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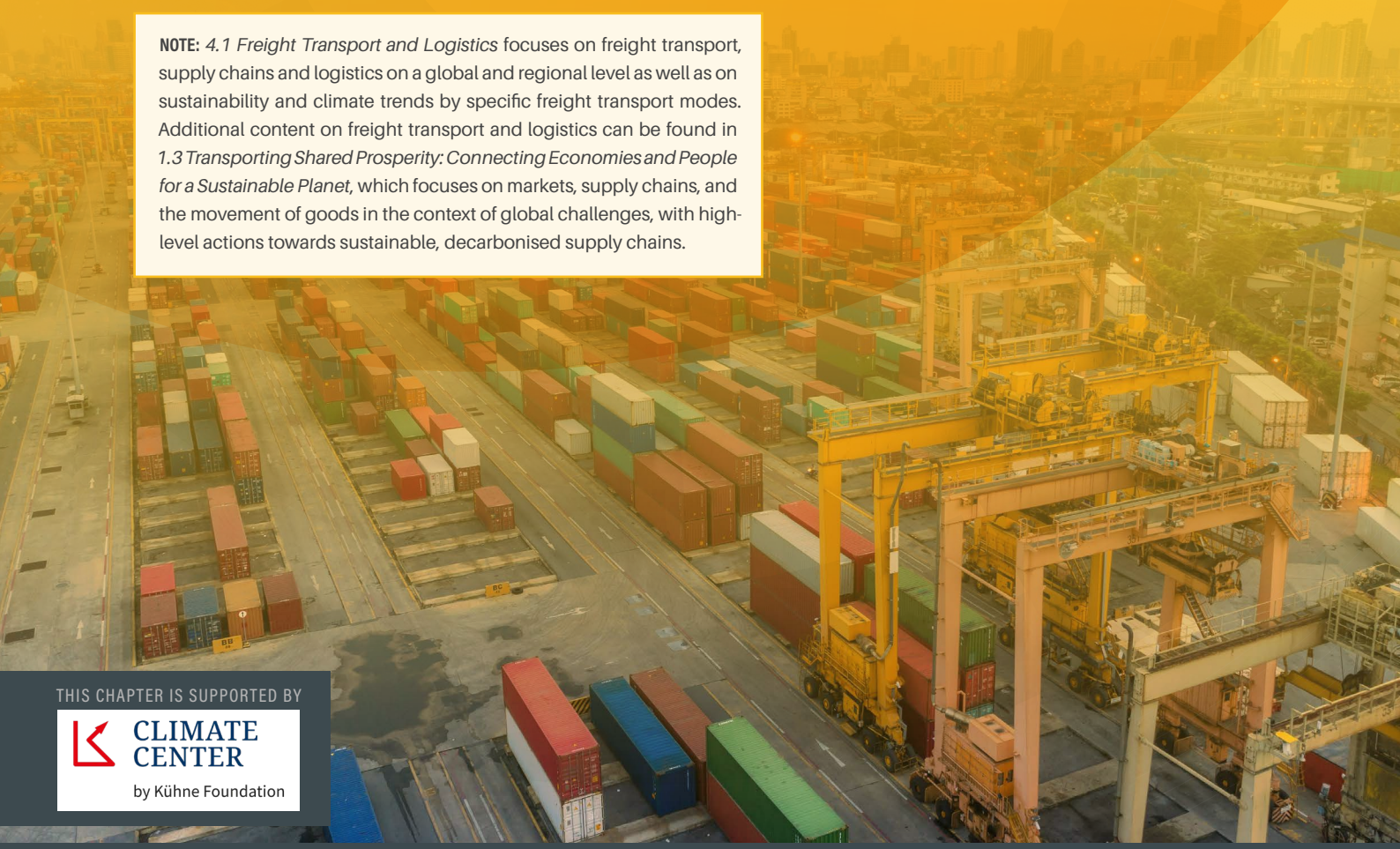
Freight Transport and Logistics

NOTE: *4.1 Freight Transport and Logistics* focuses on freight transport, supply chains and logistics on a global and regional level as well as on sustainability and climate trends by specific freight transport modes. Additional content on freight transport and logistics can be found in *1.3 Transporting Shared Prosperity: Connecting Economies and People for a Sustainable Planet*, which focuses on markets, supply chains, and the movement of goods in the context of global challenges, with high-level actions towards sustainable, decarbonised supply chains.



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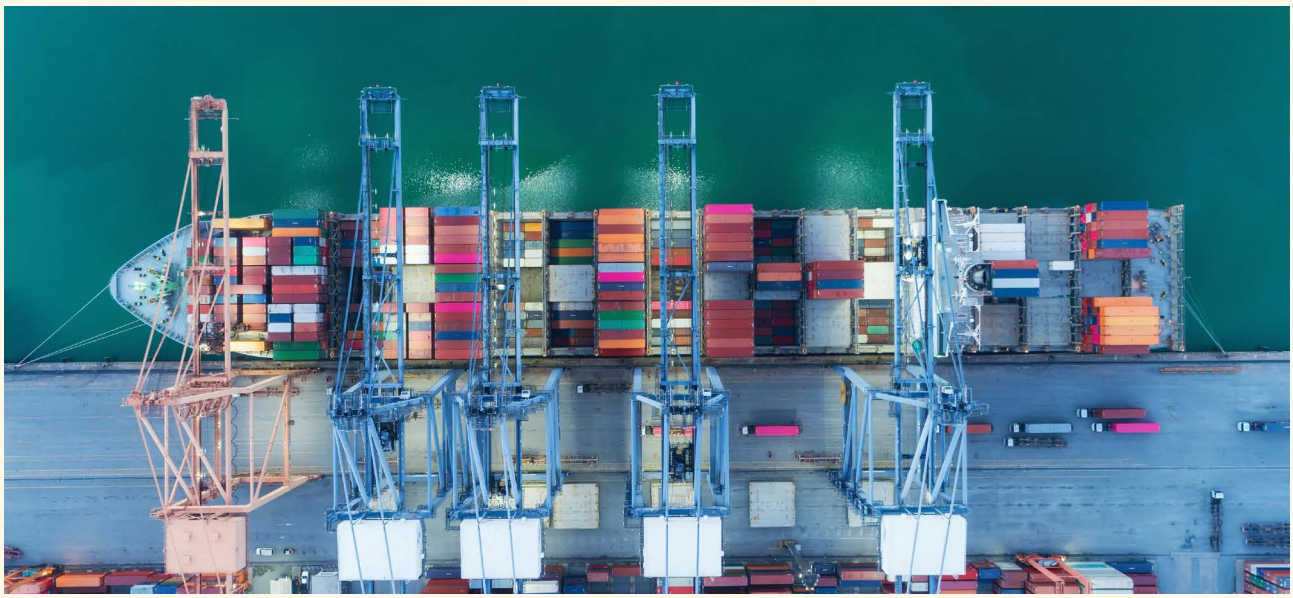
KEY FINDINGS

Demand, use and access

- Freight transport is intertwined with the economy. Logistics services – including warehousing, administration and management – generated revenues of around USD 10 trillion in 2024, or 5-10% of the global gross domestic product (GDP), with annual growth of 6-10% depending on the region. Freight transport has grown continuously in recent decades, slowing only briefly during periods of global economic crisis.
- Global freight activity grew an estimated 8% between 2020 and 2025 to surpass 171 trillion tonne-kilometres. Most of the world's freight is carried by water – in 2025, international maritime shipping accounted for 74% of all freight tonne-kilometres, and domestic maritime shipping for 5% – followed by rail (11%), road transport (10%) and aviation (0.1%).
- Shares of inland freight transport have remained relatively stable for decades, although rail's share has declined in countries that have growing market economies, such as China and India, putting into question the ambition of a modal shift from road to rail.
- Because rail transport is much less energy intensive than road transport, sustainability advocates have long supported shifting the movement of goods from road to rail. Yet so far, public policies and investments have had limited success, as the share of rail globally has dropped sharply.
- As the share of the world's people living in cities surges from 55% in 2018 to a projected 68% by 2050, urban freight transport will continue to grow. Most of this urban growth is anticipated in Africa and Asia. In 2019, urban freight activities accounted for an estimated 5% of global freight activity.
- The focus of sustainable urban freight has mainly been on technical and economic solutions, but there is a need to address pressing social issues such as health effects and social inequity.
- The weight of goods moved by maritime transport tripled over a 30-year period, rising from 4 billion tonnes in 1993 to 12 billion tonnes in 2023; by comparison, e-commerce flows achieved similar growth in less than 10 years – rising from 1.3 billion to 6.5 billion tonnes between 2014 and 2023.
- Under business as usual, freight tonne-kilometres are expected to increase 55% by 2050; Africa is likely to double its share in global freight, whereas growth in the Global North will be around 33%. International shipping and rail are expected to grow by half their 2025 volumes, while trucking activity will double and domestic shipping will reach nearly 2.5 times its 2025 volume.



KEY FINDINGS

Sustainability and climate trends

- Since the pandemic, other major disruptions to global transport, combined with the costly impacts of extreme weather events, have increased awareness among freight transport stakeholders of the importance of network and service resilience. In 2024, shipping incidents, safety threats and droughts led to dramatic declines in vessel passages in the Red Sea (down 67%), the Suez Canal (down 42%) and the Panama Canal (down 36%). As a result, global shipping rates between continents doubled or tripled.

- Global trade continued to show remarkable resilience, with few indications of regionalisation reversing globalisation – despite continued impacts such as inflation and higher costs for consumers. However, in 2025 the new US administration announced historic tariff hikes for most of its important trading partners. The impact on global trade remained unclear, given the international nature of many supply chains and the varying impacts of trade barriers. In response to the new geopolitical tensions, Europe re-balanced its sustainable development ambitions against its efforts to maintain economic competitiveness.

- The freight transport sector accounted for an estimated 5-7% of total employment in 2023, while the logistics sector – which includes transport, warehousing, administration, and information and communications technology management – had an even higher employment share (10%).

- Some sub-sectors, such as road freight, face acute shortages of workers. Challenges affecting the transport workforce include mismatches in skill requirements, new "gig markets" for e-commerce delivery that are associated with poor social conditions, and emerging technologies for autonomous and digital logistics.

- Women have been greatly under-represented in the transport workforce, accounting for only 15.6% of workers in the sector overall, and 23% in senior leadership roles, as of 2023.

- The safety of freight transport remains a serious concern, as road crashes involving heavy-goods vehicles are associated with a higher risk of fatality.

- Globally, freight transport was responsible for around 10% of energy-related CO_2 emissions and 43% of CO_2 emissions from the transport sector (including international aviation and shipping) in 2023.

- After falling slightly during the COVID-19 pandemic (in 2020), CO_2 emissions from freight transport rose to a record high of 3.5 gigatonnes in 2023. Roughly 85% of these emissions were from freight transport itself, and the rest were from the storage and handling of goods.

- By mode, the largest contributor to freight transport emissions was road freight, responsible for 70% of freight transport-related CO_2 emissions in 2023. Despite the high volume of global trade carried via water, maritime transport was responsible for 22% of emissions. Railways contributed 2.3% of emissions, the lowest share among freight transport modes.

- Aviation (domestic and international passenger and freight) contributed nearly 950 million tonnes of CO_2 emissions in 2023; of this, close to 155 million tonnes was directly linked to air freight transport (including both belly freight and air freighter transport), representing around 6% of all freight transport-related CO_2 emissions. Air cargo demand grew 11.3% in 2024, and further growth of 5.8% was expected in 2025.

- Urban freight transport was responsible for an estimated 5% of global greenhouse gas emissions and for 28% (1.1 gigatonnes) of freight transport emissions in 2023. A 2022 study found that urban freight transport represents around 15-25% of all vehicle-kilometres travelled, occupies 20-40% of the motorised road-space, and contributes 20-40% of greenhouse gas emissions and 30-50% of air pollutants.

- Modes of transport that (until recently) have relied mostly on self-regulation for emission reduction – such as maritime and air transport – have relatively high emissions and often still use less environmentally friendly propulsion technologies.

- As a result of freight growth, both greenhouse gas emissions and local emissions are predicted to increase in the future. Moreover, as emissions from passenger transport decline, freight transport's share of overall emissions is expected to rise, from 43% in 2023 to 57% in 2050.

- According to one scenario, substantially reducing freight emissions by more than two-thirds is only possible by reducing overall demand, together with shifts in transport modes and the electrification of transport.

- Battery electric trucks that run on low-carbon electricity are considered the main technology for decarbonising

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road freight transport. As electrification accelerates, battery electric trucks are expected to reach cost parity with conventional trucks in the coming years. In contrast, cost parity between hydrogen-fuelled electric vehicles and conventional trucks is not expected anytime soon.

- Global sales of medium- and heavy-duty electric trucks remained low in 2024, with shares of around 4.4% in China, 2.3% in Europe and 1.7% globally. Meanwhile, governments and industry are targeting sales shares of 50-60% by 2030 and have supported the electric truck transition through investments in charging infrastructure.
- Industrial collaborations are taking advantage of key business opportunities to drive the shift to electric trucks, enabling new actors to enter the scene. Electric mobility also opens possibilities for new business models for freight services (such as offering fleet charging services, or flexibility services to the electricity market), while digitalisation will be key to optimising routing and charging.
- The aviation industry has made some progress in using sustainable aviation fuel (SAF), the central pillar of its near- to medium-term decarbonisation strategy; however, SAF still accounted for less than 1% of aviation's total fuel consumption in 2024.
- In the rail freight sector, electrification and efficiency improvements led to a halving of emissions (both greenhouse gas and local emissions) between 2005 and 2022, even with increases in performance. As of 2022, around one-third of all railways worldwide had been electrified, mainly in India, Japan and China. With the energy demand for freight rail transport in China and India projected to nearly double by 2050 (surpassing that for passenger rail), electrification of rail networks is expected to continue.
- For maritime transport, greenhouse gas emissions per unit of dry bulk shipping fell 4% between 2019 and 2023, whereas emissions from refrigerated transport increased. Most emission improvements in the sector are attributed to efficiency measures that have relatively low or negative abatement costs.

Policy and investment developments

- The freight transport and logistics sector has remained overlooked in countries' Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. As of 1 August 2025, only 9 of the 29 third-generation NDCs that had been submitted to the United Nations Framework Convention on Climate Change included mitigation actions covering freight or a combination of freight and passenger transport.
- To reach climate targets, industry will need strong support at the national level, and many international organisations have provided comprehensive roadmaps for decarbonising freight transport. In practice, however, the scope of policies tends to be narrower, with only limited attention to demand reduction but broad support for modal shift (despite limited success). Active, successful policies have focused on efficiency improvements and electrification.
- Due to the high volume of sea transport, efforts to achieve the International Maritime Organization's (IMO) target for net zero greenhouse gas emissions by 2050 are imperative.
- Because nearly half of air freight capacity is belly freight, emission targets for air freight are directly linked to the overall emission targets for aviation, which are supported by both industry and governments. The 41st ICAO Assembly adopted the Long Term Global Aspirational Goal in 2022 and member states aim for net zero carbon emissions from international aviation by 2050. In 2021, representatives of the world's major aviation industry associations and largest aircraft and engine makers also signed the "Commitment to Fly Net Zero 2050" declaration.
- Targets for reducing pollutants from road transport have generally been harmonised across continents, despite some variations in scope and coverage.
- Governments have shown widespread support for the electrification of road freight. While several countries have official targets for reducing greenhouse gas emissions from transport, others present visions and ambitions.

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- In some regions, green corridors are being implemented to induce a transition to sustainable, low-carbon long-haul freight transport.
- In the context of road safety, several governments and other stakeholders have adopted Vision Zero strategies to end road traffic-related fatalities. For commercial drivers, interventions include safety technology standards for vehicles, infrastructure and driver behaviour/training.
- In the EU, reporting and improvement of transport emissions will become mandatory for bigger companies from 2026 and 2028 onwards, with the introduction of the EU Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive (CSDDD). Pressure for small and medium-sized enterprises to follow suit will increase in Europe.
- Industry-driven initiatives at different levels have shown that companies and organisations already gain advantages from emissions accounting and reporting. A proposed EU regulation related to freight and passenger transport emissions, CountEmissionsEU, outlines a methodology for calculating and reporting greenhouse gas emissions from transport services. Such efforts are further strengthened by mode-specific efforts to measure and control emissions.
- Three key concepts for measuring and reporting the emissions of organisations are the product carbon footprint (PCF), the corporate carbon footprint (CCF) and logistics network emissions. The key challenges faced by all three concepts are similar: emissions accounting and reporting need to be based on the primary data of the organisation.
- In addition to introducing and tightening legislation on vehicle emission standards, a growing number of governments have implemented biofuel regulations – including California's Low Carbon Fuel Standard, the EU's Renewable Energy Directive (RED III) and Canada's Clean Fuel Regulations.
- At the EU level, in 2024 the region's Emissions Trading Scheme began covering all vessels entering EU ports. FuelEU Maritime, a legislative package for the use of clean energy in the maritime sector within the EU's "Fit for 55" programme, was expected to take effect in 2025. Globally, to further expand the use of sustainable fuels, the maritime industry has highlighted the need for contributions at the regional and national levels.
- The main policies that countries have adopted for rail electrification are reducing the use of diesel trains, creating dedicated rail freight infrastructure and providing subsidies for operators. Recent major investments have focused on dedicated rail corridors over very long distances in Asia (within India, and China's Belt and Road Initiative). Although many countries offer operational subsidies, experience in Europe suggests that these are not always effective.
- To meet the challenges of rising urban populations, different urban last-mile concepts have been explored and developed, including consolidation hubs, off-peak deliveries and delivery robots.

Context, challenges and opportunities

Freight transport volumes have grown nearly continuously in recent decades, propelled by population growth, industrial development, increased global trade and the acceleration of material consumption. Technology is also a strong driver of demand for freight transport. Digitalisation is propelling e-commerce services, leading to both increased long-distance air freight transport and more pressure on last-mile delivery.[1] At the same time, digitalisation helps to consolidate freight flows through digital platforms, increasing the efficiency of movements through economies of scale, and keeping costs low.[2]

Globally, freight transport was responsible for around 10% of energy-related carbon dioxide (CO_2) emissions in 2023 and for 43% of the CO_2 emissions from transport (including international aviation and shipping).[3] Urban freight transport contributed an estimated 5% of global greenhouse gas emissions and 28% of global freight transport emissions in 2023.[4] Most progress towards sustainable freight transport has been achieved through efficiency improvements in individual modes of freight transport (i.e., rail, medium- and heavy-duty trucks, vessels), with growing attention to electrification and the use of alternative fuels.[5]

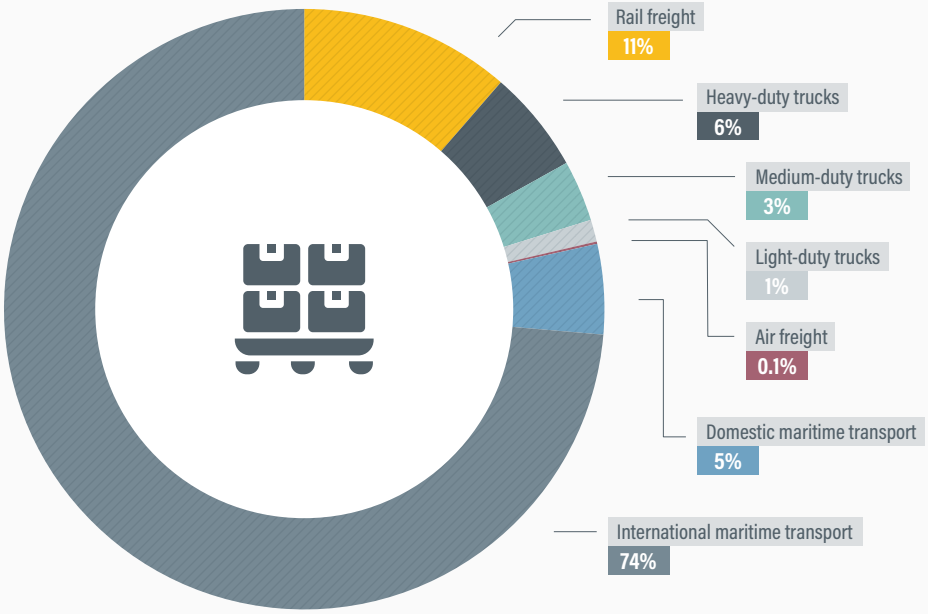
The freight transport sector supports millions of jobs worldwide and comprised an estimated 5-7% of total employment in 2023; for the whole freight transport and logistics sector, the share neared 10%.[6] Freight transport provides jobs at all training levels, including for companies and individuals that operate informally, as well as ample opportunities for upward mobility due to the strong interconnection between operations and senior management.[7] Social challenges related to rapidly evolving job markets include pressures facing logistics professionals (such as mismatches in skill requirements, rewards and absolute volumes), new "gig markets" for e-commerce delivery that are associated with poor social conditions, and emerging technologies for autonomous and digital logistics.[8]

Demand, use and access

Freight transport is intertwined with the economy. Its long-term development is driven by a growing global population, an expanding variety of products and services, and increased international trade. Efforts to deal with the climate crisis, such as rebuilding climate-damaged infrastructure and transport for carbon capture, also generate transport demand.[9]

FIGURE 1. Global freight transport by modal share, based on transport performance, 2025 estimates

Freight transport modes by freight activity in tonnes-kilometers



Most of the world's freight is carried by water – in 2025, international maritime shipping accounted for 74% of all freight tonne-kilometres, and domestic maritime shipping for 5% – followed by rail (11%), road transport (10%) and aviation (0.1%).

Note: Total = 171 trillion tonne-kilometres.

Source: See endnote 13 for this section.

Logistics services – including warehousing, administration and management – generated revenues of around USD 10 trillion in 2024, or 5-10% of the global gross domestic product (GDP), with annual growth of 6-10% depending on the region.[10] **Freight transport has grown continuously in recent decades, slowing only briefly during periods of global economic crisis.** Strong and resilient logistics performance facilitates the movement of essential goods, such as the distribution of vaccines during the COVID-19 pandemic as well as humanitarian aid, for which 14% of the cost is related to its supply chain.[11]

Global freight activity grew an estimated 8% between 2020 and 2025 to surpass 171 trillion tonne-kilometres.[12] **Most of the world's freight is carried by water – in 2025, international maritime shipping accounted for 74% of all freight tonne-kilometres, and domestic maritime shipping for 5% – followed by rail (11%), road transport (10%) and aviation (0.1%)** (Figure 1).[13] **Shares of inland freight transport have remained relatively stable for decades, although rail's share has declined in countries that have growing market economies, such as China and India, putting into question the ambition of a modal shift from road to rail** (Box 1).[14] Roughly half of global rail freight movements take place in China and the United States, 20% in the Russian Federation and 30% in other countries.[15]

Box 1. Shifting freight from road to rail?

Because rail transport is much less energy intensive than road transport, sustainability advocates have long supported shifting the movement of goods from road to rail. Yet so far, public policies and investments have had limited success, as the share of rail globally has dropped sharply. Studies indicate that the effect of rail subsidies has been limited and that greatly increasing the share of rail freight transport will require not only improved services and lower costs, but also extensions in railway networks and service capacity. It is unclear to what extent governments and industry are able and willing to successfully implement modal shift policies to help decarbonise freight transport.

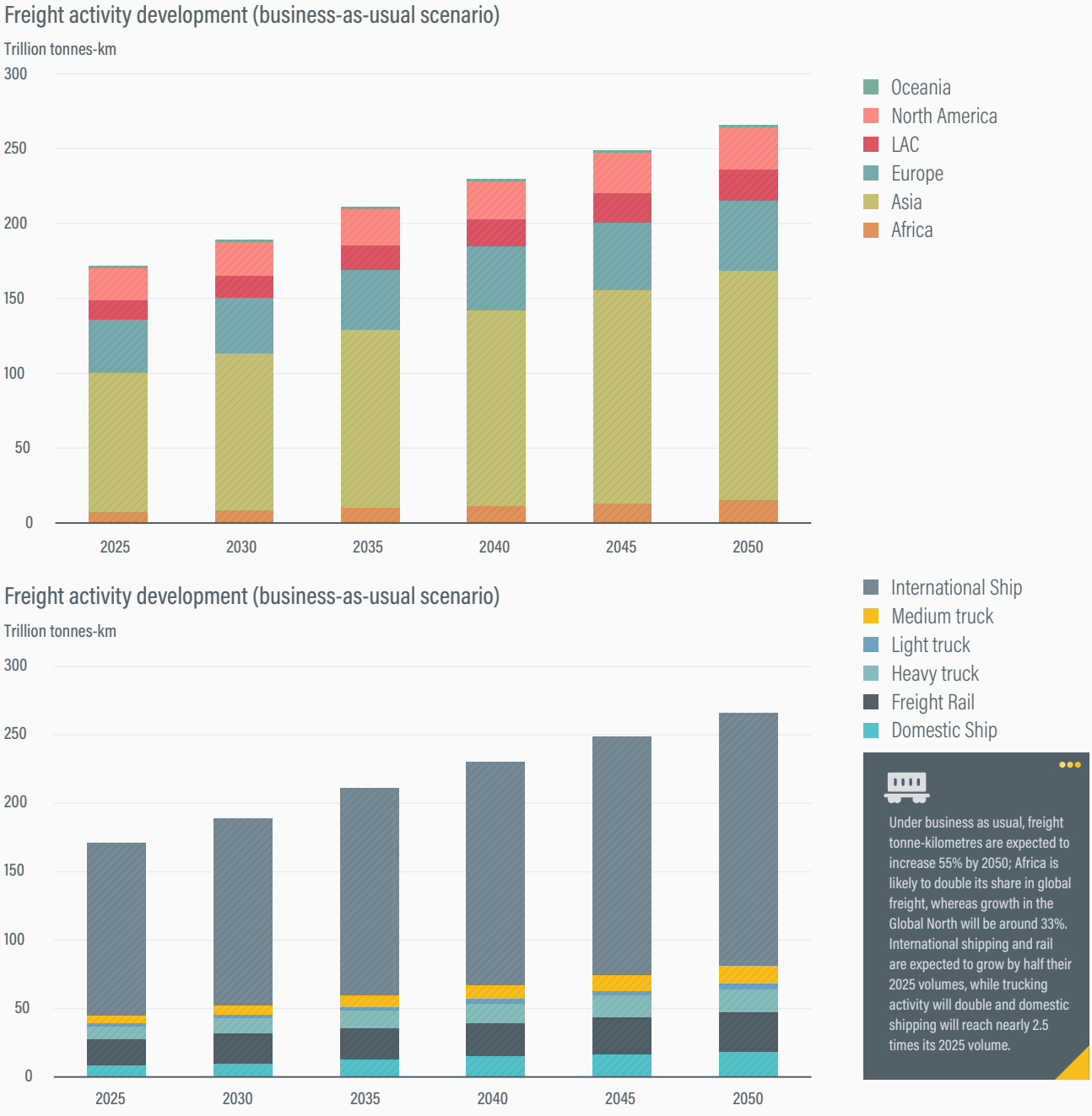
Source: See endnote 14 for this section.

As the share of the world's people living in cities surges from 55% in 2018 to a projected 68% by 2050, urban freight transport will continue to grow.[16] **Most of this urban growth is anticipated in Africa and Asia.**[17] **In 2019, urban freight activities accounted for an estimated 5% of global freight activity.**[18] Every day, cities require around 200 to 400 freight trips and deliveries per 1,000 residents, with volumes varying according to city size, economic activity and urban structure.[19] **The focus of sustainable urban freight has mainly been on technical and economic solutions, but there is a need to address pressing social issues such as health effects and social inequity.**[20]

The weight of goods moved by maritime transport tripled over a 30-year period, rising from 4 billion tonnes in 1993 to 12 billion tonnes in 2023; by comparison, e-commerce flows achieved similar growth in less than 10 years – rising from 1.3 billion to 6.5 billion tonnes between 2014 and 2023.[21]

Under business as usual, freight tonne-kilometres are expected to increase 55% by 2050; Africa is likely to double its share in global freight, whereas growth in the Global North will be around 33%.[22] **International shipping and rail are expected to grow by half their 2025 volumes, while trucking activity will double and domestic shipping will reach nearly 2.5 times its 2025 volume** (Figure 2).[23]

FIGURE 2. Freight transport growth, by region and mode, under a business-as-usual scenario, 2025-2055



Under business as usual, freight tonne-kilometres are expected to increase 55% by 2050; Africa is likely to double its share in global freight, whereas growth in the Global North will be around 33%. International shipping and rail are expected to grow by half their 2025 volumes, while trucking activity will double and domestic shipping will reach nearly 2.5 times its 2025 volume.

Source: See endnote 23 for this section.

Sustainability and climate trends

The COVID-19 pandemic, starting in 2020, increased global awareness of the importance of logistics and supply chains for everyday life. It sent severe shocks through global supply chains due to temporary changes in economic demand related to precautionary buying, online purchases and changes in consumption patterns. Consequences included dynamic acceleration (bullwhip) effects[i] in supply chains, unavailability of the labour force in manufacturing and logistics, and volatility in capacities and prices in transport chains.

Since the pandemic, other major disruptions to global transport, combined with the costly impacts of extreme weather events, have increased awareness among freight transport stakeholders of the importance of network and service resilience. In 2024, shipping incidents, safety threats and droughts led to dramatic declines in vessel passages in the Red Sea (down 67%), the Suez Canal (down 42%) and the Panama Canal (down 36%).[24] As a result, global shipping rates between continents doubled or tripled.[25]

Global trade continued to show remarkable resilience, with few indications of regionalisation reversing globalisation – despite continued impacts such as inflation and higher costs for consumers.[26] However, in 2025 the new US administration announced historic tariff hikes for most of its important trading partners. The impact on global trade remained unclear, given the international nature of many supply chains and the varying impacts of trade barriers. In response to the new geopolitical tensions, Europe re-balanced its sustainable development ambitions against its efforts to maintain economic competitiveness.[27]

The freight transport sector accounted for an estimated 5-7% of total employment in 2023, while the logistics sector – which includes transport, warehousing, administration, and information and communications technology management – had an even higher employment share (10%).[28] Some sub-sectors, such as road freight, face acute shortages of workers. Challenges affecting the transport workforce include mismatches in skill requirements, new "gig markets" for e-commerce delivery that are associated with poor social conditions, and emerging technologies for autonomous and digital logistics.[29] Despite regional variations, a global shortage of drivers could result in 3.6 million unfilled positions, a situation that is expected to worsen due to difficulties in recruiting younger drivers.[30]

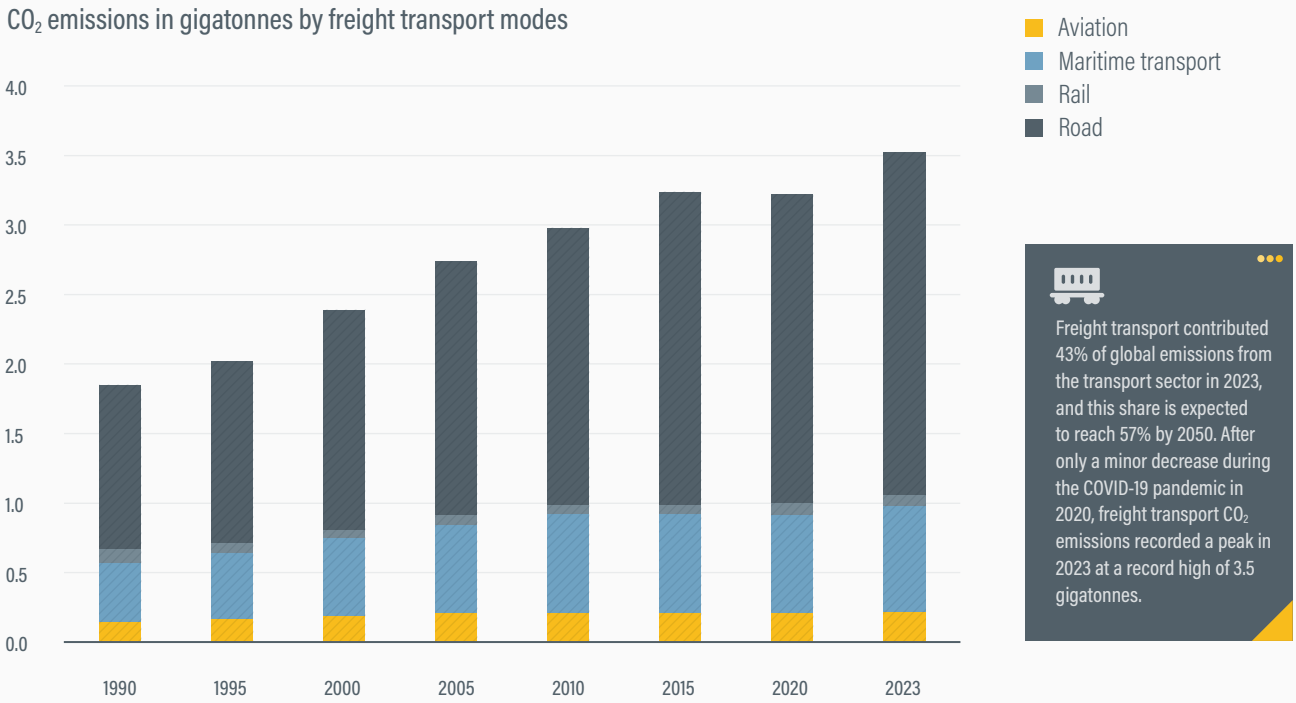
Women have been greatly under-represented in the transport workforce, accounting for only 15.6% of workers in the sector overall, and 23% in senior leadership roles, as of 2023.[31] Although increases in female participation and leadership have been linked to improved economic and environmental performance, such advancements are constrained by gender norms, security and safety challenges, and a lack of educational opportunities for women.[32]

The safety of freight transport remains a serious concern, as road crashes involving heavy-goods vehicles are associated with a higher risk of fatality. In the EU, the fatality rate for crashes with heavy-goods vehicles is 2-5 times as high as with light vehicles, and such incidents resulted in around 14% of road fatalities in 2019.[33]

Globally, freight transport was responsible for around 10% of energy-related CO_2 emissions and 43% of CO_2 emissions from the transport sector (including international aviation and shipping) in 2023.[34] After falling slightly during the COVID-19 pandemic (in 2020), CO_2 emissions from freight transport rose to a record high of 3.5 gigatonnes in 2023 (Figure 3)**.[35] Roughly 85% of these emissions were from freight**

i A dynamic acceleration (bullwhip) effect occurs when small changes in consumer demand are amplified at later stages of the supply chain. By the time manufacturers react to these shifts, the demand they face often bears little resemblance to the original customer demand. Source: A. Preston (2022), Bullwhip Effect in Supply Chain, Skill Dynamics, https://skilldynamics.com/blog/understanding-the-bullwhip-effect-in-supply-chains/.

FIGURE 3. Global CO_2 emissions by mode of transport, 1990-2023



Source: See endnote 35 for this section.

transport itself, and the rest were from the storage and handling of goods.[36]

By mode, the largest contributor to freight transport emissions was road freight, responsible for 70% of freight transport-related CO_2 emissions in 2023.[37] **Despite the high volume of global trade carried via water, maritime transport was responsible for 22% of emissions.**[38] **Railways contributed 2.3% of emissions, the lowest share among freight transport modes.**[39]

Aviation (domestic and international passenger and freight) contributed nearly 950 million tonnes of CO_2 emissions in 2023; of this, close to 155 million tonnes was directly linked to air freight transport (including both belly freight and air freighter transport), representing around 6% of all freight transport-related CO_2 emissions.[40] **Air cargo demand grew 11.3% in 2024, and further growth of 5.8% was expected in 2025.**[41] This rising demand is attributed mainly to the surge in international e-commerce: Amazon, for example, aims to double its freight transport air fleet in the coming years.[42] In addition, two-thirds of aviation's climate impact is not related to CO_2 but stems from factors such as water vapour and contrails.[43] (See 4.9 Aviation.)

Urban freight transport was responsible for an estimated 5% of global greenhouse gas emissions and for 28% (1.1 gigatonnes) of freight transport emissions in 2023.[44] **A 2022 study found that urban freight transport represents around 15-25% of all vehicle-kilometres travelled, occupies 20-40% of the motorised road-space, and contributes 20-40% of greenhouse gas emissions and 30-50% of air pollutants.**[45]

Modes of transport that (until recently) have relied mostly on self-regulation for emission reduction – such as maritime and air transport – have relatively high emissions and often still use less environmentally friendly propulsion technologies. Compared to a truck, a container ship can carry up to 25,000 times more containers, but it also can emit 1 million times more harmful substances (by volume).[46]

In addition to CO_2, harmful substances emitted by combustion engines include nitrogen oxides (NO_x); greenhouse gas agents such as methane (CH_4) and non-methane compounds like nitrous oxide (N_2O), sulphur dioxide (SO_2); and particulate matter (PM_{10} and $PM_{2.5}$). With the electrification of propulsion, non-exhaust emissions will become more relevant, especially small particulate matter originating from tyre and brake wear, as well as road abrasion. Black carbon, or soot, emitted during the incomplete combustion of fuel has negative health impacts in addition to being a potent greenhouse gas agent.[47]

As a result of freight growth, both greenhouse gas emissions and local emissions are predicted to increase in the future. Moreover, as emissions from passenger transport decline, freight transport's share of overall emissions is expected to rise, from 43% in 2023 to 57% in 2050.[48] Although various scenarios predict the effects of a radical decarbonisation of transport, only a few of these analyses are at a global level, and contexts vary widely.

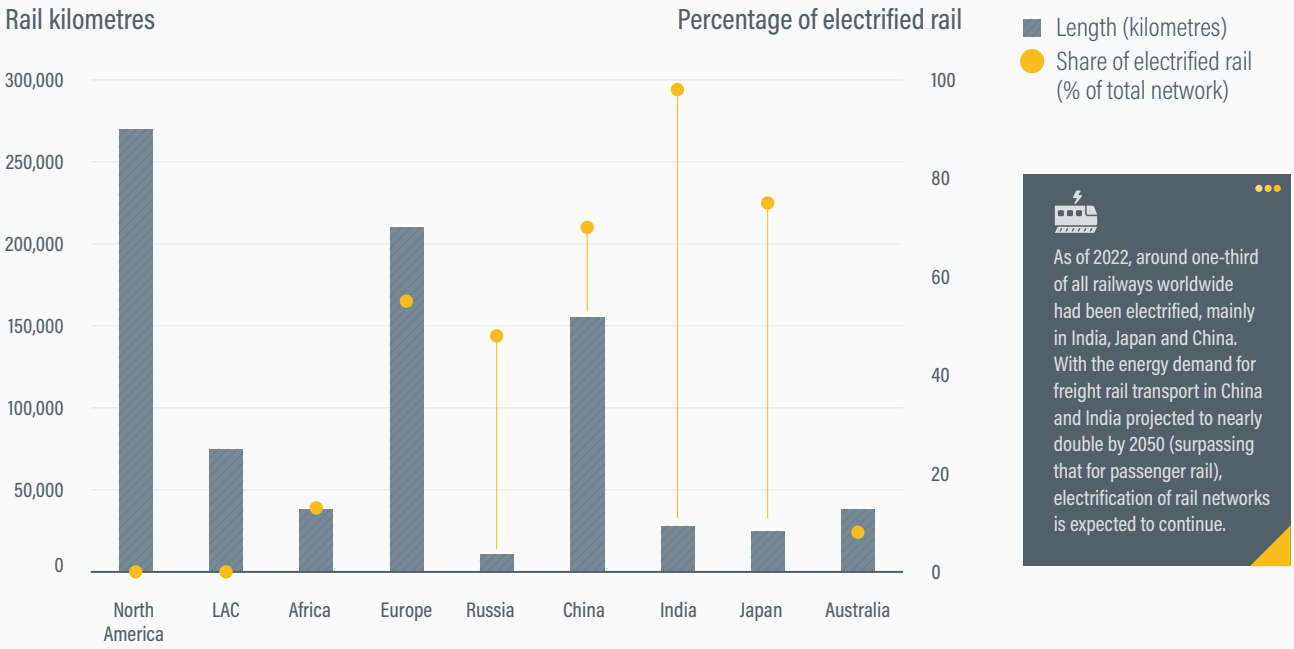
According to one scenario, substantially reducing freight emissions by more than two-thirds is only possible by reducing overall demand, together with shifts in transport modes and the electrification of transport.[49] Another key lever is reducing the carbon content of the energy used in freight transport.[50] Such analyses have enabled insights into the combined framing and global potential of measures implemented at scale, albeit with strong assumptions about their political, technological, behavioural and economic feasibility. Also, these scenarios are formulated at a high level, leaving room for many operational variants that can only be assessed jointly by stakeholders in a policy-making process. Further scrutiny and collaborative development of such roadmaps is needed.

Battery electric trucks that run on low-carbon electricity are considered the main technology for decarbonising road freight transport.[51] **As electrification accelerates, battery electric trucks are expected to reach cost parity with conventional trucks in the coming years.**[52] **In contrast, cost parity between hydrogen-fuelled electric vehicles and conventional trucks is not expected anytime soon,** as the costs of hydrogen production and distribution are prohibitive for business.[53]

Global sales of medium- and heavy-duty electric trucks remained low in 2024, with shares of around 4.4% in China, 2.3% in Europe and 1.7% globally.[54] **Meanwhile, governments and industry are targeting sales shares of 50-60% by 2030 and have supported the electric truck transition through investments in charging infrastructure.**[55] Achieving this goal will require a significant transition of the road freight sector in the coming five years. Truck manufacturers expect electric drivetrains to be the main technology in Europe in the foreseeable future, accounting for more than 60% of sales by 2030.[56]

Industrial collaborations are taking advantage of key business opportunities to drive the shift to electric

FIGURE 4. Rail length and share of electrification in selected countries, 2022



Source: See endnote 72 for this section.

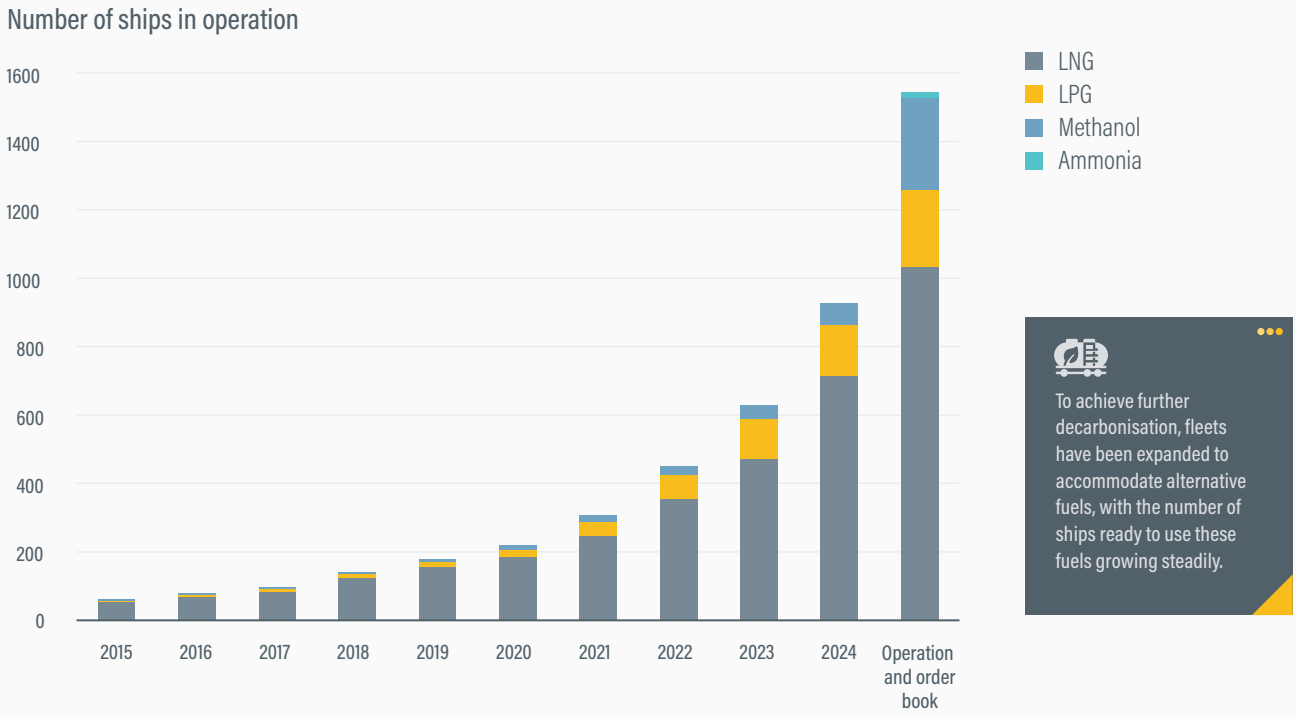
trucks, enabling new actors to enter the scene.[57] **Electric mobility also opens possibilities for new business models for freight services (such as offering fleet charging services, or flexibility services to the electricity market), while digitalisation will be key to optimising routing and charging.** Manufacturers now offer trucks with ranges of up to 600 kilometres, and Europe relies on Megawatt Charging Standards (MCS) for power above 600 kilowatts.[58] Continued development of batteries will reduce their costs and weight.[59]

- The Swedish forestry industry aims to be fossil-free by 2040 through renewable energy, electric vehicles and greater use of rail.[60]
- As of October 2024, Amazon had 10,000 electric vehicles in its delivery fleet in India.[61]
- In California (United States), as of 2025, around 500 zero-emission (electric) trucks were in service or being delivered to major ports for drayage operations (moving of shipping containers).[62]
- Europe's Alternative Fuel Infrastructure Facility incentivises the expansion of charging stations along the main freight corridors in the TEN-T road network.[63]
- The United Kingdom has adopted a scheme to boost charging infrastructure along motorways.[64]
- In South Africa, ultra-fast charging stations have been installed that are off-grid and zero-emission.[65]
- As of 2024, Germany had implemented 7 out of the 15 projects in Europe aimed at developing electric road systems for the dynamic charging of trucks.[66]
- In China, half of the electric medium- and heavy-duty trucks in operation as of 2023 relied on battery swapping.[67]

The aviation industry has made some progress in using sustainable aviation fuel (SAF), the central pillar of its near- to medium-term decarbonisation strategy; however, SAF still accounted for less than 1% of aviation's total fuel consumption in 2024.[68] Since 2016, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) – developed by the International Civil Aviation Organization (ICAO) – has called on participating airlines to offset at least 85% of their CO_2 emission growth above 2019 levels, including by using "eligible fuels" such as SAF.[69] However, SAF faces challenges related to high costs, feedstock availability, lack of investment and slow technology uptake.[70] (See 4.9 Aviation and 5.1 Transport Energy Sources.)

In the rail freight sector, electrification and efficiency improvements led to a halving of emissions (both greenhouse gas and local emissions) between 2005 and 2022, even with increases in performance.[71] **As of 2022, around one-third of all railways worldwide had been electrified, mainly in India, Japan and China** (Figure 4)**.**[72] **With the energy demand for freight rail transport in China and India projected to nearly double by 2050 (surpassing**

FIGURE 5. Number of ships capable of using alternative fuels (excluding liquefied natural gas carriers), 2015-2024



Source: See endnote 77 for this section.

that for passenger rail), electrification of rail networks is expected to continue.[73] Alternatives to the conventional catenary-based charging of freight trains include battery electric and fuel cell trains. Projects such as the Trans-Siberian rail line show that electrification can be implemented on long-distance dedicated rail corridors.[74]

For maritime transport, greenhouse gas emissions per unit of dry bulk shipping fell 4% between 2019 and 2023, whereas emissions from refrigerated transport increased.[75] **Most emission improvements in the sector are attributed to efficiency measures that have relatively low or negative abatement costs.** These include reductions in port congestion; improved vessel construction, retrofits and capacity use; slow steaming; and advancements in marine propulsion technology.[76] To achieve further decarbonisation, fleets have been expanded to accommodate alternative fuels, with the number of ships ready to use these fuels growing steadily (Figure 5).[77]

Policy and investment developments

The freight transport and logistics sector has remained overlooked in countries' Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement. As of 1 August 2025, only 9 of the 29 third-generation NDCs that had been submitted to the United Nations Framework Convention on Climate Change included mitigation actions covering freight or a combination of freight and passenger transport.[78] These included the NDCs from Brazil, Canada, Maldives, Monaco, Montenegro, Niue, the Republic of Moldova, Uruguay and the United States.

- The recent NDCs of Brazil, Canada, Maldives and Montenegro focus on vehicle efficiency and the electrification of heavy-duty vehicles.[79]
- Two of the third-generation NDCs focus on maritime transport: Monaco commits to banning fuel bunkering in its waters and to supplying electricity to ships in its ports, while Niue will pursue lower-emission energy for the fishery sector and other transport.[80]
- In its third-generation NDC of 2025, the United States aims to establish zero-emission freight hubs and corridors and to expand inter-modal freight operations through improved collaboration with stakeholders.[81]

- Uruguay's NDC includes pursuing intra-modality for freight and passenger transport.[82]

To reach climate targets, industry will need strong support at the national level, and many international organisations have provided comprehensive roadmaps for decarbonising freight transport (e.g., the European Technology Platform Alliance for Logistics Innovation through Collaboration in Europe, ALICE).[83] In practice, however, the scope of policies tends to be narrower, with only limited attention to demand reduction but broad support for modal shift (despite limited success).[84] Active, successful policies have focused on efficiency improvements and electrification.

Due to the high volume of sea transport, efforts to achieve the International Maritime Organization's (IMO) target for net zero greenhouse gas emissions by 2050 are imperative.[85] A key IMO objective for 2025 is "to support safe, secure, efficient and sustainable shipping through robust international regulations, supported by technical assistance to Member States".[86] The IMO ambitions are supported by initiatives, such as the Global Maritime Forum, the Getting-to-Zero Coalition and the Poseidon Principles for Finance and Insurance.[87] (See 4.10 Shipping.)

Because nearly half of air freight capacity is belly freight, emission targets for air freight are directly linked to the overall emission targets for aviation, which are supported by both industry and governments.[88] The 41st ICAO Assembly adopted the Long Term Global Aspirational Goal in 2022 and member states aim for net zero carbon emissions from international aviation by 2050.[89] In 2021, representatives of the world's major aviation industry associations and largest aircraft and engine makers also signed the "Commitment to Fly Net Zero 2050" declaration.[90] This builds on the Four Pillar Strategy of the IATA, which includes 1) development of new, more efficient aircraft and engines; 2) operational measures, including weight savings; 3) infrastructure measures, such as navigational improvements, and 4) market-based measures. (See 4.9 Aviation.)

Targets for reducing pollutants from road transport have generally been harmonised across continents, despite some variations in scope and coverage. As of 2025, emission standards for internal combustion engine vehicles were at comparable levels across China (Euro 6), Europe (Euro 6), India (Bharat VI), Japan (2016 Standards) and the Republic of Korea (Euro 4).[91] Europe, the United States and China planned to further reduce nitrogen oxide (NO_x) and PM emissions in their regulations around 2027-2028.[92] CO_2 emission standards are generally less stringent in the United States, Japan (fleet-level restrictions), India (vehicle-level fuel consumption restrictions) and China (vehicle-level fuel consumption restrictions).[93] (See 4.8 Road Transport.)

- EU standards aim to progressively reduce emissions from heavy-duty fleet vehicles 90% by 2040, compared to 2025 levels.[94]
- In the United States, CO_2 emission reductions from new road vehicles were targeted to reach 40-60% below 2027 levels by 2032.[95] However, in March 2025 the Trump administration revoked these targets for vehicle emission reduction.[96]
- Through its Advanced Clean Fleets regulation, California (United States) targets that state and local agencies acquire only zero-emission trucks from 2035 onwards (depending on vehicle size up to 2042).[97]

Governments have shown widespread support for the electrification of road freight. While several countries have official targets for reducing greenhouse gas emissions from transport, others present visions and ambitions. A growing number of countries (including Ghana, the Netherlands and Tonga) have signed a global memorandum of understanding for zero-emission medium- and heavy-duty vehicles, aiming for 100% zero-emission vehicle (ZEV) sales by 2040 and net zero emissions by 2050.[98] The idea is to support and accelerate the transition to ZEVs through collaboration among governments. In several cases, actions towards the adoption of electric vehicles go beyond emission reduction to also target factors such as wellbeing, health and job creation. (See 5.2 Road Vehicle Electrification.)

- Australia has a national vision to increase the uptake of electric vehicles to reduce emissions and improve wellbeing.[99]
- Chile, Pakistan and several US states have official governmental targets for the adoption of electric trucks.[100]
- In the EU, truck manufacturers are mandated to cut the average emissions of new trucks 45% by 2030, 65% by 2035 and 90% by 2040.[101]
- India's government set a target for 30% of all vehicles sold in 2030 to be electric.[102]
- Norway uses public procurement regulations to foster the adoption of zero-emission vans.[103]
- Uganda's e-mobility strategy aims to increase electric vehicle adoption to reduce emissions and create green jobs.[104]

In some regions, green corridors are being implemented to induce a transition to sustainable, low-carbon long-haul freight transport (Box 2).[105] Green corridors support the development of infrastructure and financial models, and have been deployed across many forms of transport, including maritime shipping and road freight transport.

Box 2. Green corridors to speed the transition to sustainable long-haul freight transport

Shifting long-haul freight transport to sustainable solutions requires support and commitment from many countries, including for developing the necessary infrastructure. Collaborative efforts exist for different modes of transport to align regulation and investments along critical international trade and development corridors.

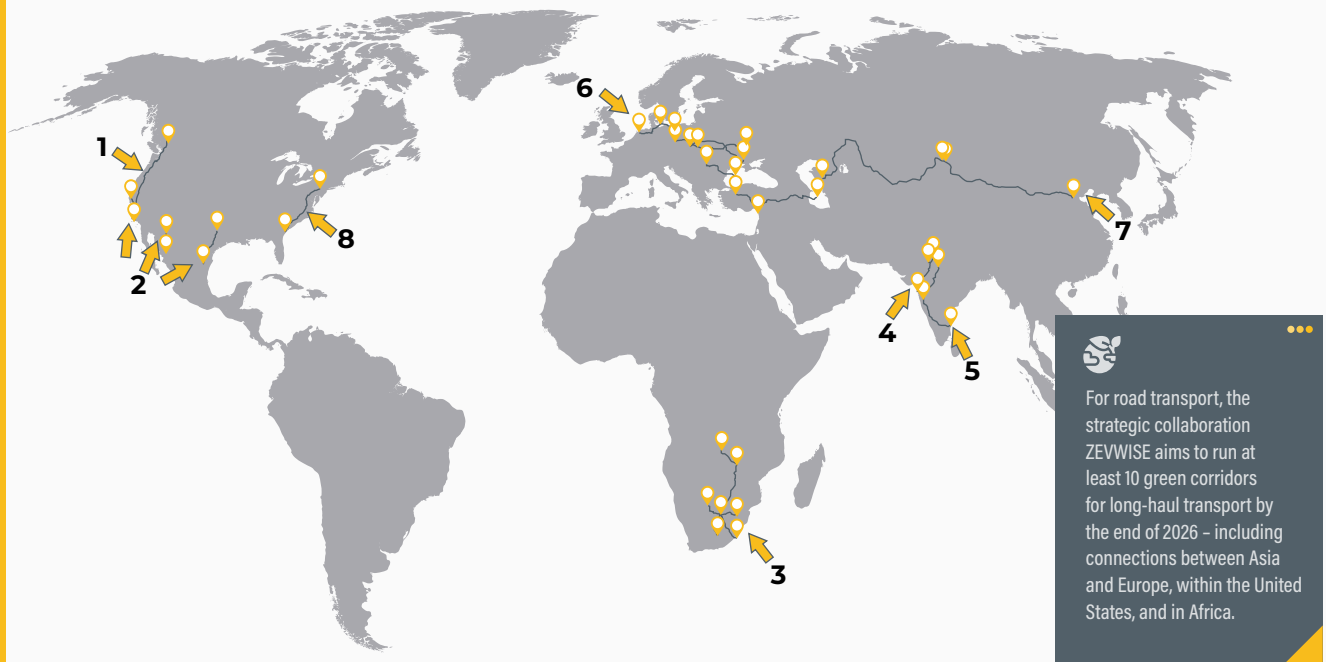
Green corridors are an approach to develop and pilot successful infrastructure and financial models, and have been deployed across many forms of transport. Pilot initiatives not only contribute to low-carbon transitions in the targeted areas, but also create blueprints and reference models for further roll-outs in other locations. By narrowing in on clearly defined corridors, public infrastructure investments can be focused, and private sector stakeholder groups can be approached, integrated and supported in targeted manner.

The International Maritime Organization (IMO) and the International Air Transport Association (IATA) have promoted green shipping corridors and the shift to low-emission solutions on a global scale for international sea and air transport, respectively. (See 4.9 Aviation and 4.10 Shipping.)

For road transport, the strategic collaboration ZEVWISE aims to run at least 10 green corridors for long-haul transport by the end of 2026 – including connections between Asia and Europe, within the United States, and in Africa (Figure 6). Co-ordinating partners include CALSTART / Drive to Zero, the Electric Vehicles Initiative, the International Council on Clean Transportation, the International Transport Forum, the Smart Freight Centre, the United Nations Environment Programme, the World Bank, and the World Business Council for Sustainable Development, as well as the Netherlands, the UK Department for Energy Securing & Net Zero and the US Department of Energy.

In China, the Shenzhen-Dongguan-Huizhou green corridor, initiated by Smart Way China in co-operation with the Smart Freight Centre, provides an example of how such pilots can be deployed successfully. The project focuses on the viability of using electric trucks (and related charging networks and battery swapping services) along this critical trading route, with the aim of addressing the operational, financial and environmental challenges of transitioning to zero-emission freight solutions.

FIGURE 6. ZEVWISE green corridors as of 2024



Source: See endnote 105 for this section

In the context of road safety, several governments and other stakeholders have adopted Vision Zero strategies to end road traffic-related fatalities.[106] **For commercial drivers, interventions include safety technology standards for vehicles, infrastructure and driver behaviour/training.**[107] As of mid-2025, 139 companies had joined the Vision Zero network maintained by the International Social Security Association.[108]

In the EU, reporting and improvement of transport emissions will become mandatory for bigger companies from 2026 and 2028 onwards, with the introduction of the EU Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive (CSDDD).[109] **Pressure for small and medium-sized enterprises to follow suit will increase in Europe.** Elsewhere in the world, measuring and reporting transport emissions has been voluntary, with a few exceptions such as France, which introduced a law making it compulsory in 2010.[110]

Industry-driven initiatives at different levels have shown that companies and organisations already gain advantages from emissions accounting and reporting. The process of evaluation can help companies identify inefficiencies, realise energy savings, and strengthen brand images and customer commitment. Increasingly, more investors have judged sustainability commitments and efforts positively, recognising that the impacts of climate change can affect the stability of companies and economies in the form of credit risks, market risks, liquidity risks, operational risks and reputational risks.[111]

- The Global Logistics Emissions Council (GLEC), a voluntary partnership of companies, industry associations, and green freight programmes, has developed the GLEC Framework to help providers and users calculate and report their operating emissions from freight transport.[112]
- At the company level, Schneider Electric (2024), DHL (2025) and Procter & Gamble (2025) regularly measure and communicate their transport emissions and set reduction targets in their annual reporting.[113]

A proposed EU regulation related to freight and passenger transport emissions, CountEmissionsEU, outlines a methodology for calculating and reporting greenhouse gas emissions from transport services.[114] The regulation is aligned with ISO 14083:2023 "Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from transport chain operations", which itself builds on and is aligned with the GLEC Framework.[115] This alignment is the result of a co-operation among industry, government bodies, and non-governmental organisations to ensure continued progress in emission accounting and reporting. Such alignment, globally and across transport modes, is key, as transport chains tend to be international and multi-modal, and the industry can benefit from a single approach applicable over all transport networks.[116]

Such efforts are further strengthened by mode-specific efforts to measure and control emissions.

- For the shipping industry, the IMO introduced regulations in 2013 that require new vessels to contribute to the industry's sustainability improvement (Energy Efficiency Design Index, or EEDI); these regulations were strengthened in 2023 by an EEXI (Energy Efficiency Existing Ship Index) that requires the operational efficiency of existing vessels to be made transparent and improved (Carbon Intensity Indicator CII).[117]
- A planned amendment to the International Convention for the Prevention of Pollution from Ships (MARPOL) will require ships to comply with emission controls in new areas including the Mediterranean Sea (SO_x), Canadian Arctic (NO_x and SO_x) and Norwegian Sea (NO_x and SO_x).[118] Existing areas with NO_x and SO_x emission controls are the US Caribbean Sea, the Baltic Sea and the North Sea.[119]
- The IMO's GreenVoyage2050 provides financial support to developing countries, with the aim of achieving the IMO GHG Strategy's target of net zero emissions by 2050 at the latest.[120]

Three key concepts for measuring and reporting the emissions of organisations are the product carbon footprint (PCF), the corporate carbon footprint (CCF) and logistics network emissions.[121] The two leading global standards for calculating the greenhouse gas emissions of value chains and organisations are the Greenhouse Gas Protocol and the ISO 14000 series. Both are voluntary and rely on references and applying organisations such as CDP and the Science Based Targets initiative (SBTi).[122] With the GLEC Framework and ISO 14083:2023, standardisation covering all modes of transport is provided.[123] These two are aligned, and further alignment could be achieved with the current review of SBTi and GHG protocol Scope 3 standards.

The key challenges faced by all three concepts – PCF, CCF and logistics networks – are similar: emissions accounting and reporting need to be based on the primary data of the organisation.[124] However, the complexity of supply chains, which often include numerous sub-contractors operating in different countries and jurisdictions, can make access to primary data difficult. Secondary data, modelled data or default data can help estimate emissions from supply chains.[125] Standardisation for the development and update of a database for secondary data is key to achieving meaningful calculations and reporting.

In addition to introducing and tightening legislation on vehicle emission standards, a growing number of

governments have implemented biofuel regulations – including California's Low Carbon Fuel Standard, the EU's Renewable Energy Directive (RED III) and Canada's Clean Fuel Regulations.[126] These regulations dictate how sustainability is defined, verified, and monitored, and set targets for fuel suppliers to increase the supply share or blending of biofuel with existing fuels. The regulations aim to decrease the well-to-wheel carbon intensity of transport (at least 65% under the RED III), while ensuring that the full life cycle of the fuels is globally sustainable. They also help reduce reliance on biofuels that are produced from crops with a high risk of indirect land use, such as palm oil. (See 5.2 Transport Energy Sources.)

At the EU level, in 2024 the region's Emissions Trading Scheme began covering all vessels entering EU ports.[127] **FuelEU Maritime, a legislative package for the use of clean energy in the maritime sector within the EU's "Fit for 55" programme, was expected to take effect in 2025.**[128] **Globally, to further expand the use of sustainable fuels, the maritime industry has highlighted the need for contributions at the regional and national levels.** As in the aviation sector, the use of book and claim systems is considered an important tool for the transition to sustainable maritime fuels.[129] The development of green corridors also facilitates the use of alternative or sustainable fuels, including e- or bio-methanol, electricity, green ammonia, green hydrogen and advanced biofuels.[130]

The main policies that countries have adopted for rail electrification are reducing the use of diesel trains, creating dedicated rail freight infrastructure and providing subsidies for operators. Recent major investments have focused on dedicated rail corridors over very long distances in Asia (within India, and China's Belt and Road Initiative).[131] **Although many countries offer operational subsidies, experience in Europe suggests that these are not always effective.**[132] Electrification appears to be the most effective approach to reduce emissions for existing users. Satisfying the growing demand for rail requires an improvement of service levels, cost reductions and significant infrastructure extension. Challenges are manifold, given the poor inter-connectivity and inter-operability of networks across countries.

To meet the challenges of rising urban populations, different urban last-mile concepts have been explored and developed, including consolidation hubs, off-peak deliveries and delivery robots. These solutions are technically and socially intertwined, and each city offers its unique context.[133] Important tensions include the trade-off between using many smaller vehicles (robots, delivery bikes and motorcycles) versus fewer and more efficient larger vehicles, together with consolidation schemes and off-peak deliveries.

- Cities in China, France, the Netherlands, Sweden and the United Kingdom are implementing zero-emission zones, with a strict ban on all petrol and diesel vehicles.[134]
- Through government-supported recognition schemes, many companies commit to emission reductions and social sustainability towards their customers and employees.[135]
- Although many studies and projects showcase technological solutions (such as consolidation hubs, e-bikes and delivery robots), there is less focus on social implications, wellbeing and workforce conditions.[136]

Partnerships in action

In 2023, **C40 Cities** launched the **Laneshift** initiative to decarbonise freight transport in low- and middle-income countries, in partnership with The Climate Pledge (co-founded by Amazon and Global Optimism).[137] Electric trucks will be deployed in cities in India as well as in Latin America and the Caribbean (Brazil, Colombia, Ecuador and Mexico).[138]

The **EcoLogistics** project of **ICLEI–Local Governments for Sustainability** released a guide in 2023 on how to implement zero-freight-emission zones in cities, through a collaborative effort involving C40, the California Air Resources Board, CALSTART, Concito, Freight Matters, ICLEI, POLIS, the Transport Decarbonisation Alliance, the Transport Research Lab and the World Resources Institute.[139]

The Swedish forestry sector's **TREE** (**"transition to efficient electrified forestry transport"**) partnership is aligned around a target to have 50% of new heavy-duty long-haul trucks be electric by 2030.[140] The 23-member partnership integrates partners both horizontally and vertically in the value chain, and includes transport buyers, logistic companies, and technology and service suppliers. The partnership helps to implement heavy electric trucks (gross vehicle weight of 70 tonnes and above) in commercial operation, including solving challenges related to charging infrastructure and transport planning. It also demonstrates novel technological solutions, such as a battery electric 94-tonne truck and electric trailers.[141]

The **Ship Recycling Transparency Initiative** (**SRTI**), hosted by the Smart Freight Centre, is launching a collaborative initiative to accelerate steel decarbonisation in India by unlocking the potential of sustainable ship recycling as a reliable source of high-quality scrap.[142] Recognising the maritime industry's critical role in the circular economy, the project connects shipowners, recyclers and steelmakers to establish traceable, certified scrap supply chains that feed into India's low-carbon steel production. With more than 15,000 vessels expected to reach end-of-life in the next decade, this effort addresses an environmental imperative and an industrial opportunity, linking the decarbonisation goals of the steel sector with the growing need for responsible ship dismantling.[143] The initiative emphasises regulatory alignment, material certification, and innovative contracting mechanisms, while drawing on global best practices and active stakeholder engagement, particularly from the Global South. It seeks to deliver measurable emission reductions and systemic change across both the maritime and steel industries.

The **Zero Emission Maritime Buyers Alliance** (**ZEMBA**) is committed to accelerating sustainable, scalable and economically viable solutions for the maritime sector.[144] In 2024, Amazon and IKEA led a new ZEMBA initiative to demand green fuels to support shipping decarbonisation.[145] In 2025, a tender by ZEMBA kicked off the first-ever commercial deployment of e-fuels in the maritime sector, with the aim of aggregating 86 billion tonne-nautical miles of demand for shipping powered by e-fuels from 2027 onwards (equal to transporting around 1.5 million twenty-foot equivalent units (TEU) from Shanghai to Los Angeles).[146]

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