath-we-take-the-lifelong-impact-of-air-pollution.

100 Ibid.

101 Ibid.

102 Ibid.

103 BBC (2020), Ella Adoo-Kissi-Debrah: Air pollution a factor in girl's death, inquest finds, https://www.bbc.co.uk/news/uk-england-london-55330945.

104 F. Bernardi and R. Conte Keivabu (2024), Poor air quality at school and educational inequality by family socioeconomic status in Italy, Research in Social Stratification and Mobility 91, 100932, https://doi.org/10.1016/j.rssm.2024.100932; S. Chung et al. (2025), The Effects of Daily Air Pollution on Students and Teachers, https://conference.iza.org/IZA_Climate_2025/chung_s36059.pdf.

105 J. Rentschler and N. Leonova (2023), Global air pollution exposure and poverty, Nature Communications 14, 4432, https://doi.org/10.1038/s41467-023-39797-4.

106 Ibid.

107 J. Walker et al. (2022), Walking and Cycling in Africa – Evidence and good practice to inspire action, UNEP and UN-Habitat, https://www.unep.org/resources/report/walking-and-cycling-africa-evidence-and-good-practice-inspire-action.

108 S.J. Herath Bandara and N. Thilakarathne (2025), Economic and public health impacts of transportation-driven air pollution in South Asia, Sustainability 17, 2306, https://doi.org/10.3390/su17052306.

109 Ibid.

110 M. Tainio et al. (2016), Can air pollution negate the health benefits of cycling and walking? Preventive Medicine 87, 233-236, https://doi.org/10.1016/j.ypmed.2016.02.002.

111 P. MacNaughton et al. (2014), Impact of bicycle route type on exposure to traffic-related air pollution. Science of the Total Environment 490, 37-43, https://doi.org/10.1016/j.scitotenv.2014.04.111.

112 I. Järlskog et al., (2021), Traffic-related microplastic particles, metals, and organic pollutants in an urban area under reconstruction, Science of The Total Environment, Volume 774, https://doi.org/10.1016/j.scitotenv.2021.145503. ; S. Smethurst (2024), Road runoff is a 'toxic cocktail' polluting UK waterways, Chartered Institute of of Environmental Health, https://www.cieh.org/ehn/environmental-protection/2024/july/road-runoff-is-a-toxic-cocktail-polluting-uk-waterways/; Final Straw Foundation (2025), Highway Runoff: An Overlooked Environmental Threat, https://finalstrawfoundation.org/highway-runoff-an-overlooked-environmental-threat/

113 US Environmental Protection Agency (2025), What Are Heat Islands? https://www.epa.gov/heatislands/what-are-heat-islands, accessed June 2025.

114 K. Huang et al. (2025), Declining urban density attenuates rising population exposure to surface heat extremes, Scientific Reports 15, 13860, https://doi.org/10.1038/s41598-025-96045-z.

115 Ibid.

116 M. Matias et al. (2025), The underestimated impact of parked cars in urban warming, City and Environment Interactions 28, https://doi.org/10.1016/j.cacint.2025.100232.

117 D.P. Lakhoo et al. (2025), A systematic review and meta-analysis of heat exposure impacts on maternal, fetal and neonatal health, Nature Medicine 31, 684-694, https://doi.org/10.1038/s41591-024-03395-8.

118 WHO (2024), Obesity and overweight (fact sheets), https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.

119 A. Martin et al. (2015), Impact of changes in mode of travel to work on changes in body mass index: evidence from the British Household Panel Survey, Journal of Epidemiology and Community Health 69/8, 753, https://doi.org/10.1136/jech-2014-205211; T. Sugiyama, D. Ding and N. Owen (2013), Commuting by car: weight gain among physically active adults, American Journal of Preventive Medicine 44/2, 169-173, https://doi.org/10.1016/j.amepre.2012.09.063.

120 A. Martin et al. (2015), Impact of changes in mode of travel to work on changes in body mass index: evidence from the British Household Panel Survey, Journal of Epidemiology and Community Health 69/8, 753, https://doi.org/10.1136/jech-2014-205211.

121 **Figure 4** from World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

122 World Health Organization (WHO) (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

123 Ibid.

124 WHO (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

125 Ibid.

126 Ibid.

127 P. Anciaes and A. Bradbury (2022), Community severance in urban Africa, in R.A. Acheampong et al., eds., Transport and Mobility Futures in Urban Africa, 111-127, https://doi.org/10.1007/978-3-031-17327-1_8.

128 M. Chatukuta et al. (2021), An analysis on the risk of being injured and killed in road travel injuries in Namibia, International Journal of Injury Control and Safety Promotion 28/2, 185-193, https://doi.org/10.1080/17457300.2021.1894180; A. Sukhai, R. Govender and A. Van Niekerk (2021), Fatality risk and issues of inequity among vulnerable road users in South Africa, PLOS One 16, e0261182, https://doi.org/10.1371/journal.pone.0261182.

129 P. Pokorny et al., (2017), Accidents between freight vehicles and bicycles, with a focus on urban areas, Transportation Research Procedia, Volume 25,Pages 999-1007,https://doi.org/10.1016/j.trpro.2017.05.474.

130 International Road Assessment Programme (iRAP) (2025), iRAP Safety Insights Explorer, https://irap.org/safety-insights-explorer.

131 International Road Assessment Programme (iRAP) (2025), iRAP Safety Insights Explorer, https://irap.org/safety-insights-explorer; Institute for Health Metrics and Evaluation(IHME) (2024), Global Burden of Disease 2021: Findings from the GBD 2021 Study, , https://www.healthdata.org/research-analysis/library/global-burden-disease-2021-findings-gbd-2021-study.

132 iRAP (2025), iRAP Safety Insights Explorer, https://irap.org/safety-insights-explorer.

133 **Figure 5** from Ibid.

134 Ibid.

135 M. Chatukuta et al. (2021), An analysis on the risk of being injured and killed in road travel injuries in Namibia, International Journal of Injury Control and Safety Promotion 28/2, 185-193, https://doi.org/10.1080/17457300.2021.1894180; M. Chatukuta et al. (2021), Road traffic injuries in Namibia: health services, public health and the motor vehicle accident fund, International Journal of Injury Control and Safety Promotion 28/2, 167-178, https://doi.org/10.1080/17457300.2021.1879870.

136 WHO (2023), Global Status Report on Road Safety 2023, https://www.who.int/publications/i/item/9789240086517.

137 Ibid.

138 Ibid.

139 Ibid.

140 Ibid.

141 A. Lwanga, H.H. Mwanga, and E.J. Mrema (2022), Prevalence and risk factors for non-collision injuries among bus commuters in Dar es Salaam, Tanzania, BMC Public Health, 22, 963, https://doi.org/10.1186/s12889-022-13284-9 ; W. Yeung et. al., (2025), The burden of injuries associated with accidents involving passengers carried in open bed pickup trucks - a review of 371 patients managed in a major trauma centre in South Africa, *European Journal of Trauma and Emergency Surgery,* 51:188, https://doi.org/10.1007/s00068-025-02857-z

142 B. Giles-Corti et al. (2022), What next? Expanding our view of city planning and global health, and implementing and monitoring evidence-informed policy, Lancet Global Health, https://doi.org/10.1016/S2214-109X(22)00066-3.

143 D. Kasraian et al. (2024), Health in mobility planning: an assessment of how health is considered in Sustainable Urban Mobility Plans, Journal of Transport & Health 39, 101919, https://doi.org/10.1016/j.jth.2024.101919.

144 J. Hosking et al. (2022), Towards a global framework for transport, health and health equity, Environment International 169, 107472, https://doi.org/10.1016/j.envint.2022.107472.

145 B. van Wee (2009), Transport Policy: What It Can and What It Can't Do? European Transport Conference, Association for European Transport, https://aetransport.org/public/downloads/JjcOU/4183-514ec5ce6cdc9.pdf.

146 D. S. Morrison, M. Petticrew and H. Thomson (2003), What are the most effective ways of improving population health through transport interventions? Evidence from systematic reviews, Journal of Epidemiology & Community Health 57/5, 327-333, https://doi.org/10.1136/jech.57.5.327.

147 WHO (2022), Environmental noise, in Compendium of WHO and other UN guidance on health and environment, 2022 update, https://iris.who.int/bitstream/handle/10665/352844/WHO-HEP-ECH-EHD-22.01-eng.pdf.

148 C. Moreno et al. (2021), Introducing the "15-minute city": sustainability, resilience and place identity in future post-pandemic cities, Smart Cities 4/1, 93-111, https://doi.org/10.3390/SMARTCITIES4010006.

149 M. Kärmeniemi et al. (2018), The built environment as a determinant of physical activity: a systematic review of longitudinal studies and natural experiments, Annals of Behavioral Medicine 52/3, 239-251, https://doi.org/10.1093/ABM/KAX043.

150 E. Graham-Rowe et al. (2011), Can we reduce car use and, if so, how? A review of available evidence, Transportation Research Part A: Policy and Practice 45/5, 401-418, https://doi.org/10.1016/J.TRA.2011.02.001.

151 I. Belloc, J.I. Gimenez-Nadal and J.A. Molina (2024), The gasoline price and the commuting behavior of US commuters: exploring changes to green travel mode choices, Journal of Transport Geography 121, https://doi.org/10.1016/j.jtrangeo.2024.104006.

152 J.S. Mindell (2015), Active travel is (generally) good for health, the environment and the economy, Journal of Transport & Health 2/4, 447-448, https://doi.org/10.1016/j.jth.2015.10.006.

153 S. Eggimann (2022), Expanding urban green space with superblocks, Land Use Policy 117, 106111, https://doi.org/10.1016/j.landusepol.2022.106111.

154 D. Boffey (2020), Utrecht restores historic canal made into motorway in 1970s, https://www.theguardian.com/world/2020/sep/14/utrecht-restores-historic-canal-made-into-motorway-in-1970s

155 M. Lowe et al. (2022), City planning policies to support health and sustainability: an international comparison of policy indicators for 25 cities, The Lancet Global Health 10/6, e882-e894, https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(22)00069-9/fulltext.

156 L. Sagaris and D. Lanfranco (2019), Beyond "safe": Chilean "Kool" routes to school address social determinants of health, Journal of Transport & Health 15, 100665, https://doi.org/10.1016/j.jth.2019.100665.

157 S. Lucchesi (2025), Harnessing youth engagement and big data for road safety: insights from the AI&Me project in Vietnam, Cities & Health (in press).

158 E. Roaf, H. Larrington-Spencer and E.R. Lawlor (2024), Interventions to increase active travel: a systematic review, Journal of Transport & Health 38, 101860, https://doi.org/10.1016/j.jth.2024.101860.

159 M. Winters, R. Buehler and T. Götschi (2017), Policies to promote active travel: evidence from reviews of the literature, Current Environmental Health Reports 4, 278-285, https://doi.org/10.1007/s40572-017-0148-x.

160 J. Pucher, J. Dill and S. Handy (2010), Infrastructure, programs, and policies to increase bicycling: an international review, Preventive Medicine 50, S106-S125, https://doi.org/10.1016/j.ypmed.2009.07.028.

161 R. Aldred, A. Goodman and J. Woodcock (2024), Impacts of active travel interventions on travel behaviour and health: results from a five-year longitudinal travel survey in Outer London, Journal of Transport & Health 35, 101771, https://doi.org/10.1016/j.jth.2024.101771.

162 R. Frost (2024), Cycling is now more popular than driving in the centre of Paris, study finds, Euro News, https://www.euronews.com/green/2024/04/12/cycling-is-now-more-popular-than-driving-in-the-centre-of-paris-study-finds.

163 Partnership for Active Travel and Health (PATH) (2025), Safer Active Travel: Addressing a Global Blind Spot, FIA Foundation, https://pathforwalkingcycling.com/wp-content/uploads/PATH-SAFER-ACTIVE-TRAVEL-Addressing-a-Global-Blind-Spot.pdf.

164 D. Pulido and V. Raffo (2022), Saving Lives Through Private Investment in Road Safety, World Bank, http://documents1.worldbank.org/curated/en/099525002222214332/pdf/P1750030e6c58506b08d5b05ccba3311628.pdf; R. McInerney et al. (2024), Innovative results-based financing platforms for infrastructure and road safety investment, IRF World Road Congress 2024; FIA Foundation (2016), Investing to Save Lives: An Impact Investment Case for Preventing Road Trauma, https://www.fiafoundation.org/media/1dgbzm5r/investing-to-save-lives-lr-spreads.pdf.

165 Global Road Safety Facility (2025), Financing Road Safety: Catalyzing the Sustainable Finance Market to Bridge the Gap, World Bank, https://www.globalroadsafetyfacility.org/publications/financing-road-safety-catalyzing-sustainable-finance-market-bridge-gap.

166 S. Kahlmeier et al. (2023), The Health Economic Assessment Tool (HEAT) for walking and cycling-experiences from 10 years of application of a health impact assessment tool in policy and practice, Frontiers in Sports and Active Living 5, https://doi.org/10.3389/FSPOR.2023.1146761.

167 D. Kasraian et al. (2023), Prioritising Health in Mobility Planning: Assessing Health and Co-benefits in European Sustainable Urban Mobility Plans, European Public Health Alliance, https://epha.org/wp-content/uploads/2023/12/gph_urban-mobility-sumps.pdf.

168 World Health Organisation (2020), Decade of Action for Road Safety 2021-2030, https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030.

169 Ibid.

170 WHO (2025), Fourth Global Ministerial Conference on Road Safety: https://www.who.int/news-room/events/detail/2025/02/18/default-calendar/fourth-global-ministerial-conference-on-road-safety

171 WHO (2025), Marrakech Declaration Fourth Ministerial Conference on Road Safety: One World, One Road, Commit to Life, Marrakech, 18-20 February 2025, https://www.who.int/news/item/19-02-2025-global-leaders-make-new-road-safety-commitments--endorse-new-declaration-on-action-to-reduce-road-deaths.

172 M. Chatukuta et al. (2022), Access to rehabilitation services for road traffic injury patients in Namibia, Disability and Rehabilitation 44/25, 7985-7992, https://doi.org/10.1080/09638288.2021.2008521.

173 Movernos Seguros (2025), Motor Insurance for All, https://movernosseguros.org/en.

174 Global Road Safety Facility (2024), Global Road Safety Facility Annual Report 2024, World Bank, https://www.globalroadsafetyfacility.org/sites/default/files/2024-11/GRSF%20Annual%20Report%202024_1.pdf.

175 PATH (2025), Safer Active Travel: Addressing a Global Blind Spot, https://pathforwalkingcycling.com/wp-content/uploads/PATH-SAFER-ACTIVE-TRAVEL-Addressing-a-Global-Blind-Spot.pdf.

176 FIA Foundation (2020), These are our streets. Manifesto 2030: Safe and healthy streets for children, youth and climate, https://www.fiafoundation.org/media/l1slkasy/these-are-our-streets-manifesto-2030-print.pdf.

177 Sustainable Mobility for All (nd), Our Vision, https://www.sum4all.org/priorities.

178 Sustainable Mobility for All (nd), Policy Decision-Making Tool for Sustainable Mobility 3.0, https://www.sum4all.org/online-tool.

179 THSG Science Group (nd), Transport and Health Science Group, www.transportandhealth.org.uk.

180 WHO (2025), Promoting Walking and Cycling: A toolkit of policy options, https://www.who.int/publications/i/item/9789240109902.