Transport and Energy

SLOCAT Partnership on Sustainable, Low Carbon Transport

TRANSPORT, CLIMATE AND SUSTAINABILITY GLOBAL STATUS REPORT

4TH EDITION

MODULE 5

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Transport Energy Sources

KEY FINDINGS

Demand, use and access

- Global energy consumption in the transport sector increased 20.6% between 2010 and 2023, rising from 101 exajoules (EJ) to 122 EJ. The sector's 2023 energy use exceeded pre-pandemic (2019) levels by 2 EJ and signalled a continuation of the consistent, long-term growth trend of recent decades.
- Energy demand from transport rose 4% in 2023, doubling the average annual growth rate of 2010-2023, driven by rising personal mobility in developing economies, global economic expansion, growing freight transport volumes and continued reliance on energy-intensive transport modes despite efficiency improvements in vehicle technologies.
- Transport energy demand is projected to grow 10% between 2023 and 2030. The rise in energy demand poses significant challenges for decarbonisation efforts.
- Disparities in transport energy consumption and growth rates were evident across regions. The Asia-Pacific region led with 38% of total sectoral demand in 2023 and recorded a 7% increase that year, reflecting economic development, urbanisation and an expanding middle class.

- North America remained the second largest consumer, accounting for 29% of transport energy demand in 2023, whereas Europe, ranking third, experienced a slight decline in energy use for transport, due likely to energy efficiency policies, modal shifts and economic factors.
- In Africa, the region with the lowest transport energy use, demand fell 1.6% in 2023, possibly due to economic constraints, fuel price increases and structural transport changes.
- North America led by far in per capita energy demand from transport in 2023, with values 22 times those of Africa and more than twice those of Europe. Between 2010 and 2023, per capita energy demand from transport grew 33% in Asia-Pacific, 17% in Eurasia and 13% in Latin America and the Caribbean.
- Road transport continued to dominate energy consumption in transport, accounting for 75% of demand in 2023. Passenger cars consumed 38% of the total energy used in transport, followed by heavy-duty trucks (22%), aviation (10%) and shipping (9%).
- Aviation's relatively high share of transport energy use, despite its smaller share of total passenger-kilometres, reflects the energy-intensive nature of air travel. The shipping sector is comparatively energy efficient per tonne-kilometre of freight moved.
- The trend towards larger and fuel-intensive sport-utility vehicles (SUVs) contributes greatly to transport's rising energy demand. On average, SUVs consume around 20% more energy per kilometre than medium-sized cars, further increasing the energy intensity of the passenger vehicle fleet.
- SUVs reached a record 48% of global car sales in 2023, reinforcing the shift towards larger and heavier cars and making SUVs the defining automobile trend of the early 21st century across both developing and advanced economies.
- Despite ongoing diversification efforts, fossil oil still supplied 90% of transport energy demand in 2023. This highlights the persistent technological and infrastructure lock-in effects that hinder energy transition efforts in the transport sector.
- In line with trends since 2015, renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport

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in 2023; this underscores the significant challenge of decarbonising the sector.

- Global demand for liquid biofuels reached 175.2 billion litres in 2023, marking a steady increase since 2013 as blending mandates have resulted in increased biofuel use in road transport. Bioethanol remained the dominant biofuel used in transport, followed by biodiesel (fatty acid methyl ester, or FAME) and a growing share of renewable diesel.
- In 2024, more than 58 million electric cars were on the world's roads, representing 4.5% of the global car fleet.
- Sales of electric vehicles (including battery electric and plug-in hybrids) grew 25% to reach 17.5 million units, accounting for more than a fifth (21.7%) of all passenger car sales that year. However, this was not enough to counterbalance the energy demand from ICE vehicles. Electric vehicle sales growth was slower than in 2022 (60%) and 2023 (34%).
- Meanwhile, electric bus sales increased 30% in 2024, reaching a total fleet of 730,000 units. Electric medium- and heavy-duty truck sales surged nearly 80% in 2024 to approach 2% of the total truck market.
- In maritime transport, battery-electric shipping corridors began to take shape, although they were largely limited to short sea routes in Northern Europe. In aviation, early innovation included the successful test flight of a 4-tonne civil electric aircraft, developed in collaboration with battery manufacturer CATL, marking a notable step in electrifying short-haul aviation.
- Overall, renewable energy sources – mainly wind and solar power – supplied nearly one-third (32%) of the world's electricity in 2024. A renewable electricity supply is critical for ensuring that transport electrification contributes meaningfully to emission reductions.
- However, advancements in renewable electricity and electric vehicles alone are insufficient to fully decarbonise the transport sector, as aviation and shipping respectively contributed around 11% of transport greenhouse gas emissions in 2023.
- Sustainable aviation fuel (SAF) production doubled in 2024 to reach 1 million tonnes (1.3 billion litres). Despite this growth, SAF represented only 0.3% of global jet fuel production and 11% of total renewable fuel.
- In 2025, the International Maritime Organization (IMO) approved its Net-Zero Framework, combining mandatory emission limits and greenhouse gas pricing. Low- and middle-income countries – despite strong renewable energy potential – face persistent financing gaps, underscoring the need for targeted international support to scale up green shipping supply chains.

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Sustainability and climate trends

- Transport is now the second-largest and fastest-growing contributor to global greenhouse gas emissions. In 2023, the sector was responsible for 21.9% of carbon dioxide (CO_2) emissions.
- Air pollution caused an estimated 8.1 million deaths globally in 2021 (including 700,000 deaths among children under five years), with 61% of these fatalities linked to fossil fuel combustion.
- Scaling up public transport, walking and cycling – which are more energy-efficient than private vehicles – can support a reduction in transport energy demand, as well as in related emissions from road transport.
- A shift towards renewable energy in transport offers a critical pathway to reduce emissions and improve health outcomes. By 2028, biofuels and renewable electricity are projected to cut oil demand from transport by nearly 4 million barrels per day (or more than 7% of the forecasted transport oil demand).
- Electrification across all modes is transforming the transport landscape; however, energy access and affordability challenges remain significant barriers to scaling up electric vehicle adoption. Although 91.6% of the global population had access to electricity as of 2023, at least 1.18 billion people remained "energy poor", lacking basic electricity access. Price volatility and regional differences in electricity costs create barriers for electric vehicle charging.
- More than 1.3 million public electric vehicle charging points were added to the global stock in 2024 (mostly in Asia and Europe), expanding the infrastructure needed for electric vehicle adoption. Although essential, this growth places additional strain on power grids and increases uncertainty in electricity demand.
- An estimated USD 6.9 trillion is required annually by 2030 to expand and stabilise grids and electric vehicle charging infrastructure, and to build their resilience.
- The transition to low-carbon transport creates new jobs, and global employment in the renewable energy sector reached a record 16.2 million jobs in 2023. However, education and reskilling are needed to address the requirements of a shifting workforce and to ensure a just transition.

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Policy and investment developments

- The transport sector plays an essential role in meeting international climate and energy targets. However, policies and climate commitments that support the uptake of renewables in transport have fallen short of the pace needed to drive meaningful change.
- At the 2023 United Nations Climate Change Conference in Dubai, United Arab Emirates (COP 28), governments agreed to triple global renewable energy capacity and double energy efficiency improvements by 2030. For the transport sector, comparable ambition and measures remain limited, highlighting a gap between high-level energy targets and sectoral implementation.
- As of 1 August 2025, a total of 26 of the 29 submitted third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement included mitigation measures or adaptation actions related to transport. However, many of these intended transport actions lack coherence with broader renewable energy objectives, limiting their transformative potential.
- In the Long-Term Low Emission Development Strategies (LT-LEDS) submitted by countries under the Paris Agreement in the first half of 2025, countries highlight the key roles of both the transport and energy sectors; however, they provide little to no detail on how renewables are integrated into the transport sector.
- Of the 31 countries with a carbon tax in 2024, 22 targeted the transport sector with this tax. Of the 44 countries that had an emissions trading system (ETS) in 2024, 36 countries had one that covered transport emissions.
- By 2024, a total of 13 countries had established or proposed fuel efficiency or greenhouse gas emission standards for passenger vehicles or light commercial vehicles and trucks. Although these regulations lacked global reach, they applied to more than 85% of all passenger vehicle sales, guiding the strategic decisions of major vehicle manufacturers worldwide.
- Most standards apply only to light-duty vehicles, but in 2024 the EU introduced the world's first heavy-duty vehicle standard, with a mandatory target to reduce CO_2 emissions from new trucks 90% by 2040.
- Jurisdictions that had enacted targets for both passenger vehicles and light commercial vehicles as of 2024 included Australia, Canada, China, Chile, the EU, Mexico, New Zealand, the Republic of Korea, the United Kingdom, and the United States, while Japan enacted a passenger car target of 106 grams of CO_2 per kilometre by 2030. Three jurisdictions had targets for 2035, including Canada, the United Kingdom, and the EU, and only the EU had a target for 100% zero-emission passenger cars and light commercial vehicles by 2035.
- In 2025, the Euro 7 emission standard came into force, combining regulations for light- and heavy-duty vehicles in a single regulation. From 2025, all European manufacturers must comply with fleet-wide average CO_2 emissions and reduce the emissions of new trucks by 15% by 2025 and 45% by 2030. However, some jurisdictions including the EU have scaled back or delayed their fuel efficiency plans and emission standards, and very few governments worldwide have enacted their announced bans on sales of ICE vehicles.
- In certain regions and sectors, such as aviation, efficiency improvements have stalled due to a lack of sufficiently strong standards.
- In recent years, several countries have strengthened or introduced vehicle efficiency labelling schemes, which have become a growing practice globally; meanwhile, the EU plans a 2026 review to boost the uptake of zero-emission vehicles.
- Pollutant emission standards are crucial to address the health impacts of poor air quality, especially in urban areas, but the stringency of such measures needs to be increased.
- Although 89 countries had economy-wide renewable energy targets in place as of 2024, only 23 countries had new or revised renewable energy targets for the transport sector. Targets for 2030 range from 13.4% in Greece, to 14% in Estonia and Hungary, to 40% in China and Iceland. All the countries that adopted new renewable targets for transport in 2024 were EU Member States.
- As of 2024, 20 countries had in place biofuel blending mandates, with growing emphasis on stricter sustainability criteria. Countries that have enacted new or updated biofuel blending mandates since 2023 are Belgium, Brazil, Indonesia, Japan, Nigeria, the Philippines and Poland.
- In 2024, seven jurisdictions – China, the EU, India, the Republic of Korea, Malaysia, Singapore and Thailand – announced new targets for the production or use of SAF.

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- As of 2024, 68 countries had in place electric vehicle targets, reflecting a growing prioritisation of electric vehicle adoption and zero-emission transport as part of climate and energy strategies. However, electric vehicle targets alone do not necessarily lead to increased renewable energy use unless they are coupled with specific mandates or bans on ICE vehicles, as well as efforts to boost the overall share of renewables in a country's electricity mix.

- Although global ambitions for electric vehicle adoption have increased, trade tensions have grown as major export markets apply tariffs to protect domestic industries. Geopolitical tensions, regional conflicts, energy security concerns and continued fossil fuel subsidies risk delaying progress on electric vehicle and renewable energy uptake and climate action in the transport sector.

- Beyond electricity and biofuels, advancements in other alternative fuels included initiatives to promote hydrogen-powered transport. However, persistent challenges such as high production costs, limited infrastructure and regulatory uncertainties have hindered widespread adoption.

Context, challenges and opportunities

Energy consumption in the global transport sector has rebounded from the impacts of the COVID-19 pandemic and continued to grow steadily, increasing more than 20% between 2010 and 2023 to surpass pre-pandemic levels.[1] This growth, driven by rising personal mobility, freight transport, and economic activity, was especially pronounced in the Asia-Pacific region, whereas Europe and Africa experienced declines in transport energy use due to efficiency improvements and structural shifts.[2]

Road transport remained the dominant energy consumer in the transport sector in 2023, accounting for three-quarters of transport's total energy demand and for 74% of its greenhouse gas emissions.[3] Fossil fuels still supplied 90% of transport energy, despite rising electrification.[4] Electric vehicle sales surged to nearly 22% of global passenger car sales in 2024; however, internal combustion engine (ICE) vehicles and large, fuel-intensive sport utility vehicles (SUVs) contributed to rising energy demand.[5] Aviation's final energy consumption in 2023 totalled 13 exajoules, while fuel consumption in maritime transport grew 4% in 2024, propelled by rerouting due to the Red Sea crisis.[6] Aviation and shipping emissions continued to increase, with sustainable fuels only in the early stages of adoption.

As the transport sector's environmental impact continues to grow, air pollution from vehicle emissions has contributed to millions of premature deaths annually. Transitioning to renewable energy sources in transport offers critical climate and health benefits, with biofuels and renewable electricity projected to reduce oil demand substantially by 2028.[7] Achieving this reduction will require substantial investments in energy infrastructure as well as addressing inequities in energy access and affordability.

Although transport is increasingly recognised in climate frameworks, most policies do not adequately support the uptake of renewables, limiting the potential for synergies in the transformation of the transport and energy sectors. Energy efficiency and emission standards for transport reflect ambitions but remain concentrated in a few countries. As more jurisdictions implement such standards, this sends signals to vehicle manufacturers and enables them to follow a timeline towards zero-emission vehicles. However, geopolitical tensions, fossil fuel subsidies and regional conflicts have hampered progress and even led to setbacks. Co-ordinated policy action and investment are essential to accelerate the transition to low-carbon transport through renewable electrification, clean fuels and integrated renewable energy solutions.

By 2024, 89 countries had economy-wide targets for renewable energy, but only 23 had sector-specific renewable targets for transport, and 20 had biofuel blending mandates, with a rising emphasis on sustainability criteria.[8] Both Brazil and Indonesia have increased biofuel blending mandates in recent years. However, large-scale biofuel production can raise concerns about land use, food prices, and biodiversity, highlighting the need for careful policy and investment choices. Sustainable biofuels are expected to play a key transitional role in transport sectors less suited to direct electrification, such as long-distance aviation and shipping, and in heavy-duty road transport where electric vehicle charging infrastructure remains limited. Sectors long-considered "hard to abate", such as heavy-duty trucks and aviation, are exploring new energy solutions through legislation (Euro 7) and other frameworks (such as targets for sustainable aviation fuels).

Demand, use and access

Global energy consumption in the transport sector increased 20.6% between 2010 and 2023, rising from 101 exajoules (EJ) to 122 EJ.[9] The sector's 2023 energy use exceeded pre-pandemic (2019) levels by 2 EJ and signalled a continuation of the consistent, long-term growth trend of recent decades.[10]

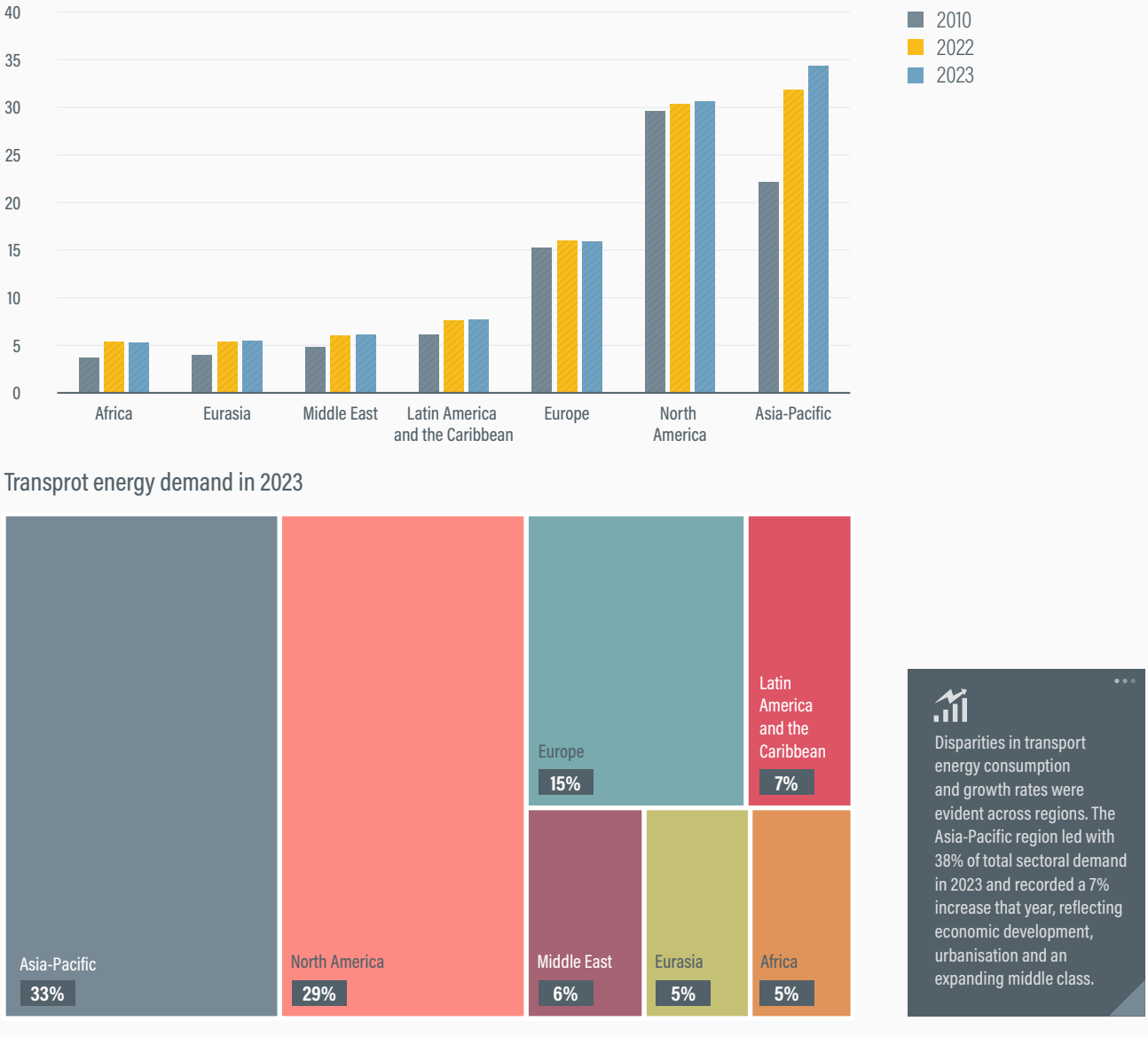
Energy demand from transport rose 4% in 2023, doubling the average annual growth rate of 2010-2023, driven by rising personal mobility in developing economies, global economic expansion, growing freight transport volumes and continued reliance on energy-intensive transport modes despite efficiency improvements in vehicle technologies.[11] Transport energy demand is projected to

grow 10% between 2023 and 2030.[12] The rise in energy demand poses significant challenges for decarbonisation efforts.

Disparities in transport energy consumption and growth rates were evident across regions (Figure 1).[13] The Asia-Pacific region led with 38% of total sectoral demand in 2023 and recorded a 7% increase that year, reflecting economic development, urbanisation and an expanding middle class.[14]

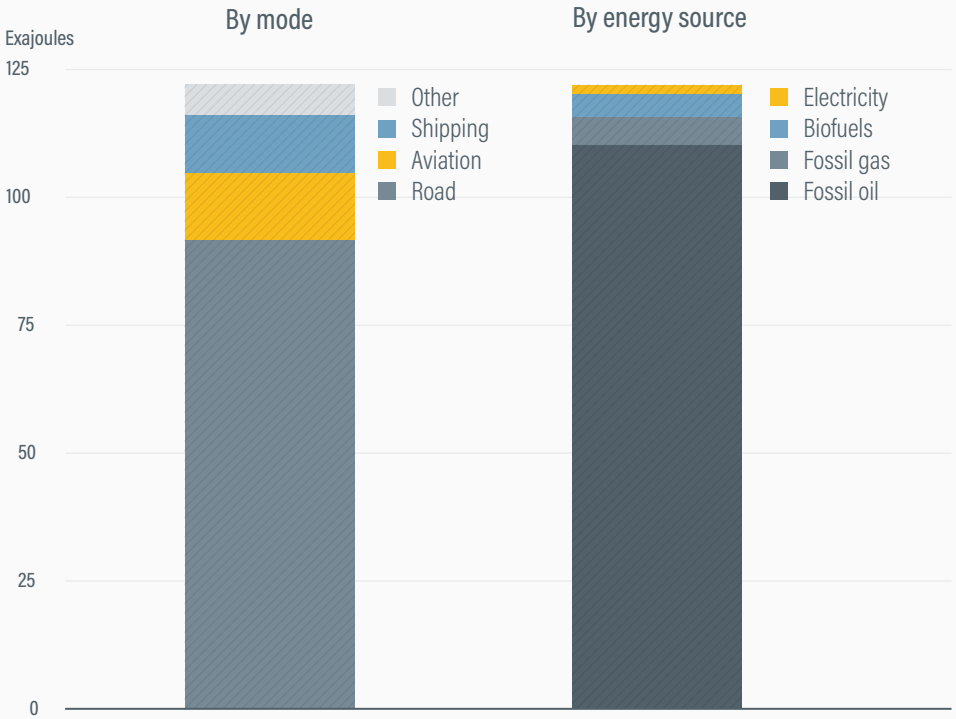
- North America remained the second largest consumer, accounting for 29% of transport energy demand in 2023, whereas Europe, ranking third, experienced a slight decline in energy use for transport, due likely to energy efficiency policies, modal shifts and economic factors.[15]
- In Africa, the region with the lowest transport energy use, demand fell 1.6% in 2023, possibly due to economic constraints, fuel price increases and structural transport changes.[16] The fuel price increases are likely linked to higher import costs, triggering unaffordability and inflation.[17]

FIGURE 1. Energy demand in transport by region, 2010, 2022 and 2023



Source: See endnote 13 for this section.

FIGURE 2. Energy demand in transport by sector and source, 2023



Road transport continued to dominate energy consumption in transport, accounting for 75% of demand in 2023. Passenger cars represented 38% of total energy consumption in transport, heavy-duty trucks 22%, aviation 10%, and shipping 9% reflecting the energy-intensive nature of air travel despite its smaller share of total passenger kilometres seasoned revenue passenger kilometres reaching around 700 revenue billions passenger kilometer for aviation and shipping's notable energy efficiency in per tonne-kilometre of freight moved.

Source: See endnote 21 for this section.

- Eurasia, Latin America and the Caribbean, and North America all saw moderate growth in energy for transport use of 1-2% in 2023.[18]

North America led by far in per capita energy demand from transport in 2023, with values 22 times those of Africa and more than twice those of Europe.[19] Between 2010 and 2023, per capita energy demand from transport grew 33% in Asia-Pacific, 17% in Eurasia and 13% in Latin America and the Caribbean.[20]

Road transport continued to dominate energy consumption in transport, accounting for 75% of demand in 2023 (Figure 2)**.[21] Passenger cars consumed 38% of the total energy used in transport, followed by heavy-duty trucks (22%), aviation (10%) and shipping (9%).[22] Aviation's relatively high share of transport energy use, despite its smaller share of total passenger-kilometres, reflects the energy-intensive nature of air travel.[23] The shipping sector is comparatively energy efficient per tonne-kilometre of freight moved.[24]**

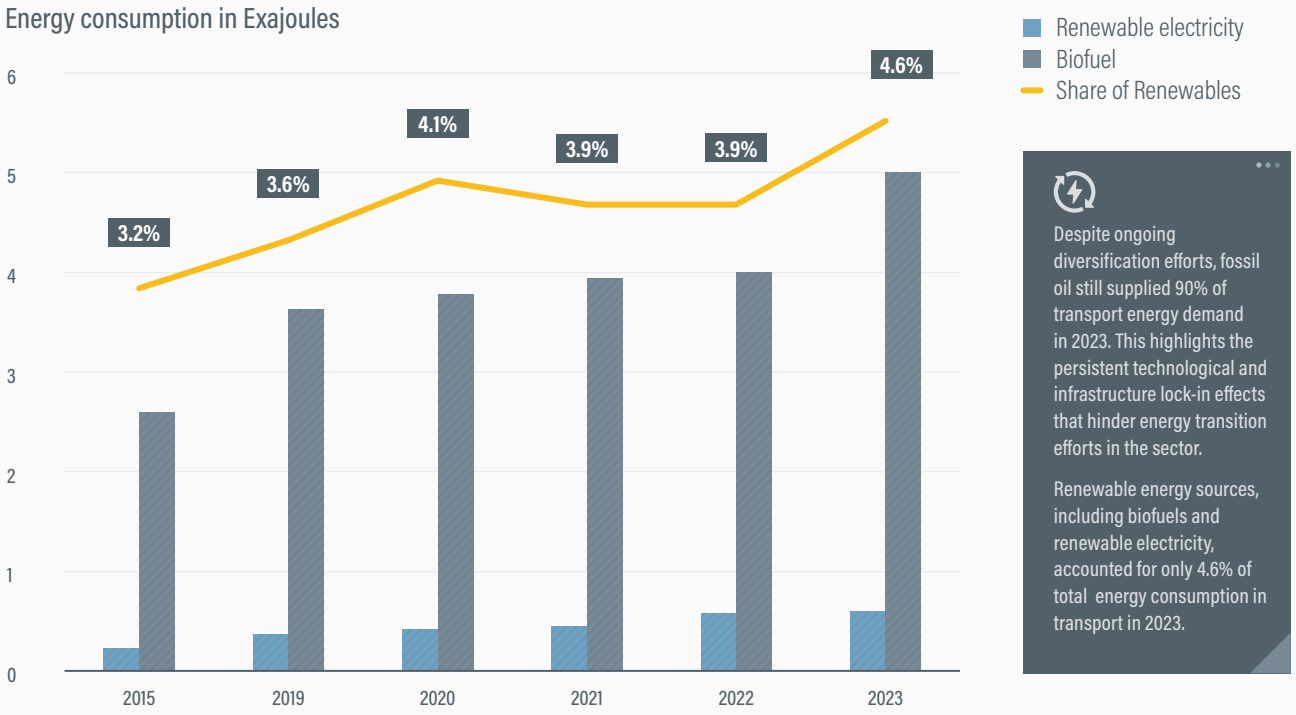
The trend towards larger and fuel-intensive sport-utility vehicles (SUVs) contributes greatly to transport's rising energy demand. On average, SUVs consume around 20% more energy per kilometre than medium-sized cars, further increasing the energy intensity of the passenger vehicle fleet.[25] SUVs reached a record 48% of global car sales in 2023, reinforcing the shift towards larger and heavier cars and making SUVs the defining automobile trend of the early 21st century across both developing and advanced economies.[26]

Despite ongoing diversification efforts, fossil oil still supplied 90% of transport energy demand in 2023.[27] This highlights the persistent technological and infrastructure lock-in effects that hinder energy transition efforts in the transport sector. Biofuels and fossil gas each contributed 4% of global transport energy use, while electricity, although growing, represented only 2%.[28]

In line with trends since 2015, renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport in 2023 (Figure 3)**; this underscores the significant challenge of decarbonising the sector.[29]** Despite rising climate ambitions, the share of renewables in transport has increased only marginally since 2015, due to the continued dominance of fossil fuels and the steady growth in overall transport energy demand.[30]

Global demand for liquid biofuels reached 175.2 billion litres in 2023, marking a steady increase since 2013 as

FIGURE 3. Renewable energy consumption in transport, 2015-2023



Despite ongoing diversification efforts, fossil oil still supplied 90% of transport energy demand in 2023. This highlights the persistent technological and infrastructure lock-in effects that hinder energy transition efforts in the sector.

Renewable energy sources, including biofuels and renewable electricity, accounted for only 4.6% of total energy consumption in transport in 2023.

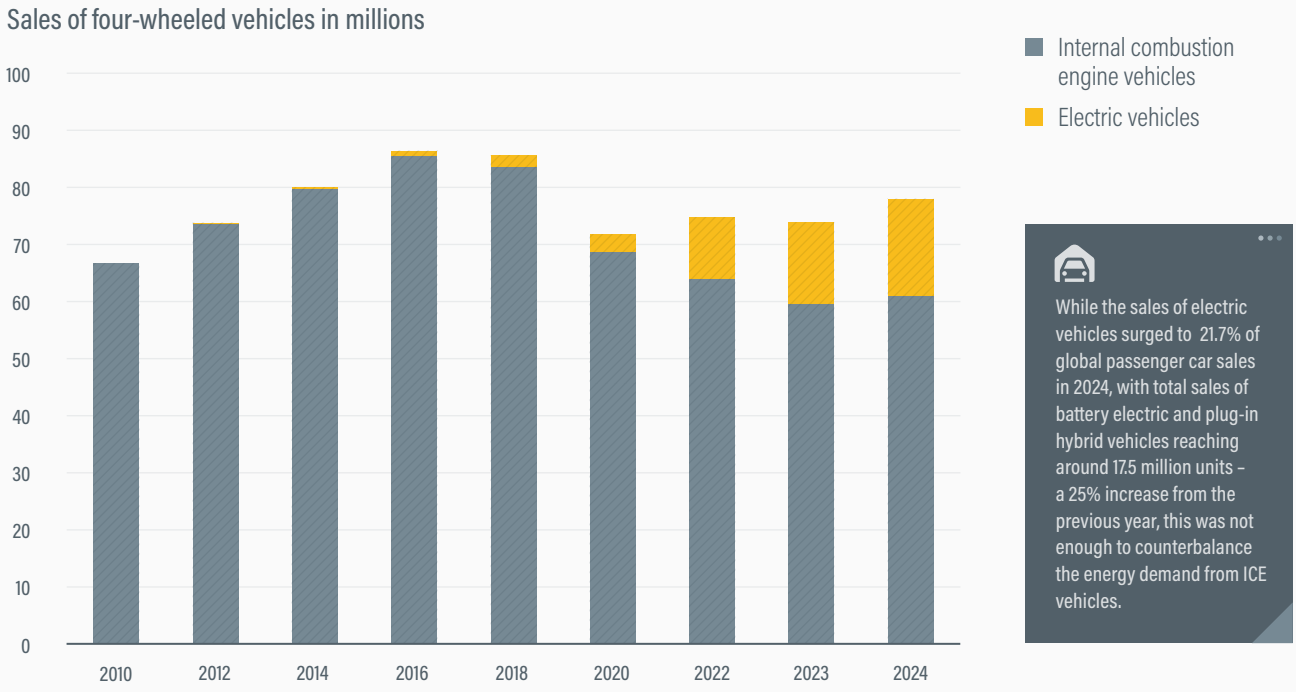
Source: See endnote 29 for this section

blending mandates have resulted in increased biofuel use in road transport.[31] **Bioethanol remained the dominant biofuel used in transport, followed by biodiesel (fatty acid methyl ester, or FAME) and a growing share of renewable diesel.**[32] Renewable diesel has experienced a notable rise, in recent years, reflecting growing interest in drop-in fuels that are compatible with existing infrastructure.[33]

- In early 2025, Indonesia implemented the highest national biofuel mandate globally, requiring a biodiesel mix of 40%, up from 35% previously.[34] In May 2025, the government announced plans for a 50% blending rate by early 2026.[35]
- Biofuels represent 22% of energy used in transport in Brazil, a very high share compared to other countries in the world.[36] Bioethanol dominates, representing nearly 40% (by energy) of combined gasoline and ethanol use.[37] The role of biodiesel as a substitute for diesel in heavy-duty vehicles is growing; in 2022, it represented 9.3% (by energy) of diesel use.[38]
- The United States and the European Union (EU) continued to be the most advanced markets for ethanol and biodiesel.[39]

In 2024, more than 58 million electric cars were on the world's roads, representing 4.5% of the global car fleet.[40] **Sales of electric vehicles (including battery electric and**

FIGURE 4. Global sales of internal combustion engine vehicles and electric vehicles, 2010-2024



Source: See endnote 41 for this section

plug-in hybrids) grew 25% to reach 17.5 million units, accounting for more than a fifth (21.7%) of all passenger car sales that year (Figure 4)**.**[41] **However, this was not enough to counterbalance the energy demand from ICE vehicles.**[42] **Electric vehicle sales growth was slower than in 2022 (60%) and 2023 (34%).**[43] Sales of ICE vehicles rose slightly in 2024 to around 61 million units, up from 59.6 million in 2023.[44]

Meanwhile, electric bus sales increased 30% in 2024, reaching a total fleet of 730,000 units.[45] **Electric medium- and heavy-duty truck sales surged nearly 80% in 2024 to approach 2% of the total truck market.**[46] Across all electric vehicles, challenges persist in scaling up charging infrastructure, ensuring grid stability and addressing the life-cycle emissions associated with battery production. (See 5.2 Road Vehicle Electrification for more on electric cars, buses, trucks and two- and three-wheelers.)

In maritime transport, battery-electric shipping corridors began to take shape, although they were largely limited to short sea routes in Northern Europe.[47] **In aviation, early innovation included the successful test flight of a 4-tonne civil electric aircraft, developed in collaboration with battery manufacturer CATL, marking a notable step in electrifying short-haul aviation.**[48] (See 4.9 Aviation and 4.10 Shipping.)

Overall, renewable energy sources - mainly wind and solar power - supplied nearly one-third (32%) of the world's electricity in 2024.[49] **A renewable electricity supply is critical for ensuring that transport electrification contributes meaningfully to emission reductions. However, advancements in renewable electricity and electric vehicles alone are insufficient to fully decarbonise the transport sector, as aviation and shipping respectively contributed around 11% of transport greenhouse gas emissions in 2023.**[50] Renewable electricity consumption has outpaced the consumption of non-renewable electricity.[51]

Sustainable aviation fuel (SAF) production doubled in 2024 to reach 1 million tonnes (1.3 billion litres).[52] **Despite this growth, SAF represented only 0.3% of global jet fuel production and 11% of total renewable fuel.**[53] SAF production growth fell short of forecasts due to delays in US facility timelines.[54] Europe led in SAF commitments, with binding mandates but facing high costs; the United States offered strong incentives yet suffered from production delays; and Asia focused mainly on SAF exports.[55] Emerging markets remained under-represented in SAF production, highlighting the need for greater global policy alignment and capacity building.[56] (See 4.9 Aviation.)

- As of May 2025, the International Civil Aviation Organization (ICAO) estimated 13.9 million tonnes of SAF capacity from 67 facilities already operational or under construction.[57]
- The EU's ReFuelEU Aviation regulation, in effect since January 2025 and part of the Fit for 55 climate package, sets legally binding minimum shares of SAF that must be blended into aviation fuel supplied at EU airports, starting at 2% in 2025 and rising to 6% in 2030, 20% in 2035 and 70% by 2050.[58]
- India, Indonesia and the Republic of Korea all issued new SAF mandates between 2023 and 2024.[59]

Sustainability and climate trends

Transport is now the second-largest and fastest-growing contributor to global greenhouse gas emissions. In 2023, the sector was responsible for 21.9% of carbon dioxide (CO_2) emissions. Transport has a sustained dependence on petroleum fuels and is a major energy consumer and a leading source of global emissions.[60]

Air pollution caused an estimated 8.1 million deaths globally in 2021 (including 700,000 deaths among children under five years), with 61% of these fatalities linked to fossil fuel combustion.[61] Transport-related pollutants, particularly particulate matter ($PM_{2.5}$), have direct and consistent linkages to poor health outcomes.[62]

Scaling up public transport, walking and cycling – which are more energy-efficient than private vehicles – can support a reduction in transport energy demand, as well as in related emissions from road transport.[63] (See 4.3 Walking, 4.4 Cycling and 4.5 Public Transport.)

A shift towards renewable energy in transport offers a critical pathway to reduce emissions and improve health outcomes. By 2028, biofuels and renewable electricity are projected to cut oil demand from transport by nearly 4 million barrels per day (or more than 7% of the forecasted transport oil demand).[64] If biofuels replaced 90% of conventional aviation fuels, emissions from aviation could be reduced 53% by 2050.[65]

Electrification across all modes is transforming the transport landscape; however, energy access and affordability challenges remain significant barriers to scaling up electric vehicle adoption. Although 91.6% of the global population had access to electricity as of 2023, at least 1.18 billion people remained "energy poor", lacking basic electricity access.[66] **Price volatility and regional**

differences in electricity costs create barriers for electric vehicle charging. Decentralised solar photovoltaics coupled with battery storage – which have lifetime electricity costs at or below USD 0.20 per kilowatt-hour – could help serve populations that lack electricity access.[67] Electricity access for basic services (lighting, refrigerator, washing machines) takes priority over charging electric vehicles. (See 5.2 Road Transport Electrification.)

More than 1.3 million public electric vehicle charging points were added to the global stock in 2024 (mostly in Asia and Europe), expanding the infrastructure needed for electric vehicle adoption.[68] Although essential, this growth places additional strain on power grids and increases uncertainty in electricity demand. Emerging technologies, such as time-shifted charging and bi-directional charging, offer the potential to balance demand and allow electric vehicles to send power back to the grid when needed.[69]

An estimated USD 6.9 trillion is required annually by 2030 to expand and stabilise grids and electric vehicle charging infrastructure, and to build their resilience.[70] Climate-related hazards such as wildfires, floods, sea-level rise and heat waves threaten not only physical transport infrastructure, but also the stability of renewable-powered mobility systems.

The transition to low-carbon transport creates new jobs, and global employment in the renewable energy sector reached a record 16.2 million jobs in 2023.[71] However, education and reskilling are needed to address the requirements of a shifting workforce and to ensure a just transition. The electrification of transport creates job opportunities in scientific research, design, manufacturing, maintenance, and sales, as well as in the installation and maintenance of millions of charging stations. However, in some countries, such as the United States, the decline of ICE vehicle manufacturing has triggered backlash from traditional labour groups and led to strikes.[72]

- China led in both electric vehicle and renewable energy employment in 2023, accounting for more than 45% of global renewables employment and experiencing a 32% increase in electric vehicle industry recruitment.[73]
- In the United States, software developers and chemical engineers, two key occupations related to electric vehicles, are projected to grow 17% and 10%, respectively, between 2023 and 2033, well above the average for all occupations.[74]
- In 2023, Tesla and Panasonic initiated an apprenticeship programme with the American Association of Community Colleges focused on charging infrastructure, with a USD 8 million grant from the US Department of Labor.[75]

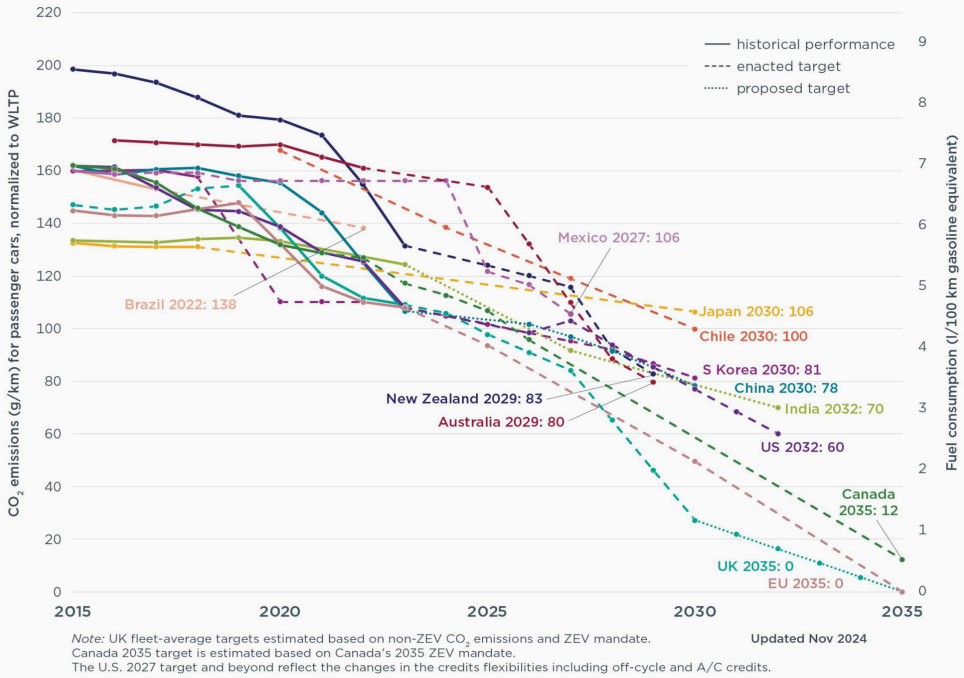
Policy and investment developments

The transport sector plays an essential role in meeting international climate and energy targets. However, policies and climate commitments that support the uptake of renewables in transport have fallen short of the pace needed to drive meaningful change. At the 2023 United Nations Climate Change Conference in Dubai, United Arab Emirates (COP 28), governments agreed to triple global renewable energy capacity and double energy efficiency improvements by 2030.[76] For the transport sector, comparable ambition and measures remain limited, highlighting a gap between high-level energy targets and sectoral implementation.

As of 1 August 2025, a total of 26 of the 29 submitted third-generation Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement included mitigation measures or adaptation actions related to transport.[77] However, many of these intended transport actions lack coherence with broader renewable energy objectives, limiting their transformative potential.

- The 26 third-generation NDCs integrated a total of 32 non-greenhouse gas transport targets, including 14 targets on zero-emission vehicles and 5 targets on vehicle efficiency.[78] Most of the zero-emission vehicle targets refer to the uptake of electric vehicles, but none specifies the use of renewable electricity.[79]
- Only three of the transport targets in the third-generation NDCs are biofuel targets – in Brazil, Monaco and the United Arab Emirates (UAE).[80]
- Only Botswana, Canada, Nepal, Saint Lucia and Uruguay included renewable energy support for transport in their third-generation NDCs as of August 2025, mostly focusing on renewable fuels.[81]
- Saint Lucia's third-generation NDC calls for a 14.7% reduction in energy sector emissions by 2030 relative to 2010, to be achieved through 40% renewable energy penetration (solar, wind and battery storage), increased energy efficiency and electric vehicle uptake.[82]
- In its third-generation NDC, Botswana aims to increase the renewable energy share in the transport sector 10% each decade.[83]
- The "New Industry Brazil" programme, launched in January 2024, aims to increase the share of biofuels in Brazil's transport energy mix 50% by 2033, as specified in the country's third-generation NDC.[84]
- The third-generation NDCs of Moldova, Singapore and the United Kingdom emphasise their commitment to banning ICE vehicles.[85] Only the United Kingdom refers to the elimination of fossil fuel subsidies, while Singapore highlights its fossil fuel tax.[86]

FIGURE 5. Equivalent passenger car CO_2 emissions and fuel consumption in countries with mandatory vehicle efficiency or emission standards, 2015-2035



By 2024, a total of 13 countries had established or proposed fuel efficiency or greenhouse gas emission standards for passenger vehicles or light commercial vehicles and trucks. Although these regulations lacked global reach, they applied to more than 85% of all passenger vehicle sales, guiding the strategic decisions of major vehicle manufacturers worldwide.

Source: See endnote 91 for this section.

In the Long-Term Low Emission Development Strategies (LT-LEDS) submitted by countries under the Paris Agreement in the first half of 2025, countries highlight the key roles of both the transport and energy sectors; however, they provide little to no detail on how renewables are integrated into the transport sector.[87]

Of the 31 countries with a carbon tax in 2024, 22 targeted the transport sector with this tax.[88] **Of the 44 countries that had an emissions trading system (ETS) in 2024, 36 countries had one that covered transport emissions.**[89] As of 2024, a total of 53 countries had in place carbon pricing policies – including carbon taxes and ETS – and 45 countries had both carbon pricing policies and net zero emission targets.[90]

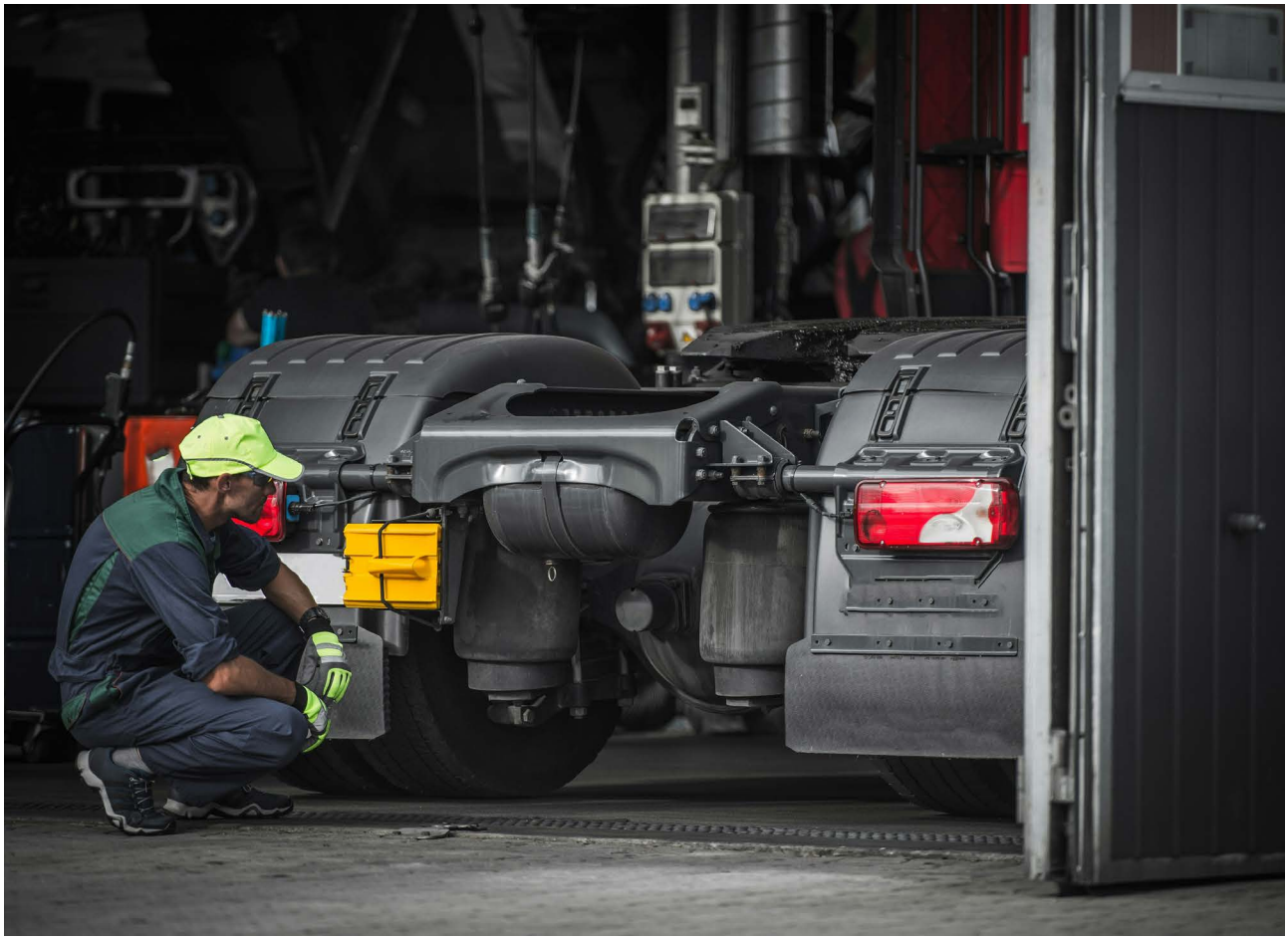
By 2024, a total of 13 countries had established or proposed fuel efficiency or greenhouse gas emission standards for passenger vehicles or light commercial vehicles and trucks (Figure 5).[91] **Although these regulations lacked global reach, they applied to more than 85% of all passenger vehicle sales, guiding the strategic decisions of major vehicle manufacturers worldwide.**[92] **Most standards apply only to light-duty vehicles, but in 2024 the EU introduced the world's first heavy-duty vehicle standard, with a mandatory target to reduce CO_2 emissions from new trucks 90% by 2040.**[93] Fuel efficiency and emission standards are crucial to accelerate production and sales of electric vehicles to meet emission targets.

Jurisdictions that had enacted targets for both passenger vehicles and light commercial vehicles as of 2024 included Australia, Canada, China, Chile, the EU, Mexico, New Zealand, the Republic of Korea, the United Kingdom, and the United States, while Japan enacted a passenger car target of 106 grams of CO_2 per kilometre by 2030.[94] **Three jurisdictions had targets for 2035, including Canada, the United Kingdom, and the EU, and only the EU had a target for 100% zero-emission passenger cars and light commercial vehicles by 2035.**[95]

- In 2024, Australia adopted its first-ever CO_2 emission standards for new light-duty vehicles, setting annual targets from 2025 to 2029, with a 2026 review to consider stricter post-2029 targets and reclassifying SUVs as passenger vehicles.[96] The measure is projected to reduce 321 million tonnes of emissions by 2050 and to result in health cost savings of USD 3 billion (AUD 5 billion) by 2050.[97]
- Chile's first fuel efficiency standards for light-duty vehicles took effect in 2024, with the aim of increasing fuel economy from a 2020 baseline of 14.9 kilometres per litre of petrol equivalent (km/lpe) to 18.8 km/lpe from 2024 to 2026, 22.8 km/lpe from 2027 to 2029, and 28.9 km/lpe in 2030.[98]
- In China, Phase V of the fuel consumption standards set a fleet average target of 4.0 litres per 100 kilometres (l/100km) by 2025 and 3.2 l/100km by 2030, based on

the New European Driving Cycle (NEDC).[99] The draft of Phase VI, released in August 2024, proposes a target fuel consumption for passenger cars of 3.3 l/100km by 2030.[100] It sets progressively stricter annual compliance rates from 2026 to 2030 and provides a 0.14 l/100km flexibility for the 2030 target.[101]

- In 2024, the Republic of Korea updated its Enforcement Order of the Energy Use Rationalisation Act, stating that automakers in the country must comply with either fuel efficiency standards (33.1 km/litre for passenger cars and 17.3 km/litre for light trucks) or CO_2 emission standards (70 grams of CO_2 per kilometre for passenger cars and 146 grams of CO_2 per kilometre for light trucks.[102] If manufacturers fail to meet their chosen target, a surcharge is imposed based on the shortfall.
- In its 2025 second-generation NDC submission, Lesotho aims to improve the fuel efficiency of road vehicles, with targets for 2030 including 21,838 efficient petrol vehicles and 4,368 efficient diesel vehicles (reducing greenhouse gas emissions by 9 kilotonnes of CO_2 equivalent per year and 1 kilotonne of CO_2 equivalent per year, respectively).[103] Additional targets are for 43,677 efficient petrol vehicles and 8,735 efficient diesel vehicles (reducing 18 kilotonnes of CO_2 equivalent per year and 2 kilotonnes of CO_2 equivalent per year respectively), alongside regulations to reduce the number of poor-performing imported used cars.[104]
- In 2024, the United States finalised new, more stringent greenhouse gas emission standards for light-duty and medium-duty vehicles, starting with model year 2027 and aiming to achieve fleet-wide emission reductions of 56% and 44%, respectively, by 2032 (compared to 2026 levels).[105] As part of phase 3 emission standards for heavy-duty vehicles, new 2024 standards aimed for up to a 60% reduction in CO_2 emissions for vocational trucks and 40% for tractor trucks by 2032, compared to 2027 levels.[106]
- The United States also established new Corporate Average Fuel Economy (CAFE) standards requiring passenger cars to improve fuel efficiency 2% annually from model years 2027 to 2031, reaching an average of 50.4 miles per gallon (mpg) by 2031.[107] However, the new Trump administration has indicated intentions to review and potentially roll back these regulations, citing concerns about industry competitiveness and the legality of the standards.[108]
- Viet Nam's Ministry of Transport introduced a new national standard – which took effect in June 2025 – that sets mandatory fleet-average fuel consumption limits and evaluation methods for newly manufactured, assembled and imported passenger cars with up to eight seats, including ICE, hybrid, battery electric and fuel cell vehicles.[109]



In 2025, the Euro 7 emission standard came into force, combining regulations for light- and heavy-duty vehicles in a single regulation.[110] **From 2025, all European manufacturers must comply with fleet-wide average CO_2 emissions and reduce the emissions of new trucks 15% by 2025 and 45% by 2030.**[111] **However, some jurisdictions including the EU have scaled back or delayed their fuel efficiency plans and emission standards, and very few governments worldwide have enacted their announced bans on sales of ICE vehicles.**[112]

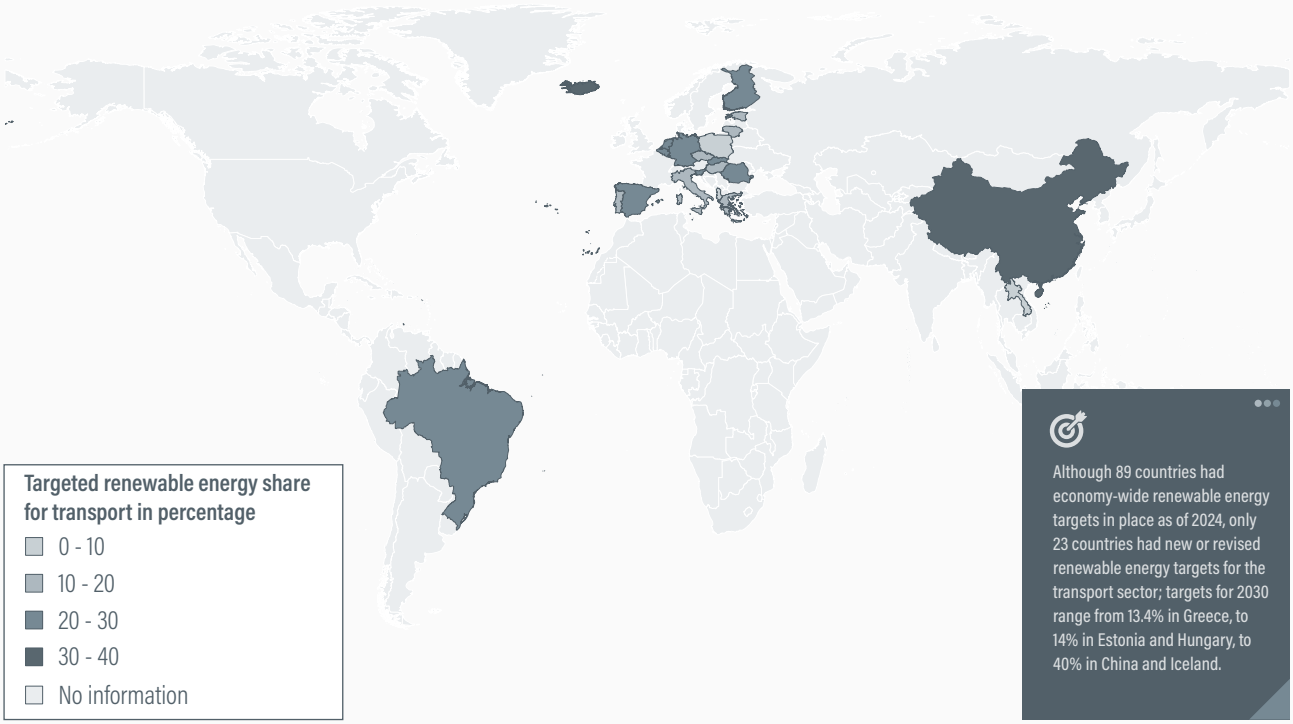
- In 2023, the EU amended its regulation to allow ICE cars with CO_2-neutral fuels beyond 2035.[113]
- In early 2025, the European Commission announced a relaxation of the EU's 2024 CO_2 emission targets for car manufacturers in Europe, allowing for a three-year compliance period instead of annual compliance to account for the challenging circumstances facing the industry.[114]

In certain regions and sectors, such as aviation, efficiency improvements have stalled due to a lack of sufficiently strong standards.[115] Improvements in aircraft fuel efficiency have stalled since international CO_2 standards took effect in 2020.[116]

In recent years, several countries have strengthened or introduced vehicle efficiency labelling schemes, which have become a growing practice globally; meanwhile, the EU plans a 2026 review to boost the uptake of zero-emission vehicles.[117] Vehicle efficiency labelling informs consumers and encourages cleaner vehicle choices, although many countries still lack such programmes.

- The EU's Car Labelling Directive requires standardised fuel economy and CO_2 emissions information at the point of sale, informing consumer choices and supporting emission reduction targets.[118]
- In 2024, China issued a policy requiring auto manufacturers and imported vehicle dealers to ensure that their light-duty vehicles are affixed with energy consumption labels at the time of sale.[119]
- Germany enhanced its car energy efficiency labelling in 2024, mandating more comprehensive information on vehicles' carbon emissions and fuel efficiency. This amendment, based on the European Car Labelling Directive, aims to empower consumers with better data for informed purchasing decisions and to incentivise manufacturers to develop more efficient vehicles.[120]
- In 2024, the Philippines introduced a new Vehicle Fuel Economy Labeling Program covering both ICE and electric

FIGURE 6. Renewable energy targets in the transport sector, as of 2024



Source: See endnote 126 for this section.

vehicles, requiring manufacturers and importers to display standardised fuel economy labels to help consumers compare efficiency and reduce emissions.[121]

- Taiwan (Province of China) amended its fuel economy regulations in 2024 to require energy efficiency labels for all manufactured or imported petrol, diesel and electric vehicles – including passenger cars, motorcycles, light-duty trucks and commercial vehicles under 3,500 kilograms – with labelling for heavier electric trucks to take effect in 2030.[122]

Pollutant emission standards are crucial to address the health impacts of poor air quality, especially in urban areas, but the stringency of such measures needs to be increased.

- The EU's Euro 7 standards, which entered into force in 2024, aim to reduce air pollutant emissions from all vehicles, including cars, vans and trucks.[123] A study shows that the regulation could avoid 7,200 premature deaths linked to nitrogen oxide (NO_x) emissions in Europe by 2050.[124]
- Phase B of China's National Stage 6 Vehicle Emission Standards was fully implemented in July 2023, setting new limits on carbon monoxide (CO), NO_x, particulate matter, non-methane hydrocarbons and hydrocarbon (THC) emissions.[125]

Although 89 countries had economy-wide renewable energy targets in place as of 2024, only 23 countries had new or revised renewable energy targets for the transport sector (Figure 6)**.**[126] **Targets for 2030 range from 13.4% in Greece, to 14% in Estonia and Hungary, to 40% in China and Iceland.**[127] **All the countries that adopted new renewable targets for transport in 2024 were EU Member States**, reflecting the impact of region-wide legally binding standards.[128] Seven countries enacted new renewable energy targets for transport, while some introduced targets ranging from a 15.8% renewable target by 2030 in Lithuania to a 30% target in Finland.[129]

- China, in its Plan for Carbon Peaking in the Industry Sector, aims for 40% of transport to be powered by "new energy" – such as hydrogen and renewable-based electricity – and other clean energy sources by 2030.[130]
- Estonia aims for a 14% renewable energy share in transport by 2030, primarily through domestic biomethane production – targeting up to 340 gigawatt-hours annually – and increased use of electric vehicles powered by renewable electricity.[131]
- The EU's revised Renewable Energy Directive (RED III), adopted in late 2023, targets an overall renewable energy share of at least 42.5% in overall energy consumption binding at the EU level by 2030.[132] In the transport

sector, EU Member States can choose between a target of reducing greenhouse gas intensity 14.5% by 2030 or ensuring a share of at least 29% of renewables in final energy consumption by 2030.[133]

- Germany aims for 30% of gross final energy consumption in transport to come from renewable sources by 2030, in line with the RED II methodology.[134]
- The Slovak Republic targets a progressive increase from 10.4% renewable energy in transport in 2025 to 29% by 2030, including multipliers.[135]

As of 2024, 20 countries had in place biofuel blending mandates, with growing emphasis on stricter sustainability criteria.[136] **Countries that have enacted new or updated biofuel blending mandates since 2023 are Belgium, Brazil, Indonesia, Japan, Nigeria, the Philippines and Poland.**[137] In recent years, countries have introduced stricter sustainability criteria to ensure that biofuel production does not lead to deforestation or other environmental harm.

- Indonesia further raised its already leading biofuel blending mandate from 35% to 40% (and 50% in 2026).[138]
- Blending mandates for 2030 range from 7% in the Netherlands to more than 10% in Burkina Faso and Japan, 12% in Argentina and 34% in Finland.[139]
- In its NDC from November 2024, Brazil aims to increase the share of biofuels in transport energy use from 21.4% in 2025 to 50% in 2033.[140]
- The EU's RED III sets out a binding target for non-crop-based advanced biofuels of 1% by 2025 and 5.5% by 2030, with at least one percentage point being from renewable fuels of non-biological origin by 2030.[141]
- Indonesia's new B50 palm oil-based biodiesel blending mandate for 2026 is part of a wider energy transition plan aimed at cutting emissions, but it will require a stark increase in local production and more than 9.2 million hectares of new palm oil plantations.[142] The government has continued to carry out tests for renewable diesel and SAF.[143]
- Since January 2024, Poland has introduced E10 fuel containing 10% bioethanol to replace E5 petrol, aligning with EU directives to reduce fossil fuel use, although older vehicles may require higher-octane fuel due to compatibility issues.[144]
- In its NDC, submitted in November 2024, the UAE announced that it would shift portion of diesel consumption in land transport to biodiesel by introducing B7 (7% biodiesel in conventional diesel) by 2030 and B20 (20% biodiesel) by 2050.[145]
- In the EU, the use of conventional palm biofuel fell 80% between 2019 and the end of 2023, due to early phase-outs in multiple EU countries in response to concerns about deforestation.[146]

In 2024, seven jurisdictions – China, the EU, India, the Republic of Korea, Malaysia, Singapore and Thailand – announced new targets for the production or use of SAF.[147]

- In 2024, Brazil adopted the Fuel of the Future law, which requires airlines to reduce domestic flight greenhouse gas emissions 1% by 2027, increasing to 10% by 2037 through SAF.[148]
- The EU's Fuel Quality Directive limits ethanol blends to 10% or less when ethanol is used as an oxygenate, and places limits on palm oil and soy oil content of biodiesel.[149] ReFuelEU targets 6% SAF by 2030 with a 1.2% sub-target for renewable fuels of non-biological origin.[150]
- In 2024, the United Kingdom mandated minimum targets of 2% in 2025, 10% in 2030, and 22% in 2040, with sub-targets for synthetic fuels.[151] In 2023, the UK government announced grant funding through a USD 207 million (GBP 165 million) Advanced Fuels Fund to support the development of commercial-scale SAF plants in the country.[152]

As of 2024, 68 countries had in place electric vehicle targets, reflecting a growing prioritisation of electric vehicle adoption and zero-emission transport as part of climate and energy strategies.[153] **However, electric vehicle targets alone do not necessarily lead to increased renewable energy use unless they are coupled with specific mandates or bans on ICE vehicles, as well as efforts to boost the overall share of renewables in a country's electricity mix.** Several countries announced financial support for electric vehicle adoption, including purchase incentives and tax credits.[154] In Europe, the withdrawal of electric vehicle purchase subsidies in Germany, combined with an anticipated roll-out of EU-wide CO_2 standards in 2025, led to a cooling of electric vehicle sales and sales volumes decreasing by 0.6%.[155] (See 5.2 Road Vehicle Electrification.)

Although global ambitions for electric vehicle adoption have increased, trade tensions have grown as major export markets apply tariffs to protect domestic industries.[156] **Geopolitical tensions, regional conflicts, energy security concerns and continued fossil fuel subsidies risk delaying progress on electric vehicle and renewable energy uptake and climate action in the transport sector.**[157]

In 2024, major export markets implemented a range of unilateral tariffs on Chinese-made electric vehicles.[158] In return, China launched a series of countermeasures, such as anti-dumping investigations on EU and Canadian products, and has increasingly looked to diversify exports to Australia and other emerging markets.[159]

- Canada imposed a 100% surtax on Chinese-produced electric vehicles effective 1 October 2024, to counteract unfair trade practices in China, including subsidisation and lax labour and environmental standards.[160]
- In 2024, the EU imposed countervailing duties on Chinese electric vehicles for five years, with rates varying by company: BYD at 17.0%, Geely at 18.8%, SAIC at 35.3%, and other co-operating companies at 20.7%, while Tesla faces a duty of 7.8%; non co-operating companies are subject to a duty of 35.3%.[161]
- In 2024, the United States increased tariffs on imported electric vehicles from China from 25% to 100%, and raised tariffs on batteries from China from 7.5% to 25%.[162]

Beyond electricity and biofuels, advancements in other alternative fuels included initiatives to promote hydrogen-powered transport. However, persistent challenges such as high production costs, limited infrastructure and regulatory uncertainties have hindered widespread adoption.[163]

- In 2024, the Netherlands earmarked USD 129 million (EUR 125 million) to put hydrogen-powered vehicles on the road, with the aim of increasing the number of hydrogen-powered trucks, vans and buses, as well as establishing hydrogen refuelling stations across the country.[164] The scheme for hydrogen trucks and vans runs from 2024 to 2028 and will subsidise thousands of fuel cell electric vehicles and set up 40 new hydrogen refuelling stations, offering up to USD 310,515 (EUR 300,000) per vehicle and up to USD 2.1 million (EUR 2 million) per refuelling station.[165]
- The EU's first binding target to supply green hydrogen and e-fuels to the transport sector under RED II only aims for hydrogen and e-fuel to account for 1% of all fuels used in the transport sector by 2030; the EU also includes non-binding sub-targets for shipping and aviation.[166]
- The EU's Alternative Fuels Infrastructure Regulation (AFIR), which entered into force in 2024, mandates legally binding national targets for the deployment of electric charging stations, hydrogen refuelling stations, liquefied natural gas refuelling points and shore-side electricity supply across all transport modes.[167]
- As of 2024, China had introduced 556 hydrogen energy policies, including 221 development plans, accounting for 39.7% of the total; the country's hydrogen energy applications were focused mainly on transport, with projects reaching a total capacity of 351.3 megawatts.[168]
- Panama's second-generation NDC from 2024 includes a target for 2% of heavy-duty transport vehicles and machinery to use green hydrogen and/or its derivatives by 2027.[169]

Initiatives on clean shipping by Australia, the EU, the United Kingdom, and parts of China and the United States are addressing emissions from the shipping sector.[170] **In 2025, the International Maritime Organization (IMO) approved**

its Net-Zero Framework, combining mandatory emission limits and greenhouse gas pricing.[171] **Low- and middle-income countries – despite strong renewable energy potential – face persistent financing gaps, underscoring the need for targeted international support to scale up green shipping supply chains.** (See 4.10 Shipping.)

- The FuelEU Maritime regulation, adopted in 2023 and in force as of January 2025, sets maximum limits on the annual average greenhouse gas intensity of the energy used by ships calling at EU ports; the aim is to encourage the adoption of renewable, low-carbon fuels and clean energy technologies.[172]
- In Europe, policy mechanisms such as the EU Emissions Trading System and FuelEU Maritime have spurred significant investments in green fuels and vessel efficiency.[173]
- In Asia and North America, major projects have emerged around methanol and ammonia infrastructure, including port upgrades and fuel production facilities.[174]

Partnerships in action

The **Global Fuel Economy Initiative** (**GFEI**) has advanced global vehicle fleet transformation to support transport decarbonisation, as a partnership among the International Energy Agency, the UN Environment Programme, the International Transport Forum, the International Council on Clean Transportation (ICCT), the University of California at Davis and FIA Foundation. In Australia, the GFEI's long-standing engagement — including analysis by ICCT — informed the consultation on a mandatory standard for light-duty vehicle CO_2 emissions.[175]

In 2023, the **International Energy Agency** (**IEA**) conducted a workshop on Low-emissions Transport Fuels: Technology and Policy Pathways to Decarbonise Shipping and Aviation, and in 2024 it held two technical workshops on the Global EV Outlook 2024, supported by the Global EV Data Explorer and Global EV Policy Explorer tools.[176]

The **International Renewable Energy Agency** (**IRENA**) hosted a Policy Talk in 2025 on advancing the renewables-based electrification of road transport, presenting findings from its report on this topic. The event highlighted key policies, examples and regional best practices to overcome barriers and accelerate adoption.[177]

REN21's **Global Futures Report: Renewables for Sustainable Transport** examines pathways to rapidly scale renewable energy in transport, emphasising tailored policies, strategies and guidance for stakeholders. The report forms part of REN21's work as the renewable energy voice of the NDC Transport Initiative for Asia consortium.[178]

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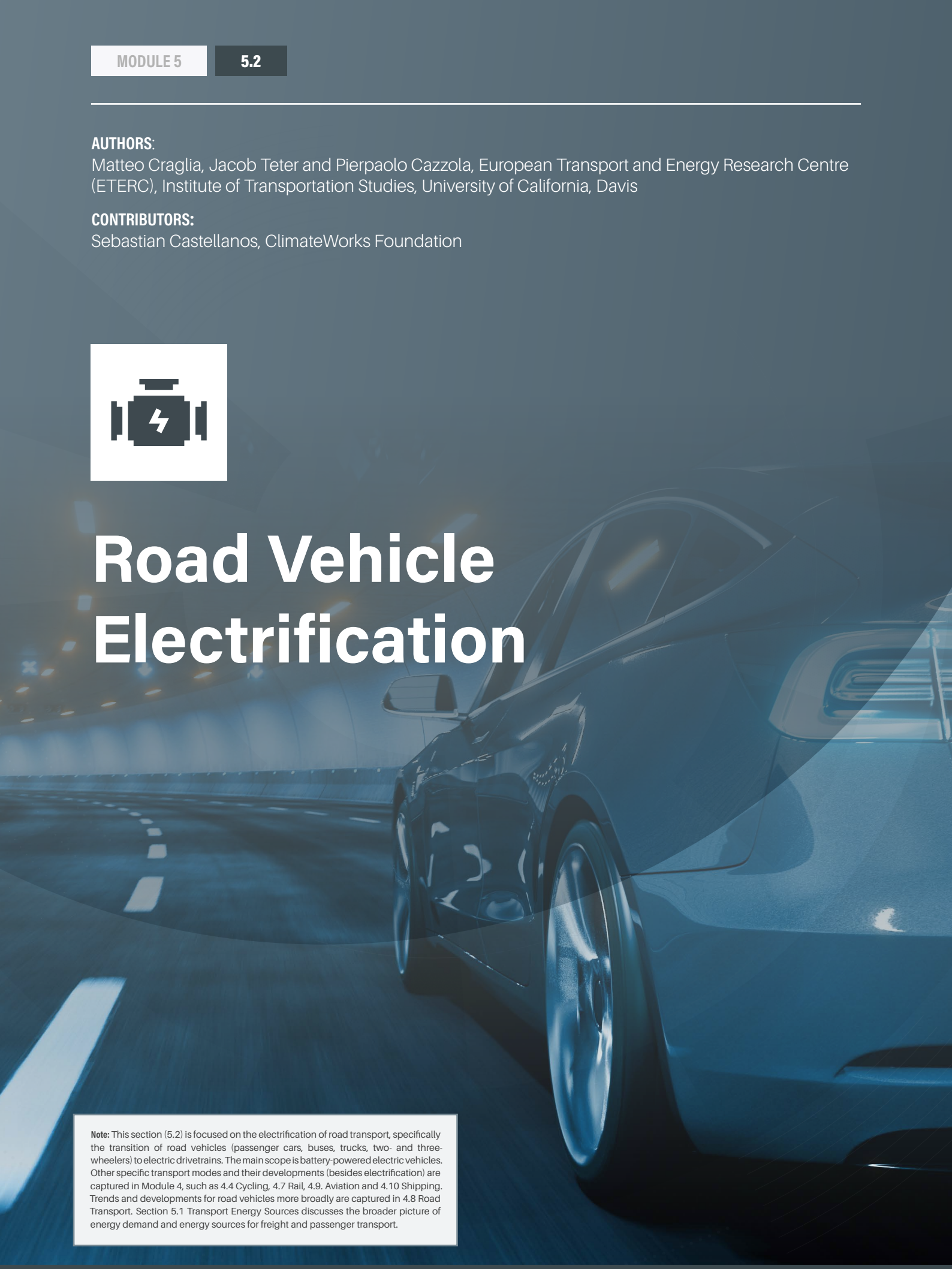
Road Vehicle Electrification



Note: This section (5.2) is focused on the electrification of road transport, specifically the transition of road vehicles (passenger cars, buses, trucks, two- and three-wheelers) to electric drivetrains. The main scope is battery-powered electric vehicles. Other specific transport modes and their developments (besides electrification) are captured in Module 4, such as 4.4 Cycling, 4.7 Rail, 4.9. Aviation and 4.10 Shipping. Trends and developments for road vehicles more broadly are captured in 4.8 Road Transport. Section 5.1 Transport Energy Sources discusses the broader picture of energy demand and energy sources for freight and passenger transport.

KEY FINDINGS

Context, challenges and opportunities

- Electrification is central to the decarbonisation of both road and rail transport, and is also relevant for ferries, short-distance shipping and port emissions. Electric passenger cars, in particular, are one of the bright spots of the clean energy industry. Electric powertrains for road transport are a mature, scalable technology aligned with trends in energy decarbonisation, digitalisation and industrial innovation.
- The electrification of road transport vehicles is a pivotal part of a broader transformation needed in transport systems. This transformation will need to proceed rapidly worldwide and to encompass universal access to sustainable, low-carbon transport, and broader societal and industrial goals. This transformative change requires an integrated multi-modal, multi-level approach that goes beyond transport electrification and addresses all aspects of the transport system.
- The technological transition brought by EVs and low-carbon electricity has implications for supply chains, with deep impacts on skills, jobs and their geographical distribution. This and other socio-economic, equity, and access implications of the transition to electric mobility require careful and calibrated policy to anticipate and manage in a fair manner that protects vulnerable groups and enables shared and resilient prosperity.
- Despite the success of electric two- and three-wheelers and urban public transport buses, including in emerging markets and developing economies, the risk of an electric mobility divide remains a concern. Early EV markets in most countries have been dominated by expensive, high-end models, limiting affordability and access, particularly for low-income households and countries.

Demand, use and access

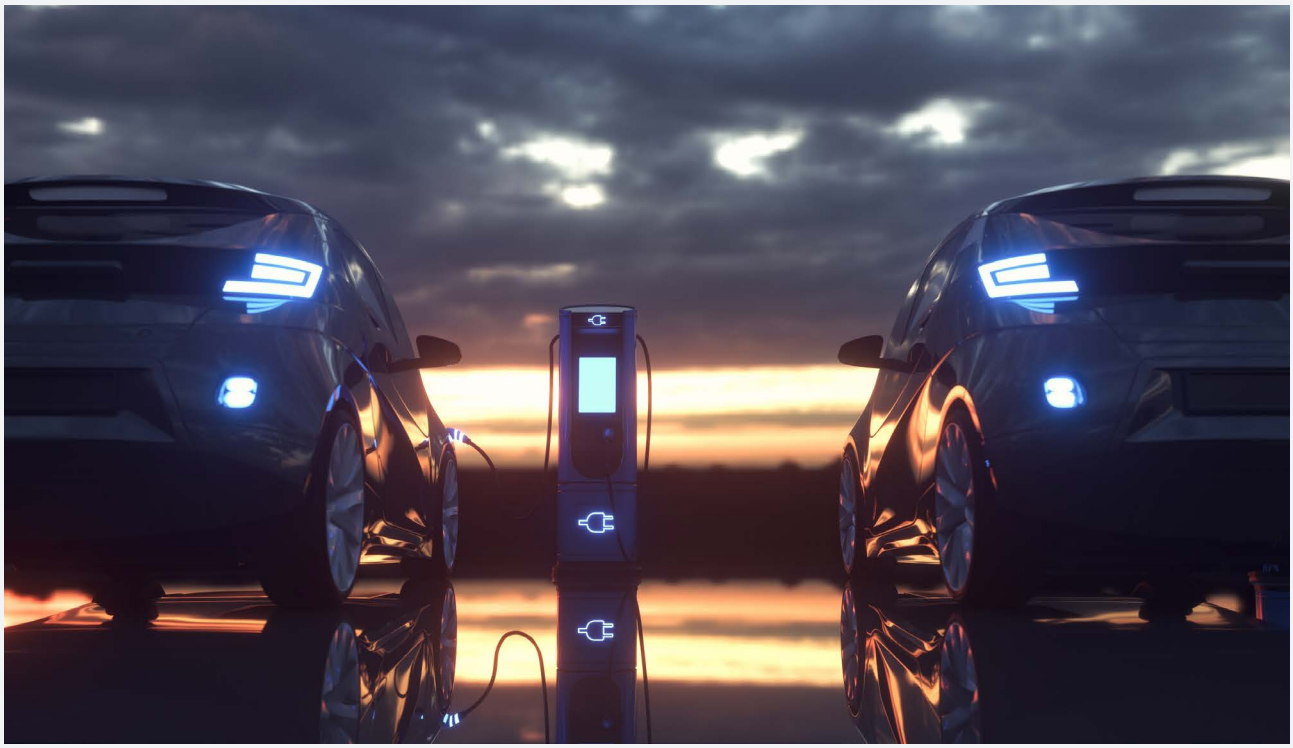
- A total of 58 million electric cars were on the world's roads in 2024, more than 11 times the number in 2018. The global electric car fleet was 5.7 times larger in 2024 than in 2020, maintaining four-year average growth of 54%.
- Despite this growth, electric cars accounted for less than 5% (4.5%) of vehicles globally, with more than two-thirds of the fleet operating in China.
- In 2024, global sales of electric cars (including battery electric and plug-in hybrid models) increased more than 25% to reach 17.5 million units. More than one-fifth (20%) of all passenger cars sold during the year were electric (13.8% battery electric, 8.2% plug-in hybrid), up from 14% in 2021.
- Electric car sales in China reached 11 million units in 2024, accounting for 65% of EVs sold worldwide and for nearly half (48%) of all domestic car sales. Monthly sales of electric cars in China have overtaken sales of new ICE cars since July 2024, marking a major milestone in the transition of the world's largest automotive market.
- EV sales in Europe remained relatively constant in 2024, with around a 20% share. The limited growth in European sales was aligned with regulatory requirements that did not require an increase in the region's EV market share until 2025. Several European countries also phased out EV purchase subsidies.
- Electric car sales in the United States grew 40% in 2023, driven by policy support from the Inflation Reduction Act. In 2024, however, sales growth fell to only 10%, with a total of 1.6 million units sold.
- During 2023 and 2024, consumer interest in electric cars expanded from the dominant markets of China, Canada, Europe, Japan, the Republic of Korea and the United States towards a broader group of emerging markets and developing countries. These include Costa Rica, Thailand, Türkiye, and Viet Nam, followed closely by Brazil, Colombia, Indonesia and Uzbekistan.
- Electric car sales in South-East Asia surged nearly 50% in 2024, accounting for 9% of the region's total car sales.
- Electric car sales in Latin America more than doubled in 2024, with the regional market share rising to 4%. Brazil led with 125,000 electric cars sold (a two-times increase), reaching 6.5% of total car sales.

KEY FINDINGS

- Africa's electric car market remained nascent in 2024 but showed signs of acceleration, with sales more than doubling to 11,000 units in 2024; however, EVs still comprised less than 1% of total car sales. Challenges included limited charging infrastructure and parts availability.
- Electric two- and three-wheelers continued to far exceed numbers of other electric vehicles, although estimates of their stock and sales vary greatly. Available data for 2024 suggest close to 400 million units globally, including nearly 80 million electric motorcycles and 320 million electric mopeds and low-speed electric scooters (and not including electric bicycles and micromobility vehicles such as kick-scooters). China accounted for 85% of all electric motorcycles, with other Asia-Pacific countries contributing an additional 12%.
- Annual sales of electric motorcycles, mopeds and low-speed electric scooters totalled an estimated 35-50 million between 2021 and 2024, or between 40% and 50% of all two-wheeler sales annually. Electric motorcycle sales ranged from 6 million to 10 million annually during this period, accounting for a global sales share of 15% compared with ICE motorcycles.
- In 2024, electric two-wheelers made up over 30% of total sales in South-East Asia, with strong progress in Indonesia, Thailand and Viet Nam. Electrification of two- and three-wheelers has advanced rapidly in the region due to the vehicles' high market presence and suitability for short-range urban travel. Governments have encouraged adoption through fiscal incentives, reduced VAT and local manufacturing requirements.
- Electrification of two-wheelers in Africa is still emerging but has gained momentum in cities. Local start-ups and partnerships have focused on battery swapping networks and low-cost models suited for shared mobility and deliveries. Kenya, Rwanda and Uganda are noted hubs of innovation, although data on market penetration are limited. Barriers across the continent include import tariffs, financing access and lack of standards.
- Globally, an estimated 40 million electric bikes (a bicycle equipped with a battery-powered motor, typically with pedal-assist) were sold annually as of 2023 (representing around 30% of all bikes) as well as an estimated 50 million electric kick-scooters.
- The global electric light commercial vehicle stock (vans) reached 1.9 million vehicles in 2024.Electric sales totalled 650,000 units, or 7.1% of all sales. Both the sales and stock more than doubled between 2022 and 2024.
- Sales of electric buses totalled 70,000 in 2024 (6% of total sales), up 30% from 2023; this brought the global stock to 730,000 units, or 4.9% of the total fleet. Battery-electric buses continued to outpace fuel cell electric buses 35 to 1 due to their lower operational costs.

KEY FINDINGS

- China continued to dominate the electric bus market, accounting for 68% of global new sales and 89% of the global electric bus stock.
- In the European Union (EU), nearly 6,000 e-buses were delivered in 2024, up from 4,900 in 2023. Electric buses accounted for 17% of the region's total bus sales in 2024. However, EV adoption has varied widely depending on the size class and type of operations.
- Electric bus adoption in the United States has been slower than in European and Chinese markets; nonetheless, in the first quarter of 2024, zero-emission[4] buses accounted for 11% of all bus sales, with 641 newly registered units.
- Outside China, Europe, and North America, new sales of electric buses in 2024 totalled 9,500, a similar scale as in the European market. Frontrunners included India, with 3,200 new sales in 2024, and the Republic of Korea with 2,800.
- Latin American countries – notably Chile and Colombia – continued to lead emerging markets in electric bus deployment, driven by strong public transport electrification initiatives.
- Electrification of buses in Africa has remained limited but is growing, with developments centred in Egypt, Kenya and South Africa. Key hurdles include a lack of financing, grid limitations and insufficient charging infrastructure.
- Electrification of buses in Africa has remained limited but is growing, with developments centred in Egypt, Kenya and South Africa. Key hurdles include a lack of financing, grid limitations and insufficient charging infrastructure.
- EV charging infrastructure more than doubled between 2022 and 2024, to exceed 5 million charge points globally. An estimated 1.3 million new publicly available chargers were installed during 2024. China was home to roughly two-thirds (65%) of the world's public charge points in 2024, with more than 3 million.
- By 2024, the global stock of fast chargers (with a power output of more than 22 kW) reached 2 million; stocks of ultra-fast chargers (150 kW or higher) grew more than 50% to account for nearly 10% of all fast chargers. China remained the global leader in fast-charging deployment.



KEY FINDINGS

Sustainability and Climate Trends

- The EV transition provides wide-ranging environmental, social and economic benefits and should be considered in the broader context of sustainable development. EVs offer a pathway to improved air quality and health and reduced fossil fuel dependency, particularly in countries that rely on imported oil products. They also support integration with renewable power systems and lead a broader energy and economic transition.

- Global energy consumption for electric mobility increased 60% in 2024, with more than half of this demand coming from electric cars.

- To put the transport sector on track to limit warming to around 1.8°C, electric passenger cars will need to reach 100% of new sales by 2030 (at the latest) in leading markets (China and member countries of the Organisation for Economic Co-operation and Development, OECD), with other markets reaching 100% by 2040. Electric trucks will need to reach 100% adoption by 2035 in leading markets and by 2040 in other markets, with urban buses reaching these targets by 2027 and 2030, respectively.

- Recent roll-backs and delays are likely to slacken the pace of EV adoption at a time when substantial acceleration is needed to keep the 2°C goal within reach.

- Excluding low-speed electric scooters and mopeds (but including all other motorised vehicle categories covered in this section), EVs displaced an estimated 1.32 million barrels of oil per day (Mbd) in 2024, nearly double the level of 2022. This exceeds the national oil demand of large countries such as Spain (1.27 Mbd), Italy (1.24 Mbd) and Australia (1.12 Mbd). Light-duty vehicles accounted for around three-quarters of the oil displaced by EVs as of 2024; however, this share is set to fall to around 60% by 2030 as the deployment of heavy-duty EVs increases.

- Excluding low-speed electric scooters and mopeds, EVs led to an estimated net reduction of 180 million tonnes of greenhouse gas emissions (well-to-wheel emissions) in 2024, more than double the reduction in 2022.If low-speed electric scooters and mopeds are included, the savings near an estimated 250 million tonnes.

- Overall, battery electric vehicles emit far fewer greenhouse gas emissions on a life-cycle basis than fossil fuel-powered vehicles, especially when the vehicles are charged using low-carbon electricity. On average, a battery electric car sold in 2023 was expected to emit 50% fewer emissions over its entire life (including the emissions from vehicle production and end-of-life) than a comparable ICE vehicle. Similar or even greater life-cycle emission reductions have been calculated for other vehicle categories including micromobility modes, buses, and trucks in the EU, buses in Latin America, trucks in India, two-wheelers in India and Indonesia, and cars in China and the Middle East and North Africa region.

- Supply chains for EV batteries have become increasingly concentrated in recent years, even as battery demand has increased. In 2024, the top three refining nations controlled 86% of global production for key minerals (up from 82% in 2020), with China dominating cobalt, graphite, rare earths, and refiners of 19 of 20 minerals. Concentration of mining has also increased, from 73% in 2020 to 77% in 2024 for the top three producers – the Democratic Republic of the Congo for cobalt, Indonesia for nickel, and China for graphite and rare earths.

- Evidence suggests that a gender gap exists in the adoption and use of EVs, with women being under-represented across nearly all segments of the e-mobility ecosystem.

- Systemic barriers to EV adoption include a general tendency for men to travel longer distances than women, greater risk perception among women in using remote charging points, advertising more often targeting men, and few policies directly addressing gender equity in transport electrification, particularly in emerging markets. Solutions to help close the gender gap include increasing female participation in transport planning and e-mobility industries and better considering gender factors in e-mobility.

KEY FINDINGS

Policy and Investment developments

- Since 2023, both the Group of Seven (G7) governments and a broad set of countries under the United Nations framework have made high-level international commitments to decarbonising road transport.
- At the national level, policy developments towards vehicle electrification included new regulations as well as challenges and repeals of existing regulations (as in the United States) and modifications to vehicle standards (as in the United Kingdom and the EU).
- China's target for electric cars to comprise 47% of new car sales by 2027 was met two years early, with quarterly sales in 2025 already reflecting this target.
- In early 2025, the EU pushed back its initial target requiring manufacturers to reduce the CO_2 emission intensities of new passenger cars by 2025; instead, it allowed manufacturers to average their emissions intensities over the three-year period 2025-2027, thereby reducing the stringency.
- Canada's EV Availability Standard, adopted in December 2023, requires rising shares of battery-electric and plug-in hybrid vehicles, starting at 20% and increasing annually to 100% in 2035.
- Australia's New Vehicle Efficiency Standard, adopted in 2024, requires emission reductions (in grams of CO_2 per kilometre) of more than 60% for new passenger vehicles and around 50% for light-commercial vehicles (vans), from 2025 to 2029.
- In the United Kingdom, amendments to the zero-emission vehicle (ZEV) mandate, proposed in April 2025, expand and extend flexibilities for ICE and plug-in hybrid vehicles to 2030.
- Clean fleet mandates, which require fleets to transition to zero-emission vehicles, have increasingly been established at the national and sub-national levels.
- Several governments across high-income countries and emerging economies have promoted electric buses and put in place policies that have enabled them to leverage concessional finance, thanks in part to collaboration and support from development finance institutions.
- In the United States, policies to reduce greenhouse gas emissions from road vehicles and to promote EV sales were being rolled back by the Trump administration as of early 2025. However, the situation remained dynamic and difficult to anticipate.
- Several countries have announced policy packages providing financial support to promote EV adoption, including purchase incentives and tax credits. Newly adopted fiscal policies increasingly promote EVs by reducing or exempting them from registration and taxes, rather than explicitly subsidising their purchase. Especially in advanced economies, subsidies and tax exemptions are increasingly targeted to apply only to lower-cost EVs (such as through price caps) and/or to lower-income households.
- Countries have increasingly used exemptions or reductions in import tariffs – often coupled with similar reductions/exemptions to VAT, registration and circulation fees – to incentivise EV adoption, with increased adoption notable in emerging markets and developing economies. Many of these markets have implemented selective import duty and/or VAT or excise tax exemptions on EVs.
- Multiple policy initiatives have aimed to accelerate the deployment of charging and refuelling infrastructure for zero-emission vehicles. To increase the availability of charging in apartment complexes, policies have included: regulations that require charge points in the garages of renovated or new apartments, subsidies targeting multi-unit dwellings and apartments, competitive bidding for public charging infrastructure, and credit guarantees to reduce lending risks.
- The EU's Alternative Fuels and Infrastructure Regulation (AFIR) sets mandatory targets for the deployment of charging stations and hydrogen refuelling along the main TEN-T motorway network.
- China's National Development and Reform Commission and State Council both set deployment targets for EV supply equipment in 2022 and 2023.
- Other Asian countries have announced policies supporting the deployment of charging infrastructure, and in some cases concrete policies have been set up to implement targets.
- In the United States, as of mid-2025, the new Trump administration had taken significant steps towards rolling back EV infrastructure initiatives established by the previous administration.
- Several initiatives like The Global Green Road Corridors Initiative aim to develop "green corridors" with charging and refuelling infrastructure for heavy-duty vehicles on major roads around the world. Additionally, significant

KEY FINDINGS

progress was made towards piloting and testing a standard for heavy vehicles.

- In addition to governments, manufacturers have announced increasing ambition for heavy-duty vehicle electrification. Although most industry initiatives were announced in Europe, some also occurred in the United States.
- Policies are increasingly being adopted to promote strategic on-shoring of parts of the EV and battery value chains, as a means of securing better jobs and industrial development prospects and to ensure resilience of this rapidly emerging clean energy sector. Policies to help diversify supply chains for EV battery manufacturing and related industries include government incentives to attract new mining and processing players, with fiscal and financial incentives on both the supply and demand sides.
- Producer and consumer subsidies for EVs and batteries are increasingly being coupled with local content conditions. Alternatively or in addition, countries have begun to impose selective tariffs on fully built-up imported EVs.
- In the EU, efforts have been made to frame EV uptake using a circular economy approach that includes the end-of-life recycling of batteries and the re-use and recovery of other materials (e.g., electronics, metals, minerals).

Context, challenges and opportunities

Current transport systems are highly emissions intensive. Meeting the world's climate and sustainability goals requires transitioning to low-emission and energy- and resource-efficient ways of moving people and goods, supported by appropriate measures to manage transport demand, adopt infrastructure and technologies, and ensure access to sustainable transport. This transition must enable a fair and resilient socio-economic transformation that protects vulnerable groups and promotes economic opportunity.

Electrification is central to the decarbonisation of both road and rail transport, and is also relevant for ferries, short-distance shipping and port emissions. Electric passenger cars, in particular, are one of the bright spots of the clean energy industry. Electric powertrains for road transport are a mature, scalable technology aligned with trends in energy decarbonisation, digitalisation and industrial innovation. Electric vehicles (EVs) offer a pathway to improved air quality and health and reduced fossil fuel dependency. They also support integration with renewable power systems, enabling a broader energy transition.

The electrification of road transport vehicles is a pivotal part of a broader transformation needed in transport systems. This transformation will need to proceed rapidly worldwide and to encompass universal access to sustainable, low-carbon transport, and broader societal and industrial goals. This transformative change requires an integrated multi-modal, multi-level approach that goes beyond transport electrification and addresses all aspects of the transport system.

The technological transition brought by EVs and low-carbon electricity has implications for supply chains, with deep impacts on skills, jobs and their geographical distribution. This and other socio-economic, equity, and access implications of the transition to electric mobility require careful and calibrated policy to anticipate and manage in a fair manner that protects vulnerable groups and enables shared and resilient prosperity.

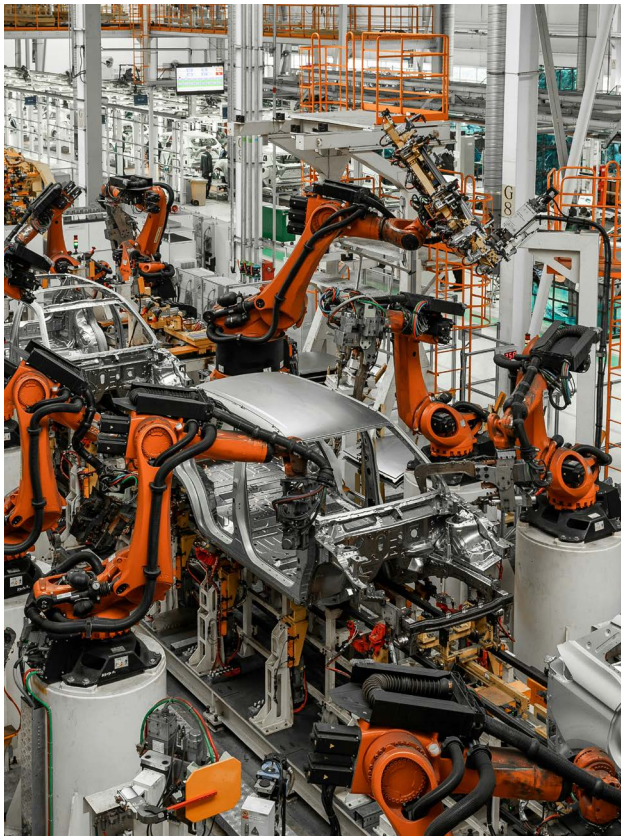
Complementing electrification are low-emission technologies such as sustainable biofuels, hydrogen and hydrogen-based fuels. Sustainable biofuels remain critical for sectors less suited to electrification, such as long-distance aviation and shipping (see 4.9 Aviation and 4.10 Shipping). Alternative fuels can help reduce emissions from heavy-duty road transport, where EV charging infrastructure is currently lacking or unaffordable. However, not all of the biofuels used in road transport meet sustainability criteria, and large-scale biofuel production poses risks to food prices and biodiversity. Meanwhile, clean hydrogen remains costly and investment-intensive, making fuel cell and other hydrogen vehicles unable to compete economically with direct electrification or conventional vehicles (see 5.1 Transport and Energy).[1]

Despite the success of electric two- and three-wheelers and urban public transport buses, including in emerging markets and developing economies, the risk of an electric

mobility divide remains a concern. Early EV markets in most countries have been dominated by expensive, high-end models, limiting affordability and access, particularly for low-income households and countries.[2] Low-cost charging is often scarce, especially in multi-unit (apartment) buildings.[3]

In recent years, many countries have adopted policies to accelerate EV and renewable electricity uptake, aiming to meet economic development, environmental and sustainability goals in a resilient and cost-effective manner. Some countries have set targets to phase out internal combustion engine (ICE) vehicles. Increasingly, policy efforts combine technology transition with greater consideration for social protections, wealth redistribution and trade. Some low- and middle-income countries have also started to set ambitions and targets for local EV manufacture or assembly (for example, based minimum local content or value-added requirements).

Key regulatory policies to improve the efficiency of road vehicles and accelerate EV adoption include removing subsidies for fossil fuels (and factoring in their true pollution and climate costs) and setting fuel economy or vehicle efficiency standards, carbon dioxide (CO_2) emission standards and EV sales targets for road vehicles to drive the adoption of efficient technologies.[4] Governments can also use fiscal policies, such as "feebates", to incentivise the purchase or use of more efficient vehicles (including EVs). Policies to promote EV sales have increasingly shifted from direct subsidies or purchase tax rebates to targeted tax exemptions or reductions. Examples include import duties, value-added tax (VAT), luxury taxes, road tolls and parking fares, and registration and/or circulation taxes.



For electric buses and trucks, the availability of affordable and convenient charging is particularly important. Electrification of buses is proceeding based on public funding, leveraged by loans from multilateral development banks, and supported by clean fleet mandates at the national and sub-national levels. Corporate and civil society initiatives, together with public policies and international standardisation (such as megawatt charging standards) are creating the necessary conditions to upscale electrification in medium- and heavy-duty truck segments.

Large EV fleets alone will not address a variety of challenges to sustainable transport, such as improving the inclusivity of access, reducing emissions to the levels required for climate action, or resolving congestion, land-use pressures and other environmental impacts. Extreme weather can also reduce vehicle performance, although modern EVs increasingly feature IP67-rated, water- and shock-resistant battery systems and can provide back-up power sources during electricity outages.[5]

An additional risk is the increasing concentration of supply chains for EV battery manufacturing and related industries in a few countries (particularly China), which can create potential bottlenecks for critical materials such as copper and lithium (see Box 1).[6] Addressing this will require a co-ordinated response across countries, including proactive industrial, resource, and trade policies as well as national policies that promote value-added in batteries and automotive sectors, where relevant and feasible from a competitive and industry policy perspective. International co-operation will remain vital to reduce risks of conflict and enhance supply security.

The overall contribution of low-emission vehicles to climate and sustainability goals will critically depend on their integration with wider socio-economic systems. The uptake of EVs can better align with broader integration of transport systems when they are rolled out among broad measures under the Avoid-Shift-Improve (A-S-I) framework – avoiding unnecessary travel while guaranteeing access to sustainable transport; shifting to public, shared and active transport; and improving vehicle and fuel efficiency. The key is to focus on a diverse set of options to provide access to sustainable mobility for all and to achieve a net zero emission pathway.[7]

(See 1.2 The Right to Mobility in a Sustainable and Inclusive Society, 1.3 Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet; 4.2 Integrated Transport Planning Across Urban and Rural Contexts; 4.5 Public Transport, 4.6 Popular Transport, 4.7 Rail and 4.8 Road Transport.)

Box 1: Mining and material use, and their sustainability implications for battery production

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Key minerals are essential for a wide range of industries, from construction to automobiles and electronics. Driven by battery production and clean energy deployment, the demand for certain minerals – copper, lithium, nickel, cobalt, graphite and rare earth elements – has surged in the past years. In 2023, demand for critical minerals experienced strong growth, with lithium demand increasing 30%, while demand for nickel, cobalt, graphite, and rare earth elements grew 8% to 15%. This growth trend is predicted to continue, resulting in turbulence in the mineral market.

Globally, mining of minerals increased in 2023. Critical mineral supply outpaced demand growth, and, combined with inventory build-up in downstream industries, it led to a decline in market prices. Key mineral extraction is concentrated in several countries; however, the geographic distribution of mining production ownership differs greatly. Chile is the world's largest copper producer, but European companies dominate as the leading producers. Similarly, while lithium mining is centred in Australia and Chile, major US companies control production. Nickel and cobalt mining in Indonesia and the Democratic Republic of Congo is largely controlled by Chinese and European companies. In 2025, Indonesia has banned export of raw nickel and requires processing before exporting to local use and supporting the domestic mineral market.

Electric vehicles are the major source of demand for batteries. Global electric vehicle sales in 2024 reached 17.5 million units, growing 25%. Electric vehicles have become the largest consumer of lithium and account for a remarkable share of nickel, cobalt and graphite. Battery demand from storage also rose sharply, with installed capacity reaching over 85 gigawatts. More than 90% of the market share is dominated by lithium-ion batteries, while lithium iron phosphate (LEP) batteries are rising rapidly due to different technical needs between electric vehicles and storage.

The prosperous development of the mining and battery industries has raised concerns around sustainability. Mining and refining activities have significant impacts on ecosystems due to land degradation, water pollution, and greenhouse gas emissions, while also having effects related to human rights, local community conflicts and geopolitical relations. To enhance their sustainability, various methods exist. From the technological and industrial perspective, technology advancement and recycling can reduce waste and emissions, as well as relieve mineral demand pressure. For example, the use of silver and silicon in solar cells has decreased in the past decade, which alleviates supply strains. Although the recycling of some metals is mature, recycling processes for key minerals used in batteries are still under development.

As the first generation of electric vehicles reaches the end of its life, large-scale battery recycling will become a critical challenge. The International Energy Agency assesses that around 30 gigawatt-hours of spent electric vehicle batteries will be available for recycling by 2030. It is also crucial to monitor environmental, social and governance (ESG) risks in the mineral supply chain, with transparent and reliable reports and data. Finally, consumer behaviours also influence sustainability. SUVs accounted for two-thirds of battery-electric models on the market in 2023, with a demand for bigger batteries using more materials. Regulating vehicle battery sizes and promoting efficient travel patterns could help reduce mineral demand and mitigate sustainability concerns.

- Canada imposed a 100% surtax on Chinese-produced electric vehicles effective 1 October 2024, to counteract unfair trade practices in China, including subsidisation and lax labour and environmental standards.
- In 2024, the EU imposed countervailing duties on Chinese electric vehicles for five years, with rates varying by company: BYD at 17.0%, Geely at 18.8%, SAIC at 35.3%, and other co-operating companies at 20.7%, while Tesla faces a duty of 7.8%; non-cooperating companies are subject to a duty of 35.3%.
- In 2024, the United States increased tariffs on imported electric vehicles from China from 25% to 100%, and raised tariffs on batteries from China from 7.5% to 25%.

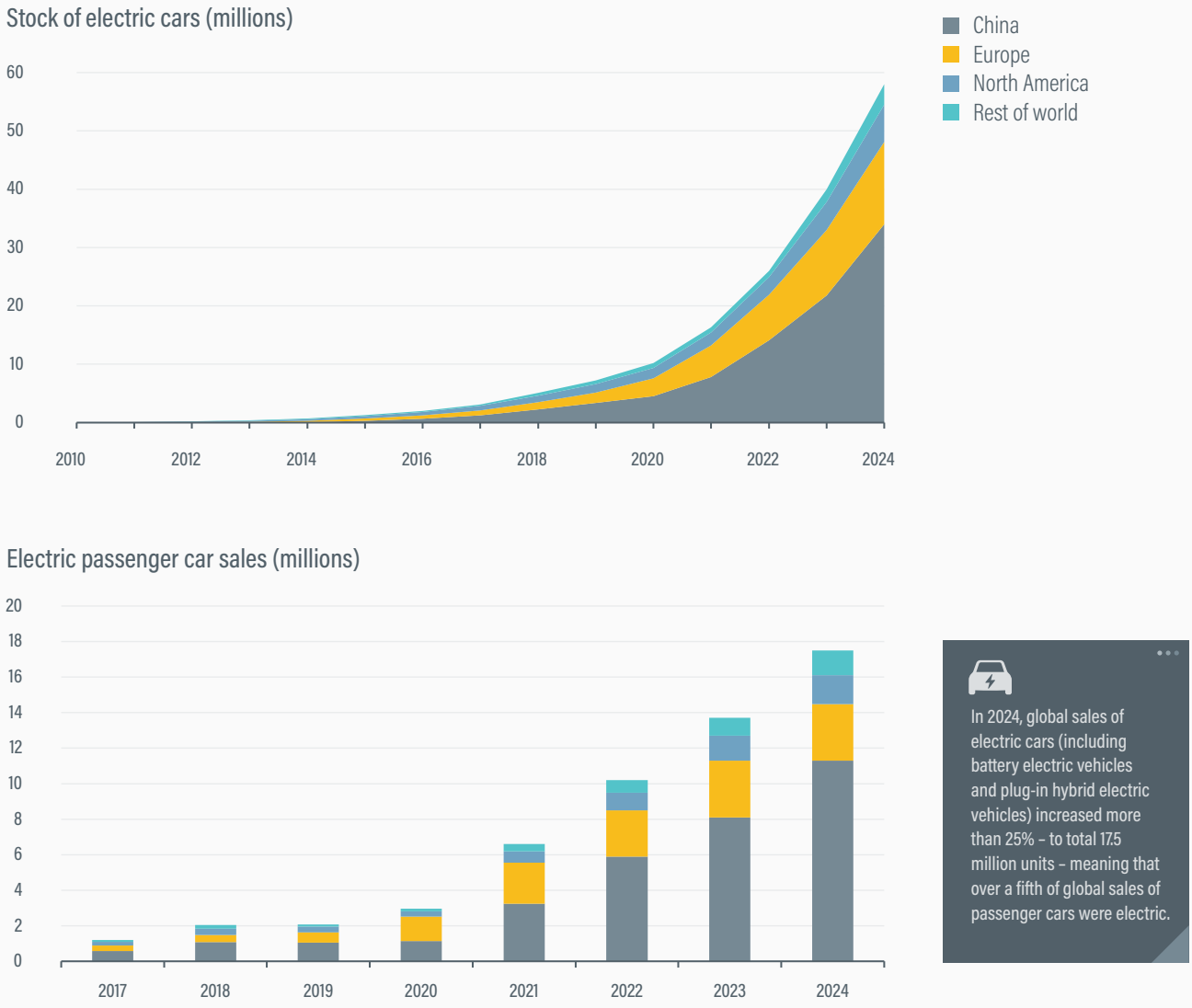
Source: See endnote 6 for this section

Demand, use and access

A total of 58 million electric cars were on the world's roads in 2024, more than 11 times the number in 2018 (Figure 1)**.**[8] **The global electric car fleet was 5.7 times larger in 2024 than in 2020, maintaining four-year average growth of 54%.**[9] **Despite this growth, electric cars accounted for less than 5% (4.5%) of vehicles globally, with more than two-thirds of the fleet operating in China.**[10] Around 67% of electric cars in 2024 were battery electric vehicles, and the rest consisted of plug-in hybrids.[11]

In 2024, global sales of electric cars (including battery electric and plug-in hybrid models) increased more than 25% to reach 17.5 million units (Figure 1)**.**[12] **More than one-fifth (20%) of all passenger cars sold during the year were electric (13.8% battery electric, 8.2% plug-in hybrid), up from 14% in 2021.**[13] Early estimates suggest that in 2025, more than one-in-four car sales will be electric, with sales exceeding 20 million units.[14] However, EV sales may reach only 18.5 million units for the year due to tariff-related uncertainties, evolving EV sales targets in Europe and the roll-back of incentives in the United States.[15]

FIGURE 1. Electric passenger car stock (top) and sales (bottom), 2010-2024



In 2024, global sales of electric cars (including battery electric vehicles and plug-in hybrid electric vehicles) increased more than 25% – to total 17.5 million units – meaning that over a fifth of global sales of passenger cars were electric.

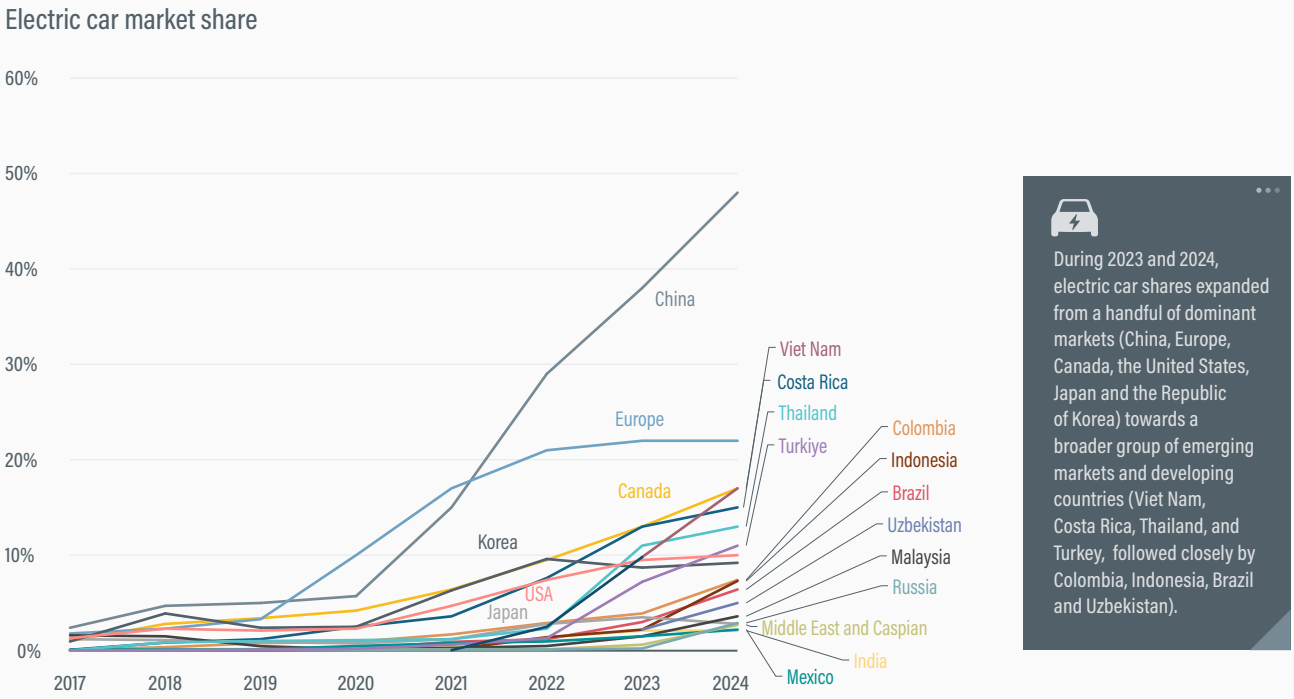
Source: See endnote 8 for this section.

Electric car sales in China reached 11 million units in 2024, accounting for 65% of EVs sold worldwide and for nearly half (48%) of all domestic car sales.[16] **Monthly sales of electric cars in China have overtaken sales of new ICE cars since July 2024, marking a major milestone in the transition of the world's largest automotive market.**[17]

EV sales in Europe remained relatively constant in 2024, with around a 20% share.[18] **The limited growth in European sales was aligned with regulatory requirements that did not require an increase in the region's EV market share until 2025.**[19] **Several European countries also phased out EV purchase subsidies.**[20]

- Norway continued to lead the world in electric car sales, with shares of 92% in 2024 and 95.2% in early 2025, up from 90% in 2023.[21]
- EV sales shares in Denmark grew from 46% in 2023 to 56% in 2024.[22]
- In Germany, EV sales shares dropped from 31% in 2022, to 25% in 2023, to 20% in 2024.[23]
- Data for the first quarter of 2025 showed that European EV sales resumed their growth in almost all countries – with Germany reaching a 26.6% sales share and Denmark 68.3% – as manufacturers aimed to meet European regulatory CO_2 emission requirements by year's end.[24]

FIGURE 2. Market shares of electric cars in selected markets, 2017-2024



During 2023 and 2024, electric car shares expanded from a handful of dominant markets (China, Europe, Canada, the United States, Japan and the Republic of Korea) towards a broader group of emerging markets and developing countries (Viet Nam, Costa Rica, Thailand, and Turkey, followed closely by Colombia, Indonesia, Brazil and Uzbekistan).

Source: See endnote 27 for this section.

Electric car sales in the United States grew 40% in 2023, driven by policy support from the Inflation Reduction Act.[25] In 2024, however, sales growth fell to only 10%, with a total of 1.6 million units sold.[26]

During 2023 and 2024, consumer interest in electric cars expanded from the dominant markets of China, Canada, Europe, Japan, the Republic of Korea and the United States towards a broader group of emerging markets and developing countries. These include Costa Rica, Thailand, Türkiye, and Viet Nam, followed closely by Brazil, Colombia, Indonesia and Uzbekistan[i] (Figure 2).[27] Electric car sales showed promising signs of expanding in South-East Asia, Latin America and Africa. Across all three regions, Chinese auto manufacturers played a dominant role, in many cases representing more than 85% of EV imports.[28]

Electric car sales in South-East Asia surged nearly 50% in 2024, accounting for 9% of the region's total car sales.[29]

- Indonesia's EV sales tripled to reach over 7% market share, aided by reduced VAT and waived import duties for auto manufacturers investing in local production.[30]
- Malaysia's EV sales more than doubled, with local production ramping up by firms such as Perodua and Proton.[31]
- Thailand led the region in 2024, with a 13% EV sales share despite a decline in total car sales.[32]
- Viet Nam nearly doubled its EV sales (17% share), buoyed by local champion VinFast, which also began exporting to nearby countries.[33]

Electric car sales in Latin America more than doubled in 2024, with the regional market share rising to 4%.[34] Brazil led with 125,000 electric cars sold (a two-times increase), reaching 6.5% of total car sales.[35] Other strong performers were Costa Rica (15% share), Uruguay (13%) and Colombia (7.5%).[36] This growth was supported by government incentives (such as tax exemptions, reduced registration fees and traffic privileges for EVs) as well as relatively high fossil fuel prices.[37]

Africa's electric car market remained nascent in 2024 but showed signs of acceleration, with sales more than doubling to 11,000 units in 2024; however, EVs still comprised less than 1% of total car sales.[38] Challenges included limited charging infrastructure and parts availability.

i With the exception of Costa Rica, all these countries have domestic automotive manufacturing and/or assembly capacity. Indonesia and Brazil also have access to domestically available mineral resources. In many cases, these market share increases are associated with investments from China, reflecting its technology lead in EVs and its drive for growth opportunities in emerging markets.

- Notable growth occurred in Egypt and Morocco, driven by policy support and planned local manufacturing; the two countries have focused on building export-oriented EV supply chains.[39]
- Ethiopia implemented a ban on importing fossil fuel vehicles in 2024, reportedly leading to 100,000 EVs deployed, although reliable sales data are lacking.[40]
- Nigeria joined the Zero Emission Vehicles Declaration, aiming for 100% zero-emission car sales by 2040.[41]

Electric two- and three-wheelers continued to far exceed numbers of other electric vehicles, although estimates of their stock and sales vary greatly. Available data for 2024 suggest close to 400 million units globally, including nearly 80 million electric motorcycles and 320 million electric mopeds and low-speed electric scooters (and not including electric bicycles and micromobility vehicles such as kick-scooters).[42] China accounted for 85% of all electric motorcycles, with other Asia-Pacific countries contributing an additional 12%.[43]

Annual sales of electric motorcycles, mopeds and low-speed electric scooters totalled an estimated 35-50 million between 2021 and 2024, or between 40% and 50% of all two-wheeler sales annually.[44] Electric motorcycle sales ranged from 6 million to 10 million annually during this period, accounting for a global sales share of 15% compared with ICE motorcycles.[45] Outside of China, electric two- and three-wheelers in other Asian markets (India and South-East Asia) are significant – with close to 1 million units sold in India in 2024 – and are expected to add 10 million more units by 2030.[46]

In 2024, electric two-wheelers made up over 30% of total sales in South-East Asia, with strong progress in Indonesia, Thailand and Viet Nam.[47] Electrification of two- and three-wheelers has advanced rapidly in the region due to the vehicles' high market presence and suitability for short-range urban travel. Governments have encouraged adoption through fiscal incentives, reduced VAT and local manufacturing requirements.

- In Indonesia, the government has mandated local production for companies wishing to benefit from tax breaks, leading to growth in domestic assembly.[48]
- Viet Nam's VinFast is expanding its electric scooter offerings and exports, while Thailand's subsidies have boosted uptake among delivery fleets and private users alike.[49]

Electrification of two-wheelers in Africa is still emerging but has gained momentum in cities. Local start-ups and partnerships have focused on battery swapping networks and low-cost models suited for shared mobility and deliveries. Kenya, Rwanda and Uganda are noted hubs of innovation, although data on market penetration are limited. Barriers across the continent include import tariffs, financing access and lack of standards.

Globally, an estimated 40 million electric bikes (a bicycle equipped with a battery-powered motor, typically with pedal-assist) were sold annually as of 2023 (representing around 30% of all bikes) as well as an estimated 50 million electric kick-scooters.[50]

The global electric light commercial vehicle stock (vans) reached 1.9 million vehicles in 2024.[51] Electric sales totalled 650,000 units, or 7.1% of all sales.[52] Both the sales and stock more than doubled between 2022 and 2024, with the vehicles' stock share growing from 0.9% in 2023 to 1.3% in 2024.[53]

- By 2024, China accounted for 57% of the global stock of electric vans, with new sales reaching a 33% sales share.[54]
- In Europe, leading markets in 2024 included Norway (29% sales share), Sweden (22.7%), and Denmark (17.6%), followed distantly by France (7.1%), the United Kingdom (6.6%) and Germany (5.3%).[55]
- Data from the first quarter of 2025 show that electric vans have grown rapidly in all European markets, with high sales shares in Norway (41%), Sweden (27.5%), Denmark (25%), the United Kingdom (10.3%), France (9.7%) and Germany (6.6%).[56]

Sales of electric buses totalled 70,000 in 2024 (6% of total sales), up 30% from 2023; this brought the global stock to 730,000 units, or 4.9% of the total fleet.[57] Battery-electric buses continued to outpace fuel cell electric buses 35 to 1 due to their lower operational costs.[58]

China continued to dominate the electric bus market, accounting for 68% of global new sales and 89% of the global electric bus stock.[59] In the first half of 2024, 96% of urban bus sales in China were battery electric, with the rest being hybrid electric (2% of sales) and fuel cell buses (2%).[60] (Globally, battery-electric buses and trucks continued to far outpace fuel cell electric options, due to their lower operational costs.[ii]) Electric coaches comprised only 9% of sales, reflecting their earlier state of technological development.[61]

ii Fuel cell electric vehicles (FCEVs) face the major challenges of low conversion efficiency (and high costs) in the production of low-emission hydrogen (especially electrolytic hydrogen), as well as lower efficiency (compared with battery electric vehicles) in converting the energy stored in hydrogen to motive energy at the wheels (Bai et al., 2024; ITF, 2024). FCEVs require dedicated fuel transport and dispensing infrastructure, which implies further energetic losses and costs (Shao and Zheng, 2023).

In the European Union (EU), nearly 6,000 e-buses were delivered in 2024, up from 4,900 in 2023.[62] Electric buses accounted for 17% of the region's total bus sales in 2024.[63] However, EV adoption has varied widely depending on the size class and type of operations. In the class 1 segment (typically used for urban operations and with a low floor), electric bus sales overtook conventional diesel bus sales for the first time in 2024, reaching 55% of sales in the fourth quarter.[64] Coaches, which account for around half of bus sales in Europe and typically drive longer distances, had fewer electric models but reached 6% of new sales in the fourth quarter, with new European-made models due in 2026.[65] Non-EU European countries (including Norway and the United Kingdom) brought the region's 2024 e-bus sales to around 9,750.[66]

Electric bus adoption in the United States has been slower than in European and Chinese markets; nonetheless, in the first quarter of 2024, zero-emission[iii] buses accounted for 11% of all bus sales, with 641 newly registered units.[67]

Outside China, Europe, and North America, new sales of electric buses in 2024 totalled 9,500, a similar scale as in the European market.[68] Frontrunners included India, with 3,200 new sales in 2024, and the Republic of Korea with 2,800.[69]

Latin American countries – notably Chile and Colombia – continued to lead emerging markets in electric bus deployment, driven by strong public transport electrification initiatives.

- Santiago (Chile) operates one of the largest electric bus fleets outside China.[70]
- Bogotá (Colombia) has rapidly expanded its fleet through public-private partnerships and concessional financing models.[71]
- Brazil, despite being the region's largest vehicle market, has been slower to scale electric bus deployment but is building momentum with support for local manufacturing and municipal pilot programmes.[72]

Bus electrification in South-East Asia has accelerated in Indonesia, Thailand and Malaysia.

- Thailand's electric bus sales more than tripled in 2024, supported by government fleet procurement and infrastructure support.[73]
- Indonesia has begun electrifying urban transport fleets in Jakarta, aiming for a full transition in the coming years. Domestic assembly by local firms and Chinese manufacturers (such as BYD, which is active across the region) is contributing to cost reductions and faster deployment.[74]
- Malaysia has committed to greening public transport, with electric buses being adopted in select cities through public-private projects.[75]

Electrification of buses in Africa has remained limited but is growing, with developments centred in Egypt, Kenya and South Africa. Key hurdles include a lack of financing, grid limitations and insufficient charging infrastructure.

- Cairo (Egypt) is piloting electric buses in its urban fleet, supported by local manufacturing of components.[76]
- Kenya has seen progress through start-ups and utility-backed programmes for e-bus deployment in Nairobi.[77]
- South Africa is exploring integrating electric buses into bus rapid transit systems but faces challenges of high upfront costs, vehicle homologation[iv] and limited infrastructure.[78]

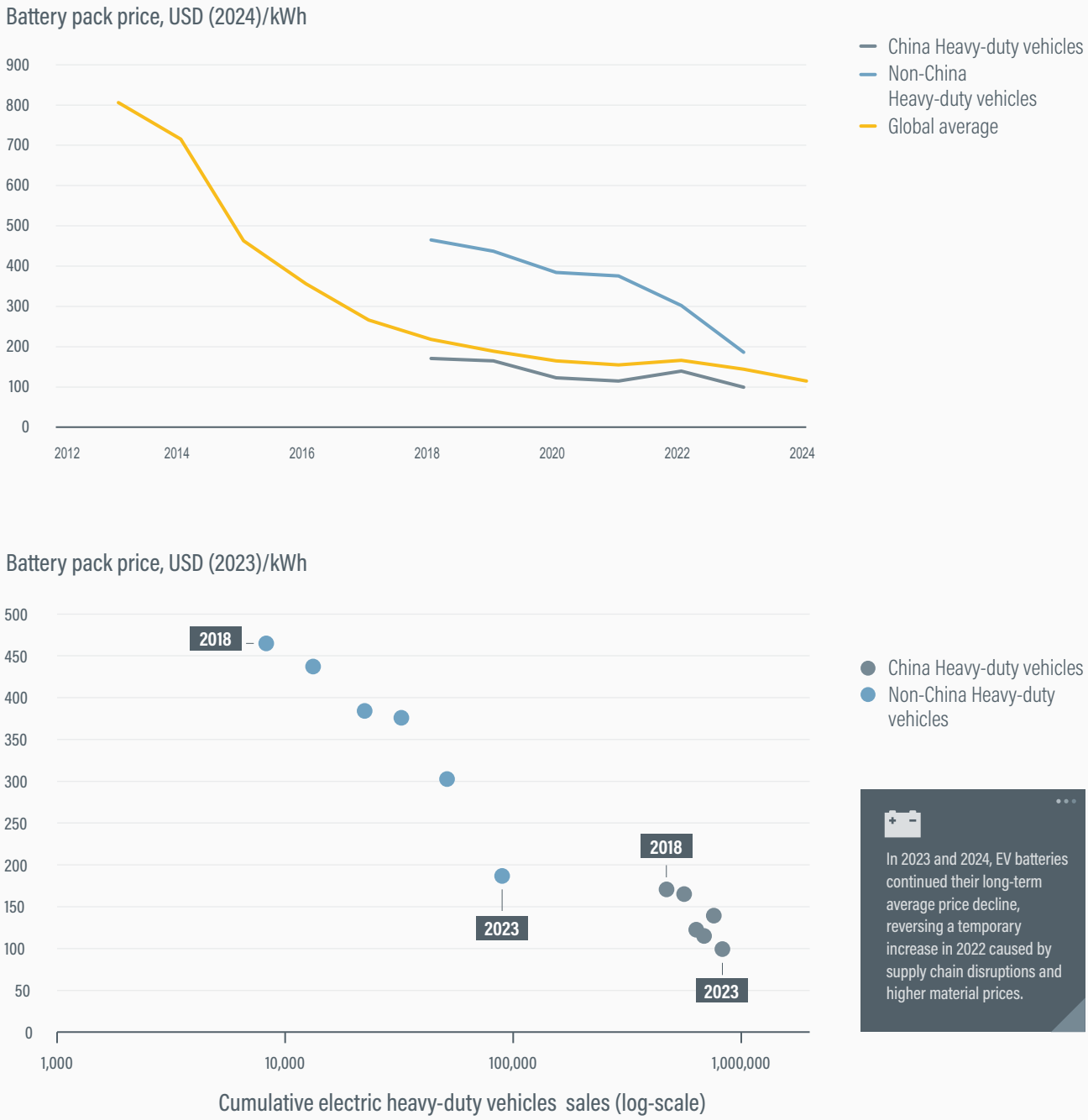
The number of zero-emission medium- and heavy-duty trucks on the world's roads increased 20% between 2022 and 2024 to 420,000 vehicles (around 0.5% of the global fleet); battery electric trucks represented 96% of the total.[79] Sales of zero-emission trucks increased from 36,000 units in 2022 to around 98,000 units in 2024, although this equates to just 1.7% of total truck sales.[80]

- Electric trucks accounted for 9% of both medium- and heavy-duty truck sales in China in the first half of 2024.[81] The Chinese market remained the largest market for zero-emission trucks, accounting for 82% of global sales.[82]
- In the EU-27, zero-emission heavy duty truck sales reached 3,356 in 2024, representing 1.2% of total sales (1.5% in the fourth quarter of 2024).[83]
- Germany had the largest sales volume of electric heavy-duty trucks in Europe in 2024, at 1,198 trucks, accounting for 36% of total EU sales.[84]
- The highest sales share of electric heavy-duty trucks in Europe was in Sweden (home to many large EU truck manufacturers), where the e-trucks accounted for 6.4% of new truck sales in 2024.[85]
- European adoption of electric light- and medium-duty trucks (weighing 3.5-12 tonnes) was much higher, accounting for 6,000 new registrations in the EU in 2024, or a 17% sales share.[86] Leading markets were Finland (83% sales share), Luxembourg (76%), Denmark (68%), and the Netherlands (46%), while the largest market was Italy with 1,047 new registrations.[87]
- In the United States, 764 zero-emission heavy-duty trucks

iii Zero-emission is used here to identify vehicles with zero tailpipe CO_2 emissions, using electricity or hydrogen as energy carrier. Ensuring that these vehicles effectively deliver very low emissions depends on how the electricity and hydrogen are produced. Today, battery electric options are better placed to deliver actual emission reductions, using a life-cycle perspective, due to their better energy efficiency and to the fact that nearly all hydrogen is currently produced from fossil energy, without carbon capture.

iv In South Africa, all new, built-up, or modified vehicles – local or imported – must meet compulsory safety-critical specifications and be homologated by the NRCS under SANS 10267 via a sample and manufacturer evidence, including recognised lab reports for the vehicle and components; only then is a NATIS number issued, enabling sale, registration and licencing.

FIGURE 3. Battery price development from 2012-2024 (left) and compared with cumulative production (right)



Sources: See endnote 91 for this section.

were registered in 2023, accounting for around 0.3% of total sales.[88] In the first half of 2024, this share rose to around 0.5% of heavy-duty vehicle sales.[89] Sales of electric medium-duty trucks (weight of 6.4 to 15 tonnes) remained low, at just 0.14% of sales in the first half of 2024.[90]

In 2023 and 2024, EV batteries continued their long-term average price decline, reversing a temporary increase in 2022 caused by supply chain disruptions and higher material prices (Figure 3).[91] **The ongoing battery price reductions are due to a combination of economies of scale (as EV deployment continues to increase) and innovation, including a shift to cheaper battery chemistries. The global**

average battery pack price (across all sectors) fell 31% between 2022 and 2024, to reach USD 115 per kilowatt-hour (kWh) (in real 2024 USD).[92]

- Chinese manufacturers have enjoyed a competitive advantage due to lower battery prices for electric heavy-duty vehicles, with average battery pack prices in 2023 estimated at USD 99 per kWh, compared with USD 186 per kWh elsewhere (both in real 2023 USD).[93]
- Chinese cumulative sales of electric heavy-duty vehicles are around an order of magnitude larger than the rest of the world, contributing to lower production costs[v]. Scaling up the deployment of electric heavy-duty vehicles will likely drive further price reductions, accelerating adoption.

EV charging infrastructure more than doubled between 2022 and 2024, to exceed 5 million charge points globally.[94] **An estimated 1.3 million new publicly available chargers were installed during 2024.**[95] **China was home to roughly two-thirds (65%) of the world's public charge points in 2024, with more than 3 million.**[96] To reach the levels of EV deployment targeted for 2035 under current policies worldwide, public charging infrastructure would need to increase six-fold compared to 2023 levels.[97]

- Charging infrastructure in the EU more than doubled between 2022 and 2024, reaching 880,000 EV charge points.[98] By the second quarter of 2025, the EU had a total of 948,000 charge points, including 155,000 direct current (DC) units.[99]
- In North America, the number of public charge points reached 208,000 in the United States and 34,000 in Canada as of May 2025, with DC fast chargers accounting for around 25% of the total.[100]
- Charging infrastructure also expanded in markets such as Brazil (with 12,000 charge points in 2024), and in Indonesia, Malaysia, Thailand and Viet Nam.[101]

By 2024, the global stock of fast chargers (with a power output of more than 22 kW) reached 2 million; stocks of

v However, it is not clear from the data how differences in battery chemistry mixes between regions may influence these results, nor is it clear whether the data on batteries produced outside of China excludes all Chinese-made components (BNEF, 2024).

ultra-fast chargers (150 kW or higher) grew more than 50% to account for nearly 10% of all fast chargers.[102] **China remained the global leader in fast-charging deployment.** Ultra-fast charging infrastructure has seen rapid global growth since 2022, with prices dropping 20% between 2022 and 2024.[103] Fast and ultra-fast public chargers deliver more energy daily than slow chargers, serving more vehicles. However, this electricity comes at higher costs, except with extremely high (and not common) use rates.

- China added 400,000 fast chargers in 2024 (80% of global growth) for a total of 1.6 million.[104] As of 2024, China offered more than 3 kW of public fast charging capacity per electric light-duty vehicle.[105]
- In China, cities such as Beijing and Chongqing, along with companies like XPeng and Volkswagen, aim to install tens of thousands of ultra-fast chargers by 2025 to support growing EV demand.[106]
- The United States expanded its fast charger network from 40,000 to 50,000 in 2024, yet had less than 1.5 kW of capacity per electric light-duty vehicle.[107]
- In the EU, the number of fast chargers (excluding ultra-fast) increased nearly 50% in 2024, to 71,000.[108] Ultra-fast chargers grew 60% to more than 77,000, with 20% of these offering 350 kW or more.[109]
- In Denmark, Finland, France, and Germany, the number of ultra-fast charger units increased 70-95% in 2024.[110] The Charge France initiative plans to invest USD 4.1 billion (EUR 4 billion) to more than double France's ultra-fast charger stock by 2028.[111]
- The Republic of Korea increased its fast charger count 38% in 2024, to 47,000 units, and planned to add 4,400 more in 2025, backed by an infrastructure budget of USD 425 million (KRW 620 billion).[112]
- In India, three state-run oil companies installed nearly 8,000 fast chargers between late 2021 and the first quarter of 2024, under the FAME II programme.[113]

In addition to road vehicle electrification, efforts to rapidly electrify and modernise rail networks has continued, led by China and India. Direct electrification is generally the most promising option to reduce emissions associated with diesel trains, particularly for urban and inter-city rail systems that provide efficient and high-throughput passenger and cargo transport.[114] For markets that continue to rely heavily on diesel trains – including the United States and Canada as well as Eastern European countries, Indonesia, and South Africa – capital needs to be allocated rapidly and rationally to electrify lines and locomotives, starting with the most heavily utilised assets, where the payback is typically faster .[115] Climate and development finance, as well as loans from international finance institutions, can help ensure the implementation of high-priority projects in emerging markets and developing countries. (See 4.7 Rail.)

Sustainability and climate trends

The EV transition provides wide-ranging environmental, social and economic benefits and should be considered in the broader context of sustainable development (Box 2)**.**[116] **EVs offer a pathway to improved air quality and health and reduced fossil fuel dependency, particularly in countries that rely on imported oil products. They also support integration with renewable power systems and lead a broader energy and economic transition.**

Box 2. Benefits to sustainable development from the transition to electric vehicles

Lower emissions and energy use: EVs emit no tailpipe CO_2, consume much less energy per kilometre than petrol or diesel vehicles, and produce fewer greenhouse gas emissions over their life cycle. These benefits grow as electricity grids decarbonise: in 2024, low-carbon electricity contributed more than 40% of global generation (over 30% from renewables, a record share). In all major EV markets, the CO_2 intensity of electricity generation fell between 2015 and 2024 – including in the EU (-6.3%), the United States (-3.9%) and China (-1.7%). As renewable capacity expands and EVs become even cleaner, this will lead to further emission cuts and air quality improvements. (See 5.1 Transport Energy Sources.)

Enabling the energy transition: EVs enable the broader energy transition by reducing oil dependence, improving energy efficiency, increasing renewable power use, providing flexibility in electricity demand, and enabling innovation in grid management and digital services. Renewable electricity can lower EV charging costs, especially in countries that have volatile fossil energy prices and/or carbon taxes. (See 5.1 Transport Energy Sources.)

Managed EV charging during the cheapest periods and via vehicle-to-grid services can reduce costs and improve the efficiency of the electricity system. In the United Kingdom, some utilities offer vehicle-to-grid deals with free charging overnight in exchange for using the EV's battery for grid support. Bi-directional energy transfer, combined with smart-grid technology, is reshaping energy management.

Cost-effectiveness: EVs are often the most cost-effective option for reducing transport costs, with other low-emission technologies also contributing. Declining costs for batteries and renewable power have improved affordability.

Digital integration: Digital advances – from connected services and software updates to smart charging and bi-directional energy transfer – are enhancing EV capabilities.[117] For connected EVs, their functionality and performance are primarily controlled, enhanced and updated through software. The top digital automakers include EV manufacturers such as US-based Lucid, Rivian,

and Tesla, and Chinese rivals like Nio, Xpeng and BYD, while legacy automakers have struggled to keep pace. The low operating costs of EVs makes them well suited for high-use digital applications such as ride-sharing (e.g., Waymo's Jaguar I-PACE electric cars) and passenger and freight co-loading. In the United States, digital platforms optimise EV charging access, sitting and costs.

Economic and employment impacts: As they become increasingly cost-competitive, EV batteries and renewable power can support economic development and job creation. EVs and their batteries benefit from so-called "technology learning effects" and have been driving significant technological innovations and economic productivity, also due to their clear synergies with digital technologies. Economic diversification will be critical in oil-exporting countries as energy demand shifts toward renewables.

However, this technological transition has implications for supply chains and for countries whose auto industries are focused on ICE vehicles, with impacts on skills, jobs and their geographical distribution. Targeted investment in diversifying automotive value chains, along with workforce retraining, are essential to offset job losses in auto parts and components industries with new job opportunities. Job losses in ICE vehicle manufacturing can be compensated by net job growth in battery and low-carbon value chains and in charging infrastructure, as battery and renewable energy value chains are generally more labour-intensive than fossil fuel supply chains.

This transition must be managed in a fair manner that protects vulnerable groups and enables shared and resilient prosperity (see 1.6 A Just Transition in Transport: A Double Challenge) and calls for the integration of energy, transport, industrial, social, and trade policies and investment through co-ordinated public and private sector action.

Source: See endnote 116 for this section.

Global energy consumption for electric mobility increased 60% in 2024, with more than half of this demand coming from electric cars.[118] **In total, EV fleets consumed an estimated 180 terawatt-hours of electricity in 2024.**[119] Comprehensive EV deployment is essential to achieve aggressive emission reduction pathways aligned with the Paris Agreement's goal of keeping global temperature rise within 1.5 degrees Celsius (°C) – and well below 2°C – by 2100.[120]

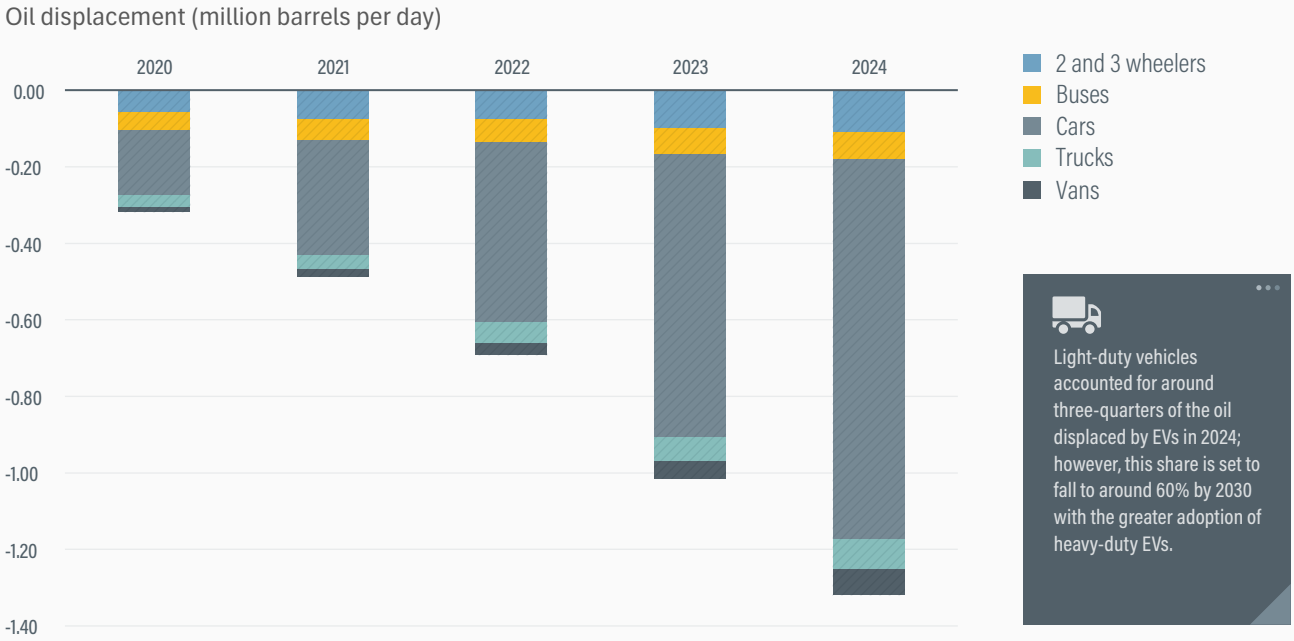
To put the transport sector on track to limit warming to around 1.8°C, electric passenger cars will need to reach 100% of new sales by 2030 (at the latest) in leading markets (China and member countries of the Organisation for Economic Co-operation and Development, OECD), with other markets reaching 100% by 2040.[121] **Electric trucks will need to reach 100% adoption by 2035 in leading markets and by 2040 in other markets, with urban buses reaching these targets by 2027 and 2030, respectively.**[122]

Recent roll-backs and delays are likely to slacken the pace of EV adoption at a time when substantial acceleration is needed to keep the 2°C goal within reach.[123] Reducing emissions to be compatible with 1.5°C of warming would require meeting all current targets for EV adoption along with extremely ambitious reductions in travel demand.[124] Despite the high expected EV adoption under current policies, more is needed to greatly reduce emission levels by 2060.

Excluding low-speed electric scooters and mopeds (but including all other motorised vehicle categories covered in this section), EVs displaced an estimated 1.32 million barrels of oil per day (Mbd) in 2024, nearly double the level of 2022 (Figure 4).[125] **This exceeds the national oil demand of large countries such as Spain (1.27 Mbd), Italy (1.24 Mbd) and Australia (1.12 Mbd).**[126] **Light-duty vehicles accounted for around three-quarters of the oil displaced by EVs as of 2024; however, this share is set to fall to around 60% by 2030 as the deployment of heavy-duty EVs increases.**[127]

- Electric two- and three-wheelers (excluding low-speed electric scooters and mopeds) accounted for around 8% of the reduced oil demand from EVs, while electric buses, trucks and vans each contributed around 5-6%.[128]
- Considering low-speed electric scooters and mopeds as replacements for petrol-powered mopeds (comparable to ones used in Southern Europe in the 1970s) delivers an additional 0.5 Mbd in oil demand savings.[129] These estimates are based on assumptions of the shares of car, bus, and walking and cycling travel that are displaced by electric two- and three-wheelers.[130]

FIGURE 4. Oil displacement through electric vehicles, 2020-2024



Source: See endnote 125 for this section.

Excluding low-speed electric scooters and mopeds, EVs led to an estimated net reduction of 180 million tonnes of greenhouse gas emissions (well-to-wheel emissions) in 2024, more than double the reduction in 2022.[131] **If low-speed electric scooters and mopeds are included, the savings near an estimated 250 million tonnes.**[132] The reductions in transport emissions are due mainly to the rising numbers of EVs on the road, and will be accelerated further as the increasing penetration of renewable energy reduces the carbon intensity of electricity – a trend that is clear across nearly all of the world's countries.

Overall, battery electric vehicles emit far fewer greenhouse gas emissions on a life-cycle basis than fossil fuel-powered vehicles, especially when the vehicles are charged using low-carbon electricity.[133] **On average, a battery electric car sold in 2023 was expected to emit 50% fewer emissions over its entire life (including the emissions from vehicle production and end-of-life) than a comparable ICE vehicle.**[134] **Similar or even greater life-cycle emission reductions have been calculated for other vehicle categories** (Box 3)**, including micromobility modes, buses, and trucks in the EU, buses in Latin America, trucks in India, two-wheelers in India and Indonesia, and cars in China and the Middle East and North Africa region.**[135]

The exact emission reduction potential of a battery or plug-in hybrid EV relative to a conventional ICE vehicle depends on many factors, including the battery size, electricity grid emission intensity, annual mileage and vehicle efficiency; even so, greenhouse gas emission reductions can be expected even in the most coal-intensive and highly emitting grids.[136] An electric car sold today can be expected to achieve life-cycle greenhouse gas emission reductions of 20% in India and 40% in China.[137]

Box 3. Comparative analysis of life-cycle emissions of low-emission vehicles in the European Union

- **Battery electric vehicles** emit **73% fewer** life-cycle greenhouse gases than petrol cars (63 versus 235 grams of CO_2 equivalent per kilometre) on the 2025-2044 average EU electricity mix — and **78% less** (52 gCO_2e/km) when powered by renewable electricity.
- **Production emissions** of battery electric vehicles (notably from battery manufacturing) are offset within **17,000 kilometres**, well within the first 1-2 years of use.
- **Hybrid and plug-in hybrid vehicles** offer modest reductions of **20-30%**, but still emit **2-3 times more** than battery electric vehicles.

- **Fuel cell electric vehicles** only match the emissions of battery electric vehicles when using **renewable hydrogen**; using fossil-based hydrogen yields emissions of **175 gCO_2e/km**, only 26% better than petrol.
- An ICCT study found that Doubling biofuel blending in Europe from today's levels would only improve the lifecycle GHG emissions of an ICEV sold in 2025 by 0.5-3%

Source: See endnote 135 for this section.

Supply chains for EV batteries have become increasingly concentrated in recent years, even as battery demand has increased[vi]. In 2024, the top three refining nations controlled 86% of global production for key minerals (up from 82% in 2020), with China dominating cobalt, graphite, rare earths, and refiners of 19 of 20 minerals.[138] **Concentration of mining has also increased, from 73% in 2020 to 77% in 2024 for the top three producers – the Democratic Republic of the Congo for cobalt, Indonesia for nickel, and China for graphite and rare earths.**[139] So far, the production and processing needed for nickel, cobalt, graphite, and rare earths may be sufficient to meet projected demand growth; however, copper and lithium remain at risk, with copper facing a projected 30% supply gap by 2035 unless measures are taken to ensure its availability.[140]

Evidence suggests that a gender gap exists in the adoption and use of EVs, with women being under-represented across nearly all segments of the e-mobility ecosystem. Although the use of electric three-wheelers has shown promise in enhancing women's mobility in low-income regions, this has not been the case everywhere. High costs limit women's access to e-bikes and to electric two-wheelers globally.[141]

- In the United States, women accounted for 41.2% of new car registrations but for only 28% of EV registrations as of 2022.[142]
- Data from early EV markets in California (United States) found that sales and leases of electric cars were skewed towards men.[143]
- Studies in Spain and the United Kingdom found that men had greater rates of adoption and lower knowledge barriers on EVs.[144]
- In China, wealthier men were found to have a higher chance of intending to purchase plug-in hybrid and battery electric vehicles.[145]
- In India, there is clear evidence of a gender gap in the use and driving of electric two- and three-wheelers (e-rickshaws), with women being under-represented among drivers.[146]
- Men are reported to be more frequent users of shared electric micromobility services: according to one platform, men accounted for roughly 60% of ridership.[147]

Systemic barriers to EV adoption include a general tendency for men to travel longer distances than women, greater risk perception among women in using remote charging points, advertising more often targeting men, and few policies directly addressing gender equity in transport electrification, particularly in emerging markets. Solutions to help close the gender gap include increasing female participation in transport planning and e-mobility industries and better considering gender factors in e-mobility.[148]

Policy and investment developments

Since 2023, both the Group of Seven (G7) governments and a broad set of countries under the United Nations framework have made high-level international commitments to decarbonising road transport.

- The G7 targets in 2024 focused on fiscal policies to "accelerate vehicles fleet turnover" as a means to achieve greenhouse gas emission reductions aligned with the goals of the Paris Agreement.[149]
- In 2025, the United Nations Economic Commission for Europe advanced the global decarbonisation strategy for road transport (and other inland modes) by 2050, which acknowledges a broad set of policies that will be needed to cut road transport emissions.[150] Through the strategy's collaborative platform, signatory countries pledged to implement policies towards transport decarbonisation.[151]

At the national level, policy developments towards vehicle electrification included new regulations as well as challenges and repeals of existing regulations (as in the United States) and modifications to vehicle standards (as in the United Kingdom and the EU).

vi Demand for the critical materials used in EV batteries has surged. Lithium demand jumped around 30% in 2024, exceeding its average increase during the 2010s by an order of 10%. Demand for nickel, cobalt, graphite, and rare earths also rose, with more than 85% of this growth driven by energy applications, including EVs, stationary batteries, renewables and grids. Despite this strong demand growth, prices have stayed low as the new supply from each of the three top producers has outstripped demand: lithium prices fell more than 80% during 2021-22, and prices of cobalt, nickel and graphite all dropped 10-20% in 2024. This pricing squeeze has hampered mining investment, which rose just 5% in 2024 (2% in real terms), and exploration stalled. There is overdependence on China to supply low-cost and high-performance EV batteries, and to manufacture affordable EVs.

China's target for electric cars to comprise 47% of new car sales by 2027 was met two years early, with quarterly sales in 2025 already reflecting this target.[152] China's shift towards EVs has been accelerated by stricter fuel consumption and emission standards, which make it increasingly difficult for conventional ICE vehicles to comply. China's previous Stage 3 standards, incentivising the adoption of electric vans, trucks[153] Updated fuel consumption standards also set tighter limits for passenger cars to 2030[154] In 2025, China was expected to adopt China 7/VII standards, tightening pollutant emission requirements[155]

In early 2025, the EU pushed back its initial target requiring manufacturers to reduce the CO_2 emission intensities of new passenger cars by 2025; instead, it allowed manufacturers to average their emissions intensities over the three-year period 2025-2027, thereby reducing the stringency.[156] A second phase of the EU's CO_2 emission standards for heavy-duty vehicles, adopted in May 2024, expands the scope of vehicle classes covered from around 65% to over 90%, requires greater CO_2 reductions in 2030 (of 45%, up from 30%), and requires CO_2 reductions of 65% in 2035 and 90% in 2040.[157] The standards also set minimum requirements for 90% zero-emission urban bus sales by 2030 and 100% by 2035.[158] In April 2024, under Euro 7/VII, the EU adopted new pollutant emission standards for cars, vans, and trucks, as well as battery durability requirements.[159]

Canada's EV Availability Standard, adopted in December 2023, requires rising shares of battery-electric and plug-in hybrid vehicles, starting at 20% and increasing annually to 100% in 2035.[160] Canada's EV sales share grew from 13% in 2023 to 17% in 2024; this continuing growth in Canada (and in the United Kingdom), compared with the stagnating shares in the EU and the United States, hints at the benefits of linear increases in performance or technical standards.

Australia's New Vehicle Efficiency Standard, adopted in 2024, requires emission reductions (in grams of CO_2 per kilometre) **of more than 60% for new passenger vehicles and around 50% for light-commercial vehicles (vans), from 2025 to 2029.**[161]

In the United Kingdom, amendments to the zero-emission vehicle (ZEV) mandate, proposed in April 2025, expand and extend flexibilities for ICE and plug-in hybrid vehicles to 2030.[162] These flexibilities have the potential to substantially weaken the near-term effectiveness of the policy.[163]

Clean fleet mandates, which require fleets to transition to zero-emission vehicles, have increasingly been established at the national and sub-national levels. These mandates generally target urban buses as well as municipal, public service, and government fleets, requiring that all vehicles purchased or operating transition to zero-emission powertrains.

- California's Advanced Clean Fleet requirements, and aspects of it that have been integrated into the Advanced Clean Trucks rule, require government fleets to operate 50% on ZEVs by 2026 and 100% by 2036, and will require large fleets to operate 100% on ZEVs by 2036.[164]
- Colombia has set minimum EV purchase quotas of 30% for public bus fleets and 10% for city bus fleets in 2025, with the latter rising to 100% by 2035.[165]
- In 2019, both Ecuador and France required that new public transport vehicles transition to 100% electric by 2025.[166] France also required that at least 50% of city- and town-level bus purchases be low-emission by 2022.[167]
- Israel set EV sales requirements on municipal buses in 2022 for a rapid ramp-up to 100% by 2026.[168]
- In 2018, Poland set minimum ZEV sales share targets for public service and government vehicles, and city buses.[169]
- Viet Nam issued a requirement in 2024 that all urban buses purchased from 2025 onward be battery electric.[170] Similar fleet requirements have been put in place at the city and state/provincial levels.

Globally, countries are increasingly prioritising EV adoption and zero-emission transport as part of their climate and energy strategies. Moreover, countries, including Ethiopia and Kenya, have introduced policies to accelerate the shift towards electric mobility in 2024, setting ambitious targets for EV adoption in the coming decades. However, it's important to note that EV targets alone do not necessarily lead to increased renewable energy usage unless they are coupled with specific mandates or internal combustion engine (ICE) bans. The impact of these targets largely depends on a country's electricity mix; without a corresponding shift towards renewable energy sources, the environmental benefits of EV adoption may be limited.

- The government of **Ethiopia** has announced a ban on internal combustion engine (ICE) vehicle imports in 2024, effective immediately, to accelerate the transition to electric mobility and reduce fossil fuel dependence.[171]
- In 2024, **Kenya** has set a target for 5% of all registered vehicles to be electric by 2025 as part of its strategy to reduce transport emissions, although infrastructure and affordability remain challenges.[172]
- **Greece** announced in 2023 that by 2030, 50% of new passenger car registrations and 40% of new light commercial vehicle (LCV) registrations are required to be electric, supporting Greece's climate commitments and European Green Deal objectives.[173]
- **India** aims to boost the adoption of battery electric vehicles (BEVs) in part by setting a national goal of 30% of all vehicle sales in 2030 being BEVs.[174]
- As announced in its latest NDC, published in early 2025, **Cuba** aims for 15% of the total vehicle fleet to be electric by 2035, while 70% of newly registered vehicles in 2035 are expected to be electric.[175]
- **Azerbaijan**'s latest NDC sets targets for the share of electric vehicles in the total vehicle fleet, aiming for 46% in the high ambition scenario and 90% in the very high ambition scenario by 2050 for electric cars; 38% in the high ambition scenario and 75% in the very high ambition scenario by 2050 for electric scooters/motorcycles; and 38% in the high ambition scenario and 75% in the very high ambition scenario by 2050 for electric golf carts.[176]
- **Panama**'s latest NDC includes targets for 2027 and 2030: by 2027, 7% - 18% of the total private vehicle fleet will be electric, 15% - 30% of private vehicle sales will be electric, 14% - 25% of buses in authorized concession fleets will be electric, and 21% - 35% of public fleets will be electric. By 2030, these targets increase to 10% - 20% of the total private vehicle fleet being electric, 25% - 40% of private vehicle sales being electric (subject to climate financing and international market conditions), 15% - 35% of buses in authorized concession fleets being electric (subject to climate financing and international market conditions), and 25% - 50% of public fleets being electric (subject to climate financing and international market conditions).[177]
- **Lesotho** aims to electrify motorcycles, targeting 910 electric two-wheelers by 2030, resulting in a GHG reduction of 0.2 kt CO2eq per year by 2030, as announced in their latest NDC.[178]
- **Saint Lucia** has set an ambitious target in their third NDC: to achieve 30% electric vehicle (EV) sales by 2030, increasing to 40% by 2035.[179]
- As indicated in its latest NDC, the **United Kingdom**'s Zero Emission Vehicle (ZEV) mandate is the world's most ambitious national-level regulatory framework of its kind, with annual minimum targets for the proportion of new cars and vans sold in the UK from 2024 rising to 80% of cars and 70% of vans by 2030 on a pathway to 100% by 2035.[180]
- **Canada** finalised the Electric Vehicle Availability Standard (regulated targets for zero-emission vehicles) in December 2023, which requires 100% of new light-duty vehicles (LDVs) offered for sale in Canada to be ZEVs by 2035.[181]

Several governments across high-income countries and emerging economies have promoted electric buses and put in place policies that have enabled them to leverage concessional finance, thanks in part to collaboration and support from development finance institutions. Countries with policies that support the leveraging of concessional finance (i.e., finance provided by multilateral development banks with interest rates below those offered by high-street banks) to deploy electric buses include Albania (2023), Chile (2023), Colombia (2022), Jordan (2020), Kazakhstan (2024), the Kyrgyz Republic (2021), Mexico, Panama (2024), Thailand (2023), Türkiye (2024), Uzbekistan (2023) and Paraguay and Uruguay (2022). Countries that offer grants towards the purchase of e-buses include Canada (from 2022), Cyprus

(from 2023), Hungary (from 2019), Israel (from 2021) and the Republic of Korea (from 2023).[182]

In the United States, policies to reduce greenhouse gas emissions from road vehicles and to promote EV sales were being rolled back by the Trump administration as of early 2025. However, the situation remained dynamic and difficult to anticipate.

- A US executive order in early 2025 froze funding for EV-related loans, grants, and tax incentives, including for batteries, vehicles and charging infrastructure.[183] A federal judge later ordered that the funds be reinstated; however, continuing delays in disbursement led to litigation, and the uncertainty engendered by the freeze and tariffs spurred the cancellation or delay of major EV production plans.
- In May 2025, the US Congress passed a bill to phase out the tax credits of the Inflation Reduction Act which previously offered purchase subsidies for zero-emission vehicles.[184]
- To implement ambitious targets set by the previous administration, in 2024 the US Environmental Protection Agency (EPA) finalised greenhouse gas emission standards for heavy-duty vehicles, setting targets for 2032 requiring vocational trucks (such as utility vehicles and delivery trucks) to reduce their CO_2 emissions up to 60% per tonne-mile and road tractor trucks up to 40%.[185] In early 2025, the new administration's EPA announced that it would reconsider both pieces of legislation as well as the nitrogen oxide (NO_x) engine standards for heavy-duty vehicles adopted in 2022.[186]
- In 2022, the US Congress voted to rescind California's waiver to the Clean Air Act that is the basis for that state's recent EV sales requirements for light-duty vehicles (Advanced Clean Cars II) and trucks (Advanced Clean Trucks), as well as strict NO_x emission rules for heavy-duty engines.[187] The legislative actions came despite assertions that refute Congress' authority to revoke the waiver. Because California's rules are followed by multiple other US states, they have served to accelerate market diffusion of clean transport technology at a national level.[188]

Several countries have announced policy packages providing financial support to promote EV adoption, including purchase incentives and tax credits. Newly adopted fiscal policies increasingly promote EVs by reducing or exempting them from registration and taxes, rather than explicitly subsidising their purchase. Especially in advanced economies, subsidies and tax exemptions are increasingly targeted to apply only to lower-cost EVs (such as through price caps) and/or to lower-income households.

- In 2024, the Indian government announced funding of around USD 1.3 billion (INR 10,900 crore) for two years for the PM E-DRIVE policy package, which provides EV purchase incentives of around USD 440 million (INR 3,679 crore) to promote electric two- and three-wheelers, ambulances, buses, and trucks, with additional measures for charging infrastructure.[189]
- Japan announced public funding of around USD 830 million to support ZEV subsidies in 2024.[190]

- Brazil's 2023 National Green Mobility and Innovation Program (MOVER) measure, in addition to establishing new guidelines for fleet sustainability and incentives for new automotive technologies, outlines financial incentives and support for EVs, including credits and fiscal incentives for 2024- 2028.[191]
- China extended its purchase tax exemption for new energy vehicles (NEVs) to the end of 2025; through 2027, the taxes will continue to be half those for conventional ICE vehicles.[192]
- A Chinese "cash-for-clunkers" style fleet renewal subsidies programme, introduced in the third quarter of 2024 and extended through 2025 (albeit at lower per-vehicle rates), has incentivised the purchase of millions of efficient and electric vehicles.[193]
- The Republic of Korea adapted its subsidies for electric cars and trucks in 2025 to target EVs that have longer driving ranges and faster charging speeds; it will provide additional electric car subsidies to young buyers and households with multiple children.[194]
- Belgium's phase-out of tax deductions for company ICE vehicles and plug-in hybrid EVs, alongside continued incentives for battery electric and fuel cell vehicles, has driven a sharp rise in EV uptake. In 2024, registrations of new battery electric vehicles increased 37% – to nearly 128,000 – with 87% of the vehicles registered by companies.[195]

Countries have increasingly used exemptions or reductions in import tariffs – often coupled with similar reductions/exemptions to VAT, registration and circulation fees – to incentivise EV adoption, with increased adoption notable in emerging markets and developing economies. Many of these markets have implemented selective import duty and/or VAT or excise tax exemptions on EVs.

- Countries that have exempted or reduced import duties on EVs include Argentina (in 2025), Armenia (in 2024), Azerbaijan (exemption includes also VAT, and is on imported EV chargers, from 2024), Angola (50% exemption on both import duties and vehicle tax, from 2022), Belarus (from 2021), Bolivia (from 2021), Brazil (in 2022, with gradual phase-out of exemptions from 2023), Ecuador (from 2021), Ethiopia (with import duty and VAT exemptions/reductions in 2022 put in place well before the country's 2024 ICE import ban), Finland (from 2022), Georgia (from 2020), the Kyrgyz Republic (from 2019), Malaysia (from 2024), Moldova (from 2019), Morocco (from 2022), Nicaragua (from 2022), Rwanda (from 2021), Saint Lucia (from 2023), Tajikistan (from 2022), Trinidad and Tobago (from 2021), Tunisia (from 2022), Ukraine (from 2015) and Uzbekistan (from 2022).[196] Switzerland removed its EV import exemption in 2024.[197]
- Other countries have reduced or exempted EVs from registration or circulation taxes or provided purchase subsidies to individual electric car buyers. Examples include Australia (from 2022), Austria (from 2023), Bosnia and Herzegovina (from 2022), China (through 2027), Denmark (since 2023), Israel (since 2024), Latvia (from 2020), Lithuania (2021), Mexico (from 2019), the Netherlands (from 2019), Nigeria (from 2023), the Philippines (from 2017), Poland (from 2020), Portugal (from 2017), Serbia (from 2024), Singapore (from 2021; also "feebate"-based registration taxes in 2024, including EV rebates), the Slovak Republic (from 2023), Spain (from 2020), Thailand (from 2022; also for hybrid EVs from 2024) and Viet Nam (from 2022).[198]
- Countries that recently reduced or waived taxes on corporate EV buyers include Austria (from 2023), Belgium (from 2023), Denmark (from 2023), Germany (no date) and Latvia (from 2020).[199]

Some countries have begun to scale back or remove tax reductions/exemptions applied to EVs. Such reforms help support long-term public fiscal sustainability, since the foregone revenue from import and VAT tax exemptions or reductions can constitute a major drain on public finances. Charting a course between ambitious EV sales targets, such as those achieved in Norway, and fiscal responsibility is a challenge facing even the wealthiest of countries.[200] A solution in countries with tight budgets is to implement "feebate"-like schemes that impose high taxes on low-efficiency vehicles, and to use these revenues to directly subsidise tax exemptions on EVs (and, potentially, fuel-efficient ICE vehicles), ensuring that tax programmes are at least revenue-neutral (and ideally net revenue generators).

- The United Kingdom's excise duty exemptions for EVs will phase out in 2025, along other EU member states.[201]
- In Norway, the most recent revision to the VAT reduction for EVs came into effect in 2024, and high-price EVs are subject to import duties.[202]

Multiple policy initiatives have aimed to accelerate the deployment of charging and refuelling infrastructure for zero-emission vehicles. To increase the availability of charging in apartment complexes, policies have included: regulations that require charge points in the garages of renovated or new apartments, subsidies targeting multi-unit dwellings and apartments, competitive bidding for public charging infrastructure, and credit guarantees to reduce lending risks. Without the availability of robust and reliable charging infrastructure, consumers may be reluctant to purchase EVs for fear of running out of power on the road, leading to "range anxiety", although this fear is waning in markets with greater EV uptake.[203]

- In California (via California Green Building Standards Code—Part 11, Title 24, California Code of Regulations—known as CALGreen), parts of Canada (through multi-unit residential buildings (MURBs)), in the EU (via the Energy Performance of Buildings Directive).[204]
- Costa Rica continued its commitment to develop a nationwide charging network through a partnership between the national electricity distribution company (ICE) and private initiatives, with plans to install 230 new chargers – including 30 fast chargers, nearly doubling their number.[205]

The EU's Alternative Fuels and Infrastructure Regulation (AFIR) sets mandatory targets for the deployment of charging stations and hydrogen refuelling along the main TEN-T motorway network.[206] The first mandatory targets, for 31 December 2025, include installing a total minimum power of 400 kW for passenger cars in each charging pool on the core network.[207] To ensure the possibility of fast charging, one charge point in each pool must have a rated output power of at least 150 kW.[208] These targets are scaled up progressively to expand to secondary roads in the "comprehensive network" and to increase the charging capacity required at each station.

- For heavy-duty vehicles, 15% of the total TEN-T network mustbe covered with charging stations at a maximum distance of 120 kilometres with a capacity of 1,400 kW, including at least one charge point with at least 350 kW.[209]
- The AFIR also sets targets for charging infrastructure in urban areas, to rapidly expand the network across Europe and to reduce barriers to EV adoption.

China's National Development and Reform Commission and State Council both set deployment targets for EV supply equipment in 2022 and 2023.[210] These include installing charging infrastructure for more than 20 million EVs by 2025, implementing peak/off-peak pricing for EV charging by 2025, setting minimum target thresholds for off-peak EV charging across pilot cities, and by 2030 fully establishing interactive networks that enable EVs to provide flexibility to the grid. This can be done, for example, through V1G (unidirectional grid-to-vehicle charging) and in some cases V2G (bi-directional grid-to vehicle charging) and vehicle-to-grid discharging. Technological advances have been achieved for faster charging.

- In early 2025, BYD announced delivering up to 400 kilometres of range in five minutes, and CATL later announced even faster charging speeds, using megawatt charging previously limited to only heavy-duty vehicles.[211]

Other Asian countries have announced policies supporting the deployment of charging infrastructure, and in some cases concrete policies have been set up to implement targets.

- In 2023, Japan's Ministry of Energy, Trade and Industry announced targets for 300,000 charge points by 2030.[212]
- Singapore in 2020 announced targets to deploy 60,000 EV charging points by 2030.[213]
- The Indonesian government announced in 2021 a target to deploy 30,000 charge points by 2030.[214] In 2025, this target was more than doubled to 63,000 charge points.[215]
- Thailand aims for 12,000 charge points by 2030, and the Philippines for 66,500 by 2028.[216]
- Viet Nam in 2024 began to subsidise electricity tariffs for EV charging.[217]
- Malaysia adopted income tax rebates in 2024 for manufacturers of EV supply equipment.[218]
- In February 2025, the Federal Highway Administration directed states to halt all new obligations under the NEVI, rescinding prior approvals and indicating that new guidance would be issued, notably impacting the Joint Office of Energy and Transportation and undermining its mission to co-ordinate federal support for EV infrastructure.[219]
- Later in 2025, after government research found that more than USD 3.2 billion should have been considered obligated to the NEVI, California and 15 other states and the District of Columbia filed a lawsuit against the administration for withholding designated federal funds for EV charging infrastructure.[220]

In the United States, as of mid-2025, the new Trump administration had taken significant steps towards rolling back EV infrastructure initiatives established by the previous administration. A central action was suspending the National Electric Vehicle Infrastructure (NEVI) Formula Program, a USD 5 billion initiative under the Bipartisan Infrastructure Law aimed at expanding EV charging stations across the country.

Several initiatives like The Global Green Road Corridors Initiative aim to develop "green corridors" with charging and refuelling infrastructure for heavy-duty vehicles on major roads around the world.[221] **Additionally, significant progress was made towards piloting and testing a Megawatt Charging System (MCS) standard for heavy vehicles.**[222] The MCS will enable charging at a maximum rate

of 3.75 megawatts, and the final standard applicable in Europe and North America, was expected to be finalised in 2026 with publication of the International Electrotechnical Commission standard.[223] Society of Automotive Engineers (SAE) standards were already published in March 2025.[224]

In addition to governments, manufacturers have announced increasing ambition for heavy-duty vehicle electrification. Although most industry initiatives were announced in Europe, some also occurred in the United States.

- Traton and Volvo Group announced an ambition for 50% of their truck sales in Europe to be electric by 2030, with Volvo also targeting more than 35% of sales being electric globally the same year.[225]
- Daimler announced an ambition for 60% of its European truck sales to be "carbon neutral" by 2030 and 100% by 2039.[226]
- In 2022, Traton, Volvo and Daimler formed a joint venture to build 1,700 high-power charging stations for heavy-duty trucks in Europe by 2027.[227] The venture, known as Milence, has since opened numerous stations around Europe.[228]
- In 2024, Daimler announced plans to build 100 heavy-duty vehicle charging stations in California (United States).[229]

Policies are increasingly being adopted to promote strategic on-shoring of parts of the EV and battery value chains, as a means of securing better jobs and industrial development prospects and to ensure resilience of this rapidly emerging clean energy sector. Policies to help diversify supply chains for EV battery manufacturing and related industries include government incentives to attract new mining and processing players, with fiscal and financial incentives on both the supply and demand sides like the US Inflation Reduction Act, India's Production Linked Incentives, Indonesia's investment and industrial partnerships, including through the state-owned Indonesia Battery Corporation.[230]

Producer and consumer subsidies for EVs and batteries are increasingly being coupled with local content conditions. Alternatively or in addition, countries have begun to impose selective tariffs on fully built-up imported EVs. Increased tariffs on imports of Chinese-made EV extend beyond the well-known ones adopted by Canada, the United States and the EU. To strengthen supply resilience, there is scope for countries or bilateral or multilateral trade blocks to design and implement policies that promote domestic value-added in battery production and EV manufacturing and assembly (although it is not advised to place export restrictions on unrefined critical minerals).

- Consumer subsidies in the US Inflation Reduction Act are subject to local content and other sourcing restrictions.[231]
- Countries that have established subsidies contingent on local value-added include Bangladesh (from 2021), Bolivia (from 2021), Ethiopia (from 2022), Indonesia (from 2022), Malaysia (from 2023), South Africa (from 2024) and Thailand (from 2024).[232]
- Tariffs on Chinese-made EV imports have increased (in some cases markedly) in Brazil, India, Indonesia, Mexico, the Russian Federation and Türkiye.[233] In India, Indonesia, and Türkiye, Chinese EVs that are locally assembled are subject to far lower tariff rates.[234]

Such policies should be accompanied by tailored electrification policies that prioritise affordable and heavily utilised EV categories (such as electric bikes and two- and three-wheelers, public transit and informal bus services, and car- and ride-sharing fleets). Policies have already been adopted that seek to address these dual risks.

In the EU, efforts have been made to frame EV uptake using a circular economy approach that includes the end-of-life recycling of batteries and the re-use and recovery of other materials (e.g., electronics, metals, minerals). The EU has led with comprehensive legislation on battery value chain transparency and circularity, and further proposed legislation could help advance circular design and materials use at the full-vehicle level.

- In 2023, the EU approved new updates to its Battery Regulation ensuring that 1) increased demand for EV batteries will be met using lower-emission batteries sourced from recycled materials, and 2) increasing shares of battery-critical raw materials will be built using recycled materials.[235]
- The EU's Critical Raw Materials Act establishes targets for material extraction, processing, and recycling, including that 35% of each of these three processes should occur within the EU by 2030.
- The EU has also shown leadership through the proposed End-of-life Vehicles Regulation.[236]

Limited policy steps have been taken to promote technology innovation, although much more can be done. Innovations include the diversification of cathodes (including sodium-ion batteries and manganese-rich and lithium iron phosphate materials) as well as advanced solid-state battery chemistries to reduce reliance on specific minerals such as cobalt and nickel.[237]

Partnerships in action

- Through the **Accelerating to Zero Coalition**, established at the 2021 UN Climate Conference in Glasgow, Scotland (COP 26), more than 200 stakeholders – including governments, auto manufacturers, investors, financial institutions and fleet operators – committed through the Zero Emission Vehicles Declaration to transition to 100% zero-emission cars and vans globally by 2040, and no later than 2035 in key markets.[238] Signatories included 31 national governments and 13 emerging markets and developing economies (among them Colombia, Costa Rica and Nigeria).[239] Signatories pledge to support emerging economies through technical assistance, finance and capacity building.[240]
- The **Electric Vehicle Initiative's EV30@30 campaign**, launched in 2017, set a goal of achieving 30% EV sales (including cars, buses and trucks) by 2030, with the support of 15 countries and more than 20 companies and organisations.[241]
- **EV100**, a global group of businesses committed to fleet electrification, has committed to deploying more than 5.5 million EVs by 2030.[242]
- As of 2025, the **Global Facility to Decarbonise Transport** (**GFDT**) had disbursed USD 6.36 million in grant funding and catalysed USD 400 million in World Bank-financed green mobility projects, with a further USD 950 million in World Bank-financed investments expected.[243] The GFDT had supported the implementation of 16 World Bank projects, with another 24 projects under preparation.[244]
- As of mid-2025, a total of 40 countries had committed to the **Global MoU on zero-emission medium- and heavy-duty vehicles** (**Global MoU on ZE-HDVs**), which aims to achieve targets for new electric truck and bus sales by 2030 and 2040.[245] The signatories agree to report progress annually and to develop plans to support their zero-emission vehicle deployment ambitions.
- The **TUMI E-Bus Mission**, which formally ended in May 2025, assisted 20 cities in creating world-leading electric bus fleets and scaling e-bus adoption to hundreds more through city-to-city mentorship.[246]
- The **Zero Emission Bus Rapid-deployment Accelerator** (**ZEBRA**) **Partnership**, led by C40 Cities and the International Council on Clean Transportation, supports major Latin American cities in accelerating deployment of zero emission buses.[247]
- The **Zero Emission Vehicles** (**ZEV**) **Transition Council** was established by the UK COP 26 Presidency as the world's first political forum to discuss how to accelerate the global transition to zero-emission vehicles. It consists of ministers and government representatives from the world's largest and most progressive auto markets, collectively accounting for more than half of all new car sales globally.[248]
- The **ZEV Rapid Response Facility,** launched under the ZEV Transition Council, aims to provide co-ordinated, easy and quickly accessible short-term technical assistance to governments in emerging and developing economies seeking to accelerate EV adoption. Recent technical assistance has involved: 1) trainings on EV safety in the Seychelles, 2) developing a strategic roadmap for charging infrastructure and updating vehicle inspection legislation and Nationally Determined Contributions in Türkiye, 3) determining greenhouse gas emissions from petrol and diesel ICE vehicles in El Salvador, and 4) extensive engagement on Kenya's draft e-mobility policy, including recommendations on battery collection and recycling, a supply-side regulation for two- and three-wheelers, and projects on the availability and reliability of charging infrastructure.[249]
- The **2024 Battery Passport** pilot of the **Global Battery Alliance** involved 10 global consortia of battery cell makers and traceability providers to test real-world sustainability data collection.[250] It was the largest initiative of its kind and included companies responsible more than 80% of global EV battery production.[251] The effort published 10 prototype battery passports, most of which covered battery supply chains in China, marking significant progress towards the goal of building sustainable, responsible battery value chains.[252]

5.1
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