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Transport Pathways to Reach Global Climate and Sustainability Goals

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

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Transforming Transport and Mobility to Achieve the Targets of the Paris Agreement and the Sustainable Development Goals

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Key findings

Context and key challenges

- A just transition to equitable, healthy, green, and resilient transport and mobility systems is central to socio-economic prosperity for people and the planet. To achieve this, systemic transformations in transport and mobility – linked to wider socio-economic transformations – are needed.
- The past couple of years have changed the world. Most transport and mobility systems globally have become more vulnerable to systemic shocks, disproportionately affecting people living in vulnerable situations.
- The COVID-19 pandemic and other recent events have led to a greater understanding that decarbonised, resilient, and sustainable transport and mobility systems are an essential service that can increase the social return on investment, reduce the impacts of shocks and speed recovery.

Emission trends

- In November 2022, atmospheric concentrations of carbon dioxide (CO_2) reached their highest monthly mean ever recorded, at 417.8 parts per million. Estimates for the year indicate that CO_2 emissions hit a record high. Global fossil CO_2 emissions exceeded 37.6 gigatonnes in 2019, dropped to 35.6 gigatonnes in 2020, then rose to 37.5 gigatonnes in 2021.
- The Russian Federation's invasion of Ukraine, which began in February 2022, has had significant, long-lasting impacts on the climate, in addition to its wide-ranging humanitarian, social and economic impacts.
- During 2010-2019, the transport sector had the fastest growth in CO_2 emissions among combustion sectors globally, rising 2% annually on average and 18% overall. In 2020, due mainly to the impacts of the COVID-19 pandemic, transport CO_2 emissions fell 13%, dropping to 2012 levels. However, emissions nearly completely recovered in 2021 and likely resumed their upward trend in 2022.
- In 2021, high-income countries were responsible for 50.7% of transport CO_2 emissions, while low-income countries contributed less than 1%. Per capita transport CO_2 emissions have doubled in middle-income countries since 1980, while barely changing in low-income countries.
- During 2010-2021, Asia experienced the highest growth in transport CO_2 emissions among regions, at 36%, followed closely by Africa at 34%. In 2021, transport emissions continued to fall in Europe, North America and Oceania, due to the pandemic, but grew in Latin America and the Caribbean.
- In 2019, freight's share of transport emissions increased to 42%, while passenger transport's share fell to 58%. Road transport (passenger and freight) contributed 77% of global transport CO_2 emissions in 2019.
- Aviation (domestic and international) is responsible for around 4% of the human-induced climate change to date, despite contributing only 2.4% of annual global CO_2 emissions.
- In 2020, CO_2 emissions from international aviation fell 45%, returning to 1999 levels. They then increased 15% in 2021 but were still 37% below 2019 levels. An estimated 1% of the world's population is responsible for more than half of all CO_2 emissions from passenger air travel.
- International shipping produces more transport CO_2 emissions than the regions of Africa and Oceania combined. In 2020, CO_2 emissions from international shipping fell only 2.6%, and they recovered by 2021 to exceed pre-pandemic levels.

Transport emissions in a business-as-usual scenario

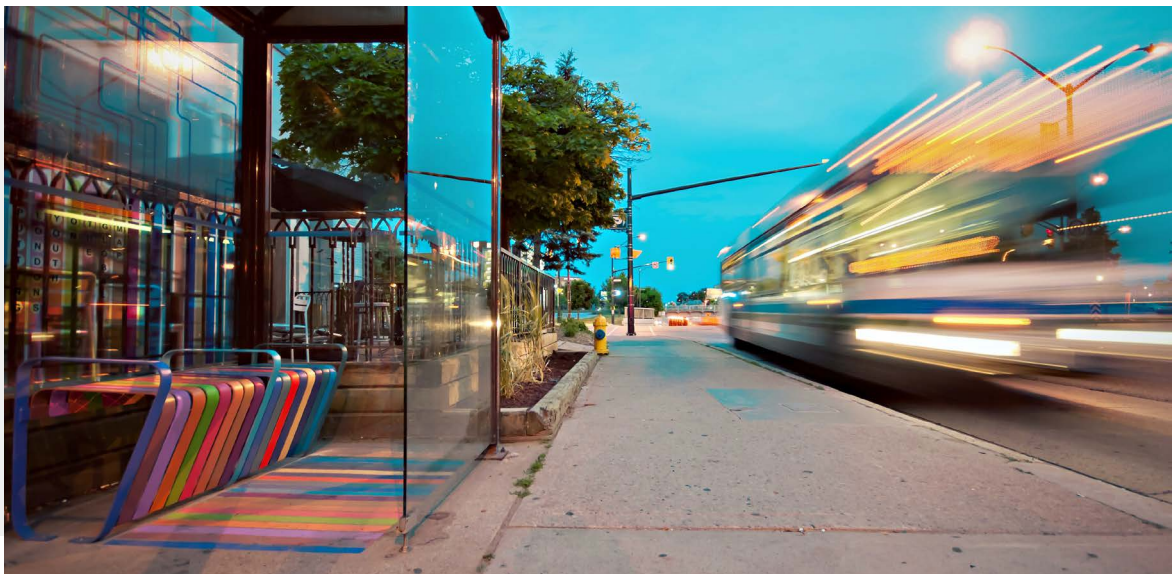
- Under business as usual, global transport activity is projected to nearly double by 2050, rising 1.8 times for passenger transport and 2.0 times for freight transport compared to 2019 levels. Without more ambitious policies, transport CO_2 emissions could grow 16-50% by 2050.
- Although countries have made progress in developing long-term visions for addressing climate change in transport, current policies and measures (focused heavily on electrification) are insufficient to put the sector on a decarbonisation pathway in line with the Paris Agreement goal of keeping global temperature rise below 1.5 degrees Celsius (°C).
- Climate action in the transport sector is still deeply insufficient, and countries' Nationally Determined Contributions (NDCs) under the Paris Agreement that feature transport lack the necessary ambition. Even if the current NDC targets for mitigating transport emissions are met, emissions in the sector will still grow.

Pathways for decarbonising transport

- Total economy-wide greenhouse gas emissions need to peak before 2025 to limit global warming to 1.5°C (with no or limited overshoot).
- Achieving low carbon transport pathways that limit global warming to 1.5°C will require a 59% reduction in transport-related CO_2 emissions by 2050, compared to 2020 levels.
- The maximum increase in passenger transport activity should be 50%, and in freight activity should be 20%, over the 2020-2050 period. Overall, the carbon intensity of the energy used in transport and of the fuels consumed needs to be halved by 2050.
- Fossil fuel dependence in road transport needs to decline drastically, from 95% in 2020 to 10% by 2050, with electricity becoming the dominant fuel in transport by the early 2040s.
- In addition to the transition of technologies ("Improve" measures), behavioural changes ("Avoid" and "Shift" measures) are needed to support transport decarbonisation, as emission reductions will not be achieved without critical transitions in transport modes. A 2021 study found that while "Improve" measures can contribute half of the required emission reductions in transport, "Avoid" and "Shift" actions are needed to meet the other half.
- Different regions need to contribute differently to the reduction of transport CO_2 emissions, with stronger reductions required in high-income countries than in low- and middle-income countries.

Transforming transport and mobility systems for more sustainable societies

- Achieving equitable, healthy, green, and resilient transport and mobility systems has both explicit and implicit implications for the success of the United Nations' 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs).
- Since the 2015 adoption of the landmark 2030 Agenda and the Paris Agreement, rising inequalities coupled with the COVID-19 pandemic and geopolitical conflicts have led to significant setbacks in the accomplishment of these agendas and their transport-related targets.
- In a world of interconnected challenges, the opportunity lies in finding solutions for systemic transformation that cut across transport, sustainability and climate action. Applying "Avoid-Shift-Improve" measures across passenger and freight transport through integrated, inter-modal and multi-dimensional approaches remains critical to deliver such cross-cutting solutions.
- Global fossil fuel subsidies have continued to rise, whereas strong financial support is lacking for sustainable, low carbon transport and mobility options. A fundamental reform of transport economics is urgently needed to deliver the necessary just transformations at the speed and scale required to achieve the targets of the Paris Agreement and the SDGs.



Overview

A just transition to equitable, healthy, green, and resilient transport and mobility systems is central to socio-economic prosperity for people and the planet. In addition to reducing greenhouse gas emissions from transport, such a transition will yield social, environmental and economic "multiplier effects" that go well beyond the scale of the necessary financial investment. This is why the transformation of transport and mobility systems has both explicit and implicit implications for the success of the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), as well as of the Paris Agreement on climate change.

To achieve this, systemic transformations in transport and mobility – linked to wider socio-economic transformations – are needed. The reality is that most of the world's population does not have access to affordable, sustainable transport. Human-caused greenhouse gas emissions continue to rise, including from transport. Although the transport sector experienced the largest decline in emissions among combustion sectors in 2020, transport emissions recovered almost completely in 2021.[1] Without a structural transformation and more ambitious policies, transport emissions could increase 16-50% by 2050.[2]

The past couple of years have changed the world. Most transport and mobility systems globally have become more vulnerable to systemic shocks, disproportionately affecting people living in vulnerable situations. The COVID-19 pandemic has amplified longstanding, unresolved, and interconnected challenges and inequalities, and has greatly impacted emerging and low-income economies. The Russian Federation's invasion of Ukraine has made even more apparent the multi-pronged consequences of humanity's addiction to fossil fuels.

Wide-ranging challenges have put the already-elusive progress towards the SDGs and the Paris Agreement at increased risk. Such challenges include: fast-growing inequalities within and among countries; rocketing prices for energy and essential goods; crises around raw materials, semiconductors and global supply chains; escalating extreme weather events; low levels of climate financing for low- and middle-income countries despite pledges; and the threat of sovereign default in many of these countries.

The Intergovernmental Panel on Climate Change (IPCC) has revealed an important gap between countries' pledged emission reductions for 2030 (outlined in their Nationally Determined Contributions, or NDCs, submitted to the United Nations in 2021) and the models for the emission reduction pathways that are needed to keep global temperature rise within 2 degrees Celsius (°C).[3] Modelled pathways to 2030 that are consistent with the NDCs submitted as of November 2021 were estimated to result in median global warming of 2.8°C by 2100.[4]

Although countries have made progress in developing long-term climate visions, current transport policies and measures are insufficient to put transport on a decarbonisation pathway in line with the Paris Agreement's goal of keeping global warming within 1.5°C. According to the International Energy Agency (IEA), electric vehicles are the only transport-related area on track with scenarios for net zero greenhouse gas emissions. Although reducing fossil fuel dependence in transport is key, electrification of transport – even if powered with renewable energy – will not be enough. A shift to more energy-efficient transport modes, complemented with behavioural changes, is mandatory.

Moreover, the substantial threat that natural hazards pose to transport systems around the world is only expected to increase due to climate change. The cascading impacts of disruptions in other sectors, as well as macroeconomic and geopolitical shocks or societal events, also can disrupt transport networks, leading to monetary costs that far exceed the damage to physical assets alone. This reinforces the need for greater adaptation and resilience of transport systems, and for holistic notions of socio-economic resilience through transport. (*See Section 1.2 Transport Adaptation and Resilience.*)

Yet, the magnitude of the challenges should not obscure the opportunities that lie ahead. Transport systems have always created prospects for socio-economic development. Humanity's inexorable desire to explore, connect, exchange and learn requires the use of transport. **The pandemic and other recent events have led to a greater understanding that decarbonised, resilient, and sustainable transport and mobility systems are an essential service that can increase the social return on investment, reduce the impacts of shocks and speed recovery.** As countries have experienced, shifting to active modes of transport can deliver a host of

resilience, social and environmental benefits. Pressures on the energy supply have reinvigorated discussions about energy efficiency and independence, as well as interest in reforming energy policies to transform transport.

The current circumstances confront us with the urgent need for profound and systemic socio-economic transformations – many of which directly impact the ability to transform transport systems over the coming decade. However, policy responses to today's transport challenges remain insufficient and are too slow. In a world of interconnected challenges, the opportunity lies in finding solutions for systemic transformation that cut across transport, sustainability and climate action. Applying the "Avoid-Shift-Improve" framework through integrated, inter-modal multi-dimensional solutions across passenger and freight transport remains critical to deliver on such cross-cutting solutions.

As global subsidies for fossil fuels have continued to rise, there remains a lack of financial support for sustainable, low carbon transport. A fundamental reform of transport economics is urgent to deliver the needed transformation at the speed and scale required to achieve the goals of the Paris Agreement and the SDGs.

Emission trends

Economy-wide emissions

In the previous (2021) edition of this report, it was reported that atmospheric concentrations of carbon dioxide (CO_2) had reached their highest level in more than 800,000 years (as of March 2019).[5] Since then, **global CO_2 levels have continued to rise, and in November 2022 they reached their highest monthly mean ever recorded, at 417.8 parts per million.**[6] The world has exceeded 1.2°C of global warming since the start of the industrial era, with each decade registering higher temperatures than the preceding one.[7] So far, in every year of the 21st century, the global average temperature has been at least 0.5°C above the average of 1951-1980, with 2016 and 2020 surpassing 1.0°C above the average (see Figure 1).[8]

Human-caused greenhouse gas emissions have risen in every major sector since 2010.[9] Efficiency improvements (measured as the energy intensity of gross domestic product, and carbon intensity) have been outweighed by absolute increases in emissions in all sectors. Starting from a 2020 baseline, the remaining "carbon budget" to keep global temperature rise within 1.5°C (at a 66% likelihood) is 400 gigatonnes of CO_2.[10] This means that, as of 2023

FIGURE 1. Global temperature change, 1880-2020

Source: See endnote 8 for this section.

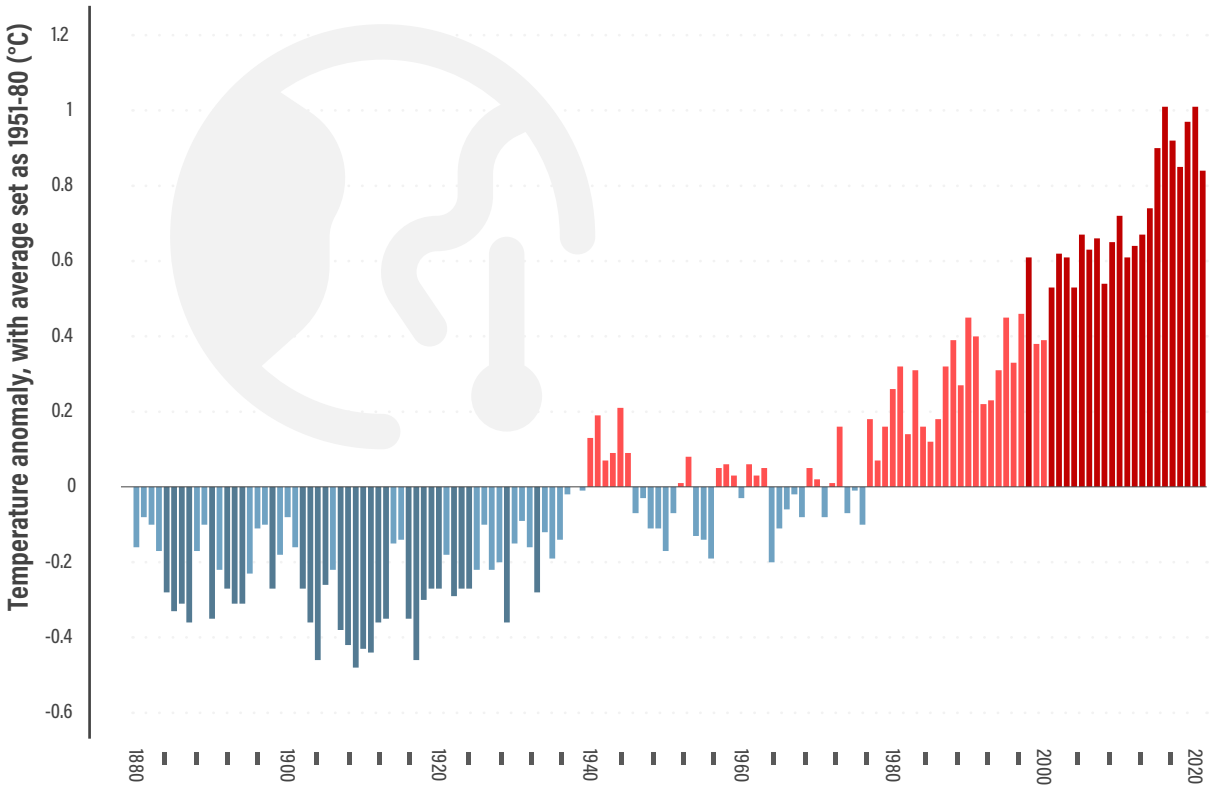
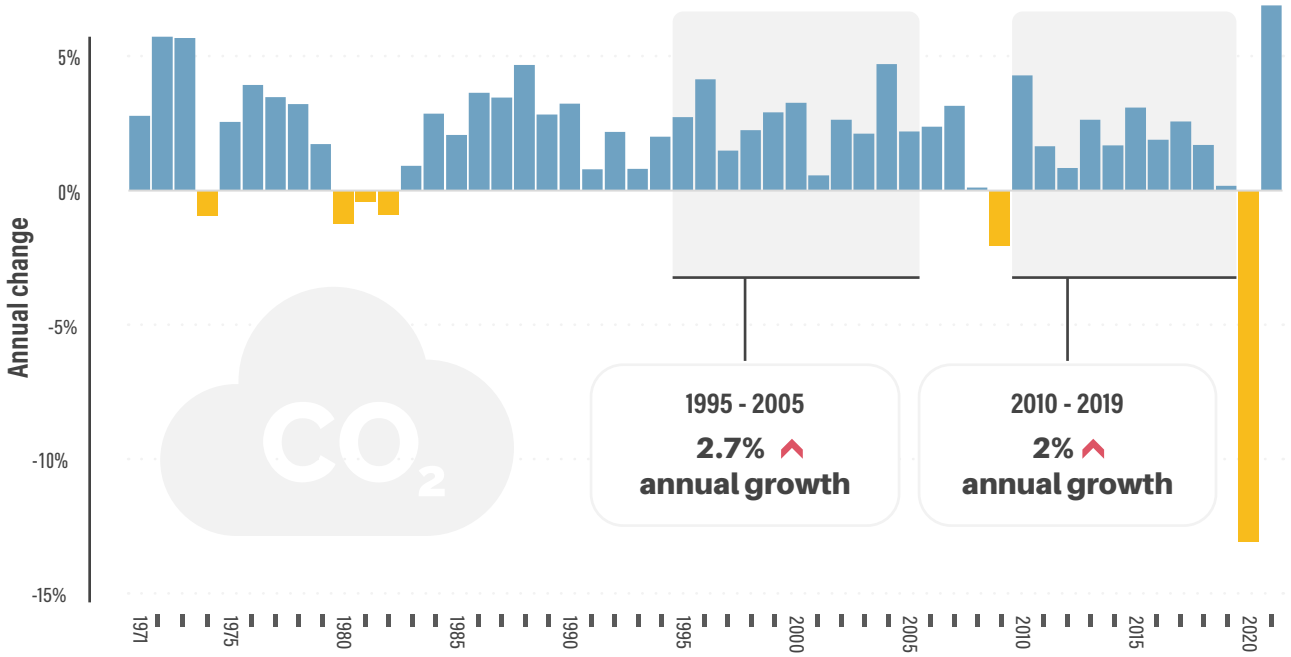


FIGURE 2. Annual change in transport CO_2 emissions (including international aviation and shipping), 1971-2021

Source: See endnote 21 for this section.



(assuming current emission rates), only nine years remain until humanity "uses up" its carbon budget to keep warming within 1.5°C by the end of this century.[11]

Global fossil CO_2 emissions exceeded 37.6 gigatonnes in 2019, dropped by 2 gigatonnes to reach 35.6 gigatonnes in 2020, then rose to 37.5 gigatonnes in 2021.[12] Estimates for 2022 indicate that global CO_2 emissions hit a record high.[13] Emissions from oil outpaced those from coal and gas, driven by rising travel demand as the sector recovered from pandemic-related declines in 2020 and 2021.[14]

The Russian Federation's invasion of Ukraine, which began in February 2022, has had significant, long-lasting impacts on the climate, in addition to its wide-ranging humanitarian, social and economic impacts.[15] In just the first seven months of the invasion, related activities resulted in the release of an estimated 100 million tonnes of CO_2-equivalent emissions, or as much as the entire country of the Netherlands emitted in this period.[16] The emissions are attributed to the movement of refugees (1.4%), warfare (9.1%), fires (24.4%), reconstruction of civilian infrastructure (50%) and pipeline leakages (15%).[17]

Global transport emissions

The average annual growth in greenhouse gas emissions slowed during 2010-2019 in most sectors globally except for transport, which has remained heavily dependent on fossil fuels.[18] In 2010, oil and petroleum products accounted for 97.4% of the energy use in transport, a share that fell slightly to 95.9% in 2020.[19] Transport emissions have continued to grow in both absolute and percentage terms (their share in total emissions). The slow progress in reducing emissions in "hard-to-abate" sub-sectors – such as aviation, long-distance road freight and shipping – has made it difficult to translate efficiency gains into absolute emission reductions.

During 2010-2019, the transport sector had the fastest growth in CO_2 emissions among combustion sectors globally (excluding "other sectors"), rising 2% annually on average and 18% overall.[20] However, this was slower than the 2.7% annual average growth during 1995-2005 (see Figure 2).[21] CO_2 emissions from transport, including international aviation and shipping, reached 8.2 gigatonnes in 2019, or 22% of total fossil CO_2 emissions.[22]

FIGURE 3. Changes in CO_2 emissions by sector, 2010-2021

Source: See endnote 24 for this section.

FIGURE 4. CO_2 emissions from ground transport and aviation, 2019-2022

Source: See endnote 25 for this section.

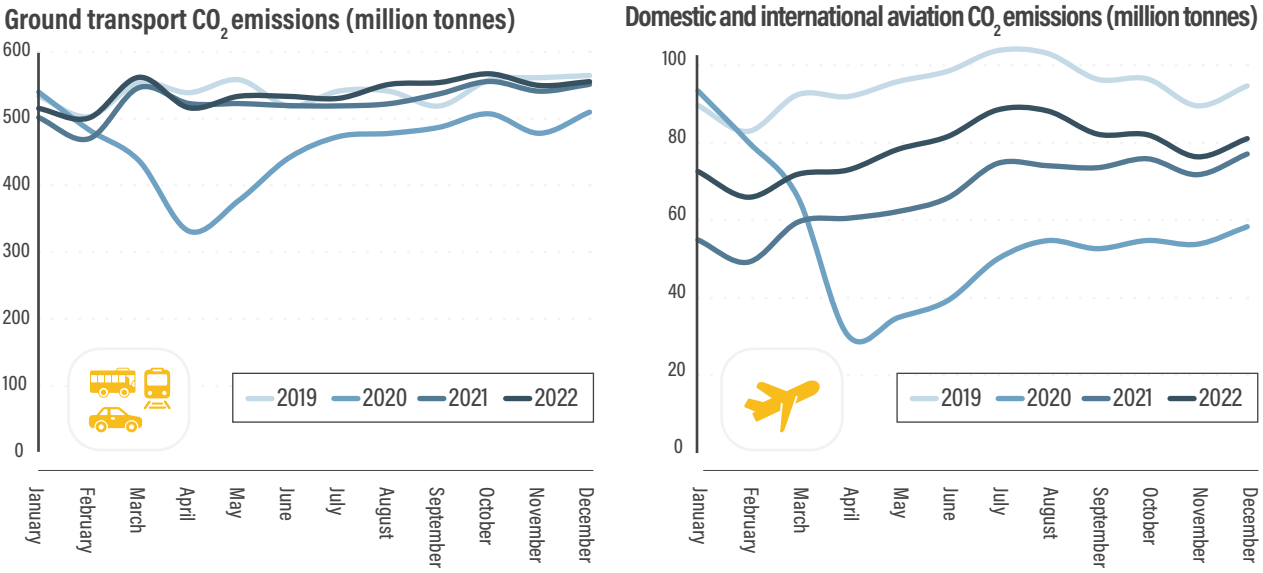
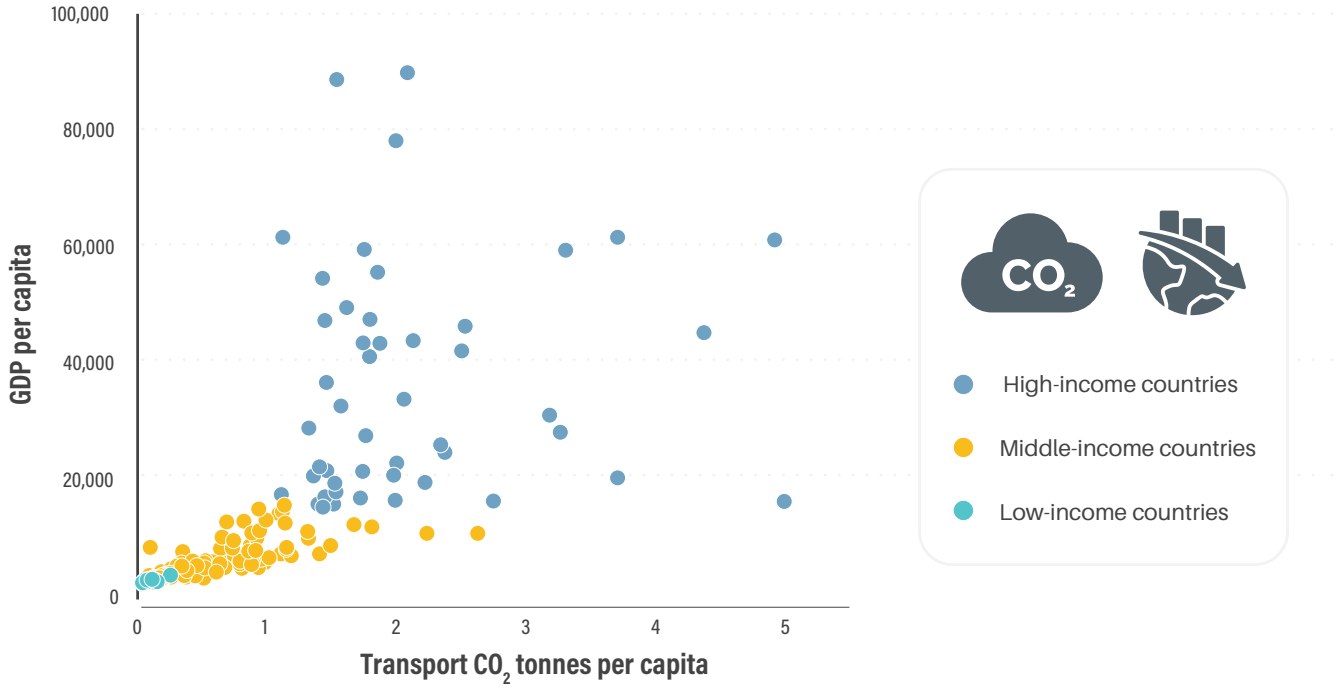


FIGURE 5. Per capita transport CO_2 emissions versus per capita gross domestic product, by country grouping, 2021

Source: See endnote 27 for this section.



In 2020, due mainly to the impacts of the COVID-19 pandemic, transport CO_2 emissions fell 13%, dropping to 2012 levels at 7.1 gigatonnes.[23] Transport experienced the greatest emission decline among combustion sectors, although it also showed the strongest rebound in 2021, to 7.6 gigatonnes of CO_2, or an average of 0.83 tonnes per capita (see Figure 3).[24] Early estimates for 2022 indicate that emissions from ground transport (road and rail) nearly recovered to pre-pandemic CO_2 levels, whereas aviation emissions (domestic and international) were still 20% below 2019 levels (see Figure 4).[25] **Overall, transport emissions nearly completely recovered in 2021 and likely resumed their upward trend in 2022.**[26]

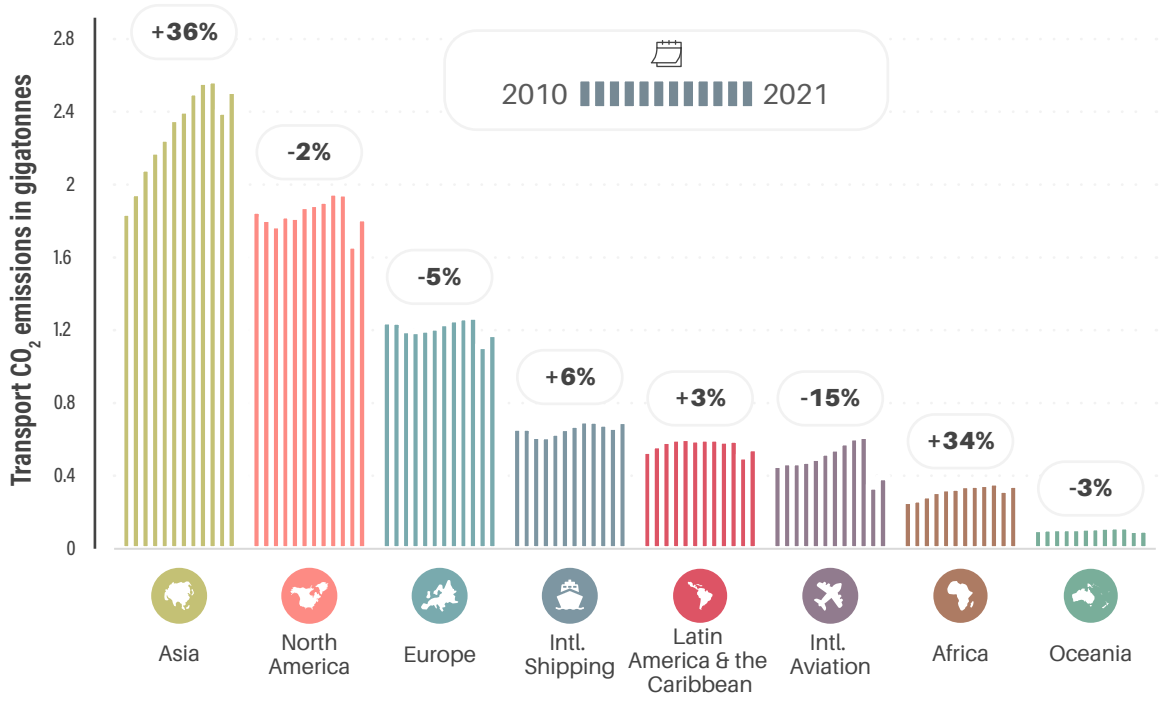
Emissions by income level

In 2021, high-income countries were responsible for 50.7% of transport CO_2 emissions, while low-income countries contributed less than 1% (see Figure 5).[27] Per capita transport CO_2 emissions totalled 2.8 tonnes in high-income countries, 0.53 tonnes in middle-income countries and 0.07 tonnes in low-income countries.[28] **Per capita transport CO_2 emissions have doubled in middle-income countries since 1980, while barely changing in low-income countries.**[29]

Examining income inequalities further, the top 1% of individual emitters globally contribute more than 1,000 times the CO_2 emissions of the bottom 1%, with the highest disparities being experienced in transport.[30] In North America, road transport makes up as much as one-quarter of the CO_2 emissions from the richest income group.[31] Globally, the gap in transport emissions between the 38 member countries of the Organisation for Economic Co-operation and Development (OECD) and the 160 non-OECD countries has nearly closed, with OECD countries contributing 51% of transport emissions in 2021.[32]

FIGURE 6. Transport CO_2 emissions, by region and for international shipping and aviation, 2010-2021

Source: See endnote 33 for this section.



Regional transport emissions

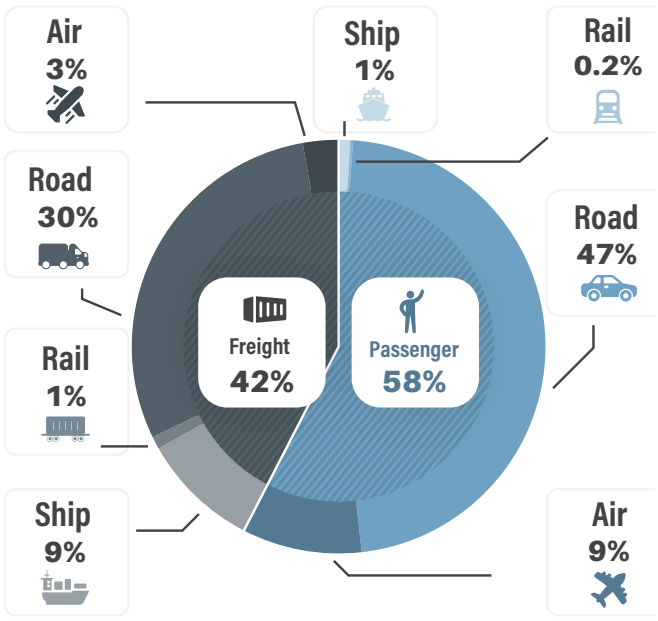
During 2010-2021, Asia experienced the highest growth in transport CO_2 emissions among regions, at 36%, followed closely by Africa at 34% (see Figure 6).[33] However, Africa's absolute emissions were the second lowest regionally, after Oceania's, in 2021.[34] **Transport emissions continued to fall 2-6% in Europe, North America, and Oceania in 2021 due to the pandemic, but grew 3% in Latin America and the Caribbean.**[35] (*See Sections 2.1 to 2.6 Regional Overviews.*)

Passenger and freight transport emissions

Emissions from freight transport comprise a growing share of transport emissions. In 2018, freight accounted for 40% of global transport CO_2 emissions, and passenger transport accounted for 60%.[36] **In 2019, freight's share of emissions increased to 42%, while passenger transport's share fell to 58%** (see Figure 7).[37] Freight was less affected by the impacts of the pandemic, with the CO_2 emissions from road freight in 2021 estimated to be only 1% below 2019 levels.[38] Freight transport emissions will likely continue to grow with rising demand for deliveries and transport of goods, as well as shifts to air freight.[39]

FIGURE 7. Transport CO_2 emissions by activity and mode, 2019

Source: See endnote 37 for this section.



Road transport (passenger and freight) contributed 77% of global transport CO_2 emissions in 2019 (see Figure 7).[40] Road transport was responsible for 82% of passenger transport emissions and 69% of freight transport emissions that year.[41] In 2020, urban travel contributed one-third of the total emissions from passenger transport.[42]

Aviation and shipping emissions

Aviation (domestic and international) is responsible for around 4% of the human-induced climate change to date, despite contributing only 2.4% of annual global CO_2 emissions.[43] This is because, in addition to the CO_2 emitted through the combustion of jet fuel, aircraft release water vapour that leads to the formation of cirrus clouds, trapping additional heat in the atmosphere.

During 2010-2019, CO_2 emissions from international aviation grew 3.6% annually on average.[44] In 2018, commercial aviation contributed the vast majority of global aviation emissions (an estimated 88%), followed by military operations (8%) and private flights (4%).[45]

In 2020, CO_2 emissions from international aviation fell 45%, returning to pre-millennium (1999) levels at 338 million tonnes.[46] **They then increased 15% in 2021, to 390 million tonnes, but were still 37% below 2019 levels.**[47] Domestic and international aviation accounted for more than 2% of global energy-related emissions in 2021, reflecting faster growth than road, rail or maritime transport emissions since 2000.[48]

An estimated 1% of the world's population is responsible for more than half of all CO_2 emissions from passenger air travel.[49] In 2018, only around 11% of the global population travelled by air, and only 2-4% took international flights.[50] The vast majority of the global population (90%) flies only one time a year or not at all, whereas 6% flies more than twice a year and 1% flies more than five times a year.[51] An analysis of private jets owned by US celebrities found that these jets emit 482 times more CO_2 emissions collectively than the average person emits in a year.[52]

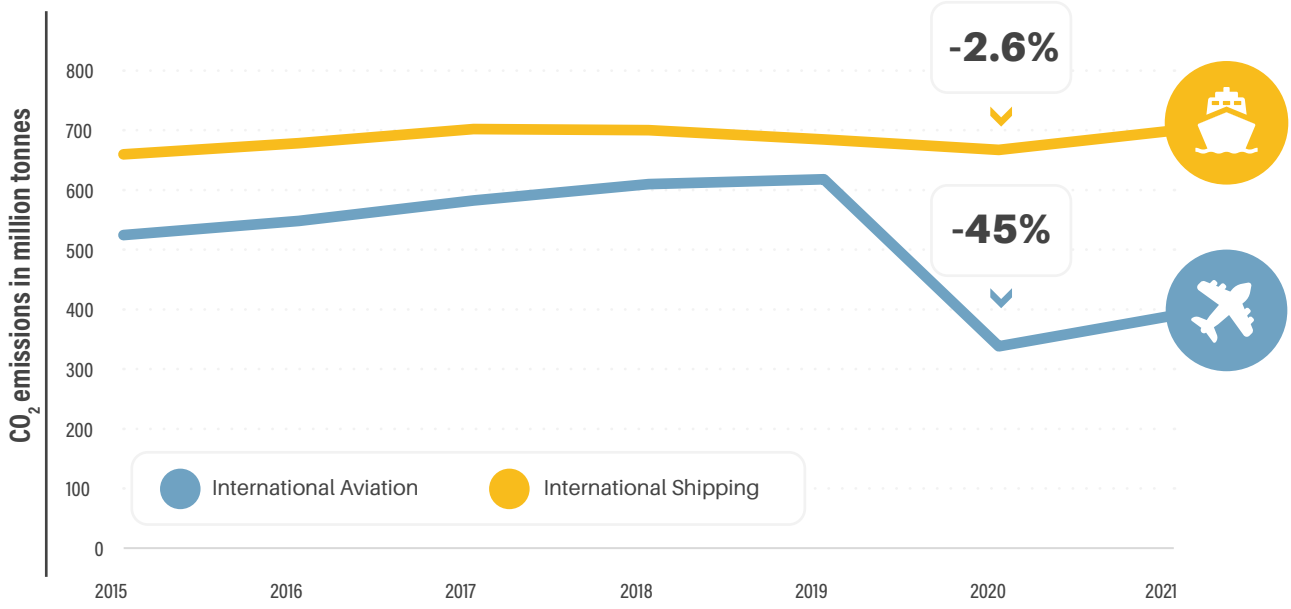
The Russian Federation's invasion of Ukraine has stalled the recovery of the airline industry and driven up jet fuel prices.[53] Moreover, closure of the Russian and Ukrainian airspaces has led to longer-distance rerouting of some flights between Asia and Europe or North America, likely driving up emissions.[54] In 2022, Finnair reported 40% longer flights to China, British Airways had a 20% longer diversion to China, and other European airlines added flight times of 15-40% for the same routes.[55] (*See Section 3.7 Aviation.*)

International shipping produces more transport CO_2 emissions than the regions of Africa and Oceania combined.[56] As much as 40% of maritime trade consists of transporting fossil fuels (including coal, oil and liquefied natural gas) from points of fuel production to points of fuel consumption.[57]

Emissions from international shipping decreased 2.2% in 2019 due to a stagnant economic year.[58] **In 2020, despite the pandemic's drastic impacts on global trade, international**

FIGURE 8. CO_2 emissions from international aviation and shipping, 2015-2021

Source: See endnote 59 for this section.



shipping CO_2 emissions fell only 2.6%, and they grew 5% in 2021 to nearly 700 million tonnes, returning to 2017 levels and exceeding pre-pandemic (2019) levels (see Figure 8).[59]

The Russian invasion of Ukraine added to the prevailing pandemic-related impacts on maritime transport (port congestion, disrupted trade, etc.), resulting in rising energy costs, higher food prices and the rerouting of supply chains (including port delays and pressure on storage).[60] It is yet unclear how this will affect shipping emissions. *(See Section 3.8 Shipping.)*

Transport emissions in a business-as-usual scenario

Under business as usual, transport activity is projected to nearly double by 2050, rising 1.8 times for passenger transport and 2.0 times for freight transport compared to 2019 levels.[61] Growing demand for freight and passenger services is expected across all transport modes, particularly in Africa and Asia.[62] The global passenger car fleet is projected to reach between 1.4 billion and 1.55 billion vehicles by 2050, up from nearly 1.2 billion vehicles in 2020.[63]

Without more ambitious policies, transport CO_2 emissions could grow 16-50% by 2050.[64] As a result, CO_2 emissions from freight transport would be 22% higher in 2050 than in 2015.[65] Without proper interventions, international aviation CO_2 emissions would grow from 617 million tonnes in 2019 to more than 1,500 million tonnes by 2050.[66] International shipping CO_2 emissions would increase 40% over this period.[67] Under current policies, urban transport emissions would decrease slightly, by 5%.[68] In Asia, the largest regional emitter in 2019, transport CO_2 emissions could grow an estimated 1.5% annually to 2030, with the share of freight in Asia's transport emissions rising from 48% in 2000 to 57% in 2030.[69]

Current transport policies and measures are insufficient to put transport on a decarbonisation pathway in line with the 1.5°C target of the Paris Agreement. A 2022 assessment of 13 transport targets (such as public transport development, cycling infrastructure, sustainable aviation fuels, etc.) found that none of them were on track, with 2 of the targets (electric light-duty vehicle sales and electric bus sales) showing promise (although off track) and 7 of the targets heading in the right direction but well off track.[70] The indicator showing the least progress was kilometres travelled by passenger cars, with private passenger cars accounting for as much as 44% of the total kilometres travelled in 2020.[71]

The International Energy Agency considers electric vehicles to be the only transport-related area that is on track with global scenarios for net zero emissions.[72] In 2022, electric car sales surpassed 10 million to account for 13% of the global new car market, resulting in 25 million electric passenger cars on the world's roads.[73] For road freight, technical solutions are less mature and not yet readily available, but important developments are under way.[74]

Countries have made progress in developing long-term visions for addressing climate change in transport through their Nationally Determined Contributions (NDCs) and Long-Term Strategies (LTS) under the Paris Agreement (see Box 1)**, with a growing number of countries committing to net zero targets.**[75] **However, the current policies announced or implemented will still contribute to average global temperature rise of 2.8°C by 2100.**[76] Achieving unconditional and conditional targets set in NDCs would reduce this to 2.6°C and 2.4°C respectively.[77] By 2030, an emissions gap will remain of 15 gigatonnes of greenhouse gases for a 2°C pathway and 23 gigatonnes for a 1.5°C pathway, reflecting the difference between emissions under business as usual and those required to achieve the Paris Agreement goals.[78]

Even if all 23 countries with transport greenhouse gas mitigation targets in their NDCs (as of the end of 2022) meet them, emissions will still grow.[79] In many cases, targets for reducing transport CO_2 emissions are relative to business-as-usual scenarios that imply absolute growth in transport emissions. Therefore, the growth in emissions will only be slowed; the 23 countries with transport targets would slow the emission growth 50% below business as usual.[80] (*See Section 1.3.1 Transport in National Climate and Sustainability Strategies to Achieve the Targets of the Paris Agreement and SDGs.*)

BOX 1. Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement

To achieve the goals of the Paris Agreement, the transport sector must accelerate climate action immediately. Under the agreement, Parties to the UN Framework Convention on Climate Change are required to submit Nationally Determined Contributions, or frameworks and strategies outlining their specific targets and actions to reduce emissions. NDCs communicate planned mitigation and adaptation actions by countries, including plans to achieve resilient, low carbon transport systems. To complement the NDCs, the Paris Agreement invites (but does not require) countries to formulate and communicate Long-Term Strategies (or long-term low greenhouse gas emission development strategies) (LTS) to help establish low carbon trajectories to 2050. *(See Section 1.3.1 Transport in National Climate and Sustainability Strategies to Achieve the Targets of the Paris Agreement and SDGs.)*

Pathways for transport decarbonisation

Total economy-wide greenhouse gas emissions need to peak before 2025 to limit global warming to 1.5°C (with no or limited overshoot).[81] Because the remaining carbon budget is limited, rapid and deep mitigation of emissions is needed until 2050. Net zero CO_2 emissions are required by 2050 for pathways limiting warming to 1.5°C, and by the early 2070s for pathways limiting warming to 2°C.[82]

Achieving low carbon transport pathways that limit global warming to 1.5°C (with no or limited overshoot) will require a 59% reduction in transport-related CO_2 emissions by 2050, compared to 2020 levels.[83] The previous edition of this report in 2021 noted that to comply with the 1.5°C target, transport CO_2 emissions must be reduced to roughly 3 gigatonnes or less by 2050.[84] This would mean a decrease in per capita transport CO_2 emissions from 0.83 tonnes in 2021 to 0.20 tonnes in 2050.[85] Global reports released between 2021 and 2023 share similar CO_2 thresholds for 2050:

- International Transport Forum (ITF) Transport Outlook: 1.6 gigatonnes
- IEA net zero emission pathway: 0.68 gigatonnes
- IPCC Sixth Assessment Report scenarios for 1.5°C: between 0.7 and 2.9 gigatonnes
- International Renewable Energy Agency pathway: 0.4 gigatonnes.[86]

In the IEA's net zero emission scenario, a 90% drop in transport CO_2 emissions (below 2020 levels) is required by 2050, with transport modes contributing differently to these reductions (see Figure 9).[87]

Shipping and aviation will contribute less than other modes due to the differing levels of technology maturity and readiness of scalable solutions.[88] To achieve a transport low carbon pathway, several key milestones need to be met (see Table 1), including shifts to more energy-efficient modes, such as electric vehicles powered by renewable electricity

FIGURE 9. Global CO_2 transport emission trajectories by mode required to achieve IEA net zero emissions scenario

Source: See endnote 87 for this section.

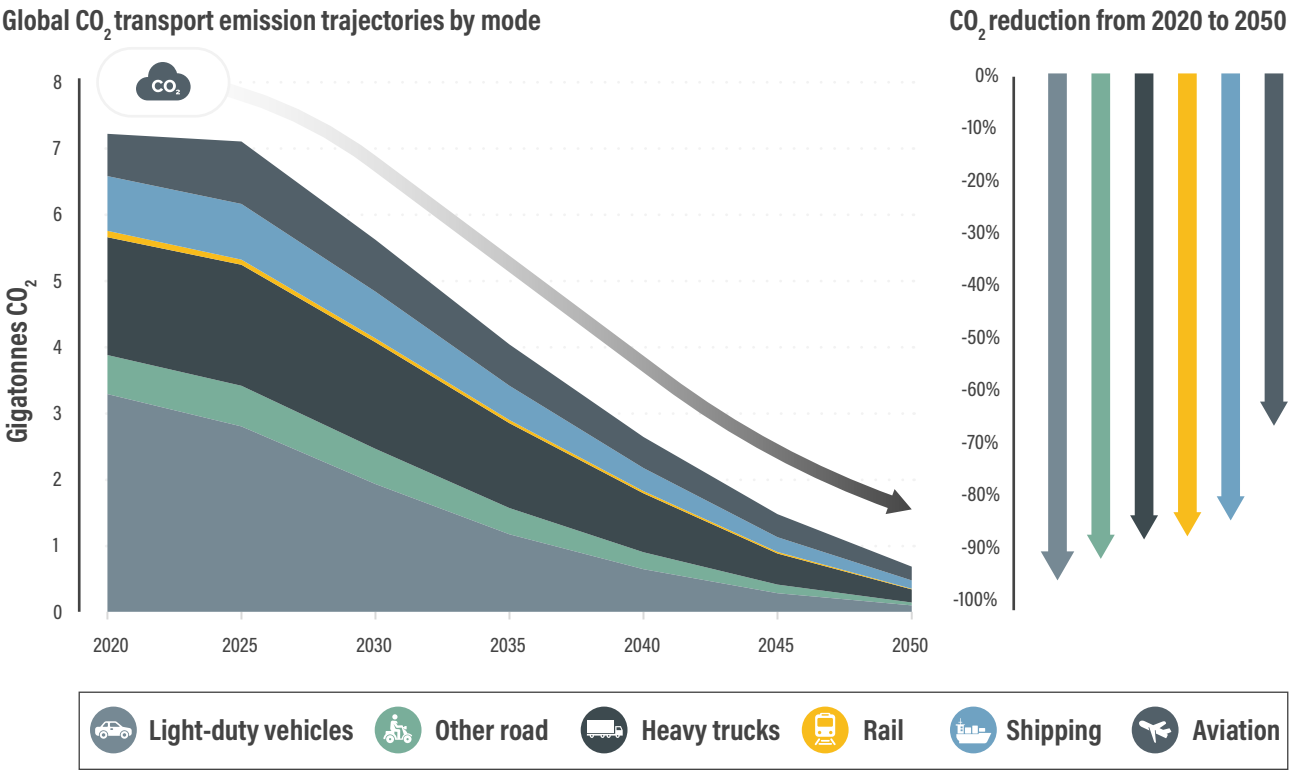
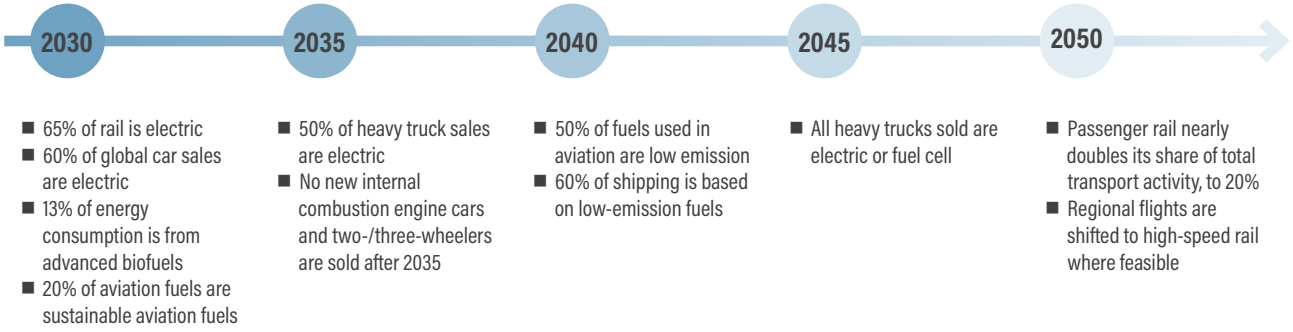


TABLE 1. Milestones towards net zero transport emissions, according to the IEA Net Zero Scenario

Source: See endnote 89 for this section.



sources, as well as public transport.[89] A 2023 World Bank report highlights that electric buses and electric two- and three-wheelers can be cost-effective, feasible entry points for transitioning to electric mobility in low- and middle-income countries, while at the same time promoting inclusive mobility, improving air quality and enhancing energy security.[90]

Transport mitigation actions except biofuels have been identified as providing more benefits than costs over their lifetime.[91] Transport is the only energy end-use sector where this is the case for all identified actions.[92]

However, even in a low carbon pathway, transport will be the second highest emitter of CO_2 among energy end-use sectors (after industry) by 2032, and by 2050 transport will be the most-polluting sector due to long-distance air travel.[93] The reduction of direct and indirect emissions from transport will contribute only 16% of the total reductions required to reach net zero emissions economy-wide, less than the 28% reductions by buildings and 29% reductions by industry.[94]

Looking at transport demand, in a low carbon pathway, the maximum increase in passenger transport activity should be 50%, and in freight activity should be 20%, over the 2020-2050 period.[95] **Overall, the carbon intensity of the energy used in passenger and freight transport and of the fuels consumed needs to be halved by 2050.**[96] The CO_2 intensity for passenger and freight transport needs to be cut 45-51%, which corresponds to average annual energy efficiency improvements of 2.0-2.4%, to contribute to the Paris Agreement goals.[97] In parallel, the carbon intensity of fuels and other direct energy used needs to decrease 37-60% by 2050, compared to 2020 levels.[98]

For freight transport, the picture is less clear, although at least moderate reductions are needed. Freight transport emissions could be reduced 76% below 2020 levels by 2050 with policies that support higher operational efficiencies, optimised routing and asset sharing, freight consolidation, enhanced collaboration in supply chains, shift to railways or inland waterways, standardisation and low carbon solutions.[99] Ambitious actions on urban passenger transport can reduce emissions more than 80% below 2019 levels by 2050.[100]

Fossil fuel dependence in road transport needs to decline drastically, from 95% in 2020 to 10% by 2050, with electricity becoming the dominant fuel in transport by the early 2040s.[101] Advanced biofuels will play a role in the transition to a zero-emission vehicle fleet in the short to medium term.[102] Biofuels will represent a 15% blending share in oil by 2030, and thereafter be used mainly for aviation and shipping.[103]

Vehicle electrification will happen faster in high-income countries, with a delay of only around five years for low- and middle-income countries.[104] Electric cars will represent 20% of all cars globally by 2030 and 60% by 2040, resulting in 350 million electric cars on the roads by 2030.[105] Electric two- and three-wheelers will double from the current 300 million to 600 million by 2030 and surpass 1.2 billion by 2050.[106] For buses, 23% of all buses in operation will be electric by 2030 and 79% by 2050, when more than 50 million electric buses will be in operation.[107] Vehicle electrification will raise electricity demand. The electric vehicle fleet consumed around 100 terawatt-hours annually in 2022 and will add another 380 terawatt-hours of electricity demand by 2030.[108]

In addition to the transition of technologies ("Improve" measures), behavioural changes ("Avoid" and "Shift" measures) are needed to support transport decarbonisation, as emission reductions will not be achieved without critical shifts in transport modes. In urban areas, a shift of 20-50% of all car trips to public transport, ridesharing, walking and cycling is required.[109] Car ownership can be reduced 35% by providing adequate public transport services and ridesharing schemes.[110]

For **international aviation,** pathways towards net zero emissions require aviation CO_2 emissions to peak in 2025 at 950 million tonnes and then fall to 210 million tonnes by 2050.[111] Governments will need to reinforce a shift to high-speed rail and constrain long-distance business travel. The difficulty is that aviation fuels require a high energy density.[112]

In 2021, the International Air Transport Association, the trade association of the world's airlines, committed to achieve net zero emissions by 2050.[113] In 2022, the International Civil Aviation Organization (ICAO) adopted a similar long-term aspirational goal for international aviation.[114] The most ambitious scenario for achieving the ICAO goal aims to reduce aviation CO_2 emissions from 600 million tonnes in 2019 to 203 million tonnes by 2050.[115] Technological improvements would contribute 21% of the reductions, operational improvements 11% and fuels 55%.[116]

Critically, none of the current ICAO scenarios are able to reach zero CO_2 emissions by 2050.[117] Moreover, the ICAO's long-term goal does not cover non-CO_2 gases, which account for two-thirds of aviation's climate impacts, nor does it reflect any short- or medium-term targets or binding commitments by countries. This goal would result in global warming of between 1.6°C and 2.3°C.[118] It has been criticised for these reasons and for its failure to create incentives to take meaningful action towards the goal.[119]

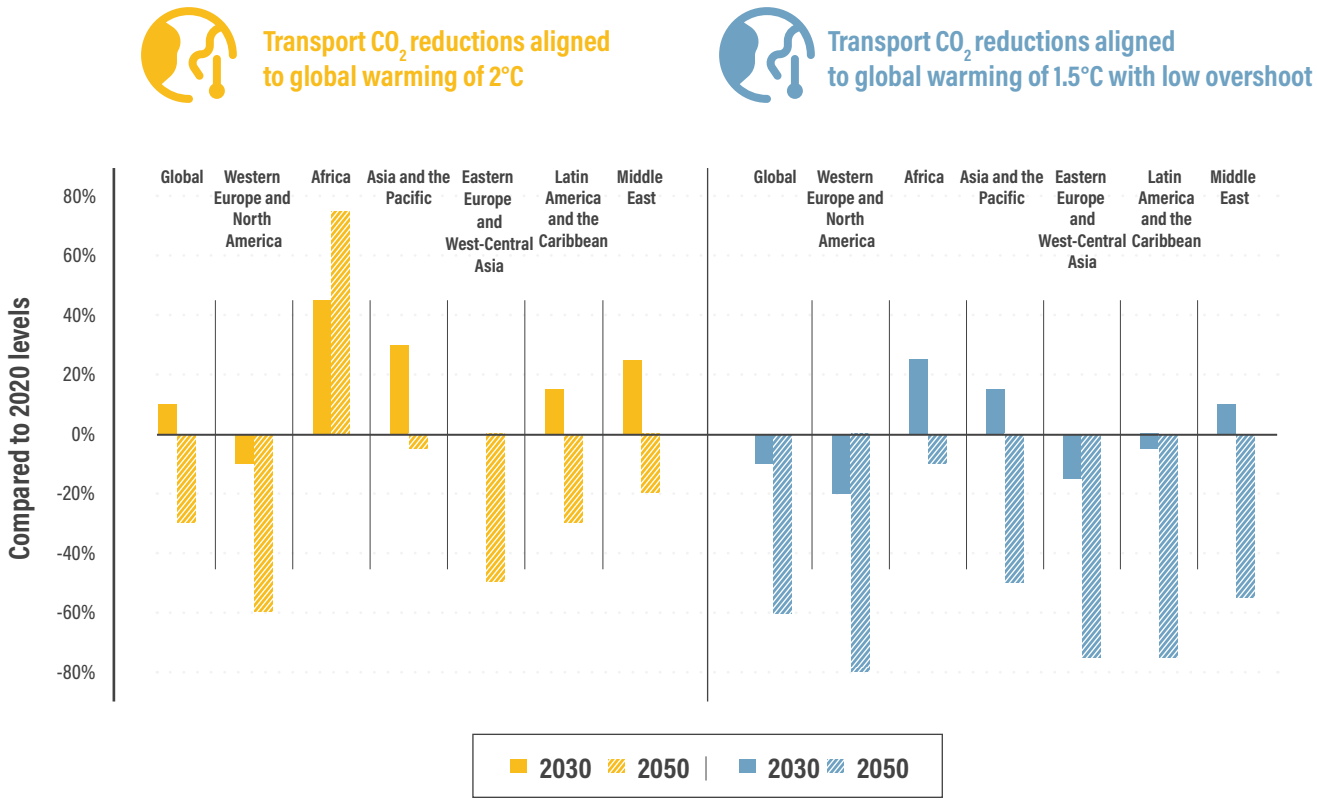
To contribute to achievement of the Paris Agreement targets, **international shipping** will need to become more efficient in the short term and to switch to low carbon fuels in the medium to long terms. This requires implementing approaches such as low steaming, wind-assistance technologies and low carbon fuels (ammonia, biofuels and hydrogen). Advanced biofuels can supply 20% of the shipping sector's energy consumption by 2050, while ammonia and hydrogen can cover 60%.[120]

In 2023, the International Maritime Organization (IMO) planned to release a revision of its 2018 Initial Greenhouse Gas Strategy.[121] The IMO's current targets are to reduce the carbon intensity of international shipping at least 40% by 2030 and 70% by 2050 and to reduce total annual greenhouse gas emissions from international shipping at least 50% by 2050 (compared to 2008 levels).[122] National governments have pressed the IMO to strengthen its regulations and targets, moving towards new interim goals for 2030 as well as zero emissions no later than 2050.[123]

Looking at regional transport decarbonisation pathways, different regions need to contribute differently to the reduction of transport CO_2 emissions (see Figure 10)**, with stronger reductions required in high-income countries than in low- and middle-income countries.**[124]

FIGURE 10. Regional transport decarbonisation pathways for 2030 and 2050, by scenario

Source: See endnote 124 for this section.



- **Western Europe and North America** need to reduce their transport CO_2 emissions drastically – at least 60% by 2050 to be aligned with the 2°C scenario and at least 80% by 2050 to be aligned with the 1.5°C scenario with low overshoot (compared with 2020 levels).[125]

- **Eastern Europe and West-Central Asia** will require extensive reductions of at least 50% below 2020 levels by 2050 for the 2°C scenario and 75% for the 1.5°C scenario with low overshoot.[126]

- **Asia and the Pacific** should reduce their transport CO_2 emissions 50% below 2020 levels by 2050 to be aligned with the 1.5°C scenario with low overshoot.[127]

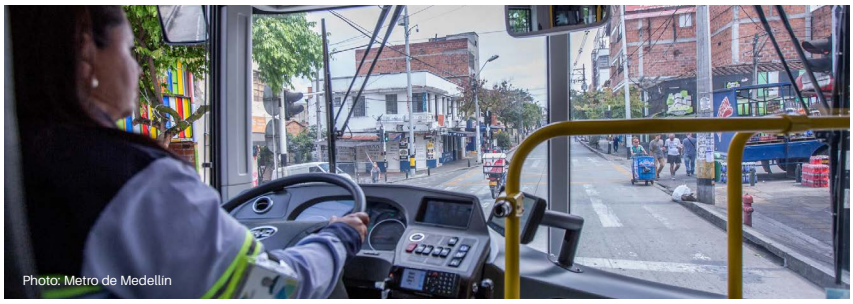


Photo: Metro de Medellin

- **Latin America and the Caribbean** will require transport CO_2 emission reductions of 30% below 2020 levels by 2050 for the 2°C scenario, and 75% for the 1.5°C scenario with low overshoot.[128]

- To be aligned with the 1.5°C scenario with low overshoot, countries in **Africa** can increase their transport CO_2 emissions around 20% by 2030, more than any other region, as long as emissions are at least 10% below 2020 levels by 2050.[129]

- Like Africa, the **Middle East** can increase its transport CO_2 emissions by 2030, but then should achieve significant reductions below 2020 levels – at least 20% by 2050 for the 2°C scenario and 55% for the 1.5°C scenario with low overshoot.[130]

Transforming transport and mobility systems for more sustainable societies

A just transition to equitable, healthy, green and resilient transport and mobility systems is central to socio-economic prosperity for the people and the planet.

To achieve equitable, healthy, green and resilient transport and mobility systems, a series of key transformations in land transport - linked to wider socio-economic transformations, are needed (see Figures 11 and 12).

The SLOCAT Wheel on Transport and the SDGs defines equitable, healthy, green and resilient transport and mobility systems based on the positive interactions with the UN 2030 Agenda and its SDGs (Figure 11). Under each theme, fundamental notions related to socio-economic and environmental systems on which sustainable, low carbon transport can affect positive change are highlighted. The analysis is complemented by a detailed list of targets across all SDGs for which action on sustainable, low carbon transport and mobility has the strongest impact.

FIGURE 11. SLOCAT Wheel on Transport and SDGs

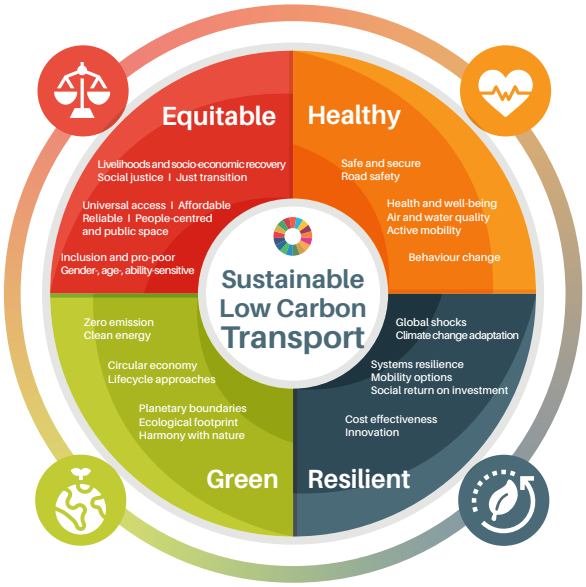


FIGURE 12. SLOCAT transformations for sustainable, low carbon land transport

I Transport connects people and prosperous societies, and works for them as a system of multiple modes and services.

II Cities are compact and managed to maximise access to socio-economic opportunities, health and equity for all.

III Rural and interurban mobility services are low in emissions and focus on users' needs to improve access.

IV Walking, cycling and public transport get priority.

V Well-managed transport demand reduces kilometres and car use.

VI Electrification drives low carbon land transport and puts the most sustainable modes first.

VII Digital technologies increase access and transport efficiency.

VIII Pricing and fiscal policy guide market forces and, together with finance, channel public and private funds towards the most sustainable transport services.

IX Freight systems efficiently combine different low carbon modes, share capacities and rely on sustainable first and last mile delivery.

X Industry, trade and transport are shaped to support a circular economy, local value creation, and short and resilient logistic chains.

XI Transport systems and services are resilient in extreme weather events and other shocks.

Click on the icons to read the details of each of the key transformations

Achieving equitable, healthy, green, and resilient transport and mobility systems has both explicit and implicit implications for the success of the UN 2030 Agenda and its 17 Sustainable Development Goals. Areas where transport has the greatest positive impacts include: ending poverty (SDG 1); ending hunger (SDG 2); promoting healthy lifestyles and well-being (SDG 3); empowering women and girls (SDG 5); ensuring sustainable and modern energy (SDG 7); building resilient infrastructure (SDG 9); making cities sustainable (SDG 11) and taking action to combat climate change and its impacts (SDG 13) (see Box 2).[131]

However, the reality is that most of the world's population does not have access to affordable, sustainable transport. Efforts to transform transport systems to achieve the SDGs are faced with a variety of weaknesses and threats (see Table 2).[132]

Important synergies and trade-offs exist between transport actions to implement the SDGs and actions for transport decarbonisation, adaptation and resilience. For example, every mitigation option listed in Figure 13 has a relation to SDG 7 (affordable and clean energy) and SDG 8 (decent work and economic growth).[133] Electric light-duty vehicles have both synergies and trade-offs with several SDGs (SDG 3 on good health and well-being, SDG 7 on affordable and clean energy, SDG 10 on reduced inequality and SDG 12 on responsible consumption and production), as this option continues to support car dependency and has strong infrastructure investment needs. Biofuels have synergies and trade-offs with SDG 2 (zero hunger) and SDG 3 (good health and well-being), because biofuels take land away from food production.[134]

Overall, synergies exceed trade-offs. The trade-offs can be further minimised by emphasising activities, such as capacity building, finance, technology transfer and making considerations for governance, gender and equity and with participation of Indigenous peoples, local communities and vulnerable populations.[135]

Since the 2015 adoption of the landmark 2030 Agenda and the Paris Agreement, rising inequalities coupled with the COVID-19 pandemic and geopolitical conflicts have led to significant setbacks in the accomplishment of these agendas and their transport-related targets. The gap between carefully agreed words in global agreements and real actions is growing ever wider.

A report from the Sustainable Development Solutions Network revealed that the pandemic has inflicted "massive humanitarian costs".[136] Coupled with geopolitical conflicts such as the Russian invasion of Ukraine, this has hampered progress towards SDG 2 (zero hunger) and SDG 7 (affordable and clean energy) and "crowd[ed] out space for long-term thinking and investments".[137]

BOX 2. Voluntary National Reviews under the 2030 Agenda for Sustainable Development

The High-Level Political Forum on Sustainable Development is the UN's apex body on sustainable development. It has a central role in the follow-up and review of the 2030 Agenda and the SDGs at the global level. The 2030 Agenda encourages UN member states to "conduct regular and inclusive reviews of progress at the national and sub-national levels, which are country-led and country-driven". This mechanism, known as the Voluntary National Review (VNR), aims to facilitate the sharing of experiences among countries, including successes, challenges and lessons learned, with a view to accelerating the implementation of the 2030 Agenda.

The VNRs from 2016 to 2022 revealed consensus about transport being a key contributing factor for the implementation of the SDGs. In 2022, 21% of the VNRs mentioned specific transport targets, up from 20% in 2021, 18% in 2020 and 17% in 2019. A number of 2022 VNRs highlight sustainable transport actions in the context of COVID-19 pandemic recovery and the urgent transition from fossil fuels to renewable energy sources. However, most 2022 VNRs only describe the adverse impacts of the ongoing crises instead of presenting concrete policy measures. And when they do, the measures do not fully address the urgent systemic transformations necessary to enable equitable access to transport and mobility for all.

(*See Section 1.3.1 Transport in National Climate and Sustainability Strategies to Achieve the Targets of the Paris Agreement and SDGs.*)

TABLE 2. Weaknesses and threats facing efforts to transform transport systems to achieve the SDGs

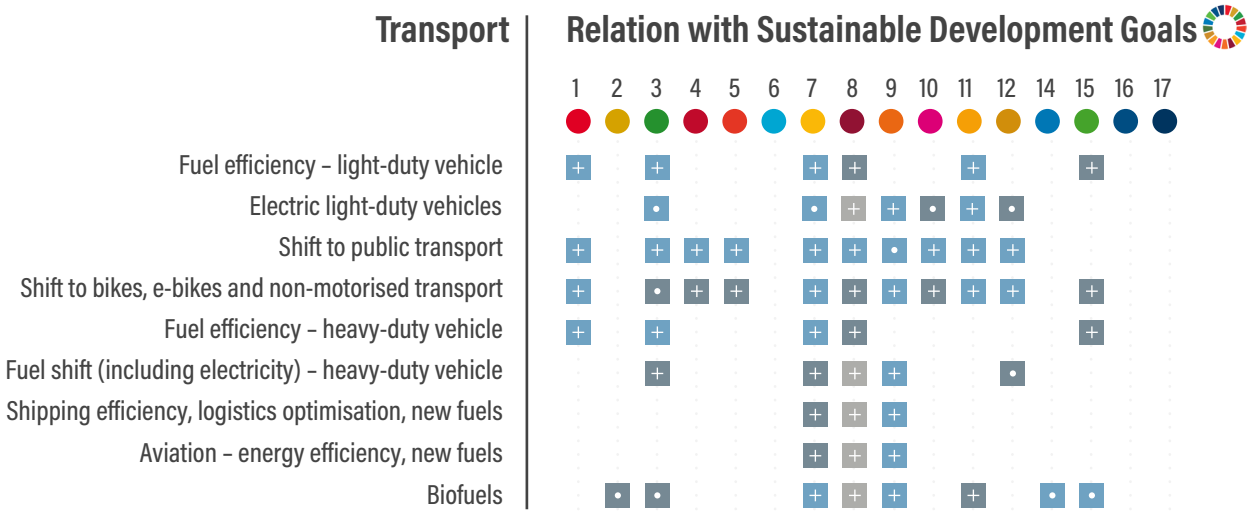
Source: See endnote 132 for this section.

SDG 3 (healthy lifestyles and well-being)	The number of road deaths fell 2% annually on average during 2010-2019. In 2020, road fatalities dropped a remarkable 19.2%, although this was still well below the target of 50% reduction by 2020 set under the United Nations Decade of Action for Road Safety.
SDG 7 (ensuring sustainable and modern energy)	Fossil fuel subsidies nearly doubled in 2021, and the Russian invasion of Ukraine drove energy prices higher while eroding energy security and geopolitical stability.
SDG 9 (building resilient infrastructure) SDG 11 (making cities sustainable)	In rapidly urbanising areas of low- and middle-income countries, access to transport and mobility services is inequitable. In Africa, the average person walks for 56 minutes per day, and 95% of roads fail to meet an acceptable level of service. Only 32% of the urban population in Africa and 38% in Asia has convenient access to public transport.
SDG 7 (ensuring sustainable and modern energy) SDG 13 (combating climate change and its impacts)	Electric vehicles are the fastest growing sector of the clean energy industry, with sales of electric cars, vans, trucks, buses more than doubling in 2021 to reach a record 6.7 million units. However, most of the attention is focused on private electric vehicles, and many current narratives fail to consider realities in the Global South.
SDG 13 (combating climate change and its impacts)	In most countries and regions, transport CO_2 emissions are not trending in the right direction. During 2010-2019, transport showed the fastest growth in CO_2 emissions among combustion sectors globally (excluding "other sectors"), rising 2% annually on average and 18% overall. Several international bodies and frameworks exist to support greater resilience and adaptation in infrastructure, but few activities focus on transport. Transport resilience to climate change impacts is not receiving the attention required in country plans (*see Section 1.2 Transport Adaptation and Resilience*).

FIGURE 13. Synergies and trade-offs between transport mitigation options and the SDGs

Source: See endnote 133 for this section.

Mitigation options have synergies with many Sustainable Development Goals, but some options can also have trade-offs. The synergies and trade-offs vary dependent on context and scale.



Similarly, the SDG Index revealed a slight decrease in the average national performance on SDG 1 (no poverty) and SDG 8 (decent work and economic growth) and noted particularly poor performance on SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), SDG 13 (climate action), SDG 14 (life below water) and SDG 15 (life on land).[138] The 2022 International Spillover Index showed that rich countries generate negative socio-economic and environmental spillovers, including through unsustainable trade, overconsumption, and inefficient supply chains, where the transport sector plays a critical role.[139]

In the past couple of years, most transport and mobility systems globally have become more vulnerable to systemic shocks, disproportionately affecting people living in vulnerable situations. Global shocks – such as the COVID-19 pandemic, extreme weather events, disrupted global value chains and conflicts – have revealed the fragility of transport systems and services.

On top of that, natural hazards present a substantial threat to transport systems around the world that is only expected to increase due to climate change, reinforcing the need for climate adaptation and resilience. Cascading impacts of disruptions to other sectors, as well as macroeconomic and geopolitical shocks or societal events, can also disrupt transport networks, and the monetary impacts of transport disruptions far exceed the damage to physical assets alone. This reinforces the need for increased adaptation and resilience of transport systems, as well as for holistic notions of socio-economic resilience through transport. (*See Section 1.2 Transport Adaptation and Resilience.*)

However, the magnitude of the challenges should not obscure the opportunities that lie ahead. The trends of recent years have contributed to greater understanding that decarbonised, resilient, and sustainable transport and mobility systems are an essential service that can increase the social return on investment, reduce impacts of shocks and speed recovery. Countries experienced that shifting to active modes of transport can deliver a host of resilience, social and environmental benefits. Pressures on energy supply have reinvigorated discussions on energy efficiency and independence, as well as interest in reforming energy policies to transform transport.

In a world of interconnected challenges, the opportunity lies in finding solutions for systemic transformation that cut across transport, sustainability and climate action. The current circumstances confront us with the urgent need for profound and systemic socio-economic transformations, many of which directly impact the ability to transform transport systems over the coming decade. The current policy responses to transport and mobility challenges remain insufficient and too slow.

Applying "Avoid-Shift-Improve" (A-S-I) measures across passenger and freight transport through integrated, inter-modal and multi-dimensional approaches remains critical to deliver such cross-cutting solutions for systemic transformation (see Figure 14). The A-S-I framework has been central to transport decarbonisation and sustainability efforts for more than a decade. It calls for transport and mobility systems that, while guaranteeing access to transport and mobility:

- *Avoid* unnecessary motorised trips based on proximity and accessibility;
- *Shift* to less carbon-intensive modes – that is, from private vehicles to public transport, shared mobility, walking and cycling, water-based freight, electrified road-rail freight, and cargo bikes for last-mile deliveries, among others; and
- *Improve* vehicle design, energy efficiency and clean energy sources for different types of freight and passenger vehicles.

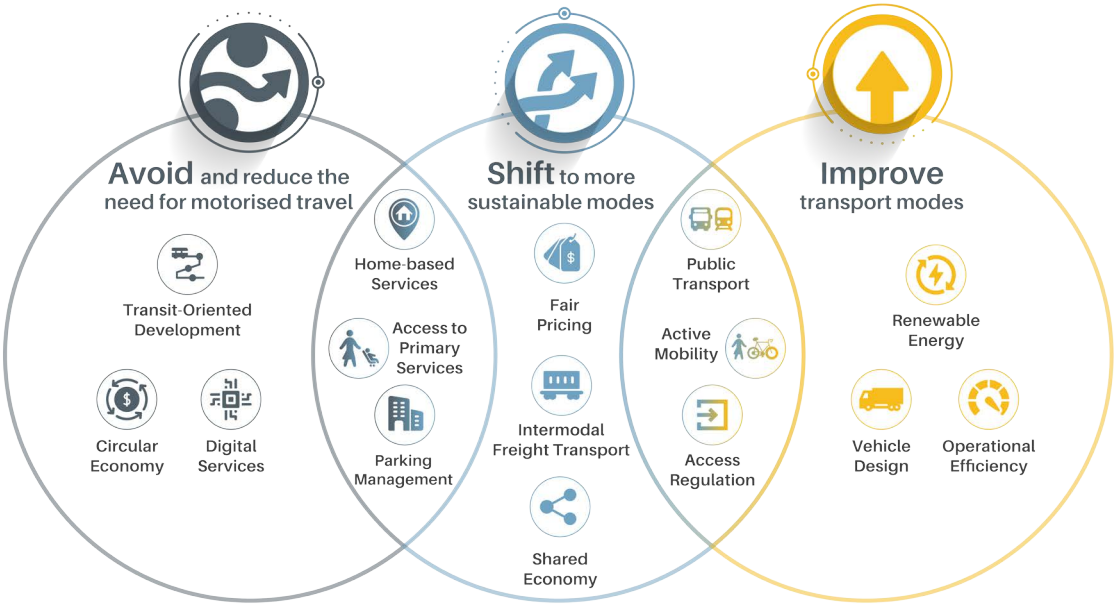
"Avoid" and "Shift" actions will contribute to half of the mitigation efforts needed by 2050. A 2021 study on demand-side mitigation actions found that, on average, emission reductions in land transport will be 10% through "Avoid" measures, 15% through "Shift" measures and 50% through "Improve" measures (compared to the 2050 baseline).[140] For aviation, "Avoid" measures (such as the implementation of carbon pricing) can lead to an average 40% reduction in emissions.[141] For shipping, on average, "Avoid" represents 47% of reductions, "Shift" 1% and "Improve" 40%.[142]

Shortly after the beginning of the Russian invasion of Ukraine in 2022, the IEA released a 10-point plan outlining how to cut oil use in advanced economies. The plan featured a detailed breakdown of how 2.9 million barrels of oil per day could be saved in the transport sector, revealing that quick measures related to "Avoid" can have a significant impact (see Figure 15).[143]

As a direct reaction to the Russian invasion of Ukraine, in March 2022 the European Commission presented the REPowerEU plan, with the aim of accelerating a shift to clean energy and reducing the region's reliance on Russian fossil fuels. Key steps relevant for transport are the transition to natural gas, liquefied natural gas and hydrogen; increased ambition to increase energy efficiency in transport; and a shift to more public transport, walking and cycling.[144]

Despite these and other steps, global fossil fuel subsidies have continued to rise, whereas strong financial support is lacking for sustainable, low carbon transport and mobility options. A fundamental reform of transport economics is urgently needed to deliver the necessary just transformations at the speed and scale required to achieve the targets of the Paris Agreement and the SDGs. (*See Section 5.1 Financing Sustainable Transport in Times of Limited Budgets.*)

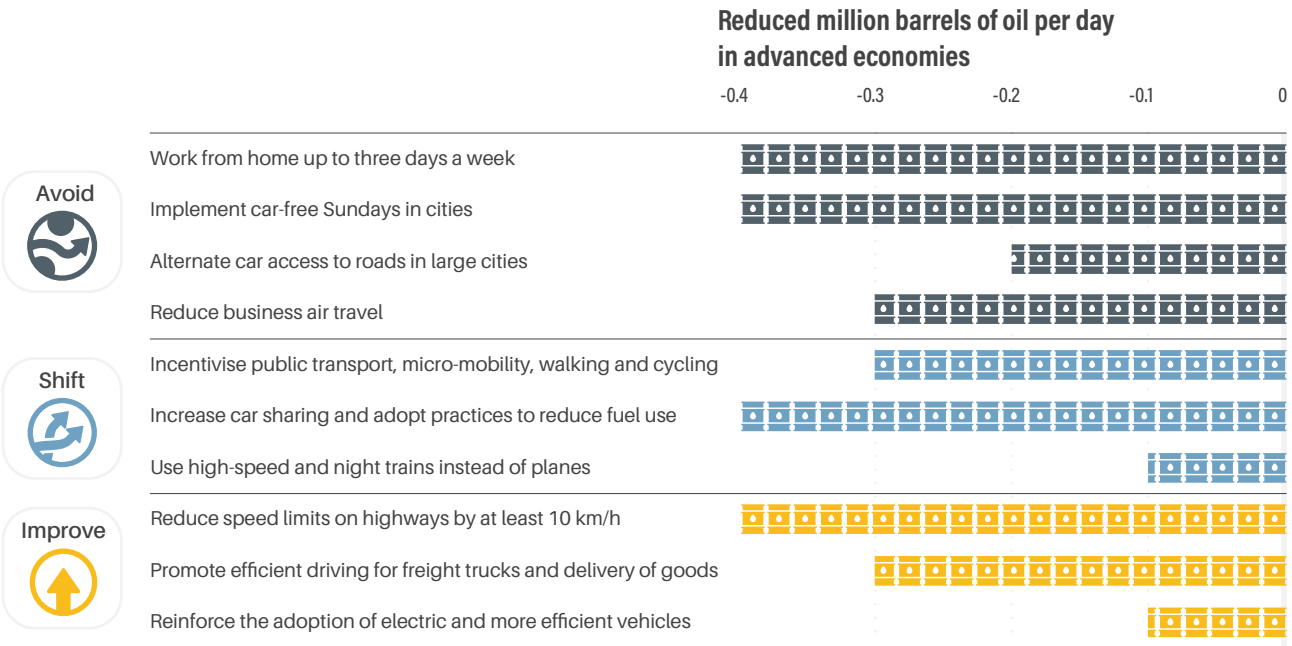
FIGURE 14. Avoid-Shift-Improve framework for transport



** The A-S-I diagramme presents a non-exhaustive list of measures for illustrative purposes only.*

FIGURE 15. Actions to reduce oil dependency in transport, through Avoid-Shift-Improve measures

Source: See endnote 143 for this section.



MODULE 1 | 1.2

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Transport Adaptation and Resilience

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Key findings

Context and key challenges

- Transport and mobility systems require not only infrastructure and operational resilience, but also resilience to shocks, macroeconomic and political disruptions, social events and climate change, to achieve financial sustainability.
- Climate change impacts – including sea-level rise and coastal flooding, more intense storms and rainfall, and more extreme temperature swings – increase the vulnerability of passenger and freight transport and heighten the impacts of other disruptors.
- Transport resilience initiatives are increasingly data dependent, but obstacles remain, including limited data collection capacity among many countries, cities, and companies, constrained access to existing data, and lack of information sharing.
- Transport systems tend to cross multiple jurisdictions, and resilience must involve non-traditional stakeholders, yet fragmentation of governance presents a continuing barrier.
- Resilience and adaptation must be balanced with the pressing need for decarbonisation and energy security, in the context of sustainability objectives.

Adaptation and resilience of transport systems

- Natural hazards cause an estimated USD 15 billion a year in direct damage to transport systems worldwide; of this, an estimated USD 8 billion occurs in low- and middle-income countries, which experience the highest costs relative to their gross domestic product.
- Cascading impacts of disruptions to other sectors can also disrupt transport networks. In extreme cases, these disruptions can undermine the viability of transport systems.
- Investment gaps continue to grow worldwide, and transport systems may become increasingly vulnerable as long-term stresses degrade assets.
- The monetary impacts of transport disruptions far exceed physical damages to assets. In low- and middle-income countries, this results in an estimated USD 107 billion in annual losses to businesses.
- Transport service interruption can bring harder-to-quantify, but no less impactful, secondary social consequences.
- Proactively adapting transport systems for future climatic conditions is far more cost-efficient than delayed adjustments or inaction.
- An "access-based" perspective on transport resilience can provide a more holistic, complex view of both the coming hazards and the available adaptation options.

Resilience through transport

- Transport is vital for supporting societal resilience during the response and recovery phases of a disaster and must be designed intentionally to serve these emergency functions.
- Transport increases people's access to jobs, health services, shelter, education and economic opportunities. These factors highlight transport's ability to deliver further "dividends of resilience": increased economic resilience and benefits for development.
- Recognition is growing of the interaction between transport investments and social inequalities, which can lead to asymmetrical impacts from climate-related events.
- Emergent approaches offer opportunities to create transport systems that both are climate resilient and have a minimal, or even beneficial, impact on the environment.
- Shifting to active modes of mobility where feasible can help deliver a host of resilience, social and environmental benefits.

International support for transport adaptation and resilience

- A global shift in perspective is helping to create frameworks that support greater resilience in infrastructure at the international level, but few of these focus specifically on transport.
- A growing number of international tools are providing incentives for transport system resilience, but gaps in capacity remain, especially in the Global South.
- International financial institutions are highlighting climate risks in infrastructure, which is producing more resilient transport investments; yet the estimated gap in adaptation finance for low- and middle-income countries is 5 to 10 times greater than current investment.

National and sub-national planning on transport adaptation and resilience

- National and sub-national actors – including governments, businesses and civil society – have begun to nominally address climate adaptation and resilience for transport, but concrete action and expenditures remain insufficient.
- National Adaptation Plans (NAPs) show promise as a means for low- and middle-income countries to prioritise actions around transport system adaptation.
- Provincial/state and municipal governments are planning and implementing transport resilience and adaptation projects with support from the private sector and civil society.
- Public-private partnerships are showing potential to mobilise private sector funding and expertise to make transport systems more resilient.
- National standards applicable to transport systems are starting to incorporate climate adaptation, building on the example of standards provided by the International Organization for Standardization (ISO).

Measuring impact – how do we know we are moving in the right direction?

- Measuring resilience and adaptation outcomes is an ongoing challenge that can be approached in multiple ways. Several methodologies have emerged that include appropriate indicators for measuring resilience and adaptation.
- Consideration of transport resilience and adaptation in combination with other critical systems offers a more robust way to ensure improved societal resilience.

Overview

Transport plays a vital role in connecting people and communities around the world, and in supporting global supply chains. Yet in the last few years, most transport and mobility systems worldwide have become more vulnerable to systemic shocks, affecting their ability to provide reliable, efficient and safe service and with disproportionate impacts on people living in vulnerable situations. Meanwhile, uncertainty about the frequency and severity of future climate-related events is growing. It is therefore urgent to consider adaptation and resilience measures, in conjunction with mitigation actions, to ensure that transport and mobility systems are both resilient to future shocks and hazards and that their development and operation contributes to social resilience and to the overall decarbonisation of our economies.

Transport resilience can be defined according to two key aspects:

- **Resilience of transport:** Ability of transport and mobility systems to withstand, respond to, recover from and adapt to a range of shocks and stresses, both now and into the future. Key elements include operational and organisational resilience (e.g., offering redundancy and diversity of mode choice for communities of differing income levels and geographic locations and various types of goods) in addition to the physical resilience of the infrastructure itself.
- **Resilience through transport:** Capacity to enhance the resilience of people and communities through passenger mobility systems, and the resilience of enterprises, economies, and supply chains through freight transport systems. Resilient transport and mobility systems provide services and deliver benefits to communities that are most vulnerable to the impacts of climate change and to the most critical supply chains.[1]

Adaptation is an integral component of resilience strategies, particularly climate resilience; however, it is not the full story. A holistic approach to resilience also takes into consideration the shocks and stresses to transport systems created by *non*-climate-related disruptors (e.g., health crises, macroeconomic and political disruptions) as well as interdependencies that transport has with other systems, both "hard" (e.g., energy and communications) and "soft" (e.g., governance and regulation).

To guide decision making, some organisations have sought to define core principles or qualities for resilience. For example, the United Nations Office for Disaster Risk Reduction's (UNDRR) six principles characterise resilient systems as those that are: continuously learning, proactively protected, environmentally integrated, socially engaged, sharing responsibility and adaptively transforming.[2]

There are many current and promising approaches for implementing adaptation and resilience in the transport sector, with the goal of mainstreaming resilience. At the same time, both trade-offs and co-benefits exist between resilience and adaptation, and mitigation. This is the first edition of the SLOCAT Transport, Climate and Sustainability Global Status Report to dedicate a full section to resilience and adaptation, with a focus mainly on road and rail transport in addition to aviation and maritime transport.

Photo: Solmaz Daryani / Climate Visuals Countdown

Context and key challenges

Transport and mobility systems require not only infrastructure and operational resilience, but also resilience to shocks, macroeconomic and political disruptions, social events and climate change, to achieve financial sustainability.[3] Several disruptors already impact transport networks around the world, and many of these are exacerbated by climatic factors.

Pandemics

In the United States, monthly total ridership on public transit dropped around 80% from 2019 to early 2020 due to the impacts of COVID-19.[4] In Brazil, the National Association of Urban Transport Companies estimates losses of around 90,000 jobs and BRL 36 billion (USD 7.3 billion) in the public transport sector between February 2020 and April 2023.[5]

Social unrest

In Peru's Amazon region, Indigenous groups blocked a large river in September 2022 to protest an oil spill, and in the United Kingdom transport unions held rail strikes throughout 2022 in a dispute over compensation and working conditions.[6]

Political conflict

As of May 2022, the Russian Federation's invasion of Ukraine had damaged up to 30% of the country's transport infrastructure, destroying 7 airports, 144,000 kilometres of roads, 1,242 bridges and nearly 6,300 kilometres of railways, with costs estimated at EUR 92.6 billion (USD 99.9 billion).[7] The impacts of the invasion on ports has affected trade flows and food security.[8] The invasion also has caused sharp increases in natural gas costs, which rose 170% from February to July 2022, in addition to impacts through inflation caused by effects on supply chains.[9]

Demographic changes and urbanisation

As more people live in cities globally, the urban population share is projected to rise from 56% in 2021 to 68% in 2050, putting greater demands on public transport systems.[10] Urbanisation will take different forms in different regions, with low-income countries expected to experience the highest urban sprawl as city land areas grow an expected 141% by 2070 (compared to 2020 levels).[11] Poor planning exacerbates this issue, and climate change will also affect land use and movement patterns, resulting in changes in transport demand.[12]

Technological innovation and disruption

Despite their benefits, new technologies can be highly disruptive, creating new pressures and vulnerabilities. For example, governments may struggle to keep up with rapidly changing transit networks for "mobility-as-a-service", often competing with established systems for users, resources and infrastructure capacity.[13] This emerging mobility trend remains largely unregulated, with an early attempt being Finland's Act of Transport Services in 2017.[14]

Ageing infrastructure assets

As insufficient maintenance budgets coincide with ageing assets and greater climate variability, this can lead to higher rates of deterioration and failure that further stretch budgets. Most road networks in high-income countries underwent major investment and expansion during the 1960s-1980s and are now approaching the end of their design life, necessitating critical upgrades.[15] Yet spending on transport systems will likely continue to be insufficient for the foreseeable future.

Consumption and commerce changes

Online shopping demand, accelerated by the COVID-19 pandemic, has resulted in a substantial increase in home deliveries. Delivery vehicles often carry poorly optimised loads along local roads that may not be well suited to freight transport, contributing to higher congestion and emissions.[16] Since the pandemic, there has been considerable upheaval in global value chains, with tendencies towards re-localisation and "friend-shoring".[17]

Climate change impacts – including sea-level rise and coastal flooding, more intense storms and rainfall, and more extreme temperature swings – increase the vulnerability of passenger and freight transport and heighten the impacts of other disruptors.[18] While uncertainty remains around specific factors and impacts, there is overwhelming scientific evidence that human-induced climate change has contributed to more frequent and intense extreme events.[19] Direct physical impacts on transport can include:

- **Sea-level rise and increased coastal flooding**, which combine with other hazards to damage ports and disrupt operations and shipping, flood airports, damage or isolate roads and railways, and impair or destroy natural coastal defences.[20]
- **More severe winds**, leading to traffic disruption, damage to bridges and to auxiliary road and rail infrastructure, and safety hazards for users.[21]
- **More intense storms**, increasing tree fall and causing damage to physical infrastructure and vehicles, widespread traffic disruption and unsafe travel conditions.[22]
- **More intense rainfall**, leading to infrastructure flooding, slope failures and landslides, washout of roads and tracks, and bridge scour.[23]
- **Changes in average rainfall**, contributing to drought and changes in the flow and sedimentation regime of rivers (affecting the navigability of inland waterways); poor road conditions and visibility; damage and obstruction to infrastructure (e.g., shrink-swell); and loss of protective vegetation.[24]
- **Increasing average and extreme temperatures**, resulting in pavement deterioration, rail deformation and buckling, air conditioning failures in vehicles due to overheating, expansion of bridge joints, impacts to underground systems through increased urban heatwaves and increased forest fires in non-urban areas, and health risks for transport workers and users.[25]
- **Unpredictable winters**, leading to potential extreme cold events, extreme snowfall and avalanche, thermal cracking of pavement, freeze-thaw deterioration and brittle failure of rails.[26]

Many of these impacts could potentially interact, creating compounded or cascading hazards.

Transport resilience initiatives are increasingly data dependent, but obstacles remain, including limited data collection capacity among many countries, cities, and companies, constrained access to existing data, and lack of information sharing. Although climate projection data are now widely available, many organisations lack the capacity to apply these to risk assessment. Data sharing among organisations is limited by barriers ranging from commercial to data security concerns.[27]


Photo: Vlad Sokhin / Climate Visuals

- Data on climate hazards are scarce in some regions, particularly in low- and middle-income countries, although efforts are under way to address these gaps in some cities and regions – for example, Rio de Janeiro's Centre of Operations links data on environment, transport and medical services.[28]
- A mismatch exists between the long-term planning required for climate adaptation and the short-term time horizons of many investors and government bodies, making it harder to secure funding.[29]
- There is a lack of consensus on metrics to track resilience and adaptation outcomes.

Transport systems tend to cross multiple jurisdictions, and resilience must involve non-traditional stakeholders, yet fragmentation of governance presents a continuing barrier.[30]

- Transport resilience requires new approaches to cross-organisational governance, such as New York City's Green Infrastructure programme, which oversees works formerly split between several city departments and resulted in the greening of nearly 850 hectares between 2010 and 2021.[31]

Resilience and adaptation must be balanced with the pressing need for decarbonisation and energy security, in the context of sustainability objectives. Because of the potential competition for attention and funding between adaptation and mitigation, it is essential to find opportunities to interweave these two focus areas. For example, improving transport infrastructure resilience improves the sector efficiency and reduces transport costs. Furthermore, using renewable resources improves sustainability and makes the sector less vulnerable to climate change and other disruptions. Finally, active travel is a resilience solution that can reduce emissions and thus can be interpreted as supporting sustainability.

Adaptation and resilience of transport systems

Natural hazards cause an estimated USD 15 billion a year in direct damage to transport systems worldwide; of this, an estimated USD 8 billion occurs in low- and middle-income countries, which experience the highest costs relative to their gross domestic product.[32] An estimated 27% of global road and rail assets are exposed to at least one cyclone, earthquake or flooding hazard.[33] Ports are even more exposed due to their placement along coastlines and rivers, with preliminary estimates indicating that 86% are exposed to three or more hazards.[34]

- Damage varies greatly among countries, with the most annual damage per kilometre of road and rail asset estimated in Vietnam, followed by Papua New Guinea and Myanmar.[35]
- In Pakistan, floods in 2022 caused more than USD 3.3 billion in damage to transport and communications, which was the third-largest sector with damages after housing (USD 5.6 billion) and agriculture (USD 3.7 billion).[36]
- Natural hazards continue to cause substantial physical damage and disruption to transport assets. In the European Union (EU), extreme weather alone contributed an average of EUR 2.5 billion (USD 2.7 billion) in direct damages to transport annually between 1998 and 2010, with indirect costs of disruption estimated at EUR 1 billion (USD 1.1 billion) .[37]
- In the aviation sector, extreme weather was responsible for around 7% of US flight delays in 2020, and a further 15% of delays were due to non-extreme weather conditions.[38]

Cascading impacts of disruptions to other sectors can also disrupt transport networks. In extreme cases, these disruptions can undermine the viability of transport systems.

An event that causes disruption to a critical infrastructure service – such as energy, water or communications – can also have substantial impacts on transport networks and public transport systems, even affecting systems that were not exposed to the initial hazard. Space weather events, for example, have the potential to cause global positioning and navigation satellite failures, which could lead to loss of communications and navigation technology, with severe consequences for all transport sectors.[39]

External stresses to upstream supply chains, such as fuel uncertainty, can also disrupt transport. Because of their complex nature, such cascading impacts are often poorly understood, with some dependencies not being appreciated until disaster brings them into focus. For example, the trend to electrify transport systems as a decarbonisation strategy creates new vulnerabilities from natural hazards that may affect power lines or transport stations.

As public transport services become more reliant on digital devices and electric vehicles, energy disruptions can have a high impact on operations.

- In 2019, an electricity outage due to a power failure affected three Indonesian provinces, rendering the MRT and the electric train inoperable and preventing customers from accessing electronic ticketing systems and ATMs to withdraw cash, thus restricting access to public bus services as well.[40]
- In Indonesia, rising floods and ground subsidence in Jakarta have led the government to begin relocating the capital to Nusantara; this points to the dual challenge facing Indonesian transport: frequent losses and damages due to natural hazards, and the need for vast new investment in the transition from existing assets to the new capital, at an estimated cost of more than USD 34 billion.[41]
- In the Maldives, 80% of the country could become uninhabitable due to sea-level rise by 2050, and climate change will have significant implications for transport connectivity, tourism and sustainability.[42]

Investment gaps continue to grow worldwide, and transport systems may become increasingly vulnerable as long-term stresses degrade assets. The projected global gap in financing for new transport infrastructure and maintenance is between USD 244 and USD 944 billion annually to 2030, for the business-as-usual development scenario, while infrastructure developments aligned to a 2-degree Celsius scenario would be lower and within the available infrastructure financing volumes.[43] Other studies estimate a financial gap of at least USD 440 billion for transport infrastructure to meet the United Nations Sustainable Development Goals by 2030.[44] This shortfall increases the maintenance and renewal backlog, further increasing the required investment and the vulnerability of assets.

The problem is compounded as climate change leads to more extreme physical stresses (e.g., shrink-swell cycles, extreme heat and precipitation), resulting in greater deterioration of assets and hence increased vulnerability to further deterioration and extreme events. For example, cracking of assets due to extreme heat leads to greater damaging infiltration of rainwater.[45] However, if decision makers act appropriately, ageing assets could provide an opportunity. As a generation of outdated infrastructure is replaced by forward-looking assets designed to withstand the future climate, resilience can be embedded – drawing on nature-based solutions, new material technology, and more flexible transport and mobility systems.

The monetary impacts of transport disruptions far exceed the physical damages to assets. In low- and middle-income countries, this results in an estimated USD 107 billion in annual losses to businesses.[46] Disruptions to transport networks have cascading impacts on the societies they exist to support. Regional economies suffer as staff and customers cannot travel, supplies are not delivered, and supporting services struggle. Climate change will exacerbate this challenge.

- Mozambique has suffered successive severe flooding events in recent decades, and changes in precipitation are projected to result in economic losses of USD 2.5 billion (roughly 15% of the country's GDP) annually to 2050.[47] This is due in part to the vulnerability of the food-transport nexus – especially in Africa – through the disruption of market access in rural areas.

Transport service interruption can bring harder-to-quantify, but no less impactful, secondary social consequences. Transport systems provide vital community links, and severing these links (particularly in remote areas) can lead to a loss of access to food, education, jobs, recreation, health, and social and government services. Disruption subsequently impacts the resilience, well-being and prosperity of affected individuals and communities.

- In Rio de Janeiro (Brazil), more affluent areas close to downtown have more resilient transport services (e.g., metro systems with multiple transfer points), while lower-income areas on the periphery are more vulnerable (e.g., bus systems dependent on infrequently maintained roads).[48] The impact of a failure in transport is therefore greater than the quantifiable monetary cost.

Proactively adapting transport systems for future climatic conditions is far more cost-efficient than delayed adjustments or inaction. When investment in resilience is used wisely, it can pay dividends that far outweigh the upfront costs. A 2019 analysis of potential infrastructure scenarios estimates that USD 1 of investment in strengthening infrastructure in low- and middle-income countries results in a median of USD 2 in benefits, which increases to USD 4 when climate change is considered.[49]

The "triple-dividend" of resilience includes avoided losses, induced economic benefits, and additional social and environmental benefits. Reduction of damages and loss of life is the first aspect of the triple-dividend; the other two aspects are discussed further in the next section.[50]

An "access-based" perspective on transport resilience can provide a more holistic, complex view of both the coming hazards and the available adaptation options. For example, the shift from mobility-based access to digitally based access (work from home, flexible work hours, satellite offices) can provide a vital risk mitigation tool. A "triple access transport planning" approach – which incorporates physical mobility, spatial proximity and digital connectivity – can be applied through the Futures Toolkit.[51]

Photo: Debarshi Mukherjee / Climate Visuals Countdown

Resilience through transport

Transport systems can enhance societal resilience by providing a range of benefits. Such systems can contribute to more-resilient communities if they are planned, delivered and managed in a way that maximises social benefits, minimises negative impacts to society and the environment, and protects and leverages natural ecosystems.

Transport is vital for supporting societal resilience during the response and recovery phases of a disaster and must be designed intentionally to serve these emergency functions. Transport links are essential parts of disaster and emergency response plans. When a disaster results in widespread impacts and disruption to transport systems, or when infrastructure and planning are insufficient to meet surges in demand, the cumulative impacts can be catastrophic (see Box 1).[52]

- Aircraft are often the first feasible means of transport for emergency response, as the basic functionality of aviation infrastructure typically can be restored quickly. An earthquake in Pakistan in 2005 killed more than 80,000 people and left up to 3.5 million without food or shelter just before the onset of the harsh Himalayan winter; road closures due to landslides cut off land access to many geographies and communities, and 168 flights delivered nearly 3,500 tonnes of relief supplies.[53]
- Following an earthquake in Nepal in 2015, more than 4,000 rescue workers and supplies were flown into Kathmandu Airport, damaging the runway and leading to closure of the airport within a week.[54]
- Unmanned drones have been utilised for humanitarian aid, including search-and-rescue efforts in Kazakhstan and vaccine delivery in Vanuatu.[55]

Transport increases people's access to jobs, health services, shelter, education and economic opportunities. These factors highlight transport's ability to deliver further "dividends of resilience": increased economic resilience and benefits for development.[56] Poverty and lack of access to markets are associated with, for example, food insecurity and dependence on sensitive assets, crops and ecosystems.[57] Rural transport in low- to middle-income countries can be key for driving development, employment opportunities and national growth.

- In Ethiopia, connection to a rural road was associated with a 10.4% decrease in residents' likelihood of being in poverty and a 2.8% increase in waged employment, over a four-year period.[58]
- A 2018 study in India identified a 5% increase in school enrolment among 5-14 year-olds in villages given access to a rural road, likely due to increased access to teachers.[59]
- In Indonesia, a modest average improvement in road quality resulted in a 20% increase in labour earnings.[60]
- Rural trail bridges in Nicaragua were found to eliminate the 18% decline in labour earnings reported during flood events.[61]

Recognition is growing of the interaction between transport investments and social inequalities, which can lead to asymmetrical impacts from climate-related events. The benefits of transport systems are not distributed evenly across society. Gender, age, social or disability status often play an important role in how people use transport. Greater mobility options could have a

BOX 1. Lessons learned from transport relief efforts in vulnerable communities

Multi-modal response plans can function effectively even when some links are overwhelmed. By ensuring that transport systems are prepared for and integrated with emergency response and disaster recovery plans, communities can be much better served.

When Hurricane Katrina struck New Orleans in the US state of Louisiana in August 2005, most of the population was evacuated by private road transport; however, an estimated 100,000 to 200,000 people were without private transport. The city's evacuation plan relied on public transit for these individuals – primarily city buses – but could not be properly executed. Many drivers evacuated themselves, buses were unprotected and damaged during the floods, and there were only enough buses for around 25% of the population. Nearly 70% of fatalities were among residents over the age of 65.

The importance of public transport's role in emergency evacuation was recognised after Hurricane Katrina, and recommendations were made to integrate public transport fully into emergency response and evacuation plans. For example, when Cyclone Fani struck the state of Odisha, India in 2019, the evacuation of 800,000 people from low-lying areas using public buses, railways and inland water transport was highly praised.

Photo: NOAA / NOAA

Source: See endnote 52 for this chapter.

particularly positive impact on traditionally disadvantaged or underrepresented groups.

- A study in India found that the provision of a rural road resulted in improvements in preventative health care for women, such as a 20% increase in women seeking antenatal care.[62]

There is also the asymmetrical climate-related vulnerability created by inadequate transport and access options. This includes informal settlements in African cities (e.g., Kampala, Uganda) forming in floodplains and on unstable hillsides, due to their proximity to economic opportunities that would otherwise be unavailable to the poorest residents due to unaffordable transport services.[63]

However, transport practitioners often overlook social inequalities, and investment and innovation can reinforce existing inequalities. For example, mobility services for first- and last-mile trips (such as ride hailing services) typically require a smartphone and bank account, but in the United States half of Black households are unbanked, and only 58% of Black individuals own a smartphone or computer.[64] Social inequalities lead to greater vulnerability to hazards, and people who are marginalised prior to a disaster often receive inferior support afterwards.[65]

Evidence reveals a gender discrepancy in disaster mortality, where women's life expectancy is affected more than men's; however, this discrepancy vanishes as women's socio-economic status increases (at lower socio-economic statuses, women tend to have most of the caring responsibilities, and in disaster settings, women are more likely to be at home protecting family members).[66] By ensuring that the needs of all users are considered, transport systems can deliver benefits that contribute to a more equitable society, and subsequently to more resilient communities.

Emergent approaches offer opportunities to create transport systems that both are climate resilient and have a minimal, or even beneficial, impact on the environment. There is a need to balance trade-offs between resilience and wider sustainability goals. Nature-based solutions and green infrastructure can create resilience of (and through) transport systems (see Box 2).[67]

Green drainage solutions, such as permeable pavements, bioswales, retention basins, rain gardens, and engineered wetlands, can mitigate flooding hazards and support ecosystems, allowing a more natural water cycle. Planting trees and other vegetation along urban infrastructure can help combat heat-island effects, reducing peak summer temperatures by 1 to 5 degrees Celsius (°C) and surface temperatures by 11° to 25°C, easing heat stress on both road users and assets.[68]

Shifting to active modes of mobility where feasible can help deliver a host of resilience, social and environmental benefits. Active mobility options such as cycling and walking reduce emissions and create societal resilience by providing healthier and more active lifestyles. Simultaneously, greater flexibility provided by a variety of active mobility solutions creates a more resilient transport system than one dependent on large-scale fixed infrastructure.

With more than 75% of urban journeys potentially short enough for active travel (including electric-assist bicycles), this presents an enormous opportunity to achieve both resilience and sustainability goals.[69] During the COVID-19 pandemic, many cities created temporary infrastructure to reduce dependence on public transport and private vehicles, and the increase in remote working reduced the need for many journeys entirely; this has spurred rising interest in "15-minute cities" connected by active travel.[70]

BOX 2. Restoring mangrove forest to enhance the resilience of coastal highways

Colombia's Ciénaga Grande de Santa Marta marsh ecosystem has been more than 50% lost, due in part to highway construction. The government is now considering expanding the highway further. A "green-grey" solution to coastal erosion has been proposed that would restore 344 hectares of mangroves annually through strategic placement of elevated roadways. This solution would also sequester around 23 tonnes of carbon a year and has around half the cost of the proposed hard-engineered solution.

Source: See endnote 67 for this chapter.

International support for transport adaptation and resilience

A global shift in perspective is helping to create frameworks that support greater resilience in infrastructure at the international level, but few of these focus specifically on transport. This shift is promoting international co-operation through co-ordinated governance mechanisms and impact frameworks as well as establishing funding, tools and incentives for action at an international scale. The transport sector is a key focus across these global co-operation mechanisms, with several noteworthy international agreements and partnerships helping to encourage co-operation between public and private sector organisations.

- The Marrakesh Partnership for Global Climate Action (MPGCA) seeks to implement the Paris Agreement with a view towards adaptation and resilience alongside climate mitigation.[71] Initiatives include increasing climate preparedness and resilience in the maritime and road sectors, among others.[72]
- The Marrakesh Partnership is complemented by the Race to Resilience campaign, which aims to catalyse action by non-state actors. At the 2022 United Nations Climate Change Conference in Egypt (COP 27), the campaign endorsed a joint statement to create a climate-smart and resilient maritime sector.[73]
- The Coalition for Disaster Resilient Infrastructure (CDRI), Global Resilience Partnership and G20 Global Infrastructure Hub are prominent partnerships among various government bodies and private sector and academic institutions that aim to promote resilient action, awareness, knowledge sharing and policy.[74]
- The International Coalition for Sustainable Infrastructure hosted the Transport Infrastructure Implementation Lab at the 2022 United Nations Climate Change Conference (COP 27), exploring the implementation of resilience in transport through engineering with a range of organisations, including the MPGCA and CDRI.[75]

A growing number of international tools are providing incentives for transport system resilience, but gaps in capacity remain, especially in the Global South.

- The Intergovernmental Panel on Climate Change (IPCC) data platform presents global climate change data and scientific consensus.[76] The IPCC's comprehensive report on *Impacts, Adaptation and Vulnerability* outlines the latest scientific understanding of climate risks faced by the transport sector.[77]

Photo Credit: Brigitte Leoni / UNISDR

- The Task Force on Climate-related Financial Disclosures' (TCFD) 2017 report recommends reporting on the financial impacts of climate change risks, including physical impacts, building resilience, addressing natural hazard risks and making transport more resilient.[78] As of 2022, more than 3,800 public and private companies supported the TCFD; for public companies in the transport industry, the average percentage of disclosure of TCFD-recommended information was 32%.[79]
- International standards include the International Organization for Standardization's ISO 14090:2019 (Adaptation to climate change – Principles, requirements and guidelines) and ISO 14091:2021 (Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment). The former details how organisations should monitor and evaluate their adaptation to climate change.[80]
- The Highway Development and Management Model Four (HDM-4) is a software tool for planning and management of road improvement and investment decisions. The tool is scheduled to be updated in 2023 by the Asian Development Bank, the World Road Association (PIARC), the UK Foreign, Commonwealth & Development Office and the World Bank) – with parameters to include resilience of highways to natural disasters.[81]

International financial institutions are highlighting climate risks in infrastructure, which is producing more resilient transport investments; yet the estimated gap in adaptation finance for low- and middle-income countries is 5 to 10 times greater than current investment.[82]

- At the 2021 UN Climate Change Conference in Glasgow, UK (COP 26), high-income countries pledged to double funding provided to low- and middle-income countries for adaptation action by 2025.[83] It remains to be seen how this will materialise for transport.[84]
- As of October 2022, USD 4.25 billion of the Green Climate Fund's USD 11.4 billion portfolio was focused on climate change adaptation; however, only USD 0.93 billion of the Fund's portfolio was invested in transport, and thus an even smaller fraction was invested in adaptation for transport.[85]
- At the 2022 UN Climate Change Conference in Egypt (COP 27), the Sharm el-Sheikh Implementation Plan established a dedicated fund to compensate vulnerable countries for climate disaster losses and damage, which is intended in part to help bridge the gap in adaptation investment in low-income countries.[86]
- The Multilateral Development Bank Joint Methodology for Tracking Climate Change Adaptation Finance assesses the climate resilience of investments (including in the transport sector) through a three-step approach based on a set of common principles.[87]

National and sub-national planning on transport adaptation and resilience

National and sub-national actors – including governments, businesses and civil society – have begun to nominally address climate adaptation and resilience for transport, but concrete action and expenditures remain insufficient.

National and sub-national actors are promoting resilience and adaptation for transport through the development of national adaptation plans, public infrastructure investment, and codes and standards – all aligned to the ambitions of global co-operation.

National governments are investing in resilience-enhancing programmes for their transport systems.

- In the United States, the Bipartisan Infrastructure Law provides USD 550 billion for new federal investments in infrastructure, which includes USD 108 billion to prioritise safety, modernisation, climate and equity in public transport.[88]
- The US Federal Highway Administration has provided USD 7.1 million in funds to 25 state transport departments as part of its Climate Challenge programme, including a grant to protect a coastal road in the state of Rhode Island with permeable pavement.[89]

Efforts by local governments to engage directly with civil society and the public have demonstrated the value of inclusive engagement in resilient transport projects.

- In Freetown (Sierra Leone), as part of data collection efforts for the road climate vulnerability assessment, local civil engineering students used mobile applications to map 4,038 kilometres of transport network.[90]
- Miami-Dade County in the US state of Florida engaged with the community while working to improve access to multi-modal and equitable mobility, through the use of an online platform where citizens could submit and vote on proposals to improve the transport network.[91]

While considerable progress has been made across multiple levels of government to promote the adaptation and resilience agenda – and to put in place adaptation plans – much work remains. Although governments are developing resilience plans that set out actions and priorities, there is less evidence of implementation and investment in these plans.[92] City and local governments will need to make much faster progress in the coming years to transform and embed resilience within transport systems.

Equally important is for the practice of transport planning itself to be more resilient. Emerging areas of research in "resilient transport planning" and "decision making under deep uncertainty" are still in their infancy, but they are growing in impact and influence around the topic of complex risk.[93] These principles were applied in the recent reform of the long-term transport planning practices of the City of Cape Town, South Africa and hold useful lessons for planning practices in other urban contexts.[94]

National Adaptation Plans (NAPs) show promise as a means for low- and middle-income countries to prioritise actions around transport system adaptation. Established in 2011, NAPs identify medium- and long-term adaptation needs for these countries as well as strategies to address them. A total of 21 NAPs were submitted between April 2021 and January 2023, out of 45 NAPs available in total since 2015.[95] All of these mention transport in some capacity, and more than 80% (17 NAPs) include an adaptation action or priority directly related to transport (compared with only 50% of the NAPs submitted between October 2015 and March 2021).[96] Meanwhile, 16 of the recently submitted NAPs refer to potential climate change impacts on transport.[97]

- Niger assesses climatic impacts on the transport sector in its NAP, including an analysis of the chain of impacts of climate change on transport and cross-cutting gender considerations. The NAP proposes five distinct transport-specific adaptation programmes, ranging from adaptation of design standards for road, air and rail to the reinforcement of protective dykes along roads and railways. Each programme outlines key objectives, the main activities over a five-year period, indicators, a budget and other considerations.[98]
- Tonga's NAP assesses both climatic impacts and adaptation issues surrounding transport infrastructure, including pointing to underdeveloped drainage and poor design in storm drains, flood mitigation devices and causeways.[99] Since 2019, the country has implemented the Tonga Climate Resilient Transport Project, which is financed under the World Bank's Pacific Climate Resilient Transport Program, which began in 2018 and includes seven projects to date.[100]

Provincial/state and municipal governments are planning and implementing transport resilience and adaptation projects with support from the private sector and civil society.

- Hong Kong (China) completed its most comprehensive assessment ever of the present and future flood risk to the city's rail infrastructure, combining climate projections and detailed urban topography datasets.[101]
- In Spain, a key component of the Barcelona Nature Plan is planting trees along streets, creating 1 additional square metre of greenery per resident with the aim of easing extreme heat and supporting biodiversity.[102]

- Montevideo (Uruguay), embraced large-scale, real-time data to improve the resilience of its transport network, including using a centralised Mobility Management Centre.[103]
- A thorough assessment of the climate resilience of the Port of Durban (South Africa), reviewed the port and its interdependent systems (road and rail) to assess their preparedness, options to adjust, and ability to rebound from various climate impacts, ultimately making recommendations for adaptation.[104]

Public-private partnerships (PPPs) are showing potential to mobilise private sector funding and expertise to make transport systems more resilient. In 2020, private investment in infrastructure in low- and middle-income countries reached a historic low due to the COVID-19 pandemic. However, investment has since recovered, led by the transport sector which received USD 43.8 billion in private investment in 2021, up from only USD 10.5 billion in 2020 (but still 9% below 2019 levels).[105]

- In Japan, a concessions-based PPP was used to procure funding for restoration and operations at Sendai International Airport following damage caused by the 2011 tsunami.[106] Although the high-risk environment presented a barrier to many private investors, the PPP was made possible by employing strict numerical systems for risk allocation.[107]

National standards applicable to transport systems are starting to incorporate climate adaptation, building on the example of standards provided by the ISO.

- In the United Kingdom, the 2021 standard BS 8631:2021 (Adaptation to climate change – Using adaptation pathways for decision making) builds on the ISO standards.[108]
- The American Society of Civil Engineers' ASCE MOP 140 standard is focused on Climate-Resilient Infrastructure Adaptive Design and Risk Management.[109]
- Austroads' Guide to Road Design for Australia and New Zealand incorporates means of accounting for the effects of climate change through the design of drainage for floodwaters.[110]
- In France, a systematic review of all standards applicable to transport systems, conducted in 2015, recommended that relevant climatic factors be included in revised standards in subsequent years.[111]

Other Initiatives

- CDRI's risk and resilience assessments of transport infrastructure include the Global Study on Disaster Resilience of Airports and the Strategy for Disaster Resilient Seaports and Port Communities in small island developing states. [112]
- The Sharm El Sheikh Adaptation Agenda, an outcome of the 2022 United Nations Climate Change Conference in Egypt (COP 27), sets out five key interventions for transport: two to make transport accessible and three to make transport resilient through infrastructure hardening, improved planning and management, and remote solutions.[113]
- UNDRR's Sendai Framework for Disaster Risk Reduction 2015-2030, now more than halfway through its duration, aims to support and implement measures to prevent and reduce hazard exposure and vulnerability.[114] Although few achievements specific to transport have been recorded to date, the framework encourages the development of early warning systems, risk monitoring and reporting, and establishing indicators and targets.[115]


Photo: Silke von Brockhausen / UNDP

Measuring impact – how do we know we are moving in the right direction?

Measuring resilience and adaptation outcomes is an ongoing challenge that can be approached in multiple ways. Resilience-focused metrics and measurements are essential to help transport planners, designers and financers regularly assess the performance of transport systems in the face of changing climate-related shocks and stresses, to inform plans, investments and operational decisions. Measuring climate resilience and adaptation is more complex than measuring mitigation because no single metric is used to measure resilience; for example, metrics to measure the resilience of maritime and inland shipping transport may include resilience of trade flows, minimisation of port delays and reliability of schedules.[116]

Although avoided losses resulting from resilience and adaptation efforts are the gold standard, they are difficult to estimate accurately. Furthermore, defining *outcome* indicators and metrics is even more challenging than defining *output* indicators and metrics, which underscores the critical need to develop climate resilience metrics for transport investment.[117]

Co-benefits of resilience approaches (such as improvements to well-being) can also be measured, but this is complex because the benefits of resilience tend to be distributed across facets of society and over time. Process indicators of the collective movement towards a more resilient transport sector are more easily measured and are often used as a proxy. These indicators can include, for example, money invested in transport resilience projects, or the prevalence of regulations that recognise changing climate hazards. However, progress on process-related indicators does not necessarily translate to impact.

Several methodologies have emerged that include appropriate indicators for measuring resilience and adaptation (see Table 1).[118] However, consensus is lacking on which methodologies are most suitable for different situations.

Consideration of transport resilience and adaptation in combination with other critical systems offers a more robust way to ensure improved societal resilience. Increasingly, methods for long-term monitoring and evaluation of systemic impacts – such as the recent EU Directive on resilience of critical entities – consider the place that transport has among other critical infrastructure systems, including its dependencies and interdependencies.[119] Strategic performance indicators with an outcome-orientated design (as opposed to technical performance indicators that provide real-time insight into performance) can focus on future aspirations rather than past performance, thereby better managing transport systems for the communities they serve.[120]

Photo: Sujan Sarkar / Climate Visuals

TABLE 1. Resilience and adaptation indicators

Source: See endnote 118 for this section.

Indicator	Description
Service continuity	Resilience measurement of transport can be approached through assessing service continuity – for example, tracking cumulative delays resulting from disruptions. In the United Kingdom, National Highways tracks the difference between the observed travel time and the speed limit travel time, as well as the availability of the network and the time taken to clear incidents from it. Travel duration and its monetary value can then be used in cost-benefit analyses.
Risk assessments	By evaluating the likelihood and potential consequences of hazards to the transport system, risk assessments can help identify areas where systems are vulnerable and where investments in resilience can have the greatest impact. A risk assessment is a means of quantifying direct and indirect costs of not investing in resilience. It can also help track the effectiveness of the implemented risk reduction and management measures over time.
Adherence to principles of resilience systems	UNDRR's six principles of resilient systems have associated quantifiable indicators that reflect the different qualities of a resilient system. For example, indicators that show that the system is "proactively protected" include the total number of possible alternative routes or modes to deliver the same critical service, or the depth and breadth of formalised emergency management mechanisms for critical infrastructure. A series of indicators exist for each of the six principles.
Life-cycle costs	Transport that is cheap to build but expensive to maintain can indicate poor resilience, as maintenance can interrupt service. Spending money up front often increases the cost of design and construction, but can save costs during operation, resulting in reduced overall life-cycle costs and increased resilience. Tracking the balance of costs across the whole life cycle of the transport is a proxy for resilience.
Standards uptake	Uptake of globally recognised standards for resilience and adaptation is a telling rubric for whether transport is moving in the right direction.
Finance allocated	The amount of finance dedicated to resilience and adaptation of transport infrastructure continues to rise but is far short of what is required.
Post-disaster evaluations	These evaluations assess how well the transport system stood up to the hazards that it was exposed to, and how well it was able to maintain or quickly restore service. Post-disaster evaluations can identify vulnerabilities and weaknesses in the system including issues with infrastructure design, construction, or maintenance, as well as issues with emergency response or evacuation plans. Such evaluations can also help to identify the dependency and interdependency with other systems, such as the dependency of road transport on the availability of power, and the interdependency of different modes of transport.
Policy and regulatory changes	This includes enforcement of regulations, construction codes and procurement rules (for example, NAPs). Peru, a country with significant exposure to natural hazards, recently adopted a Framework Law on Climate Change and a national disaster risk management plan that aims to develop a prevention culture and an integrated national system for disaster risk management, which all public entities must comply with.
Triple bottom line	Quantification of co-benefits using triple-bottom-line approaches can support the business case for resilience and adaptation interventions in transport. Co-benefits can include economic, environmental, and social benefits, such as reduced maintenance costs, reduced greenhouse gases and improved accessibility. By quantifying the co-benefits of resilience investments in transport, the full range of benefits generated by the investment can be demonstrated, which can make it more attractive to potential funders and investors. The US city of San Francisco wanted to make its transport system more equitable and sustainable, so it used scenario planning and early involvement of external stakeholders to identify potential benefits (such as safety and economic vitality) and trade-offs (such as paying more taxes or giving up resources).

Geographical Scope
- Global
- National
- Local

Implementation Stage
- In Use
- Developing

Processor Impact Indicator
- Impact
- Process

MODULE 1 SPOTLIGHT 1

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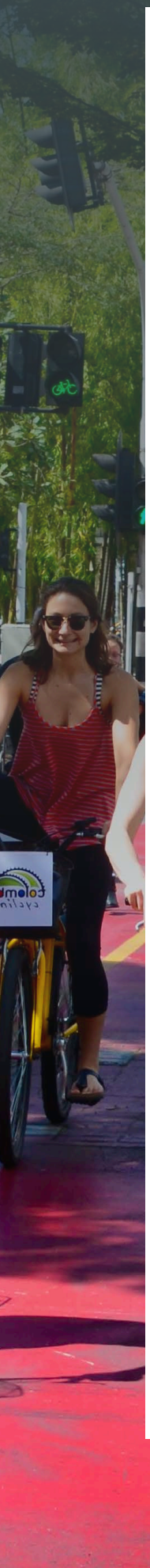
Transport - Health Nexus

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition



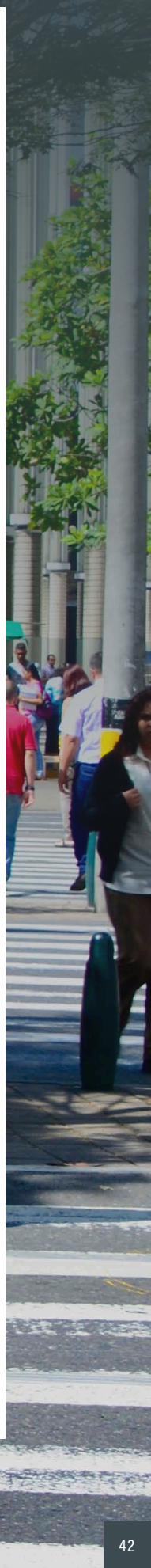
Key findings

Health impacts of transport

- Ambient air pollution increases the risk of cardiovascular and respiratory diseases, contributing to 4.2 million premature deaths in 2019.
- Land traffic contributes an estimated 5% of the mortality from small particulate matter ($PM_{2.5}$) globally, and as much as 32% in North America.
- The average level of $PM_{2.5}$ pollution in the world's largest cities is nearly four times higher than World Health Organization guidelines.
- An estimated one-in-four adults and four-in-five adolescents are not sufficiently active, due in part to urban and transport infrastructure that prioritises vehicles, not people.
- Around 1.35 million people worldwide were killed due to road traffic crashes in 2016 (latest available data), with pedestrians, cyclists and motorcyclists accounting for more than half of these deaths.
- Traffic crashes are the leading cause of death among young people ages 5-29 and the eighth greatest cause of death among all age groups. Despite ambitious targets, there has been no reduction in traffic deaths for a decade.
- In 14 of 20 countries (mostly in the Organisation for Economic Co-operation and Development), road traffic crashes increased in the first half of 2022 but remained lower than pre-pandemic levels.
- Investment in safe, reliable and affordable public transport systems can reduce crashes by attracting motorcycle users even in areas with high motorcycle ownership.
- Inaccessibility to transport can reduce opportunities for people to get the healthcare services they need, and at times even discourage them from seeking care.
- Studies have shown that safe, active transport can boost mental health and that safe and efficient public transport can reduce commuter anxiety.

Policy measures and targets for a transport-health nexus

- The indirect costs of fossil fuel subsidies (including respiratory disease and traffic crashes) are an estimated ten times greater than their direct financial cost.
- Redirecting fossil fuel subsidies towards sustainable, low carbon transport modes (and to directly benefit healthcare systems) can lead to improved health outcomes.
- Urban and national decision makers can choose from an increasing number of policy tools to promote health-focused transport systems.
- In response to stronger emission standards in many jurisdictions, decision makers are increasingly turning to newer vehicle technologies to curb outdoor pollution and promote better health.
- In the post-pandemic world, national and sub-national governments are increasingly recognising the health benefits of active mobility and are investing in policies to promote walking and cycling, such as cycle lanes and bike sharing schemes.
- After the world failed to meet road safety targets set for the decade 2010-2020, the United Nations General Assembly in 2020 declared a second Decade of Action for Road Safety (2021-2030), setting an ambitious target to halve road traffic deaths and injuries by 2030.



Overview

As cities recover from the experience of the COVID-19 pandemic, there is heightened awareness of the relationship between urban settings and people's exposure and vulnerability to health risks, which include air pollution, road crashes and sedentary lifestyles.[1] Achieving equitable, healthy, green, and resilient transport and mobility systems has implications for the success of the United Nations' (UN) 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) – particularly for synergistic implementation of SDG 3 on health and well-being and SDG 11 on sustainable cities, while responding to SDG 13 on climate action.[2]

The planning of healthy cities strongly favours public and active transport, and the health benefits from reduced car dependence are increasingly influencing urban planning processes. The promotion of active transport modes, such as walking and cycling, provides a wide range of health and economic co-benefits by reducing healthcare costs linked to cardiovascular disease, improving labour productivity and decreasing congestion costs.[3] Reducing high emissions and environmental externalities in port cities is also essential to addressing these recognised health hazards.[4]

The Intergovernmental Panel on Climate Change (IPCC) highlighted the nexus between transport, climate and health in its Sixth Assessment Report, released in 2022.[5] The IPCC notes that many strategies for mitigating climate change in the transport sector also have health benefits, including from air quality improvements, reduced fatalities, equitable access to transport services and reduced stress (see Table 1).[6] The electrification of transport, combined with renewable energy and shifts to public and active transport, can enhance health outcomes.[7] The report shows that decision making that is focused on health benefits will encourage cities to place greater emphasis on public transport, walking and cycling.[8]

TABLE 1. Health benefits from low carbon, active and electrified transport

Source: See endnote 6 for this section.

Improved air quality	Low-emission transport reduces air pollution and contributes to positive health outcomes.
Reduced traffic injuries	Public transport systems have the potential to reduce injuries and deaths from road traffic crashes, although active transport also can increase vulnerability to crashes.
Active transport	Walking and cycling have major health benefits, such as reducing the risk of obesity and other chronic health conditions, as well as improving mental health and well-being; however, active transport also may increase exposure to air pollution.
Access to services	Accessible, affordable public transport can improve access to health care and other essential services for disadvantaged population groups.
Reduced stress	Reductions in personal driving can result in reduced stress levels.

Health impacts of transport

Analysis of the health impacts of transport demonstrates the range of health and mobility inequalities experienced across the world.[9] Negative health impacts associated with transport are typically felt more acutely by people in vulnerable situations (including those in lower-income groups, people of colour, older people, children and people with disabilities) due to greater exposure to air pollutants and lower access to safer transport options. Transport impacts have higher health risks in middle- and low-income countries, and interventions to address impacts are most effective when they also aim to reduce inequalities.[10]

Air quality

Ambient air pollution increases the risk of cardiovascular and respiratory diseases, contributing to 4.2 million premature deaths in 2019.[11] In higher-income countries, more marginalised populations are often disproportionately affected, with studies showing that low-income, Black, Asian and Hispanic communities in the United States are exposed to higher levels of particulate matter 2.5 ($PM_{2.5}$) which stems from historical policy inequities.[12]

Land traffic contributes an estimated 5% of the mortality from small particulate matter ($PM_{2.5}$) globally, and as much as 32% in North America.[13] In addition to pollution impacts from urban land transport, freight transport activities in ports are key contributors to air pollution (nitrogen oxides and sulphur oxides) and leading causes of premature deaths.[14] The International Maritime Organization has a key responsibility to reduce emissions of pollutants in maritime port areas.[15]

The average level of $PM_{2.5}$ pollution in the world's largest cities is nearly four times higher than the World Health Organization's guideline of 10 micrograms per cubic metre.[16] The worst-affected urban areas are all in Asia, with cities in Pakistan, India, and China, respectively, having the highest measured levels of pollution.[17] Lockdowns during the COVID-19 pandemic led to estimated $PM_{2.5}$ reductions of 29.7% in China and 17.1% in Europe, resulting in a significant decline in premature deaths.[18] In rapidly growing African cities, rising traffic congestion is a major threat to social and economic resilience and sustainable growth (see Box 1).[19]

Active mobility and obesity

The WHO estimates that one-in-four adults and four-in-five adolescents are not sufficiently active, due in part to urban and transport infrastructure that prioritises vehicles, not people.[20] Many countries are facing health challenges associated with reduced physical activity, which include obesity, diabetes and cardiovascular diseases. Evidence suggests that promoting active mobility plays a huge role in reducing obesity and in minimising individual motorised transport, a major cause of air and noise pollution.[21] A shift to sustainable, active transport through walking, cycling and public transport is thus critical to meet both climate targets and health objectives.

- Research on transport policy in nine countries (Brazil, China, Germany, India, Indonesia, Nigeria, South Africa, the United Kingdom and the United States) found that a shift towards greater active transport would help save around 1.15 million lives across the nine countries by 2040 due to increased physical activity (while also reducing 1.18 million deaths related to air pollution).[22]
- An assessment of lessons from the world's largest bike sharing system in Shanghai (China) shows the immediate health benefits of encouraging safe active transport, including increasing levels of exercise and decreasing respiratory events (see Box 2).[23]

BOX 1. The cost of traffic congestion and air pollution for African cities

The negative impact of traffic congestion on air quality and health is understated. In Ghana, the World Bank reports that air pollution is costing the economy close to USD 2.5 billion per year. A study of four of the fastest growing African cities (Accra, Cairo, Johannesburg and Lagos) estimates that if development follows the business-as-usual scenario, the total cost related to air pollution from 2023 to 2040 will reach USD 115.7 billion[i]. Government-provided public transport options are limited in many African cities, and planning approaches that focus on private vehicles continue to have grave implications for human health.

i This number reflects the "Value of Statistical Life" applied to an estimation of premature deaths.

Source: See endnote 19 for this section.

BOX 2. Lessons from bike sharing in Shanghai

Shanghai's bike sharing scheme is being managed as part of China's first urban cycling strategy. The strategy includes a set of policies and regulations supporting the integration of cycling into the wider transport network and prioritises cycling safety to help maximise the benefits of urban cycling.

In 2020, researchers assessed data on more than 2 million trips made by bicycle in Shanghai and considered the impact that increased cycling has on air quality, levels of exercise and numbers of traffic accidents. They found that the city's bike sharing scheme, after only a year and a half of operation, prevented an estimated 23 premature deaths, hundreds of hospital visits and tens of thousands of respiratory events (such as asthma attacks). The scheme reduced greenhouse gas emissions equivalent to removing around 9,000 vehicles from Shanghai's roads[i].

i The authors accounted for the mode share and distance of the trips. Only 20% of trips are made by car in Shanghai (well below the average mode share), and bike trips under 1 kilometre are assumed to have been walked.

Source: See endnote 23 for this section.

Road traffic injuries[24]

Around 1.35 million people worldwide were killed due to road traffic crashes in 2016 (latest available data), with pedestrians, cyclists and motorcyclists accounting for more than half of these deaths.[25] Deaths of users of motorised two- and three-wheelers are increasing as a share of overall road traffic deaths.[26]

Traffic crashes are the leading cause of death among young people ages 5-29 and the eighth greatest cause of death among all age groups.[27] **Despite ambitious targets, there has been no reduction in traffic deaths for a decade.** Studies show that crash survival rates increase with good post-crash care, including access to timely care.[28]

In 14 of 20 countries (mostly in the Organisation for Economic Co-operation and Development), road traffic crashes increased in the first half of 2022 but remained lower than pre-pandemic levels.[29] Motorcycle use has risen rapidly (especially in emerging economies in Africa and Asia) in the wake of the pandemic due to restricted and uneven access to public transport. **Investment in safe, reliable and affordable public transport systems can reduce crashes by attracting motorcycle users even in areas with high motorcycle ownership** (as was demonstrated by research in Khon Kaen City, Thailand).[30]

- The WHO estimates that 93% of road crash deaths in 2016 occurred in low- and middle-income countries, where pedestrian and motorcycle vulnerability is high and road safety infrastructure and regulation are not prioritised.[31] The Southeast Asia and Western Pacific regions have the highest percentage of road traffic fatalities involving two- and three-wheeled motorised vehicles, with shares of 43% and 36% among all transport modes, respectively.[32]
- Brazil ranked fifth in the world for traffic deaths[i] in 2018, with most of the fatalities occurring among pedestrians, cyclists and motorcyclists.[33] Crashes involving motorcycles accounted for 62.2% of all traffic crash visits performed by emergency services in Brazil in 2019.[34] Disaggregation of data by gender, race and age is needed to determine the relative impacts by demographic group.

Other health-related concerns

Inaccessibility to transport can reduce opportunities for people to get the healthcare services they need, and at times even discourage them from seeking care.[35] Limited access to transport often means limited access to health care, with critical barriers including poor road infrastructure, an absence of available and connected transport routes, and a lack of affordable transport options.[36] The COVID-19 pandemic further highlighted the importance of access to transport for health care.

i Ideally, these data would be further disaggregated by gender, race, and age, to determine relative impact.

- A 2019 study in Malawi confirmed that both cost and access to transport posed significant barriers to healthcare access for rural residents, who comprise 90% of the population.[37] This challenge is higher for those with impaired health or disabilities, who may lack suitable modes of transport.[38]
- In the Philippines, studies found that the closure of public transport during the pandemic severely reduced the ability of individuals to access health care.[39]

Studies have shown that safe, active transport can boost mental health and that safe and efficient public transport can reduce commuter anxiety.[40] Conversely, the lack of access to quality transport can impact mental health in different ways, including by creating isolation, longer commutes, noise and anxiety about personal safety.[41]

- A study in Hong Kong (China) demonstrated that public transport routes using multiple modes (e.g., bus and metro) create mental and physical health benefits for older adults. The study shows that satisfaction with sidewalk width also has a positive impact on mental health.[42]
- A study in New Zealand found that promoting active mobility improved the mental well-being of low-income communities, as walking and cycling offered greater control over individual travel conditions and were less expensive.[43]
- A study in Sanandaj (Iran) showed that frequent urban traffic jams affect mental health at a human relationship level (both for urban drivers and general residents), reducing tolerance, causing discord and eroding cohesion among family members.[44]

Policy measures and targets for a transport-health nexus

Policies that target a healthy and just energy transition in transport can greatly enhance physical and mental health outcomes by providing better living and work environments. This includes increasing active transport options that enable walking and cycling and providing safer and less-congested travel solutions that improve well-being and mental health.

The indirect costs of fossil fuel subsidies (including respiratory disease and traffic crashes) are an estimated ten times greater than their direct financial cost.[45] Fossil fuel subsidies – including direct subsidies to oil producers and consumers, as well as indirect subsidies to sectors such as aviation and shipping – continue to incentivise unsustainable, unhealthy transport investments.

Redirecting fossil fuel subsidies towards sustainable, low carbon transport modes (and to directly benefit healthcare systems) can lead to improved health outcomes.

Reforming fossil fuel subsidies and scaling up the use of renewable energy in the transport sector can help reduce emissions of carbon dioxide (CO_2) and other greenhouse gases, as well as $PM_{2.5}$. It also can reduce air pollution deaths, generate economic benefits and increase social spending.

- In Egypt, fiscal savings from energy subsidy reforms were redirected towards social spending on health and education.[46]
- India has demonstrated the benefits of shifting energy subsidies to direct cash transfers to low-income households, as a way to alleviate the unintended consequences of subsidies (e.g., loss of public and private revenues, inefficient consumption of fossil fuels).[47]
- The Glasgow Climate Pact, agreed to at the 2021 UN Climate Change Conference in Glasgow, UK (COP 26), makes a clear call for countries to phase out inefficient fossil fuel subsidies and to support a just transition towards low-emission energy systems.[48]
- Recognising the health implications of making this transition, in 2022 more than 200 professional health organisations from around the world – including the WHO – signed on to the Fossil Fuel Non-Proliferation Treaty, which calls for a planned phase-out of all fossil fuels.[49] The WHO Director-General has called the continued addiction to fossil fuels an "act of self-sabotage".[50]

Other measures to reduce air pollution from transport include command-and-control measures such as fuel standards (for example, low sulphur content for ship bunkers when at port). Such standards have been mandated by the IMO and at the national and regional levels (for example, in the European Union (EU), Baltic Sea region, China and the United States). These measures have shown success in the EU and are highly relevant to increasing health outcomes in port cities worldwide.[51]

Urban and national decision makers can choose from an increasing number of policy tools to promote health-focused transport systems. Recent initiatives have aimed to encourage good practice on health-centred sustainable

transport systems.[52] This work shows that healthy, fossil fuel-free cities can be designed to be energy efficient and to support new ways of living, travelling and working that allow for healthier lifestyles and safer urban spaces.

- The SLOCAT Partnership on Sustainable, Low Carbon Transport, in collaboration with the Health and Climate Network (HCN), have put a spotlight on transport and health in the global drive for a just energy transition. SLOCAT and HCN have produced a knowledge base (and user guide) to help prioritise packages of transport policies that contribute to health and climate objectives and to complement existing resources from other HCN members.[53]
- The WHO's Health Economic Assessment Tool (HEAT) for cycling and walking assesses policy options and outcomes for health, transport and climate.[54] Through a set of questions, HEAT enables governments to assess the health benefits of active mobility among populations.[55]
- The Global Climate and Health Alliance's Healthy NDCs Scorecard ranks 94 different Nationally Determined Contributions (NDCs) submitted under the Paris Agreement, covering proposed emission reduction measures in 120 countries.[56] The scorecard ranks countries' NDCs based on five health categories: health impacts, health in adaptation measures, health co-benefits, economics and finance.

In response to stronger emission standards in many jurisdictions, decision makers are increasingly turning to newer vehicle technologies to curb outdoor pollution and promote better health. With an aim to phase out fossil fuels and meet climate targets, countries are moving away from fossil fuels and focusing on greater adoption of zero-emission vehicles. This transition has public health benefits, as it leads to reduced air pollution caused by emissions from the transport sector.

- At the 2021 UN Climate Change Conference in Glasgow, UK (COP 26), many countries, cities and companies joined transport initiatives to phase out vehicles with internal combustion engines and to scale up electric heavy-duty vehicles and electric vehicle charging.[57]
- In Brazil, an ordinance within the scope of the RENOVABIO programme to promote biofuels regulates the issuance, bookkeeping, registration, negotiation and retirement of the avoided carbon credit, which has been marketed since June 2020.[58]
- To curb outdoor air pollution, in 2022 the Israeli Ministry of Environmental Protection set mandatory targets for 100% zero-emission vehicles in new public transport procurements by 2026.[59]
- In 2022, the US Environmental Protection Agency updated its truck emission rules, the first time since 2001, with a view to halve nitrogen oxide emissions from trucks by 2045.[60]
- A study found that electrification of Mexico City's Metrobus bus rapid transit fleet, targeted for completion in 2028, is a viable option to reduce local and climate pollutants, leading to as much as an 85% reduction in CO_2 emissions.[61]
- In Ecuador, every bus that intends to enter public transport service from 2025 on must be electric, according to the Energy Efficiency Law.[62]

In the post-pandemic world, national and sub-national governments are increasingly recognising the health benefits of active mobility and are investing in policies to promote walking and cycling, such as cycle lanes and bike sharing schemes.

- In response to the pandemic, Barcelona (Spain) carried out measures such as widening sidewalks and building more cycling lanes to encourage active mobility.[63]
- In 2020, India's Ministry of Housing and Urban Affairs launched two initiatives, Cycles4Change and Streets4Change Challenge, to support cities in implementing more pedestrian and cycling initiatives.[64]
- To improve health and well-being and reduce air pollution, Canada introduced a national active transport strategy in 2021 to promote active mobility across the country.[65]
- Local associations in Argentina and Moldova are calling for speed limits of 30 kilometres per hour to improve pedestrian and cycling safety, and in Wales driving speeds will be limited to 20 kilometres per hour on all urban and village roads to reduce injuries and deaths from road crashes.[66]
- Austria's 2030 Mobility Master Plan, adopted in 2021, highlights the importance of active mobility in meeting health targets and aims to double the share of cycling in the country to 13% by 2030.[67]

After the world failed to meet road safety targets set for the decade 2010-2020, the United Nations General Assembly in 2020 declared a second Decade of Action for Road Safety (2021-2030), setting an ambitious target to halve road traffic deaths and injuries by 2030.[68] Led by the WHO, this initiative takes a holistic approach to road safety, with calls for continuing improvements in the design of cities, roads and vehicles; enhancing laws and law enforcement; and providing timely, life-saving emergency care.[69]

Countries also acknowledge the urgent need to deliver on road safety, noting that recent efforts to reduce traffic fatalities have fallen short, especially in low- and middle-income countries.[70]

- In response to the Decade of Action, Brazil's Ministry of Infrastructure revised in 2021 the National Plan of Traffic Deaths and Injuries Reduction, which has a goal to reduce traffic fatalities by 50% as a means to save around 120,000 lives between 2018 and 2030.[71]
- The European Commission's plan to improve road safety in the EU, announced in 2023, seeks to set the legal age for taking a driving exam at 17 years old, with new licence holders facing a two-year probation period.[72]
- In 2021, Colombia introduced the Julián Esteban road safety law, named after a 13-year-old killed by a truck while cycling. The law aims to implement stronger regulation of road and infrastructure design as well as speed limits of 50 kilometres per hour in urban areas and 30 kilometres per hour in residential areas and school zones.[73]
- In 2022, the United Nations Environment Programme (UNEP) established a Pan-African Action Plan for Active Mobility, recognising that millions of people in Africa are dependent on active transport **(see Box 3)**.[74]

Other Initiatives

- The Bloomberg Philanthropies Initiative for Global Road Safety focuses on five key areas: strengthening national legislation; enhancing data collection; improving user behaviour; improving road infrastructure; and enhancing vehicle safety.[75]
- The BreatheLife Campaign (led by the WHO, the UN Environment Programme and the Climate & Clean Air Coalition) calls for local, regional and national governments to commit to achieving WHO Air Quality Guidelines by 2030.[76]
- In 2023, more than 20 African countries adopted the Dakar Declaration on road safety, with the aim of improving data collection in support of the goal to halve road traffic deaths by 2030.[77]
- The Global Road Safety Partnership provides road safety programme co-ordination at a global level, supports capacity building of road safety practitioners and traffic police, and offers an expert source of road safety knowledge and good practice.[78]
- Vision Zero is a multidisciplinary strategy to bring together traffic planners and engineers, policy makers, and public health professionals to eliminate traffic fatalities and increase safe, healthy, equitable mobility.[79]
- The WHO's Global Plan for the Decade of Action, released in 2021, outlines the need to reduce road traffic injuries and to accelerate measures and targets on walking, cycling and safe public transport.[80]

BOX 3. The Pan-African Action Plan for Active Mobility

The Pan-African Action Plan for Active Mobility (PAAPAM) is focused on helping the more than 1 billion people in Africa who walk or cycle for more than 55 minutes every day to reach their workplaces, homes, schools and other essential services. The PAAPAM aims to raise the profile of active mobility, while improving the safety of people walking and cycling in every country in the region and reducing the number of fatalities and serious injuries among road users.

Source: See endnote 74 for this section.

Credit: Mohamed Mambo, via AmendPolicy

MODULE 1 **SPOTLIGHT 2**

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Transport Adaptation, Resilience and Decarbonisation in Small Island Developing States

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Key findings

Context and key challenges

- Because of their limited land area and geographic location and isolation, small island developing states (SIDS) are highly vulnerable to the impacts of climate change, and the resilience of transport infrastructure and services is closely tied to the resilience of SIDS communities.
- SIDS have experienced increasing incidences of climate change-related events such as tropical cyclones, storm surges, droughts, changing precipitation patterns, coral bleaching and invasive species.
- SIDS are highly dependent on fossil fuels for their transport systems, which contributes to greenhouse gas emissions and environmental degradation and undermines the resilience of countries to climate change impacts, such as sea-level rise and extreme weather events.
- Addressing transport access, decarbonisation, resilience and adaptation pathways in SIDS is crucial for achieving sustainable social, economic and environmental development and resilience.

Demand trends

- SIDS are highly dependent on maritime and air transport, although road transport is the dominant transport mode in terms of fuel use.
- The often small and dispersed nature of island communities leads to high transport costs and limited access to markets and services; meanwhile, transport infrastructure is often in poor condition and subject to the "build-neglect-rebuild" paradigm.
- Despite having strong renewable energy potential, SIDS remain highly dependent on fossil fuels for electricity and transport; fossil fuels accounted for 22.7% of total imports in 2019, and electricity costs in SIDS are among the world's highest.
- The average motorisation rate across SIDS is an estimated 121 vehicles per 1,000 people. As elsewhere, car dependency often results from automobile-centric urban design and limited policy incentives for other forms of transport, while SIDS have the additional issue of inexpensive second-hand imported vehicles.
- Electric cars may not be economically or environmentally feasible in SIDS in the near term for a variety of reasons, and other decarbonisation measures could be prioritised instead, such as cycling and micromobility. Still, electric vehicle uptake is on the rise in some SIDS, notably in the Caribbean islands, and in some cases the vehicles are being charged with renewable energy.
- Some SIDS have been identified as key sources for raw materials needed in global supply chains to produce electric vehicles, leading to controversy in some cases.

Emission trends

- Despite rising emissions within SIDS, together these countries represented just 1% of global carbon dioxide (CO_2) emissions in 2019, yet they disproportionately experience the effects of climate change.
- SIDS contributed just 0.5% of global transport CO_2 emissions in 2021 (excluding international aviation and shipping), despite their emissions growing 9.6% during 2010-2021.
- in 2020, transport CO_2 emissions in SIDS fell 10% to 31.2 million tonnes, due to the impacts of the COVID-19 pandemic.
- Per capita transport CO_2 emissions in SIDS vary from 0.07 tonnes in Guinea Bissau to 4.96 tonnes in Seychelles.

Photo: Sujan Sarkar / Climate Visuals

Policy measures

- For many SIDS, land transport accounts for the bulk of imported fuel use, followed by electricity generation and maritime transport. Thus, phasing out fossil fuels in these sectors is the main lever for both reducing emissions and increasing energy security.
- Strategies identified for SIDS to decarbonise transport are largely similar to those for decarbonising urban and land transport systems in other regions. However, strategies in SIDS also must include integrated planning for inter-island transport, greening of ports and maritime and aviation operations, use of small boats for coastal travel, a regional approach to aviation services, and adoption of low-emission aviation and shipping technology.
- SIDS have implemented a wide range of measures to enhance the resilience of their transport sectors, from systems planning and risk-based asset management systems to smartphone apps.
- Some SIDS have increased their efforts to decarbonise shipping while also pushing for greater ambition globally.
- Many SIDS have led the charge on efforts to increase climate equity, address loss and damage from the effects of climate change, and restructure financial systems.

Overview

Small island developing states (SIDS) are a group of 37 United Nations (UN) Member States[i] and 20 non-UN Members / Associate Members located in the Atlantic, Indian, and Pacific oceans and in the Caribbean, Mediterranean and South China seas. Despite their diverse cultures and histories, their common characteristics mean that they share many of the same challenges.[1]

Because of their limited land area and geographic location and isolation, SIDS are highly vulnerable to the impacts of climate change.[2] This places them at a distinct disadvantage compared with larger nations, making the approach to sustainable transport in SIDS somewhat different than in other contexts. **The resilience of transport infrastructure and services in SIDS is closely tied to the resilience of these communities.**[3]

SIDS have experienced increasing incidences of climate change-related events such as tropical cyclones, storm surges, droughts, changing precipitation patterns, coral bleaching and invasive species.[4] Between 1970 and 2020, hazards related to weather, climate and water led to an estimated USD 153 billion in cumulative losses in SIDS.[5] By comparison, the average gross domestic product (GDP) in these countries was USD 13.7 billion in 2020.[6]

The transport sector is a critical component of SIDS economies, facilitating trade, tourism and access to essential goods and services. However, populations in some SIDS lack adequate access to roads and transport services. For example, the Rural Access Index[ii] has rated Pacific Island nations among the lowest in the Asia Pacific region for access to roads, with the Maldives having a particularly large number of people lacking access.[7]

SIDS are highly dependent on fossil fuels for their transport systems, which contributes to greenhouse gas emissions and environmental degradation and undermines the resilience of countries to climate change impacts.[8] Extreme weather events, sea-level rise and coastal erosion can damage transport infrastructure such as airports, ports, and roads, leading to service disruptions and increased maintenance costs. For SIDS whose land lies only a few metres above sea level, projected sea-level rise represents is a direct threat to their existence.[9] This highlights the urgent need for the transport sector to play a role in tackling climate change through decarbonisation efforts.

Despite rising emissions in SIDS, these countries represent only a small share of global carbon dioxide (CO_2) emissions.[10] However, they disproportionately experience the effects of climate change, leading to calls from SIDS and others for greater international climate finance to aid with mitigation and adaptation (see Box 1).[11] By 2019, SIDS collectively had access to only USD 1.5 billion of the USD 100 billion pledged in climate finance for developing countries.[12]

i SIDS UN Members are as follows (entries with an asterisk are also least-developed countries, LDCs): Antigua and Barbuda, Bahamas, Barbados, Belize, Cabo Verde, Comoros*, Cuba, Dominica, Dominican Republic, Fiji, Grenada, Guinea-Bissau*, Guyana, Haiti*, Jamaica, Kiribati*, Maldives, Marshall Islands, Federated States of Micronesia, Mauritius, Nauru, Palau, Papua New Guinea, Samoa, São Tomé and Príncipe*, Singapore, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Seychelles, Solomon Islands*, Suriname, Timor-Leste*, Tonga, Trinidad and Tobago, Tuvalu* and Vanuatu. See https://www.un.org/ohrlls/content/list-sids.

ii A World Bank index estimating the share of the rural population with access to roads within a two-kilometre walking distance.

Across the Pacific Islands, the lack of options and infrastructure for active transport (walking and cycling) has contributed to low rates of physical exercise.[13] In 2014, these islands were home to 9 of the world's 10 most obese countries, with up to 95% of the adult population overweight in some countries.[14]

Addressing transport access, decarbonisation, resilience and adaptation pathways in SIDS is crucial for achieving sustainable social, economic and environmental development and resilience. At issue are both the resilience *of* transport and resilience *through* transport, given the sector's importance to SIDS economies. (*See Section 1.2 Transport Adaptation and Resilience.*)

SIDS have often led the call for greater climate ambition internationally and have set ambitious decarbonisation goals themselves. Many measures taken thus far have contributed to development in line with the UN Sustainable Development Goals (SDGs) that are most relevant to SIDS, promoting more equitable, healthy, green and resilient communities.[15] With their unique transport demands and the urgency of policies and strategies around decarbonisation, resilience, and adaptation of the transport sector, it is helpful to focus on the special case of SIDS and their vulnerability to climate and sustainability challenges.

Demand trends

SIDS are highly dependent on maritime and air transport, although road transport is the dominant transport mode in terms of fuel use.[16] Transport modes vary among SIDS depending on the country's size, location and main economic activities. In general, SIDS rely heavily on transport for tourism. For nearly two-thirds of SIDS, the tourism sector represents more than 20% of the gross domestic product (GDP), and this share reaches 58% in Palau and 65% in the Maldives, underscoring the importance of maintaining the sector's resilience.[17] In the Maldives, tourism accounted for around 45% of total economic activity and for around 35% of all jobs in 2021.[18]

The often small and dispersed nature of island communities leads to high transport costs and limited access to markets and services; meanwhile, transport infrastructure is often in poor condition and subject to the "build-neglect-rebuild" paradigm.[19] The reliance on fossil fuels for transport contributes to environmental degradation and undermines the resilience of SIDS to climate change impacts such as sea-level rise and extreme weather events.[20] In 2019, fossil fuel imports – mainly for electricity and transport – accounted for 22.7% of total imports among SIDS.[21] Electricity costs in these countries are among the highest globally due to the high costs of transporting fuel.[22]

Photo: Milos Bicanski / Climate Visuals

SIDS collectively accounted for 17.5% of ship registrations globally in 2020, just below the combined share for industrialised countries (21.6%); however, they experience low shipping connectivity[i], accounting for 29 of the 50 least-connected economies, according to a 2021 report.[23]

For road transport, the average motorisation rate across SIDS is an estimated 121 vehicles per 1,000 people.[24] The rate ranges from 527 vehicles per 1,000 people in Saint Kitts and Nevis, to only 10 vehicles per 1,000 people in Papua New Guinea.[25] For comparison, the European Union (EU) averages 560 vehicles per 1,000 people.[26] **As elsewhere, car dependency in SIDS often results from automobile-centric urban design and limited policy incentives for other forms of transport, while SIDS have the additional issue of inexpensive second-hand imported vehicles.**[27]

Traffic congestion has been increasing in several SIDS, in some cases leading to political tension.[28] While the traditional response to congestion globally is to add or widen roads (which, paradoxically, can lead to more traffic), this is not a viable option in SIDS, where land is scarce and financing can be challenging.[29] This has led some SIDS, such as Singapore, to develop or consider other solutions for congestion (*see Policy Developments section*).[30] The World Bank has proposed cycling support measures to help address congestion in the Pacific Islands – such as removing car parking, lowering speed limits, and adding segregated cycling lanes and bicycle parking – as well as demand management measures for private vehicles.[31]

A World Bank study found that electric cars may not be economically or environmentally feasible in SIDS in the near term for a variety of reasons, and that other decarbonisation measures could be prioritised instead.[32] In SIDS, imports have increased of low-cost, high-emitting cars from markets that have already achieved high levels of fleet decarbonisation, and electric vehicles have higher upfront (import) costs and a small market size; meanwhile, the environmental benefits from electric vehicles are limited until further deployment of renewable energy occurs, since much of the electricity in SIDS comes from generators running on imported diesel fuel.[33] Still, **electric vehicle uptake is on the rise in some SIDS, notably in the Caribbean islands, and in some cases the vehicles are being charged with renewable energy**.

- Bermuda has been developing a strategy for transitioning to an all-electric public bus fleet.[34] By 2022, the country had electrified a third of its bus fleet, replacing 30 diesel-powered buses with electric buses.[35] Bermuda also has committed to 85% renewable energy by 2035.[36]
- Barbados has become a regional leader in electric vehicle deployment, with around 430 electric vehicles on the road by 2020; as of 2013, around 1.3% of new car sales in the country were electric (a greater share that year than in some high-income countries, such as Canada).[37]
- Utilities in some SIDS, such as the Bahamas and Saint Lucia, were installing electric vehicle charging infrastructure as of 2019.[38]

The World Bank has noted that the expansion of cycling and micromobility[ii] is an untapped opportunity in many SIDS, which tend to have compact settlements and often struggle to accommodate rising motorisation rates.[39] Several Pacific Islands have large populations that, by using cycling or micromobility, could easily reach locations within a five-kilometre radius in 20 minutes or less. Micromobility would be well-suited to the Pacific context but so far has lacked a concerted push from government and the private sector to begin the self-reinforcing cycle of uptake.[40]

Although most of the electricity in SIDS remains fossil based, many of these countries have large potentials for renewable energy sources such as solar, wind, tidal, and ocean energy, and in some cases geothermal and hydropower.[41] Greater local use of renewables has the potential to boost energy independence, increase energy security, and build resilience, while providing a clean energy source for electric vehicles. The installed renewable energy capacity in SIDS has grown from 3.5 gigawatts (GW) in 2014 to more than 6.5 GW in 2021, led by solar power and followed by hydropower, bioenergy, and wind power, with smaller amounts of geothermal and marine energy.[42]

Some SIDS have been identified as key sources for raw materials needed in global supply chains to produce electric vehicles, leading to controversy in some cases.

- Tesla announced in 2021 that it would purchase nickel from a mine in New Caledonia, the fourth largest nickel producer globally.[43]
- A controversial copper mine in Papua New Guinea was set to re-open following an agreement in 2022, despite widespread opposition and a decade-long conflict over the mine.[44]
- Companies were active in resource mining in Fiji, which has had a pro-mining government.[45]

i Connectivity includes, for example, the number of shipping lines servicing the country, the number of services connecting the country to others, and the number and capacity of vessels in the country. See endnote 23 for this section.

ii Including electric sidewalk/"kick" scooters, dockless electric and traditional bicycles, and electric moped-style scooters.

Emission trends

Despite rising emissions within SIDS, together these countries represented just 1% of global CO_2 emissions in 2019.[46] For transport specifically, SIDS contributed just 0.5% of global transport CO_2 emissions in 2021 (excluding international aviation and shipping).[47] Transport CO_2 emissions from SIDS grew 9.6% during 2010-2021.[48] In 2020, transport CO_2 emissions in SIDS fell 10% – from 34.7 million tonnes to 31.2 million tonnes – due to the impacts of the COVID-19 pandemic.[49] Per capita transport CO_2 emissions in SIDS vary from 0.07 tonnes in Guinea Bissau to 4.96 tonnes in Seychelles (see Figure 1).[50]

Policy Developments

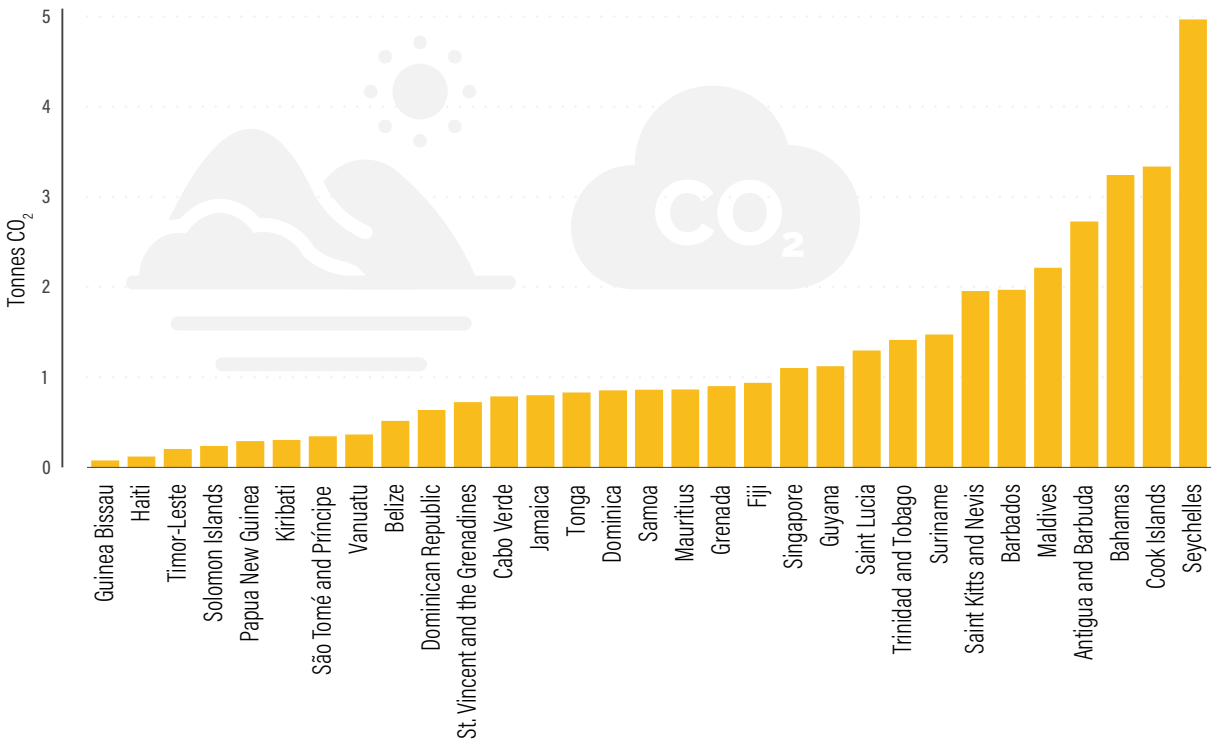
For many SIDS, land transport accounts for the bulk of imported fuel use, followed by electricity generation and maritime transport.[51] **Thus, phasing out fossil fuels in these sectors is the main lever for both reducing emissions and increasing energy security** (through greater resilience to price spikes). Strategies identified for SIDS to decarbonise transport are largely similar to those for decarbonising urban and land transport systems in other regions (*see Section 3.1 Integrated Transport Planning*).[52] However, strategies in SIDS also must include integrated planning for inter-island transport, greening of ports and maritime and aviation operations, use of small boats for coastal travel, a regional approach to aviation services, and adoption of low-emission aviation and shipping technology.[53]

SIDS have implemented a wide range of measures to enhance the resilience of their transport sectors.

- To reduce its vulnerability, Samoa pushed for a coherent and multi-pronged approach to systems planning, with the adoption of sectoral and spatial planning tools, investments in road network redundancy for critical infrastructure such as roads and bridges, the construction of pedestrian evacuation routes, and policies and planning that address disaster and climate risks.[54] Beginning in 2012, the Samoa Post Tsunami Reconstruction Project supported building the East Coast Inland Route and upgrading the Lepa-Lalomanu Route, both of which are inland routes that provide all-weather alternatives to coastal roads, helping to increase the resilience of communities to climate change.[55]

FIGURE 1. Per capita transport CO_2 emissions in SIDS

Source: See endnote 50 for this chapter.



- In Dominica, the roadway network is prone to flooding and landslide hazards, and after Tropical Storm Erika hit the island in 2015 around 60% of the roads were inaccessible.[56] In 2016, a sustainable risk-based asset management system was implemented for roadway infrastructure, to keep track of reconstruction, continuously assess conditions, assess disaster vulnerability, and prepare a multi-year investment and mitigation action plan. The system also identifies optimal investment strategies to reduce the roadway's risk and vulnerability to hazards and to maintain its functionality at an acceptable level.[57]
- In Saint Lucia, the Ministry of Infrastructure adopted a smartphone app, RoadLab Pro, as a low-budget and easy-to-use geo-mapping tool for assessing road conditions, including road roughness.[58]

Some measures in SIDS also have supported decarbonising road transport:

- Although intended to address congestion, Singapore has implemented various measures since the 1970s that also support a lower-emission transport system. To manage the increasing number and use of vehicles, measures have included vehicle and fuel taxes, parking charges and a vehicle quota system.[59] In 1971, Singapore developed a mass rapid transit system to allow for island-wide connectivity without reliance on private vehicles, and recently it enacted a walking and cycling plan.[60]
- In 2019, Bermuda set targets to reach 100% electrified public transport by 2030 and an 85% renewable share in the overall energy supply by 2035.[61]
- In Antigua and Barbuda, an electric vehicle pilot project was launched in 2017 with the donation of two electric school buses, which were integrated into the system at the start of the 2020 school term.[62]

Some SIDS have increased their efforts to decarbonise shipping while also pushing for greater ambition globally:

- In 2020, the Marshall Islands set the objectives of reducing domestic shipping emissions 40% by 2030 and fully decarbonising the sector by 2050.[63]
- The Marshall Islands, Kiribati and the Solomon Islands have been influential within the International Maritime Organization (IMO) in advocating for scaled-up ambition in decarbonising shipping.[64]

Because SIDS face disproportionate impacts from climate change, many have led the charge on efforts to increase climate equity, address loss and damage from the effects of climate change, and restructure financial systems. For example, in 2022 Barbados adopted the Bridgetown Agenda as a call to the international community for greater financial support for developing countries affected by climate change (see Box 1).[65] In March 2023, six Pacific Island countries – Fiji, Niue, the Solomon Islands, Tonga, Tuvalu and Vanuatu – signed the Port Vila Call for a Just Transition to a Fossil Fuel Free Pacific, a call to action encompassing many measures to transition the region away from fossil fuels, including reforms to international climate finance to help enable the transition.[66]

BOX 1. The Bridgetown Agenda for climate finance

In 2022, Barbados adopted the Bridgetown Agenda, calling on the International Monetary Fund, the World Bank, the G20 countries and others in the international community to increase financial support to low- and middle-income countries. The agenda is aimed at efforts to deal with climate change as a top crisis, alongside the cost of living and debt crises (which themselves have been exacerbated by climate-related disasters, the COVID-19 pandemic and the Russian Federation's war on Ukraine). The agenda outlined three actions:


Photo credit: Timothy Sullivan (UNCTAD)

1. **Provide emergency liquidity to countries in need to stop the debt crisis.**
2. **Expand multilateral lending by USD 1 trillion, placing a priority on achieving the SDGs and building climate resilience.**
3. **Activate private sector savings for use in climate mitigation, as well as funding for reconstruction following climate-related disasters using new multilateral mechanisms.**

This initiative proved to be a significant development that has had implications for the UN international climate negotiation processes, including catalysing debate at the 2022 UN Climate Change Conference in Sharm El-Sheikh, Egypt (COP 27). It also resulted in the organisation of the first Global Supply Chains Forum, scheduled to be held in Barbados in May 2024, organised by the government of Barbados and the UN Conference on Trade and Development.

Source: See endnote 65 for this section.

In addition, outside governments and organisations have taken an interest in providing **international support** to SIDS on transport-related projects, typically with the aim of also reducing emissions.

- Germany's Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has administered the Regional Pacific Nationally Determined Contribution Hub to support Pacific Island countries in reviewing, enhancing and implementing their climate commitments, including helping to identify opportunities to bring the transport sector to the fore and connect climate ambitions at the national and local levels.[67] This hub is implemented in partnership with the Global Green Growth Institute, the Pacific Community, and the Secretariat of the Pacific Regional Environment Programme, and served 14 member countries as of early 2023: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Palau, Papua New Guinea, Nauru, Niue, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.
- From 2017 to 2023, GIZ supported the Marshall Islands in reducing emissions and transitioning to energy efficient transport in the maritime sector through the Transitioning to Low Carbon Sea Transport project.[68]
- The Global Green Growth Institute has supported the SIDS within its membership – Fiji, Kiribati, Papua New Guinea, Tonga and Vanuatu – in pursuing a low carbon development approach while also promoting increased resilience.[69]
- Implemented by the IMO and funded by the EU, the Global Maritime Technology Cooperation Centre's (MTCC) Network Project was established in 2017 and extended to March 2022, with the objective of supporting least-developed countries and SIDS in particular to improve energy efficiency and decrease emissions in the shipping sector.[70]
- The Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE), supported by the United Nations Industrial Development Organization (UNIDO), has been working on standards and regulations for electric vehicles and e-micromobility in the Pacific Islands, following other work focused on exploring options for integrating electric mobility and renewable energy.[71]
- The International Renewable Energy Agency (IRENA) has supported SIDS in their efforts to transition from fossil fuel dependence to renewable energy through its SIDS Lighthouses Initiative.[72] The initiative brings together a multi-stakeholder group of countries, regional and international organisations, development agencies, the private sector, research institutes and non-governmental organisations to support SIDS in this effort.[73]
- For over 50 years, the US Department of State has supported Pacific Island countries through its Pacific Islands Forum across a range of issues, including sustainable growth, environmental challenges and natural disasters.[74] In 2022, the first ever US-Pacific Island Country Summit was held to increase co-operation on issues including climate change; it included the launch of the Pacific Partnership Strategy to support the Pacific Islands on dealing with such issues.[75]

Photo: Silke von Brockhausen / UNDP

MODULE 1 | 1.3

National and Sub-national Action for Sustainable, Low Carbon Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Section Spotlight

MODULE 1 | 1.3.1

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Transport in National Climate and Sustainability Strategies to Achieve the Targets of the Paris Agreement and SDGs

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Key findings

- To achieve the objectives of the Paris Agreement and of the 2030 Agenda on Sustainable Development – including decarbonisation by 2050 and improved accessibility, resilience and sustainability by 2030 – the transport sector must accelerate its transformation immediately.
- The Nationally Determined Contributions (NDCs) submitted as of 23 September 2022 are insufficient to avoid an average temperature increase of 2.5°C by the end of this century.

Nationally Determined Contributions in the framework of the Paris Agreement

- Most countries (169 countries in total) submitted second-generation NDCs before the end of 2022 and strengthened their overall climate ambitions.
- On average, the second-generation NDCs included more transport mitigation and adaptation actions than the first generation of NDCs. Each second-generation NDC featured nearly twice as many transport mitigation actions as did first-generation NDCs.
- The second-generation NDCs also featured twice as many transport targets (109 targets in total in 64 NDCs) as the first-generation ones. However, this does not translate into more impact because targets do not result in absolute reductions in transport emissions.
- Of the second-generation NDCs, 23 (or 16%) had a target for mitigating transport greenhouse gas emissions, mostly for countries in Europe and Africa and for the year 2030; this was up from only 13 first-generation NDCs (or 8%).
- Adaptation is still neglected in transport, as few second-generation NDCs feature transport adaptation targets and actions. In both generations of NDCs, there is little explicit mention of freight-related actions.
- The level of ambition on transport (i.e., targets and actions) in second-generation NDCs remains insufficient to achieve the goals of the Paris Agreement, and implies a further 11% increase in transport greenhouse gas emissions by 2030.

Long-Term Low Emission Development Strategies (LT-LEDS or LTS) in the framework of the Paris Agreement

- By the end of 2022, only a quarter of the world's countries had developed LTS.
- All LTS mentioned transport, although only 22% of LTS (13 countries) outlined transport targets, with nearly all having a target year of 2050.

Initiatives and commitments at recent United Nations (UN) climate conferences

- During the 2021 UN Climate Change Conference in Glasgow, UK (COP 26), stakeholders launched an unprecedented number of commitments and initiatives on sustainable, low carbon transport (i.e., zero-emission passenger and freight vehicles, shipping, aviation), and several of these have since expanded in scope and/or signatories.
- At the 2022 UN Climate Change Conference in Sharm El-Sheikh, Egypt (COP 27), the COP 27 Presidency of Egypt launched an initiative on low carbon transport for urban sustainability that aims to activate systemic change beyond the legacy "mode-first" mindset (i.e., focus on specific transport modes).

Linkages between national planning processes and Paris Agreement mechanisms

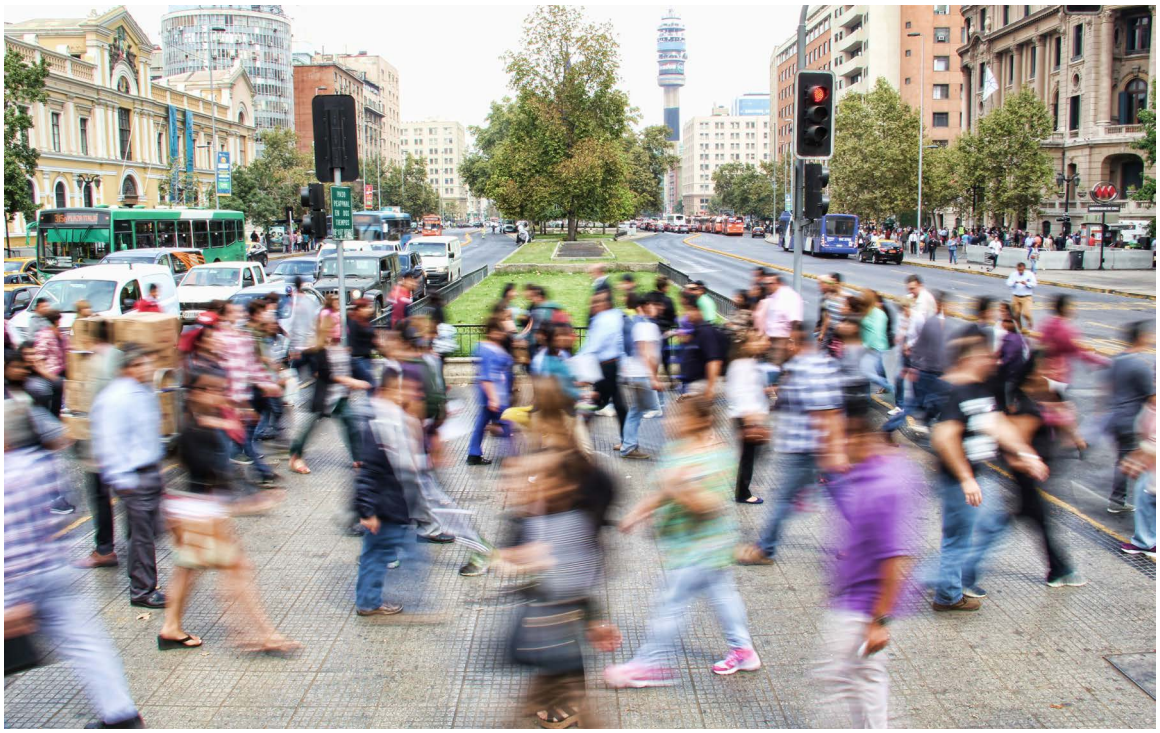
- Linkages between national strategies (such as transport development plans, electric vehicle plans and multi-year infrastructure plans) and Paris Agreement mechanisms have been strengthened as more climate strategies reference national strategies.
- The number of countries working on transport decarbonisation strategies has increased since the second edition of this report in 2021. At the sub-national level, several jurisdictions released transport decarbonisation plans.

Voluntary National Reviews (VNRs) in the framework of the 2030 Agenda for Sustainable Development

- The VNRs from 2016 to 2022 revealed consensus on the role of transport as a key contributor to implementation of the Sustainable Development Goals (SDGs). In the first VNR reporting cycle (2016-2019), 92% of VNRs highlighted progress in the transport sector, and 18% of VNRs reported specific targets covering 12 areas in sustainable transport.
- In 2022, 21% of the VNRs (9 out of 42 VNRs) mentioned specific transport targets, up from 20% (9 out of 40) in 2021 and 17% (8 out of 47) in 2020.
- Most of the 2022 VNRs described only the adverse impacts of global issues, without presenting concrete policy measures; when they did, these measures did not fully address the urgent systemic transformations necessary to enable equitable access to transport and mobility for all.

Impacts of global shocks

- Global shocks since 2020 – such as the COVID-19 pandemic and the Russian Federation's invasion of Ukraine – have put at increased risk any overall progress towards the SDGs and the Paris Agreement goals.
- The COVID-19 pandemic induced long-lasting negative impacts on urban mobility, land use and transport systems across low-, middle- and high-income countries.



Overview

To achieve the objectives of the Paris Agreement and of the 2030 Agenda on Sustainable Development – including decarbonisation by 2050 and improved accessibility, resilience and sustainability by 2030 – the transport sector must accelerate its transformation immediately. Different mechanisms under the Paris Agreement on Climate Change, the UN 2030 Agenda and the Sendai Framework for Disaster Risk Reduction provide countries with framework avenues to set their transport ambitions, targets, and actions and to learn from each other.

Under the Paris Agreement, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are required to submit Nationally Determined Contributions (NDCs), outlining their specific ambitions, targets and actions to reduce emissions and enhance adaptation and resilience.[1] In addition to NDCs, the UNFCCC provides several mechanisms under the Paris Agreement to describe intended ambitions, targets and actions on climate change mitigation and adaptation. These include: Long-Term Low Emission Development Strategies (LT-LEDS or LTS), National Adaptation Plans (NAPs), National Adaptation Programmes of Action (NAPAs) and Nationally Appropriate Mitigation Actions (NAMAs).[2]

The Paris Agreement also provides a mechanism for collaboration among Parties and non-Party stakeholders (all stakeholders that are not national governments) through the Marrakech Partnership for Global Climate Action.[3] The Marrakech Partnership elaborates Climate Action Pathways, which set out visions for various sectors – including transport – to achieve a world where global temperature rise is kept within 1.5 degrees Celsius (°C) by 2050.[4]

Countries also have the opportunity to achieve sustainable, low carbon transport through their implementation of the UN global agendas on sustainable development and adaptation and resilience – namely the 2030 Agenda for Sustainable Development and its Voluntary National Reviews (VNRs) for tracking progress towards the Sustainable Development Goals (SDGs), as well as the Sendai Framework for Disaster Risk Reduction and its Global Assessment Report.

Overall, there remains significant need to strengthen the linkages between the UNFCCC mechanisms for the Paris Agreement and the 2030 Agenda and the Sendai Framework, helping to assure that progress towards climate change mitigation and adaption yields broader positive impacts on sustainable development.

Global shocks since 2020 – such as the COVID-19 pandemic and the Russian Federation's invasion of Ukraine – have put at increased risk the overall progress towards the SDGs and the Paris Agreement goals.[5] In the words of UN Secretary-General Antonio Guterres, the war is "putting our world at immediate risk of hurtling past the 1.5-degree temperature increase limit".[6] **Already, the NDCs submitted as of 23 September 2022 are insufficient to avoid an average temperature increase of 2.5°C by the end of this century.**[7]

Global events also have had long-lasting impacts on mobility. Ridership levels on public transport and other collective urban mobility in 2021 and 2022 were still below pre-COVID-19 levels (*see Section 3.4 Shared Mobility*). Meanwhile, aviation has suffered from the rerouting of air traffic resulting from the closure of Russian skies (*see Section 3.7 Aviation*), and the Russian invasion of Ukraine has disrupted maritime shipping and raised trade costs (*see Section 3.8 Shipping*).

Since the previous two editions of this report, many countries have responded to the request to enhance their NDCs under the terms of the Paris Agreement, by submitting second-generation or updated versions. While a few submissions occurred in 2023, the available analysis to the end of 2022 provides a near-complete picture of the second generation of NDCs and the role of transport in them. Similarly, the VNRs submitted in the second reporting cycle (2020-2022) for the 2030 Agenda for Sustainable Development reveal a general consensus that transport is a key contributing factor to implementation of the SDGs, following a similar pattern to the first reporting cycle (2016-2019).

Nationally Determined Contributions in the framework of the Paris Agreement

NDCs are submitted in a five-year cycle, with the first generation submitted in 2015 and subsequent generations to be submitted every five years thereafter. The NDC process is supported by a set of "global stocktakes" to assess progress towards implementation of the Paris Agreement, with the first stocktake scheduled to occur in 2023 (and subsequent ones every five years thereafter).

Most countries (169 countries in total) submitted second-generation NDCs before the end of 2022, taking the opportunity to strengthen their overall climate ambitions.[8]

- By the end of 2022, a total of 169 countries had submitted 16 second-generation NDCs and 128 updated NDCs.[9] This was up from only 54 second-generation and updated NDCs submitted as of May 2021.[10] (The analysis includes a single NDC submitted on behalf of the European Union Member States but excludes the NDCs of Kiribati and Turkmenistan, which were submitted in 2023.)
- Between 2021 and 2022, 23 countries added enhanced economy-wide targets for greenhouse gas mitigation to their second-generation NDCs.[11]

On average, the second-generation NDCs included more transport mitigation and adaptation actions than the first generation of NDCs. Each second-generation NDC featured nearly twice as many transport mitigation actions as did first-generation NDCs.[12]

- Whereas only 66% of first-generation NDCs featured transport among their climate mitigation actions, 80% of second-generation NDCs did so.[13]
- In the **first-generation NDCs**, the most popular transport-related mitigation actions were vehicle improvements, public transport improvements, infrastructure improvements, and alternative fuels, followed by electric mobility (e-mobility).[14]
- In **second-generation NDCs**, the attention moved away from public transport actions and towards e-mobility actions, with the most popular mitigation actions being e-mobility, mode shift, demand management and low carbon fuels. The e-mobility actions featured a diversity of road transport modes, with buses and cars each representing 20% of all e-mobility actions mentioned.[15]

The second-generation NDCs featured twice as many transport targets (109 targets in total in 64 NDCs) as the first-generation ones.[16] **However, this does not translate into more impact because targets do not result in absolute reductions in transport emissions.**

- A total of **64 second-generation NDCs (45%) contained transport targets** (either transport greenhouse gas mitigation targets and/or non-greenhouse gas targets for transport that feature a quantitative target for a specific year); this was up from only 21% of first-generation NDCs with any kind of transport target in 2021.[17]
- Overall, second-generation NDCs identified **109 non-greenhouse gas transport targets** (a single NDC can include several targets).[18] The most frequent non-greenhouse gas targets were related to zero-emission vehicles (39%), followed by vehicle efficiency (25%), mode share (10%), biofuels (10%), infrastructure (9%), "Avoid" strategies (4%) and renewable energy (3%).[19]

Of the second-generation NDCs, 23 (or 16%) had a target for mitigating transport greenhouse gas emissions, mostly for countries in Europe and Africa and for the year 2030 **(see Figure 1 and Table 1)****; this was up from only 13 first-generation NDCs (or 8%).**[20]

- Grenada and Japan reiterated their targets from their first-generation NDCs, while Bangladesh, Burkina Faso and Dominica revised their transport greenhouse gas mitigation targets.

Adaptation is still neglected in transport, as few second-generation NDCs feature transport adaptation targets and actions. Only six second-generation NDCs had transport adaptation targets as of the end of 2022 **(see Table 2)**.[21] Such targets relate to climate-proof infrastructure as well as the deployment of public transport and active mobility systems towards more robust and resilient transport systems.[22]

However, the second-generation NDCs featured more transport adaptation actions than did the first-generation NDCs.

- Of the total second-generation NDCs, 63 (43%) included transport adaptation actions, compared to 22% of first-generation NDCs.[23]
- More than two-thirds (67%) of the NDCs of low-income countries featured transport adaptation measures, compared to 30% of the NDCs of high-income countries.[24]
- Transport adaptation actions in second-generation NDCs included structural and technical actions (56% of the total), institutional and regulatory actions (27%), informational and educational actions (16%) and other adaptation actions (less than 1%).[25]

TABLE 1. Transport greenhouse gas emission mitigation targets in countries' second-generation NDCs, as of end-2022

Source: See endnote 20 for this section.

Country	Targeted reductions in transport emissions (in carbon dioxide equivalents)	Type of target
Andorra	50% in road transport by 2030	●
Bangladesh	9.3% below business as usual (BAU) by 2030, to 32.9 million tonnes (unconditional) 27% below BAU by 2030, to 26.6 million tonnes (conditional)	● +
Belize	Reduce conventional transport fuel 15% by 2030, to avoid 117 kilotonnes annually Achieve 15% efficiency per passenger- and tonne-kilometre through appropriate policies and investments	●
Burkina Faso	Limit the emission increase to 1,210 gigagrams (Gg) by 2025, 3,563 Gg by 2030 and 8,265 Gg by 2050 (unconditional) Further limit to 267 Gg in 2025, 867 Gg in 2030 and 4,153 Gg in 2050 (conditional)	● +
Dominica	20% below 2014 levels by 2030; 100% below 2014 levels for shipping by 2030	●
Egypt	7% by 2030, reducing from 124,360 Gg under BAU to 8,960 Gg	●
El Salvador	Limit transport emissions to 334 kilotonnes below BAU by 2030	●
Fiji	40% below BAU for domestic maritime shipping by 2030	●
Gambia	22.2% below BAU by 2030	+
Georgia	15% below BAU by 2030	●
Grenada	20% below 2010 levels by 2025, with further reductions by 2030 (continuation from first NDC)	+
Guinea	2,300 kilotonnes per year below BAU by 2030 (unconditional) 2,600 kilotonnes per year below unconditional scenario by 2030 (conditional)	● +
Israel	No more than 3.3% above 2015 levels by 2030; 96% below 2015 levels by 2050	●
Japan	27% below 2013 levels by 2030, to reach 163 million tonnes or less (continuation from first NDC)	●
Liberia	15.1% below BAU by 2030	+
Mauritania	5.21% by 2030, avoiding 92.7 Gg between 2021 and 2030	●
Mauritius	Limit to 129 kilotonnes per year by 2030	●
Seychelles	30% below BAU for petrol vehicles by 2030	+
Samoa	5.2 Gg (land transport) and 3 Gg (maritime transport) by 2030	●
South Sudan	44% below BAU by 2030	●
Sri Lanka	4% below BAU by 2030 (1% unconditional, 3% conditional)	● +
Uganda	29% below BAU by 2030, reducing from 9.6 million tonnes under BAU to 6.8 million tonnes	+
United Arab Emirates	14% below BAU by 2030 (due mainly to enhanced vehicle standards in road transport)	●

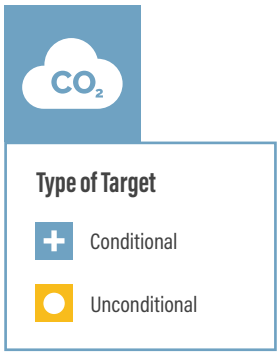


FIGURE 1. Transport targets, by type, in countries' second-generation NDCs

Source: See endnote 20 for this section.

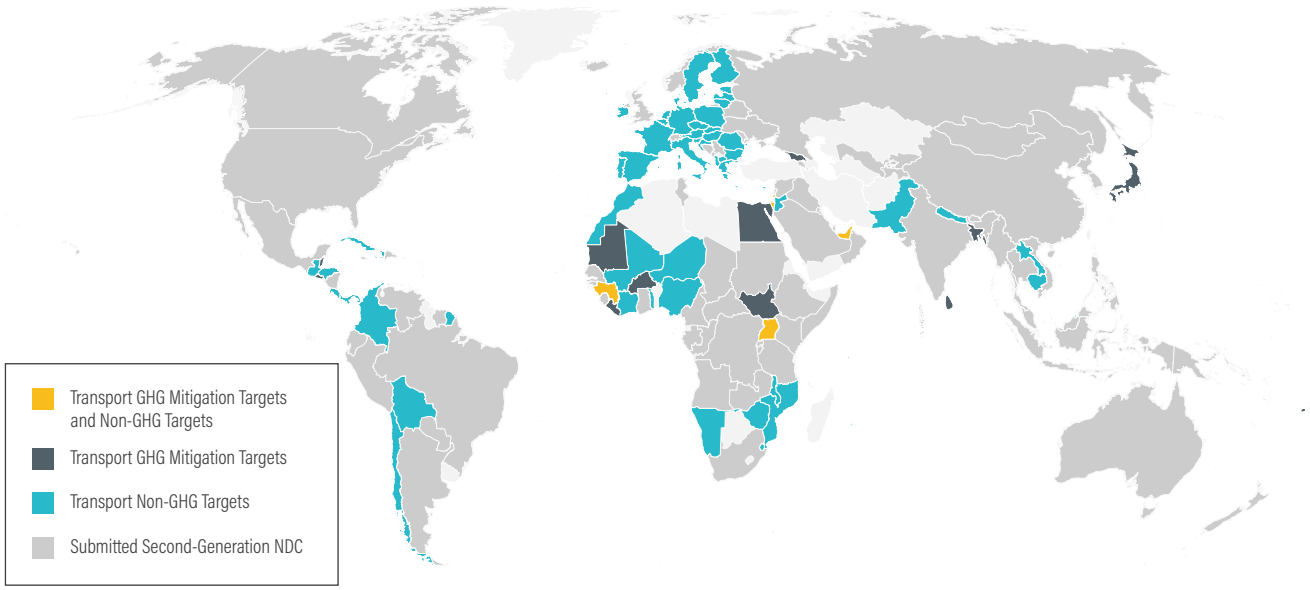


TABLE 2. Transport adaptation targets in countries' second-generation NDCs, as of end-2022

Source: See endnote 21 for this section.

Country	Transport adaptation target
Antigua and Barbuda	Ensure that all waterways are protected to reduce the risks of flooding and health impacts by 2030.
Burundi	Build 7.5 kilometres (unconditional) and 42.5 kilometres (conditional) of infrastructure exclusively for active mobility, and 3 modern ports with 6 ships to be acquired for Lake Tanganyika (conditional).
Cambodia	Develop a guidebook with design standards for climate-proof roads by 2022, establish a monitoring and evaluation framework for such roads by 2023 and ensure that road construction and repair follow these standards by 2030.
Kenya	Promote the use of appropriate designs and building materials to enhance resilience of at least 4,500 kilometres of roads.
Liberia	Implement infrastructure that fosters the development of a bus public transport network for Monrovia and that ensures that low-income groups can reach jobs, education and healthcare services through improved access to economic and social opportunities.
Papua New Guinea	Build and rehabilitate USD 1.2 billion (PGK 4.2 billion) worth of air, sea and land transport infrastructure and assets according to climate-resilient codes and standards.

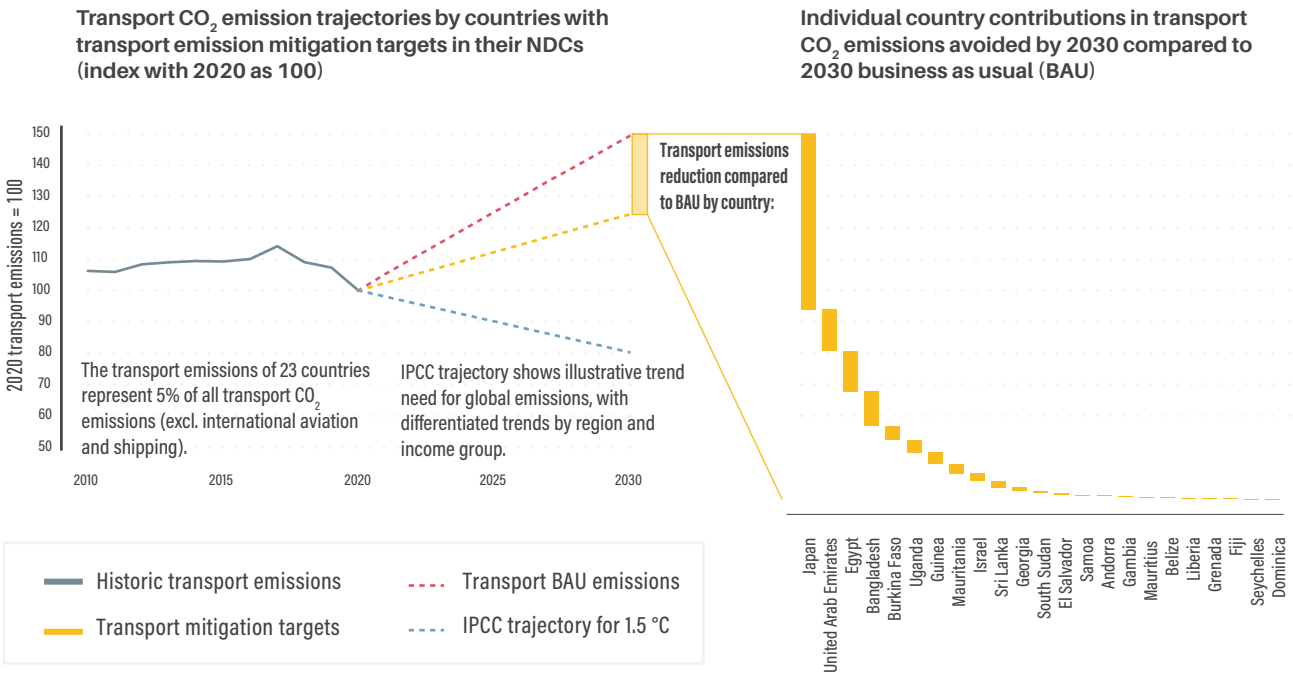
In both generations of NDCs, there were very few explicit mentions of freight-related actions. Around two-thirds of the transport mitigation actions in each generation of NDCs did not explicitly mention freight or passengers, while 25% mentioned passenger transport and only around 5% mentioned freight transport.[26]

The level of ambition on transport (i.e., targets and actions) in second-generation NDCs remains insufficient to achieve the goals of the Paris Agreement, and implies a further 11% increase in transport greenhouse gas emissions by 2030.[27] An October 2022 report found that under the current NDCs, the average global temperature would increase by 2.5 degrees Celsius (°C) (range of 2.1°C to 2.9°C).[28]

SLOCAT analysis of the transport greenhouse gas mitigation targets in the second-generation NDCs shows that while the growth in transport carbon dioxide (CO_2) emissions will slow, overall emissions will not be reduced in absolute terms, due to the shortfall in NDC ambitions. The main reason is that many transport greenhouse gas mitigation targets in the second-generation NDCs are set against a business-as-usual growth. Rather than reducing absolute transport CO_2 emissions, this just results in less growth than under business-as-usual projections (see Figure 2).[29]

FIGURE 2. Impact of transport greenhouse gas mitigation targets in NDCs

Source: See endnote 29 for this section



Long-Term Low Emission Development Strategies in the framework of the Paris Agreement

To complement the NDCs, the Paris Agreement invites (but does not require) countries to formulate and communicate Long-Term Low Emission Development Strategies (LT-LEDS or LTS), to help establish low carbon trajectories to 2050.

By the end of 2022, only a quarter of the world's countries had developed LTS.[30] All LTS mentioned transport, although only 22% of LTS (13 countries) outlined transport targets, with nearly all having a target year of 2050.[31] This continued the pattern from 2021, when all 29 of the LTS at the time mentioned transport.[32]

- In addition to the 58 LTS officially submitted, 19 individual European Union Member States submitted their respective LTS, resulting in a majority of LTS submissions (51%) coming from Europe.[33] Except for Australia, the Gambia, New Zealand and Nigeria, all of the LTS that had transport greenhouse gas mitigation targets were from European countries **(see Table 3)**.[34]
- Seven countries – Canada, France, Germany, Japan, Thailand, the United Kingdom and the United States – submitted updated LTS in 2021 and 2022.[35]

Only nine LTS (Austria, Cambodia, Colombia, Fiji, Japan, Lithuania, Malta, Singapore and Tonga) discussed the topic of transport adaptation, covering 52 transport adaptation actions.[36] This was a significant contrast to the 176 adaptation actions mentioned in second-generation NDCs.[37] Among these countries, Cambodia and Colombia also feature transport adaptation in their second-generation NDCs.

TABLE 3. Transport targets in countries' LTS as of end-2022

Source: See endnote 34 for this section.

LTS	Targeted reductions in transport CO_2-equivalent emissions
Australia	53-71% below 2005 levels by 2050
Belgium	Zero emissions for passenger and freight transport by 2050
The Gambia	From 1,026 Gg in 2020 to 315 Gg in 2050
Germany	40-42% below 1990 levels by 2030 (reducing around 95-98 million tonnes)
Lithuania	At least 14% below 2005 levels by 2030; 90% by 2050
New Zealand	Net zero by 2050
Nigeria	Around 4 million tonnes annually by 2030
Portugal	43-46% below 2005 levels by 2030; 84-85% by 2040; 98% by 2050
Slovenia	90-99% below 2005 levels by 2050
Spain	30% below BAU by 2030
Sweden	70% below 2010 levels by 2030 (excluding domestic aviation)
Switzerland	Zero for domestic land transport by 2050 (with few exceptions); net zero for international aviation by 2050
United Kingdom	Net zero for domestic aviation and shipping by 2050

Initiatives and commitments at recent United Nations climate conferences

During the 2021 UN Climate Change Conference in Glasgow, UK (COP 26), stakeholders launched an unprecedented number of commitments and initiatives on sustainable, low carbon transport, and several of these have since expanded in scope and/or signatories (see Table 4).[38] Both the aviation-related commitment and the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles have gained a substantial number of new country signatories, whereas few new countries have joined the commitments on zero-emission vehicles and green shipping corridors.

Comparing the NDCs of signatory countries to the transport commitments that they have signed onto reveals that there is a weak alignment. In particular, there is a weak alignment between NDCs and the commitments related to zero-emission vehicles and green shipping corridors. The strongest alignment exists in the case of the International Aviation Climate Ambition Coalition, as the NDCs of several of the signatory countries express their intention to engage with the International Civil Aviation Organization (ICAO) or to tackle aviation emissions (in some cases, limited only to domestic aviation emissions).[39]

At the 2022 UN Climate Change Conference in Sharm El-Sheikh, Egypt (COP 27), the COP 27 Presidency of Egypt launched an initiative on low carbon transport for urban sustainability that aims to "activate systemic change beyond the legacy 'mode-first' mindset (i.e., focus on specific transport modes)".[40] Among the 14 flagship initiatives of the COP 27 Presidency is the Low Carbon Transport for Urban Sustainability (LOTUS) initiative, which aims to activate systemic change to improve and decarbonise the urban mobility landscape, and specifically to:

- Scale up investment for electric vehicles and sustainable mobility infrastructure (led by the Institute for Transportation and Development Policy, the World Resources Institute and the Smart Freight Centre).
- Empower and invest in informal transport to decarbonise and mobilise towards achievement of SDG 11 (sustainable cities and communities), achieve climate resilience, and develop a global agenda for a just transition and transformation (led by the Global Network for Popular Transportation).
- Build capacity to develop integrated, multi-modal policy frameworks in low- and middle-income countries (led by the International Association of Public Transport (UITP), the International Union of Railways (UIC) and Walk21).[41]

TABLE 4. Overview of COP 26 commitments as of 14 December 2022

Source: See endnote 38 for this section.

COP 26 COMMITMENTS	Total signatories at COP 26 in November 2021	Total signatories as of 14 December 2022	New country signatories since COP 26 as of 14 December 2022	Other updates
Accelerating to Zero Coalition (A2Z)	178 (38 countries)	221 (40 countries)	2 (Greece and Spain)	Previously called the Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans
Breakthrough Agenda on Transport	33 countries	33 countries	0	Previously called the Breakthrough Agenda on Road Transport. The scope has since been widened to include aviation and shipping. In 2022, the focus was on implementation.
Clydebank Declaration for Green Shipping Corridors	22 countries	24 countries	2 (Palau and Singapore)	No update since April 2022.
Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles	15 countries	27 countries	12 (Belgium, Croatia, Dominican Republic, Ireland, Liechtenstein, Lithuania, Portugal, Ukraine and the United States, plus constituent countries Aruba, Curaçao and Sint Maarten)	Introduced a progress dashboard to monitor the relevant policies by signatory countries. Also received several new endorsements in 2022.
International Aviation Climate Ambition Coalition	25 countries	59 countries	34 (Albania, Austria, Belgium, Belize, Bulgaria, Chad, Côte d'Ivoire, Croatia, Cyprus, Czech Republic, Dominican Republic, Equatorial Guinea, Georgia, Greece, Guinea, Hungary, Iceland, Latvia, Lithuania, Luxembourg, Madagascar, Mexico, Monaco, Montenegro, Niger, Republic of North Macedonia, Papua New Guinea, Poland, Portugal, Romania, Rwanda, Slovak Republic, Switzerland, Ukraine)	

However, except in the first focus area related to electric vehicles and sustainable mobility infrastructure, no national governments are part of LOTUS. Additionally, during COP 27 the following transport commitments, initiatives and campaigns emerged:

- **Green Shipping Challenge:** Countries, ports and companies made more than 40 announcements under the Green Shipping Challenge, including an agreement between the Netherlands, Norway, the United Kingdom and the United States to establish green shipping corridors.[42]
- **Partnership for Active Travel and Health (PATH):** In a letter to governments signed by more than 400 civil society organisations from around the world, PATH called on national and city governments to commit to prioritising investment in walking and cycling, including through NDCs as well as concrete actions for infrastructure, campaigns, land-use planning, integration with public transport and capacity building.[43]
- **Transport Decarbonisation Alliance's Call to Support Active Mobility Capacity Building:** The Alliance called on all Parties to the UNFCCC and global financial institutions to invest USD 100 million to train 10,000 mobility professionals in the planning, design, operations, and promotion of walking and cycling, in order to build a local knowledge base and to create a pipeline of projects to ensure sustained, high-quality investment in active mobility at a global scale.[44]

Linkages between national planning processes and Paris Agreement mechanisms

Linkages between national strategies (such as transport development plans, electric vehicle plans and multi-year infrastructure plans) and Paris Agreement mechanisms have been strengthened as more climate strategies reference national strategies. As of 2021, NDCs were increasingly referencing other national strategies, and this trend continued in the NDCs and LTS submitted by countries in 2021 and 2022. Such linkages enhance policy coherence and policy synergies towards the acceleration of transport decarbonisation and broader sustainability objectives.

- The updated NDC of Mexico mentioned progress on a National Electric Mobility Strategy, with a focus on public transport, since this mode helps advance fairness, safety and other social benefits.[45]
- The LTS of Morocco referred to the Sustainable Mobility Roadmap, which is based on the Paris Process on Mobility and Climate's Global Macro Roadmap.[46]
- Vietnam's updated NDC pointed to the National Climate Change Strategy and the Transport Development Strategy, reflecting climate actions on transport closely co-ordinated with the transport ministry.[47]
- For Latin America and the Caribbean, a 2022 analysis on both climate strategies and transport policies at the national and sub-national levels found general coherence on these high-level strategies related to transport, energy and urban planning.[48]

Several countries have implemented advanced sustainable transport policies aligned to their second-generation NDCs (2020-2022). Colombia, Peru and Uruguay sent political signals from the national level to support the sub-national level in implementing sustainable mobility.[49] Many of the capitals and largest cities of the countries featured in this analysis have made efforts towards sustainable urban mobility plans (SUMPs).[50] The World Bank's Global Facility to Decarbonize Transport (GFDT) supports national commitments to the Paris Agreement and NDCs. In 2022, activities initiated under the GFDT included bus electrification in Ghana and urban transport modernisation in Lima, Peru.[51]

The number of countries working on transport decarbonisation strategies has increased since the second edition of this report in 2021, in which Costa Rica's strategy, released in 2019, was identified as a frontrunner.

- In 2021, the United Kingdom published a national transport decarbonisation plan, labelled as the "world's first greenprint to decarbonise all modes of domestic transport by 2050".[52]
- Ireland released a Climate Action Plan in 2022 with specific transport goals for 2030: reduce CO_2 emissions 50% below 2018 levels; decrease the share of cars from 72% in 2018 to 53%; increase fuel prices 65%; improve public transport and reduce prices 50%; and have all new car sales be electric.[53]

At the sub-national level, several jurisdictions released transport decarbonisation plans:

- Auckland (New Zealand) adopted the Transport Emissions Reduction Pathway aimed at reducing transport emissions 64% by 2030.[54]
- In early 2023, Freetown (Sierra Leone) launched a Climate Action Plan, including goals to encourage public transport while maintaining low shares of private transport, to pro-actively address historical land-use planning challenges to support efficient, low carbon transport and transit-oriented development, and to promote behaviour change in support of public transport, cycling and walking.[55]
- Mumbai is India's first city with a Climate Action Plan, released in 2022, and the first member of C40 Cities in South and West Asia with such a plan.[56] As one of the six key action areas, sustainable mobility aims to improve the availability and accessibility of public transport, provide inclusive planning for walking and cycling, and induce a shift from private to public transport.[57]
- In 2020, Vancouver (Canada) released its Climate Emergency Action Plan 2020-2025, with goals for 2030 that include conducting 66% of all trips by public transport, walking and cycling; and using zero-emission vehicles for 50% of all kilometres driven.[58]

Voluntary National Reviews in the framework of the 2030 Agenda for Sustainable Development

A just transition to equitable, healthy, green, and resilient transport and mobility systems is central to socio-economic prosperity for people and the planet. To achieve such systems, key transformations in land transport – linked to wider socio-economic transformations – are needed.[59]

The UN 2030 Agenda on Sustainable Development is a cross-cutting, interconnected agenda, wherein the achievement of one of the 17 Sustainable Development Goals (SDGs) is often dependent on the achievement of others. Although sustainable, low carbon mobility is not represented by a stand-alone SDG, its successful implementation supports the achievement of almost every SDG. The SLOCAT Wheel on Transport and the SDGs (*see Section 1.1*) shows the extent of positive interactions to define equitable, healthy, green, and resilient transport and mobility systems. SDG 13 (climate action) provides a direct linkage between the actions to support the 2030 Agenda and the Paris Agreement.

The 2030 Agenda encourages UN Member States to submit Voluntary National Reviews (VNRs) to the annual UN High-Level Political Forum on Sustainable Development. The VNR process facilitates sharing of successes and challenges, with a view towards accelerating the implementation of the 2030 Agenda. Since the first High-Level Political Forum in 2016, countries have reported on transport as a vital sector to implement the SDGs, showcasing on-the-ground implementation and best practices. SLOCAT has conducted detailed annual analyses of the VNRs.

The development, implementation and reporting of NDCs and VNRs can be leveraged through concerted and co-ordinated efforts to scale up sustainable transport (see Box 1).[60]

The VNRs from 2016 to 2022 revealed consensus on the role of transport as a key contributor to implementation of the SDGs.[61] In the first VNR reporting cycle (2016-2019), 92% of VNRs (144 of 156 VNRs) highlighted progress in the transport sector, and 18% of VNRs reported specific targets covering 12 areas in sustainable transport.[62] The majority of targets were short- to medium-term targets (for 2020 and 2030), with only five countries setting long-term targets for 2050.[63] The transport dimension of the VNRs reported between 2020 and 2022 revealed consensus around transport as a key contributor to implementation of the SDGs, largely following a pattern similar to the first reporting cycle (2016-2019).

All 40 VNRs submitted in 2021 included references to sustainable transport policies and, for the first time since the inaugural High-Level Political Forum in 2016, they also included transport measures.

In 2022, the number of VNRs mentioning transport decreased to 36 out of the 42 submitted VNRs, or 86%, the lowest share since 2017.[64] Yet more VNRs reported specific transport targets and included explicit references to the four themes on transport and sustainability of the SLOCAT Wheel on Transport and the SDGs: equitable, healthy, green and resilient.[65]

Possible factors that may have contributed to the decrease in transport mentions in 2022 include:

- Lack of reporting in a number of VNRs on the SDGs that have the most transport relevance (e.g., SDG 3 on good health and well-being, SDG 9 on industry, innovation and infrastructure, and SDG 11 on sustainable cities and communities) because these were not a focus of the High-Level Political Forum of 2022.
- A possible and persisting gap in incorporating green and equitable recovery strategies for transport systems in COVID-19 pandemic response packages.
- Severely limited data collection for transport infrastructure and services development due to the pandemic, especially in developing countries.
- Pandemic-related budgetary cuts in national strategies and programmes for the transport sector.

BOX 1. Synergies among Nationally Determined Contributions and Voluntary National Reviews

Creating a common methodological framework between the Paris Agreement and the implementation and monitoring mechanisms for the 2030 Agenda for Sustainable Development can maximise the combined potential of both global frameworks for accelerating sustainable, low carbon transport.

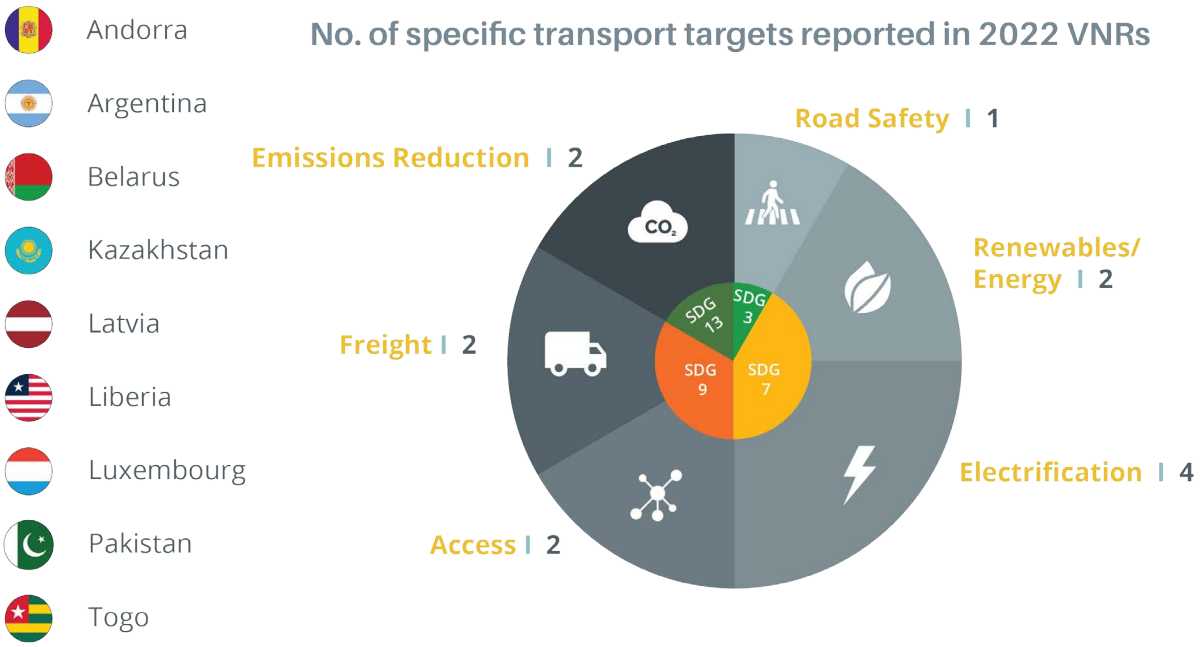
A successful implementation of sustainable transport measures in the context of the Paris Agreement and the 2030 Agenda must involve concerted and co-ordinated efforts to more closely link the processes of developing, implementing and tracking progress towards both Nationally Determined Contributions and Voluntary National Reviews. Such alignment is required both in the governance of the processes themselves and in the co-ordination among the national and sub-national actors that are formulating and putting them into practice.

In response to this identified need, in 2020 the Islamic Development Bank and the SLOCAT Secretariat proposed guidance to support the implementation of NDCs and SDGs for the transport sector at the national level. The guidance presents a set of eight components for mainstreaming the 2030 Agenda and the Paris Agreement objectives within the transport sector, to support convergence between climate action and sustainable development.

Source: See endnote 60 for this section.

FIGURE 3. Number of specific transport targets mentioned in 2022 Voluntary National Reviews

Source: See endnote 66 for this section.



In 2022, 21% of the VNRs (9 out of 42 VNRs) mentioned specific transport targets, up from 20% (9 out of 40) in 2021 and 17% (8 out of 47) in 2020 (see Figure 3).[66] Targets were focused on, among others, electrification, freight, road safety and renewable energy (see Table 5).[67]

In the 2022 VNRs, the majority of the mentions focused on developing transport infrastructure in the context of passenger and freight activities (SDG 9 on industry, innovation (SDG 9 on industry, innovation and infrastructure), all-season rural roads (SDG 9) and public transport systems (SDG 11 on sustainable cities and communities). Significant attention was also given to reducing traffic fatalities and injuries (SDG 3 on good health and well-being) and increasing renewable energy; reducing final energy consumption in the transport sector (SDG 7 on affordable and clean energy) and curbing mobile-source greenhouse gas emissions (SDG 13 on climate action).[68] Compared to previous years, there was a slight increase in mentions of gender-sensitive transport policies (SDG 5), possibly because SDG 5 was a focus of the 2022 High-Level Political Forum. Relatively fewer of the VNRs mentioned measures to phase out fossil fuel subsidies (SDG 12) and curb mobile-source greenhouse gas emissions (SDG 13), despite 40% of the VNRs spelling out connections with SDG 13.[69]

The 2022 VNRs gave ample attention to urban transport measures, based on the transport-relevant indicator 11.2.1 (public transport), although there were very few references to rural access (indicator 9.1.1). Whereas in the 2020 VNRs, both urban and rural transport received similar levels of attention, this gap widened in the 2022 VNRs.[70]

A number of the 2022 VNRs (such as Andorra, Greece, Japan, Jordan, Kazakhstan, Luxembourg, Pakistan and the Philippines) highlighted sustainable transport actions in the context of pandemic recovery efforts and the need to urgently transition to renewables from fossil fuels. However, **most of the 2022 VNRs described only the adverse impacts of global issues, without presenting concrete policy measures; when they did, the measures did not fully address the urgent systemic transformations necessary to enable equitable access to transport and mobility for all.**[71]

Impacts of global shocks

Global shocks since 2020 – such as the COVID-19 pandemic and the Russian Federation's invasion of Ukraine – have put at increased risk any overall progress towards the SDGs and the Paris Agreement goals.[72] In 2022, the UN released briefs on the global impact of the Russian invasion on food, energy, and finance systems, including the ongoing cost-of-living crisis expanding worldwide.[73]

Research revealed that the invasion affected the biodiversity-focused SDGs (SDG 6 on clean water and sanitation, SDG 13 on climate action, SDG 14 on life below water and SDG 15 on life on

TABLE 5. Specific transport targets reported in 2022 Voluntary National Reviews

Source: See endnote 67 for this section.

Countries	Focus	Targets
Andorra	Electrification	Increase the electric vehicle share to 20% by 2030 and become one of the top five European countries in the share of electric vehicle sales
Argentina	Freight	Increase the share of freight transported by rail to 9% by 2025 and 11% by 2030
	Road safety	Reduce the rate of road fatalities per 100,000 inhabitants to 8.2% by 2030
Belarus	Access	Have 100% of the rural population living within two kilometres of a year-round road by 2021 (already met)
Kazakhstan	Access	Upgrade 100% of national roads to normal conditions and improve up to 95% of local roads by 2025
	Renewables/Energy	Switch all urban passenger transport to environmentally friendly fuels by 2030
Latvia	Renewables/Energy	Increase the share of renewable energy systems in the transport sector to 7% by 2030
Liberia	CO_2 emissions	Reduce transport CO_2 emissions 15% by 2030
Luxembourg	Electrification	Increase the share of electric and plug-in hybrid cars to 49% by 2030
	CO_2 emissions	Reduce transport CO_2 emissions 57% by 2030
Pakistan	Electrification	Achieve a 30% shift to electric vehicles by 2030
Togo	Electrification	Increase the share of electric vehicles in newly sold vehicles to 3% by 2025

Focus

- Electrification
- Freight
- Road safety
- Access
- Renewables/Energy
- CO_2 emissions

land); society-focused SDGs (SDG 1 on no poverty, SDG 2 on zero hunger, SDG 3 on good health and wellbeing, SDG 4 on quality education, SDG 5 on gender equality, SDG 7 on affordable and clean energy, SDG 11 on sustainable cities and communities, and SDG 16 on peace, justice and strong institutions) at the local and global level, as well as the economic SDGs (SDG 8 on decent work and economic growth, SDG 9 on industry, innovation and infrastructure, SDG 10 on reduced inequalities and SDG 12 on responsible consumption and production).[74] To overcome the multiple global shocks, the UN Secretary-General has proposed the SDG Stimulus, which calls for tackling the high cost of debt and the rising risks of debt distress, massively scaling up affordable long-term financing for development, and expanding contingency financing to countries in need.[75]

The COVID-19 pandemic induced long-lasting negative impacts on urban mobility, land use and transport systems across low-, middle- and high-income countries.[76] The Sustainable Development Solutions Network analysed progress towards the SDGs and concluded that the pandemic, coupled with geopolitical conflicts, has led to significant setbacks in SDG 2 (zero hunger) and SDG 7 (affordable and clean energy). The report found a slight decrease in national performance on SDG 1 (no poverty) and SDG 8 (decent work and economic growth). Particularly poor was the national performance on SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), SDG 13 (climate action), SDG 14 (life below water) and SDG 15 (life on land).

MODULE 1 **SPOTLIGHT 3**

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Engagement of Transport Stakeholders in the United Nations Framework Convention on Climate Change Process

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

The engagement of transport stakeholders in the United Nations Framework Convention on Climate Change (UNFCCC) process refers to several different but interconnected aspects: the intergovernmental negotiations on climate change; the national strategies elaborated by countries to contribute to the implementation of the Paris Agreement, the so-called Nationally Determined Contributions (NDCs) and the international multi-stakeholder initiatives that stem from annual UN Climate Change Conferences (Conferences of the Parties, or COPs).

Over the past 30 years, intergovernmental processes on climate have helped put a focus on shifting economic systems away from 200 years of dependence on fossil fuels. The transport sector is central to such a paradigm shift. Despite the recent rapid increases in electric vehicles and renewable power globally, as well as steady increases in biofuels, fossil fuels have continued to supply nearly all of the energy demand in transport (96% in 2021).[1] This share has barely changed over the past decade, due mainly to increasing overall energy demand in the sector (see *Section 4.1 Transport Energy Sources*).[2]

Many criticisms have been raised about the intergovernmental processes on climate change and their weaknesses. These include concerns about their painstakingly slow pace, insufficient political ambition, and lack of legally binding accountability, with many critics suggesting that the negotiations are simply "greenwashing talk shows" or a "polluting world tour of a climate circus." Despite such (often legitimate) concerns, these intergovernmental processes have also helped catalyse new ways of thinking over the years that have resulted in positive impacts for people and the planet.

When the UNFCCC was signed in 1992, it triggered a wave of national legislation and policies across nearly all countries. In 1997, the Kyoto Protocol brought into the equation carbon markets and the crucial role of private sector investment. The Paris Agreement, agreed to at the 2015 UN Climate Change Conference in Paris (COP 21) drew attention to the social interventions needed to secure workers' rights and livelihoods as economies shift to paradigms of sustainability and climate action. This so-called just transition is central to the transformation of the transport sector.

At COP 21, negotiators also agreed that mobilising stronger and more ambitious climate action by all Parties, as well as by all other public and private actors, is urgently required to achieve the goals of the Paris Agreement. To that end, the 2016 UN Climate Change Conference in Marrakesh, Morocco (COP 22) gave birth to the Marrakech Partnership for Global Climate Action, which brings together stakeholders working in key sectors and themes. Transport was recognised among the key sectors to spur enhanced climate ambition and action. The SLOCAT Partnership on Sustainable, Low Carbon Transport was officially appointed as the focal point for the engagement of the transport sector and has been reappointed since. In 2021, for the first time in the history of the UN climate negotiations, a specific call was made at COP 26 for countries to reduce the use of fossil fuels.

Over the past 30 years, intergovernmental climate processes have moved the needle in numerous ways, including having a critical impact on long-term global warming. Projections of the expected average global temperature rise over the long term have been lowered from warming of as much as 4 to 6 degrees Celsius (°C) before the finalisation of the Paris Agreement, to warming of around 1.8 to 2.7 °C now, assuming that countries will implement the pledges made at the COPs.[3] Countries must not become complacent, however, as any projected warming above 1.5°C is still likely to be disastrous for people and the planet, and the need for greater action remains unquestionable and urgent.

Over the years, the transport dimension of UNFCCC processes has grown in intensity and impact, thanks to the increasing mobilisation and engagement of the global transport community in these processes (see Table 1).

TABLE 1. Key milestones of transport stakeholders' engagement in UNFCCC processes

1992

The UN Framework Convention on Climate Change (UNFCCC) was agreed on to serve as the fundamental platform for the negotiation and adoption of a series of protocols, modifications and agreements related to the Convention's mandate. It triggered a wave of national legislation and policies across countries.

1997

The Kyoto Protocol brought into the equation carbon markets and the crucial role of private sector investment. It shed light on a global, future issue (unusual at that time), resulting in growing demand and opportunities for research and initiatives for sectoral issues.

2013

The first SLOCAT Transport Day was organised in Warsaw, Poland at the fringe of COP 19. Under the theme, "Rethink Transport and Climate Change", the event brought together more than 200 stakeholders from the transport community and adopted the Warsaw Statement on Low Carbon Transport and Sustainable Development, which was endorsed by 450 individuals and 145 organisations.

2015

The Paris Agreement, agreed to at COP 21, drew attention to the social interventions needed to secure workers' rights and livelihoods as economies shift to paradigms of sustainability and climate action. This so-called just transition is central to the transformation of the transport sector.

At COP 21, negotiators called for mobilising stronger and more ambitious climate action by all Parties to the Paris Agreement, as well as by all other public and private actors.

The first UN Climate Change High-Level Champions were appointed to facilitate voluntary efforts, initiatives and coalitions.

Inspired by the call to action by UN Secretary General Ban Ki-moon at the 2014 Climate Summit, and followed up by the Lima Paris Action Agenda, 15 transport initiatives established by non-state actors in the transport sector were showcased at COP 21. The SLOCAT Partnership, on behalf of the Paris Process on Mobility and Climate, released progress reports on these transport initiatives in 2016, 2017 and 2018.

The Paris Process for Mobility and Climate (PPMC) was created to bring together the diverse ecosystems of SLOCAT and Movin'On (formerly Michelin Challenge Bibendum) – a mix of public and private sector entities – and to support their engagement at COPs.

2016

The Lima Paris Action Agenda – later renamed the Marrakech Partnership for Global Climate Action (MPGCA) was agreed to at COP 22, recognising transport as one of the thematic areas. SLOCAT was officially appointed as the focal point for the facilitation of the transport sector's engagement.

The PPMC Global Macro Roadmap, an actionable vision for decarbonised, resilient mobility by 2050 and beyond, was produced and showcased at COP 22 as a UNFCCC-endorsed "discussion document" in the context of the MPGCA, with active support from the UN Climate Change High-Level Champions.

2018

At total of 38 countries from five continents and 1,200 companies and international organisations, representing more than 1,500 cities and regions and including SLOCAT, joined the Driving Change Together: Katowice Partnership for Electromobility convened by the Polish Presidency of COP 24.

SLOCAT continued actively engaging the global transport community through SLOCAT Transport Day at COP and the co-organisation of other multistakeholder discussions, including related to the new Regional Climate Weeks.

2019

The Marrakesh Partnership (MPGCA) launched the first Global Climate Action Yearbook and the thematic Climate Action Pathways. The Transport Climate Action Pathway reflected on existing climate action initiatives and activities and recognised the progress made by non-party stakeholders. It presented a vision of a climate-resilient world compatible with the Paris Agreement goal of keeping global warming below 1.5°C and laid out concrete actions for policy making, financing, technology, businesses and civil society by 2020, 2030 and 2050.

SLOCAT was invited by the Chilean Ministry of Transport and Telecommunications to join the Transport Core Group in support of the Chilean Presidency of COP 25.

The Chilean Presidency of COP 25 planned the first-ever transport ministerial meeting at a COP, as part of its vision to direct climate change conversations to specific economic sectors. Plans did not materialise due to the movement of the COP from Chile to Madrid. However, the approach of thematic ministerial meetings at COPs was part of the Chilean Presidency's legacy, and the transport focus was resumed in 2021.

2020

COP 26 was postponed due to the COVID-19 pandemic. Scheduled to mark one year before the postponed date, En Route to COP26 was co-created and co-organised by SLOCAT and partners to empower action for zero-emission transport. The online event featured 11 sessions with a line-up of 150 speakers, attracting more than 1,000 registrations from audiences across the globe.

SLOCAT's mandate as the focal point for facilitating engagement of the transport sector in the MPGCA was renewed by direct appointment by transport sector peers, under a process conducted by the UNFCCC Secretariat.

The UN High-Level Climate Champions launched a series of thematic Race to Zero Dialogues to reflect the commitment and ambition of non-state actors to the climate process and to provide critical input to the 2020 UNFCCC Climate Dialogues in a year without a COP. The Transport Race to Zero Dialogue showcased how the MPGCA Transport Climate Action Pathway can be implemented in different regional contexts.

In its capacity as MPGCA focal point, SLOCAT facilitated a Transport Stakeholders' Task Force, which provided thought leadership on the enhancement of the MPGCA Transport Climate Action Pathway.

2021

In the Glasgow Pact agreed to at COP 26, Parties coalesced on a historic call to "phase down unabated coal power and phase out inefficient fossil fuel subsidies".

An unprecedented number of commitments and initiatives on sustainable, low carbon transport were launched at COP 26, reflecting the increasing attention to transport at COPs over the years. These included:

- the Breakthrough Agenda: Road Transport, an unprecedented international clean technology plan to help keep the 1.5°C goal in reach, with the aim of establishing zero emission vehicles as the new normal and accessible, affordable and sustainable vehicles in all regions by 2030;
- the International Aviation Climate Ambition Coalition, established by the UK Presidency of COP 26 to support ambitious action on international aviation emissions, including a new global goal and promotion of cleaner fuels and technologies;
- the Clydebank Declaration for Green Shipping Corridors, established by the UK Presidency of COP 26 to put the maritime sector on track to achieve net zero emissions by 2050;
- the Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans, established by the UK Presidency of COP 26 to work towards all sales of new cars and vans being zero emission globally by 2040, and by no later than 2035 in leading markets;
- the COP26 Cycling Letter, issued by the European Cyclists' Federation, a global coalition of more 60 pro-cycling organisations, to boost cycling levels to reduce carbon emissions and reach global climate goals quickly and effectively;
- the Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles, established by CALSTART's Global Commercial Vehicle Drive to Zero program and campaign, to work towards three goals: 1) enabling 100% zero-emission new truck and bus sales by 2040; 2) achieving 30% zero-emission vehicle sales by 2030; and 3) achieving net zero carbon emissions by 2050;
- the Call to Action: Charge Forward to Zero Emissions Transportation by the Transport Decarbonisation Alliance, which aims to accelerate electric vehicle charging infrastructure;
- the Zero Emission Bus Rapid-deployment Accelerator (ZEBRA) Partnership, established by C40 and the International Council on Clean Transportation to accelerate the deployment of zero-emission buses in major Latin American cities; and
- the Beyond Oil and Gas Alliance (BOGA) Declaration, established by Denmark and Costa Rica to promote the phase-out of oil and gas production in international climate dialogues and create an international community of practice.

The UK Presidency of COP 26 established the Zero Emission Vehicles Transition Council as the world's first political forum to discuss how to accelerate the global transition to zero-emission vehicles. The forum consisted 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.

The SLOCAT Secretariat was invited by the UK Presidency of COP 26 to facilitate the Knowledge Sharing and Signposting Working Group under the Zero-Emission Vehicles International Assistance Taskforce of the ZEV Transition Council.

The Just Energy Transition Partnerships were launched as a new mechanism to help emerging economies accelerate the shift from fossil fuels to clean energy sources, including a USD 700 million agreement to support the development of climate-conscious transport infrastructure in five Indonesian provinces.

(For more information, see the SLOCAT COP26 Outcomes for Sustainable, Low Carbon Transport, which provides an analysis of COP 26 outcomes from a transport and mobility lens. Events that SLOCAT helped organise at COP 26 can be found on this Trello board.)

2022

The COP 27 Sharm el-Sheikh Implementation Plan made unprecedented reference to loss and damage and called for broad financial system reform. However, it failed to strengthen ambition toward the 1.5°C goal and fossil fuel phase-out, which are central to transport decarbonisation.

The First Global Stocktake was convened to assess the world's collective progress in achieving the Paris Agreement. Two meetings of the Technical Dialogue were conducted at the Bonn Climate Change Conference in June and at COP 27 in November, with the final meeting taking place in June 2023 (see SLOCAT engagement and submissions to the First Global Stocktake).

The Independent Global Stocktake (iGST) was established as a coalition of civil society analysts and advocates providing technical capacity and expertise to help the UNFCCC create a more robust global stocktake. At COP 27, the iGST joined forces with the Climate Action Network (CAN) to co-ordinate the informal global stocktake process on behalf of civil society actors.

On 17 November, the Egyptian Presidency of COP 27 convened the first-ever Ministerial Meeting on Urbanisation and Climate Change, focusing on housing, urban development and multi-level action in relation to climate change.

Several new international multi-stakeholder initiatives on transport were launched at COP 27, including:

- The COP27 Presidency flagship initiative Low Carbon Transport for Urban Sustainability (LOTUS), which aims to activate systemic change to improve and decarbonise the urban mobility landscape, responding to the urgent need and willingness to move away from the legacy "mode-first" mindset. LOTUS was developed in a collaborative multi-stakeholder consultation process under the leadership of Egypt, jointly facilitated by the SLOCAT Secretariat and Boston Consulting Group.
- The PATH (Partnership for Active Travel and Health) Letter to Governments and Cities was issued, calling for greater investment in walking and cycling to achieve climate goals and improve people's lives.
- The Transport Decarbonisation Alliance's Call to Support Active Mobility Capacity Building calls on all UNFCCC Parties and global financial institutions to invest $100 million in the training of 10,000 mobility professionals in the planning, design, operations, and promotion of walking and cycling.
- The COP27 Global Commitment to Strengthening International Assistance for Emerging Markets and Developing Economies in the Road Transport Sector was endorsed by Germany, Japan, the Netherlands, the Republic of Korea, Sweden, the United Kingdom and the United States.
- Developments related to the commitments and initiatives launched at COP 26 in 2021 included:
- The Global Memorandum of Understanding on Zero Emission Medium- and Heavy-Duty Vehicles (MHDV), signed by 12 additional countries to reach 27 signatories.
- The Accelerating to Zero Coalition (A2Z), originally launched at COP 26 as the Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans, reached more than 220 signatories, including 40 country signatories.

The SLOCAT Transport Day at COP27 was focused on enabling meaningful investment across walking, cycling and public transport towards a transformative systemic shift in mobility. The event attracted nearly 100 in-person and online participants and a line-up of world-class experts to curate a multi-stakeholder trust space for peers in the transport community and beyond to exchange, learn from each other and collaborate.

(For more information, see the SLOCAT COP27 Outcomes for Sustainable, Low Carbon Transport, which provides an analysis of COP 27 outcomes from a transport and mobility lens. Events that SLOCAT helped organise at COP27 can be found on this Trello board.)

Transport ambition in national climate strategies in the framework of the Paris Agreement

Positive opportunities have emerged in the ways that countries address transport in their so-called Nationally Determined Contributions (NDCs), or the national strategies that they develop to contribute to global emission reductions and the implementation of the Paris Agreement.

Of the second-generation NDCs submitted as of 2022, 23 (or 16%) had a target for mitigating greenhouse gas emissions from transport, mostly for countries in Europe and Africa and for the year 2030 (see Figure 1).[4] On average, the second-generation NDCs included more transport mitigation and adaptation actions than the first generation of NDCs. Each second-generation NDC featured nearly twice as many transport mitigation actions, as well as twice as many transport targets (109 targets total in 64 NDCs), compared to the first-generation NDCs.[5] Adaptation in transport is still neglected, as few second-generation NDCs feature adaptation targets and actions. In both generations of NDCs, freight-related actions are barely mentioned (see *Section 1.3.1. Transport in National Climate and Sustainability Strategies to Achieve the Targets of the Paris Agreement and SDGs*).

SLOCAT analysis of the transport greenhouse gas mitigation targets in the second-generation NDCs shows that while the growth in transport carbon dioxide (CO_2) emissions will slow, overall emissions will not be reduced in absolute terms, due to the shortfall in NDC ambitions.[6] The main reason is that many transport greenhouse gas mitigation targets in the second-generation NDCs are set against business-as-usual growth. Rather than reducing absolute transport CO_2 emissions, this just results in less growth than under business-as-usual projections (see Figure 2).[7]

Global Stocktake

The global stocktake was established as a central element of the Paris Agreement and is intended to take a "temperature check" of progress on a five-year cycle. It is a key element of the ratchet mechanism, which is intended to incrementally raise ambition on mitigation, adaptation and means of implementation to meet Paris Agreement targets. The first global stocktake operates on a two-year cycle, consisting of an 18-month technical phase that kicked off in 2022, to be followed by a political phase in 2023.

The **First Technical Dialogue** (TD 1.1) of the First Global Stocktake took place at the Bonn Climate Change Conference (SB56) in June 2022. SLOCAT delivered transport-focused technical interventions at the TD 1.1 Roundtable 3, focusing on broadening shared electric mobility, expanding capacity building and phasing out fossil fuel subsidies to fill the financing gap.

The **Second Technical Dialogue** (TD 1.2) took place at COP 27 in November 2022, with transport issues being addressed in the "systems transformations" segment. The policy of inclusion of non-party stakeholders in these dialogues also allowed for the participation of fossil fuel lobbyists, which resulted in amplified calls to include strategies such as carbon capture and storage in outcome documents. These strategies are seen by many experts as a "false solution" to meeting Paris Agreement targets.

The **Third Technical Dialogue** (TD 1.3) took place at the Bonn Climate Change Conference (SB58) in June 2023 and allowed stakeholders to provide vital inputs to improve understanding of global efforts and priority actions towards sustainable, low carbon transport. Equity between recent and historic emissions continued to be a source of division among Parties during the discussions. Several Parties focused on technology and carbon capture and storage as a means to delay a fossil fuel phase-down/phase-out. A proposal was made for a Technical Annex to the global stocktake outcome to include regional and sectoral guidance towards more actionable outcomes. Although the proposal faced opposition from some Parties, SLOCAT advocates for such an Annex as it can enhance the substantive outcomes of the process and it supports more ambitious NDCs in 2025.

SLOCAT submissions to the First Global Stocktake: Input to TD 1.1 | Interventions at Technical Dialogue 1.1 | Input to TD 1.3 | National Urban Mobility Policies and Investment Programmes in support of Climate Commitments in Latin America and the Caribbean I Voces de América Latina y el Caribe sobre Acción Climática en el Transporte

With the process of the official global stocktake still taking shape and its impact yet to be determined, a complementary avenue to take stock has been established in the **Independent Global Stocktake** (**iGST**). Established in 2020 and endorsed by former UNFCCC Executive Secretary Christina Figueres, the iGST consists of a coalition of civil society analysts and advocates aiming to provide

technical capacity and expertise to help the UNFCCC create a more robust global stocktake that empowers countries to accelerate climate action.

The next Global Stocktake Synthesis Report is expected to be released in September 2023, with a workshop in October 2023 to frame the transition from the technical to the political phase of the dialogue. The United Arab Emirates Presidency of COP 28 has identified the global stocktake as a key priority. As countries continue to prepare for the next round of NDC submissions in 2025, the global stocktake will contribute to keep the Paris Agreement target alive.

Mitigation Work Programme

Parties established the **Mitigation Work Programme** (**MWP**) at COP 26 to "urgently scale up mitigation ambition and implementation" to help reach the Paris Agreement's 1.5°C goal. At COP 27, Parties further fleshed out the MWP, to be operationalised between 2023-2026 through at least two annual global dialogues and investment-focused events.[8] SLOCAT participated in the First MWP Global Dialogue at SB56 in June 2023 and submitted input on the critical challenges and opportunities in the transport sector, through the lens of a just energy transition.

Multi-stakeholder initiatives

The discussions and partnering spaces that occur outside the formal intergovernmental negotiations of a COP are setting agendas and sending market signals in clearer and faster ways than the formal negotiations. This is where the initiatives spearheaded by COP presidencies, countries, international organisations and non-governmental organisations around coalitions of the willing fit.

Over the years, there has been a substantial increase in the number and size of international multi-stakeholder initiatives stemming from or being launched on the occasion of the UN annual COPs. These initiatives recognise that transport is not only about negative climate impacts but also about access to socio-economic opportunities.

A panoply of multi-stakeholder transport initiatives began to emerge at **COP 21 in 2015.** Inspired by the call to action by UN Secretary General Ban Ki-moon at the 2014 Climate Summit and followed up by the Lima Paris Action Agenda (LPAA), 15 transport initiatives established by non-state actors in the transport sector were showcased at COP 21.[i] At COP 22, the action agenda was renamed the Marrakech Partnership for Global Climate Action (MPGCA), and 11 more transport initiatives joined the initial core group of transport initiatives to engage in the UNFCCC via the MPGCA, covering both passenger and freight transport and touching on all transport sectors and modes. Together, these transport initiatives represented a broad range of multi-stakeholder coalitions for transport mitigation and adaptation; demonstrated on-the-ground transport actions that yield significant climate and sustainability impacts; and helped to scale up the ambition of NDCs in the sector.

> SLOCAT, on behalf of the Paris Process on Mobility and Climate, released progress reports on these transport initiatives in 2016, 2017 and 2018. An overview of the transport initiatives was included in the official Transport Climate Action Pathway released by the MPGCA in 2019.

In **2018,** the Polish Presidency of **COP 24** launched the Driving Change Together: Katowice Partnership for Electromobility, a dedicated framework for encouraging technological and organisational changes in the sector to further develop zero-emission transport.[9] By the end of 2018, 38 countries from five continents and 1,200 companies and international organisations, representing more than 1,500 cities and regions, joined the partnership.[10]

At **COP 26 in 2021**, stakeholders launched an unprecedented number of commitments and initiatives on sustainable, low carbon transport, several of which have since expanded in scope and/or signatories (see *Section 1.3.1. Transport in National Climate and Sustainability Strategies to Achieve the Targets of the Paris Agreement and SDGs*). Both the International Aviation Climate Ambition Coalition and the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles have gained a substantial number of new country signatories, whereas few new countries have joined the commitments on zero-emission vehicles and green shipping corridors.

Nonetheless, the commitments and initiatives launched at COP 26 presented a notable lack of emphasis on the central role of public transport and walking and cycling (the main mobility modes for billions of people worldwide) in decarbonising transport and building more equitable

i SLOCAT, on behalf of the Paris Process on Mobility and Climate, released progress reports on the transport initiatives in 2018, 2017 and 2016.

societies. Remarks recognising the need to support holistic approaches to transport systems, including active travel, public transport, and shared mobility, were added at the last minute to the Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans, which was led by the UK Presidency of COP 26.

At **COP 27 in 2023**, multi-stakeholder initiatives featured an unprecedented emphasis on the central role of public transport, walking and cycling in decarbonising transport and building more equitable societies:

- As part of its 14 flagship initiatives, the Egyptian Presidency of COP 27 launched the Low Carbon Transport for Urban Sustainability (LOTUS) initiative, which aims to activate systemic change to improve and decarbonise the urban mobility landscape. Responding to the urgent need and willingness to move away from the legacy "mode-first" mindset, this approach seeks to allow existing efforts to be scaled and replicated across modes and geographies.
- The Partnership for Active Travel and Health (PATH) appealed to national and city governments to commit to prioritising investment in walking and cycling. PATH's campaign at COP 27 led to the letter to governments being signed by more than 400 civil society organisations from around the world.
- The Transport Decarbonization Alliance (TDA) called on all UNFCCC Parties and global financial institutions to invest USD 100 million to train 10,000 mobility professionals in the planning, design, operations and promotion of walking and cycling through its Call to Support Active Mobility Capacity Building.

In addition, countries, ports and companies made more than 40 announcements under the Green Shipping Challenge at COP 27, including commitments to establish green shipping corridors from the Netherlands with Norway, the United Kingdom and the United States.

These international multi-stakeholder initiatives stemming from annual climate summits demonstrate the increased attention to transport at COPs over the years, recognising that transport can reduce negative climate impacts and increase access to economic opportunities.

OPPORTUNITIES FOR TRANSPORT STAKEHOLDERS AT COP 28

1. **Thematic priority**

- The United Arab Emirates Presidency of COP 28 has identified the transport-energy nexus as its thematic priority for the transport sector. Upon request by the Presidency, the conversation opener Advancing the Energy and Transport Transitions with Railways, Public Transport and Active Mobility: A Land Transport Perspective was prepared, using the Avoid-Shift-Improve framework as a foundation and outlining key elements for mutually reinforcing transport and energy transitions. The paper was produced by a partnership of organisations, including the SLOCAT Secretariat, the International Union of Railways (UIC), the International Association of Public Transport (UITP), and the Renewable Energy Policy Network for the 21st Century (REN21), with contributions from the Institute for Sustainable Development and International Relations (IDDRI), the Institute for Transportation and Development Policy (ITDP), the International Transport Forum (ITF) and the World Resources Institute (WRI)..

2. **Official thematic day and other events**

- In addition to an official COP 28 thematic transport day scheduled for 6 December 2023, several other transport gatherings are expected at COP 28, including the annual Transport Action Event and Implementation Labs of the Marrakech Partnership for Global Climate Action (MPGCA). See the COP 28 Official Programme.

3. **Marrakech Partnership for Global Climate Action**

- The MPGCA is producing a sectoral Solutions Pathway, as well as mobilising stakeholders in the Sharm El-Sheikh Adaptation Agenda (SAA) , launched at COP 27. Transport stakeholders have been invited to engage in supporting progress on the SAA related to the resilience of infrastructure systems.

Information on SLOCAT's activities at COP 28, as well as SLOCAT's traditional tracker of transport events at COP, will be available during the event at www.slocat.net/cop28. Queries can be sent to secretariat@slocatpartnership.org.

MODULE 1 | 1.3.2

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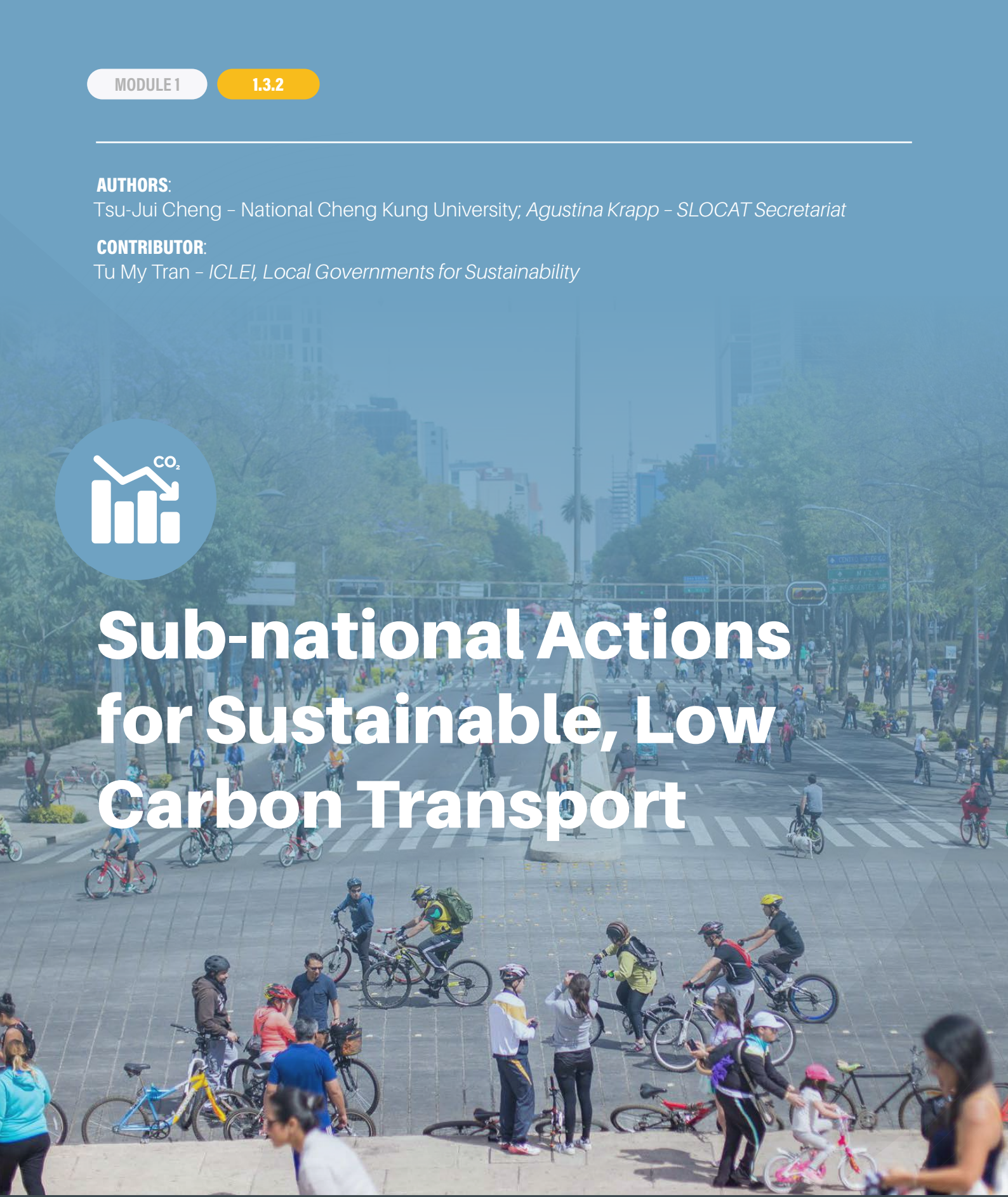
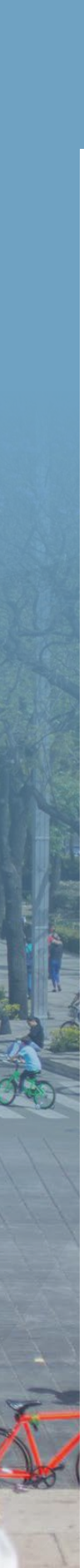


Sub-national Actions for Sustainable, Low Carbon Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition



Key findings

Demand trends

- Cities exhibit a wide range of urban transport profiles, with modal shares varying greatly across locations.
- A 2021 study on 25 major cities worldwide found that London (UK), Madrid (Spain) and Paris (France) were the top cities for transport availability – boasting extensive railway connections, well-developed road networks, and ample cycling lanes and pedestrian infrastructure.
- The COVID-19 pandemic presented both threats and opportunities for sustainable transport and mobility in cities.

Emission trends

- Urban transport accounted for 8% of global carbon dioxide (CO_2) emissions and around 40% of global transport emissions in 2020. In the absence of interventions, motorised mobility in cities could surge 94% between 2015 and 2050.
- Transport emissions in cities rebounded after pandemic-related mobility restrictions were removed.
- Urban passenger transport remains the largest source of CO_2 emissions and pollutants in the transport sector, although these emissions vary widely by city and region. Across most cities, urban transport contributes between 20% and 60% of the total CO_2 emissions.
- Cities in Europe, North America and Oceania had the highest per capita greenhouse gas emissions from 1960 to 2012, ranging between 10 and 25 tonnes of CO_2 equivalent, two to five times the levels in Asian and African cities.
- Urban freight transport contributed 25% of transport-related CO_2 emissions and accounted for 30-50% of other transport-related pollutants in 2015.

Policy developments

- To tackle urban emissions, more sub-national governments are declaring commitments to net zero greenhouse gas emissions and/or unveiling sustainable development plans.
- As of April 2023, 1,148 cities were participating in the Race To Zero campaign, launched in 2020 to drive net zero commitments prior to the 2021 United Nations (UN) Climate Change Conference in Glasgow, United Kingdom (COP 26). Around 80% of sub-national governments that had joined the campaign had yet to set a net zero target as of 2023. Less than 1% of cities and 4% of regions had implemented legally binding targets, and around 9% of cities and regions had included net zero targets in their policy documents. However, there is a disparity among sub-national governments in their commitments to net zero targets.
- An estimated 65% of the UN Sustainable Development Goals (SDGs) will not be achieved unless sub-national governments are fully and equitably involved in implementation. Localising implementation of the SDGs is crucial to raise awareness and to accelerate engagement and commitment via a bottom-up approach.
- Transport is a central element reported in the 153 Voluntary Local Reviews (VLRs) submitted by sub-national governments between 2021 and April 2023; however, specific transport targets are not commonly mentioned.
- Several cities have reported in their VLRs comprehensive transport strategies that encompass mobility and transport planning. Across these VLRs, all cities emphasise the importance of public transport and active mobility in achieving climate action, equity, safety and resilience.
- When comparing the sub-national net zero targets with the VLRs, it becomes apparent that the complex and fragmented nature of the transport sector, with its multi-level delivery structure, poses challenges in establishing measurable targets.
- Alignment between national net zero targets (such as those included in Nationally Determined Contributions under the Paris Agreement) and sub-national net zero commitments, as well as VLRs, is currently not evident.
- The use of sustainable urban mobility plans (SUMPs), initially introduced in Europe, has since expanded to cities in various regions worldwide.

- Sub-national transport policies and investments have placed increased focus on active mobility and public transport, serving as "pull" or "carrot" approaches to encourage the adoption of zero- and low-emission transport modes.
- A growing number of cities have made available free or affordable public transport locally as a means to alleviate national economic crises (such as inflation) and to shift trips from private vehicles to public transport.
- Sub-national policy makers, particularly in Europe, also have embraced "push" or "stick" approaches – such as parking management and congestion charging – to alleviate congestion and redistribute urban space.
- Many urban areas have adopted and piloted access regulations, zero-emission zones and clear air zones to reduce emissions and improve air quality. A number of cities have established specific zero-emission zones for freight transport (ZEZ-Fs), ranging from urban delivery vans to medium- and heavy-duty trucks.
- There is growing momentum for sub-national governments to electrify bus fleets as a way to enhance the energy efficiency of public transport and car-sharing fleets.

Overview

Sub-national governments include all public authorities that are under the authority of a national government – such as municipalities, states, regions, provinces, counties and districts.[1] Sub-national governments are crucial in driving climate action and sustainability in the transport sector, mainly through implementing policies related to public transport, active mobility, transit-oriented development, parking regulation and access management (for example, through low- and zero-emission zones). Sub-national governments are fundamental to achieving national goals and turning national ambition into on-the-ground action.[2] As such, they can provide valuable insights and experience in implementing measures and empowering other actors.[3]

As of 2020, cities hosted more than half of the world's population and contributed 80% of the global gross domestic product (GDP); they also consumed more than two-thirds of the world's energy and contributed more than 70% of global carbon emissions.[4] The transport sector contributes nearly a quarter (23%) of global energy-related emissions, and urban transport accounts for 40% of these, of which three-quarters are released by private vehicles.[5] The share of the world's population living in cities is expected to rise to 80% by 2050, with associated growth in urban populations, economic activity and transport demand.[6]

Urban energy consumption and emissions are projected to increase as well, making cities central to achieving sustainable, low carbon transport systems worldwide. The high density and spatial concentration of urban populations and socio-economic activities allow for economies of scale, offering great potential to reduce the costs of infrastructure and services and to leverage more efficient and equitable transport modes such as walking, cycling and public transport.[7]

In general, alignment is lacking between national and sub-national targets for achieving net zero greenhouse gas emissions. However, some sub-national governments have implemented urban mobility plans or strategies to achieve sustainability impacts beyond the reduction of carbon emissions, many of which may be more tangible to citizens. These include air quality improvement, noise pollution reduction, road safety, mobility management and less congestion. Despite this, sub-national actors often face challenges in planning and implementing sustainable mobility measures; challenges include high population growth and urbanisation rates, limited decision making power, funding constraints, limited technical expertise and the ongoing impacts of the COVID-19 pandemic.

To overcome these challenges, regional and national governments around the world have developed a range of supportive policies. Additionally, global initiatives are bringing together sub-national actors and non-governmental stakeholders to facilitate peer exchanges, capacity building, technical support and access to financing. Increasingly, sub-national governments are deploying stronger regulations, economic incentives and infrastructure investments to promote sustainable transport modes.

Context and key challenges

Sub-national governments are crucial in driving climate action and sustainability in the transport sector. As such, they are fundamental to achieving national goals and turning national ambition into action. Key measures include policies related to public transport, active mobility, transit-oriented development, parking regulation and access management (e.g., low- and zero-emission zones). However, sub-national actors have differing degrees of decision making power depending on their autonomy, mandate and scope of responsibility. This may limit the elaboration and implementation of transport policies and plans due to a lack of co-ordination, funding, technical capacity, and political will, such challenges tend to be more pronounced in low- and middle-income countries.[8]

Population growth

With the global population projected to reach 9.7 billion by 2050, the demand for mobility is set to increase.[9] However, population growth will be uneven, expanding in some regions while stabilising or declining in others. By 2037, Central and Southern Asia is expected to become the most populous region, and by 2050 the population of Sub-Saharan Africa is projected to nearly double, contributing more than half of the total population growth.[10] In 2023, 30 out of the 34 megacities with populations above 10 million were in Asia, Latin America and Africa, and by 2030 the number of megacities is expected to increase to 43 worldwide.[11]

Funding constraints

Implementing sustainable mobility measures in developing cities requires substantial investments, but often the available funding is insufficient. For example, inadequate revenue collection from the users of transport systems can lead to a reliance on subsidies. Additionally, budget allocations tend to favour the expansion of road infrastructure, benefiting car owners and perpetuating car-centric transport. The minimal contributions from car users towards infrastructure investments further exacerbate the funding challenge.[14]

Differences among sub-national governments

Sub-national governments that have greater autonomy also have more flexibility in implementing sustainable mobility measures. In contrast, those with limited autonomy rely heavily on national support to develop and execute plans towards net zero emissions.[12] Relationships between sub-national and national governments can vary greatly depending on factors such as constitutional arrangements, party politics, competitive dynamics and the willingness to collaborate.[13]

Limited technical expertise

Access to capacity development programmes is essential to promote sustainable urban mobility and ensure inclusive development. Sub-national governments may lack the technical knowledge and capacity to plan and implement sustainable mobility measures. In many cases, as sub-national governments in high-income countries advance various efforts to decarbonise transport, their counterparts in low- and middle-income countries are facing challenges simply co-ordinating transport-specific policies and plans, let alone ensuring effective implementation and sustainability measures.[15] (*See Spotlight 6. Capacity and Institutional Support to Achieve Sustainable, Low Carbon Transport*).

Demand trends

Cities exhibit a wide range of urban transport profiles, with modal shares varying greatly across locations.

- In Tshwane and Cape Town (South Africa) and Auckland (New Zealand), private cars accounted for more than 80% of trips as of 2022.[16]
- Zurich (Switzerland) and Tokyo (Japan) have the highest shares of public transport, at 35% and 28%, respectively.[17]
- Dar es Salaam (Tanzania) and Kinshasa (Democratic Republic of the Congo) rely heavily on walking as the primary transport mode, representing two-thirds of all trips.[18]
- Cycling represents a high share of trips in Amsterdam (Netherlands), at 28.7%, and Osaka (Japan), at 28.4%.[19]
- In some cities in Sub-Saharan Africa, informal transport (such as Dakar (Senegal) and Dar es-Salaam (Tanzania)) accounts for up to 95% of all trips.[20]

A 2021 study on 25 major cities worldwide found that London (UK), Madrid (Spain) and Paris (France) were the top cities for transport availability – boasting extensive railway connections, well-developed road networks, and ample cycling lanes and pedestrian infrastructure.[21]

- However, in a 2018 study on the average cost for public transport (bus, tram or metro), London had the highest costs (USD 5.66), followed by Stockholm (Sweden) (USD 5.43), Copenhagen (Denmark) (USD 4.64) and Oslo (Norway) (USD 4.49).[22]
- Cities with the lowest average costs were Cairo (Egypt) (USD 0.11), followed by Kyiv (Ukraine) (USD 0.18), Mumbai (India) (USD 0.23), Jakarta (India) (USD 0.26) and Mexico City (USD 0.29).[23]
- A few cities, including Valletta (Malta), Luxembourg City, and Tallinn (Estonia), offered free public transport options as of 2023 (*see Section 3.1 Integrated Transport Planning*).[24]

The COVID-19 pandemic presented both threats and opportunities for sustainable transport and mobility in cities. By 2021, congestion had returned to pre-pandemic levels in many cities, and in some places it worsened.[25]

- In 2020, all of the top ten cities for pre-pandemic metro ridership experienced at least a 27% drop in ridership: Tokyo (Japan), Moscow (Russian Federation), Shanghai (China), Beijing (China), Seoul (Republic of Korea), Guangzhou (China), Delhi (India), New York City (USA), Mexico City and Hong Kong (China).[26]
- By 2022, traffic delays exceeded pre-pandemic levels in 39% of US urban areas and 42% of European urban areas.[27]
- The pandemic fast-tracked the cycling agenda by presenting an opportunity to rapidly construct pop-up bike lanes, which contributed to 11-48% more cycling in 106 European cities during March to July 2020.[28]

Emission trends

Urban transport accounted for 8% of global carbon dioxide (CO^2) emissions and around 40% of global transport emissions in 2020.[29] **In the absence of interventions, motorised mobility in cities could surge 94% between 2015 and 2050.**[30]

CO_2 emissions from transport grew nearly 2% annually on average between 2010 and 2019, faster than from any other end-use sector globally.[31] Transport CO_2 emissions fell 13% in 2020 due to the impacts of the COVID-19 pandemic, then jumped 7% in 2021 as mobility restrictions were lifted.[32] (*For more on emission trends, see Section 1.1 Transforming Transport and Mobility to Achieve the Targets of the Paris Agreement and the Sustainable Development Goals).*

Transport emissions in cities rebounded after pandemic-related mobility restrictions were removed. According to Google Environmental Insights Explorer, as of 2022 public transport trips globally had not yet returned to 2019 levels, whereas private vehicle trips had increased.[33]

Urban passenger transport remains the largest source of CO_2 emissions and pollutants in the transport sector, although these emissions vary widely by city and region.[34] **Across most cities, urban transport contributes between 20% and 60% of the total CO_2 emissions.** [35]

- According to C40, a third of the total urban greenhouse gas emissions in some major cities worldwide come from transport.[36]
- In some cities in Latin America and the Caribbean (LAC) region, such as Guadalajala (Mexico), São Paulo (Brazil) and Quito (Ecuador), the share of transport CO_2 emissions exceeds 60%, due mainly to higher levels of urbanisation and motorisation.[37]
- In cities in low- and middle- income countries, the shares of transport CO_2 emissions are relatively, lower, although these emissions are growing rapidly, driven by economic development.[38]

Cities in Europe, North America and Oceania had the highest per capita greenhouse gas emissions from 1960 to 2012, ranging between 10 and 25 tonnes of CO_2 equivalent, two to five times the levels in Asian and African cities.[39] Cities in Asia and Africa had per capita emissions below 5 tonnes of CO_2 equivalent per capita.[40]

Urban freight transport contributed 25% of transport-related CO_2 emissions and accounted for 30-50% of other transport-related pollutants in 2015.[41]

Policy developments

To tackle urban emissions, more sub-national governments are declaring commitments to net zero greenhouse gas emissions and/or unveiling sustainable development plans. These commitments highlight the significance of climate change on their political agenda. Local sustainable development plans underscore the importance of sustainable mobility strategies as a key component of actions at the sub-national level.

As of April 2023, 1,148 cities were participating in the Race To Zero campaign, launched in 2020 to drive net zero commitments prior to the 2021 United Nations (UN) Climate Change Conference in Glasgow, United Kingdom (COP 26).[42] These include 482 cities from Western Europe, 406 from Latin America and the Caribbean, 182 from Asia-Pacific, 43 from Eastern Europe, and 32 from Africa, among others.[43] These cities adhere to the "Starting Line" criteria, which entails "Pledge, Plan, Proceed, Publish and Persuade."[44]

Around 80% of sub-national governments that had joined the Race To Zero campaign had yet to set a net zero target as of 2023.[45] **Less than 1% of cities and 4% of regions had implemented legally binding targets, and around 9% of cities and regions had included net zero targets in their policy documents.**[46]

As of June 2023, the Net Zero Tracker – which evaluates the net zero targets established by Parties to the UN Framework Convention on Climate Change, by other regions and territories, and by cities with populations exceeding 500,000 – revealed that 146 out of 709 regions and 252 out of 1,186 cities had included net zero commitments or similar objectives in their policy documents (see Figures 1 and 2).[47]

However, there is a disparity among sub-national governments in their commitments to net zero targets. For example, as of June 2023 none of the 138 regions in Western and Central Asia had set net zero targets, and Europe had 152 regions without net zero targets (see Figure 3).[48] At the city level, most cities in Africa, East Asia, South Asia, and Western and Central Asia (in the range of 84% to 92% of cities) had yet to establish net zero targets (see Figure 4).[49] In general, information is lacking about how transport decarbonisation is reflected in these commitments.

An estimated 65% of the UN Sustainable Development Goals (SDGs) will not be achieved unless sub-national governments are fully and equitably involved in implementation.[50] **Localising implementation of the SDGs is crucial to raise awareness and to accelerate engagement and commitment via a bottom-up approach.**[51] The 2030 Agenda for Sustainable Development and its 17 SDGs provide an opportunity and platform for sub-national governments to highlight their contributions to achieve the SDGs through the submission of Voluntary Local Reviews (VLRs).[52]

Transport is a central element reported in the 153 VLRs submitted by sub-national governments between 2021 and April 2023; however, specific transport targets are not commonly mentioned.[53] Amsterdam (Netherlands) stands out for its active efforts to achieve emission-free traffic within the

FIGURE 1. Number of regions committing to net zero targets, as of June 2023

Source: See endnote 48 for this section.

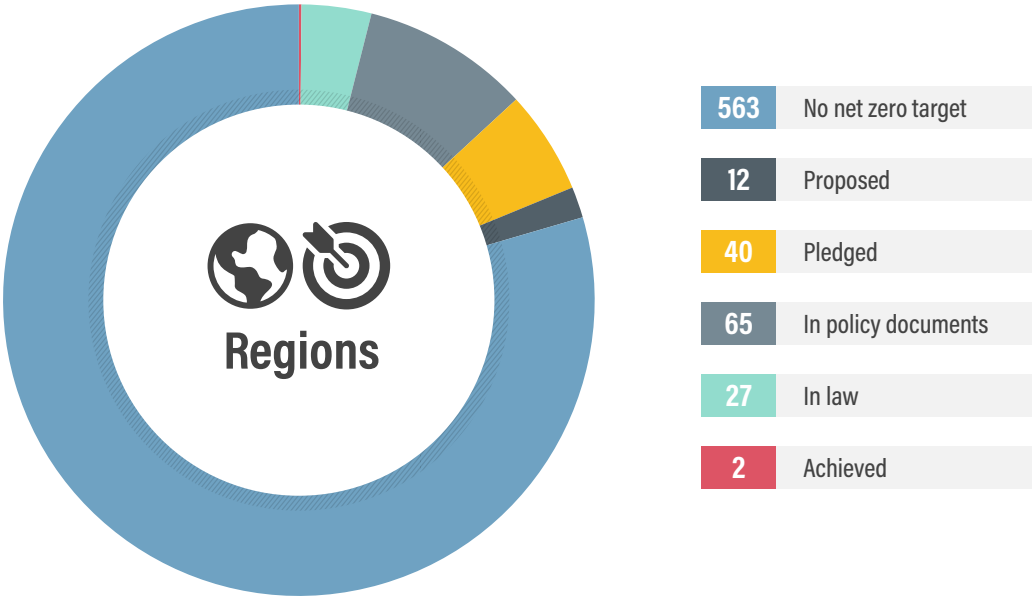
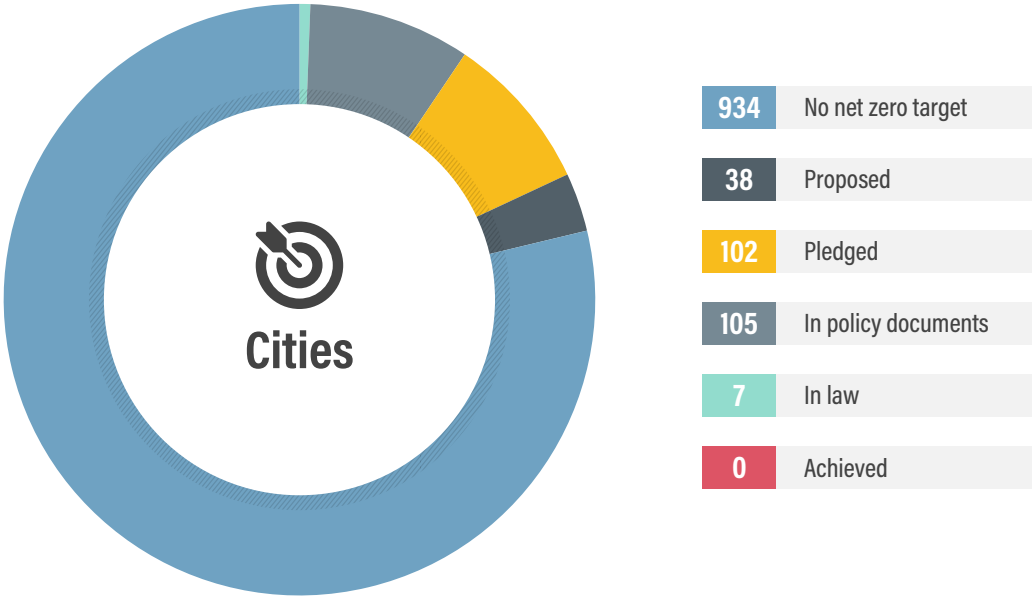


FIGURE 2. Number of cities committing to net zero targets, as of June 2023

Source: See endnote 48 for this section.



city by 2030, with the aim of staying within the World Health Organization's threshold for average annual concentrations of particulate matter (PM_{10} and $PM_{2.5}$).[54] Helsinki's VLR highlights the significant challenges in mitigating urban transport emissions, indicating that city-wide carbon neutrality targets in 2030 will not be met under the current climate actions.[55]

Several cities have reported in their VLRs comprehensive transport strategies that encompass mobility and transport planning. Across these VLRs, all cities emphasise the importance of public transport and active mobility in achieving climate action, equity, safety and resilience. Noteworthy examples include the urban mobility plans or strategies implemented in Barcelona (Spain), Malmö (Sweden), Melbourne (Australia), Tampere (Finland), and Winnipeg (Canada), as well as in the German cities of Bonn, Dortmund, Dusseldorf and Kiel. Other examples are the plans established in cities in the State of Pará (Brazil) and in the Lombardy Region (Italy), as well as the Sustainable Mobility Bill for the Basque Country (Spain).

The VLRs show that sustainable mobility offers benefits that are often more tangible to citizens than reducing carbon emissions. These include improved air quality, reduced noise pollution, enhanced road safety, and increased accessibility, among others. Even sub-national governments that do not explicitly reference urban mobility plans in their VLRs consistently recognise the significance of active mobility and public transport and the integration of sustainable mobility within regional and municipal urban planning as vital measures for environmental and social sustainability.

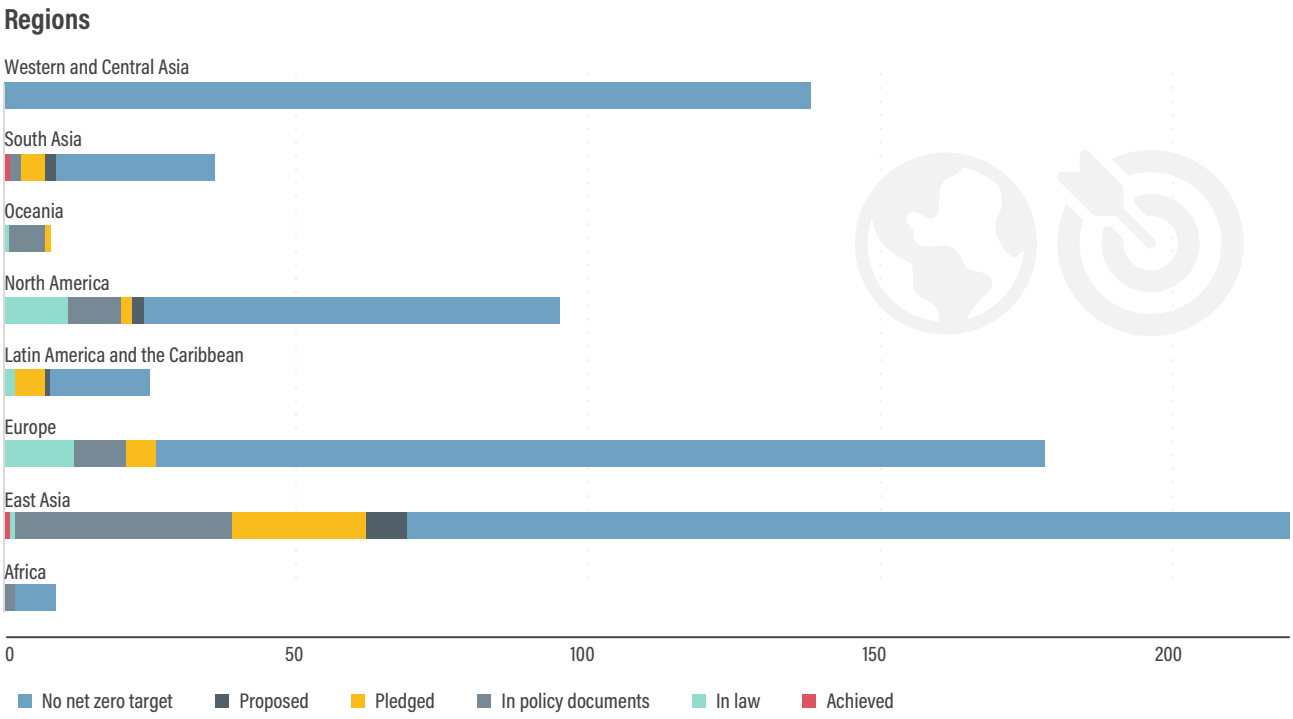
When comparing the sub-national net zero targets with the VLRs, it becomes apparent that the complex and fragmented nature of the transport sector, with its multi-level delivery structure, poses challenges in establishing measurable targets.[56] These challenges impede the capacity of sub-national governments to commit effectively to net zero targets and to adopt measures that can address the rising demand for urban mobility while minimising environmental impacts and promoting sustainable development.

Alignment between national net zero targets (such as those included in Nationally Determined Contributions under the Paris Agreement) and sub-national net zero commitments, as well as VLRs, is currently not evident.[57] Nonetheless, sub-national governments are in a favourable position to enhance climate actions vertically across different levels of government and horizontally across cities.[58] Various planning tools, case studies, precedents, and political and financial instruments are available or have been developed to facilitate sustainable transport options. Despite the lack of specific targets in the urban transport sector, sub-national governments have taken steps to address transport challenges that directly or indirectly contribute to reducing emissions.

National governments worldwide have recently developed policy frameworks and guidelines, such as national urban mobility policies and investment programmes (NUMPs), to help sub-national governments plan and implement sustainable urban mobility strategies.[59]

FIGURE 3. Number of regions committing to net zero targets, as of June 2023

Source: See endnote 49 for this section.



The use of sustainable urban mobility plans (SUMPs), initially introduced in Europe, has since expanded to cities in various regions worldwide. The aim of SUMPs is to meet the mobility needs of people and businesses in urban areas and their surroundings for a better quality of life (*see Section 3.1 Integrated Transport Planning*).

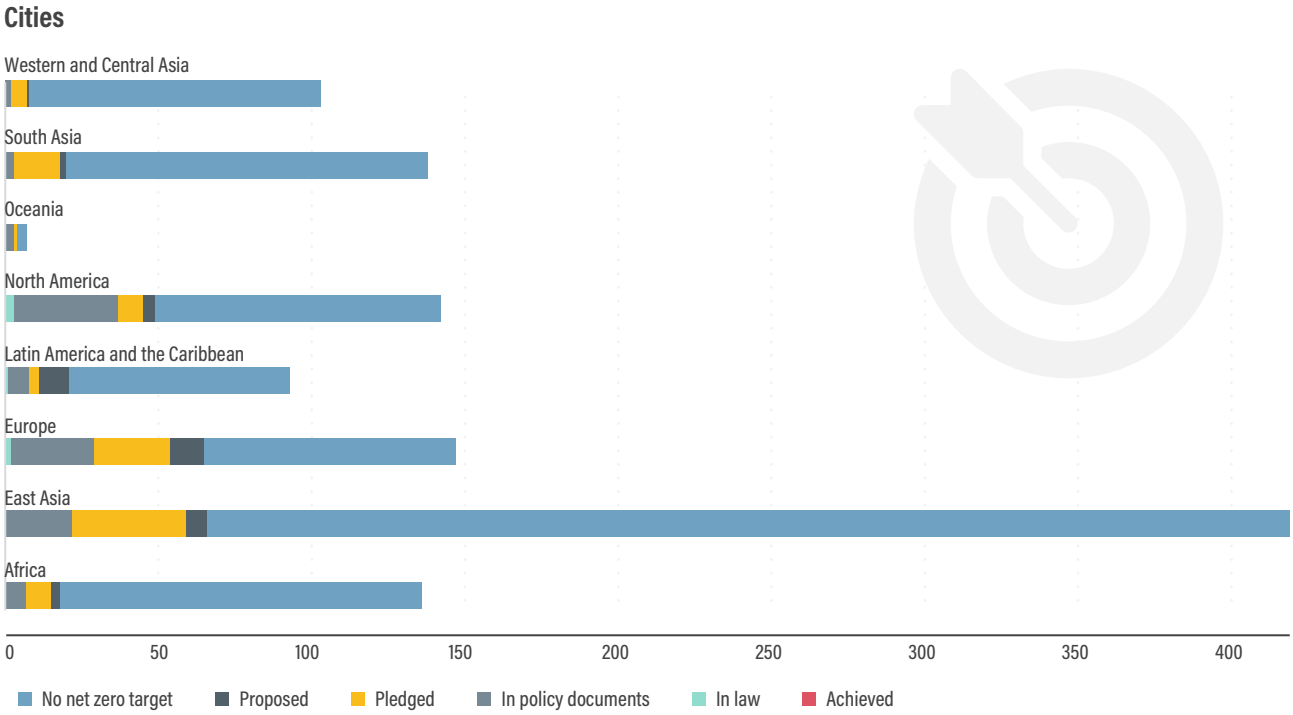
- In 2021, the European Commission released the EU Urban Mobility Framework to help cities make urban mobility more sustainable and to contribute to achieving the EU greenhouse gas reduction targets. The framework suggests measures for addressing air pollution, congestion, accessibility, urban road safety, e-commerce growth and other urban mobility challenges.[60]
- In early 2023, the European Commission released a Recommendation to Member States to establish national programmes to support cities in developing SUMPs through guidance materials, training, technical expertise and financial support.[61]
- In early 2022, Istanbul (Türkiye) completed the country's first SUMP, which was also the first SUMP in a megacity globally, covering a population of nearly 16 million.[62]
- Several initiatives were under way in India by late 2022 to support transit-oriented development, and the cities of Chandigarh, the Pune Municipal Corporation and Navi Mumbai had successfully implemented transit-oriented development in their urban planning masterplans.[63]
- Open street events held across Africa – including in Cape Town (South Africa), Kigali (Rwanda) and several Ethiopian cities – provided cities with an opportunity to reflect on and understand the benefits of people-centred development approaches.[64]

Sub-national transport policies and investments have placed increased focus on active mobility and public transport, serving as "pull" or "carrot" approaches to encourage the adoption of zero- and low-emission transport modes. The need for active mobility options, such as walking and cycling, has continue to grow even after the COVID-19 pandemic, driven mainly by local demand (see *Sections 3.2 Walking, 3.3 Cycling* and *3.4.1 Public Transport*).

- In 2022, Jakarta (Indonesia) completed 309 kilometres of bike lanes, out of a planned total of 500 kilometres, with government data showing that the average number of cyclists daily in the city had surged from 47 in 2005 to 4,000 in 2022.[65]
- In Utrecht (Netherlands), the cycling action plan outlined in the SUMP helped create a strong cycling culture, resulting in Utrecht topping the Global Bicycle Cities Index in 2020 and 2022 and ranking in the top three on the "Copenhagenize Index" of the world's most cycle-friendly cities since 2013.[66]

FIGURE 4. Number of cities committing to net zero targets, as of June 2023

Source: See endnote 50 for this section.



- In 2020, Addis Ababa (Ethiopia) launched a 10-year Non-Motorised Transport Strategy aimed at developing a comprehensive network of high-quality walking and cycling facilities to address the growing demand for better access to the city.[67]

A growing number of cities have made available free or affordable public transport locally as a means to alleviate national economic crises (such as inflation) and to shift trips from private vehicles to public transport.

- Many cities in Brazil Europe and the USA have trialled and/or fully implemented free ticketing and fares for public transport.[68]
- All public transport is free in Morungaba (Brazil).[69]
- In the United States, Albuquerque has implemented free buses, Worcester operated free buses during the summer of 2023, and Washington, D.C. enacted a zero-fare bus bill in 2023.[70]

Sub-national policy makers, particularly in Europe, also have embraced "push" or "stick" approaches – such as parking management and congestion charging – to alleviate congestion and redistribute urban space.

- In March 2023, Barcelona (Spain) implemented the Amazon tax, which charges postal operators for parking vehicles that deliver online purchases in public spaces. The tax affects the 26 postal companies, including Amazon, DHL and UPS, that bill more than EUR 1 million (USD 1.09 million) annually.[71] The tax seeks to benefit local business, encourage collecting at pick-up points, avoid excessive occupation of public space by delivery vehicles, and fight other negative impacts.[72]
- In July 2023, the Rosemont–La Petite-Patrie district in Montreal (Canada) introduced parking charges based on vehicle weight to reflect better the space they occupy.[73] Lyon (France) will implement a similar approach in 2024.[74]
- In 2023, London marked the 20th anniversary of its congestion charge, which reduced congestion 30% and emissions 16% since 2003, limiting traffic and contributing to a shift to active travel and public transport.[75] The city plans to remove its congestion pricing exemption for electric vehicles by 2025.[76] Between 2000 and 2022, London's congestion charge resulted in 1 billion fewer vehicle-miles driven by cars; however, the number of vehicle-miles driven by light commercial vehicles increased by the same amount, and taxis also filled the space left by cars.[77]

Many urban areas have adopted and piloted access regulations, zero-emission zones and clear air zones to reduce emissions and improve air quality. A number of cities have established specific zero-emission zones for freight transport (ZEZ-Fs), ranging from urban delivery vans to medium- and heavy-duty trucks.

- The zero-emission zone in Oslo (Norway), scheduled to enter into force in 2023, commenced with a "Car-Free City Life" area where pedestrians and cyclists have priority over private cars; the measure is set to expand to other areas of the city by 2026.[78]
- Jakarta (Indonesia) began implementing a low-emission zone pilot project in the Kota Tua Tourism Area in early 2021, addressing air quality, safety and social inclusion issues.[79]
- A ZEZ-F pilot in Shenzhen (China), implemented in 2018 to cover 22 square kilometres (1.1% of the total city area), applies to light-duty trucks and was scheduled to expand in July 2023.[80] In 2021, Luoyang (China) adopted a near-ZEZ-F scheme, to be implemented in 2023, that applies to urban delivery trucks and covers the city centre.[81]
- In the US state of California, the Los Angeles Cleantech Incubator and the City of Santa Monica partnered to deploy the country's first ZEZ-F in early 2021, referred to as a "zero-emission delivery zone" and covering a one-square-mile commercial area.[82]
- The Netherlands announced in 2021 that it was aiming to implement ZEZ-Fs in 30-40 of the country's largest cities by 2025.[83] As of 1 January 2025, any city in the Netherlands would be permitted to designate areas as a ZEZ-F.[84]

There is growing momentum for sub-national governments to electrify bus fleets as a way to enhance the energy efficiency of public transport and car-sharing fleets (*see Section 4.2 Vehicle Technologies*).

- At least 75 cities have joined the Accelerating to Zero (A2Z) Coalition, launched at COP 26 in 2021 to accelerate the transition to 100% zero-emission cars and vans; the aim is for all sales of new cars and vans to be zero-emission globally by 2040, and by no later than 2035 in leading markets.[85]
- Maharashtra state (India) planned to add a total of 1,900 electric buses to Mumbai's Brihanmumbai Electric Supply and Transport fleet (a public entity providing transport services and electricity).[86] The city also aims to have a 100% electric fleet by 2027, with an interim 50% target by 2023.[87]
- In 2021, California (USA) approved the Clean Miles Standard, the first programme in the country requiring ride-hailing companies to transition towards electric vehicles by 2030.[88]
- São Paulo (Brazil) banned bus companies from purchasing new diesel buses starting in 2020 and targets at least 2,600 e-buses by 2024, representing around one-fifth of the fleet.[89]
- In 2022, Bogotá (Colombia) expanded its e-bus fleet and built the largest bus depot outside of China.[90] With all 1,485 of the city's e-buses in service, annual avoided emissions are projected to reach 94,300 tonnes of CO_2.[91]

Partnership in Action

SLOCAT partners engaged in dozens of actions during 2020-2022, including:

- By mid-2022, 36 cities (mostly in Europe and the United States) had committed to the **C40 Cities Green and Healthy Streets Declaration**, aiming for zero emissions in a major area of their cities by 2030; establishing a zero-emission zone is a clear pathway to reaching that commitment.[92]
- The **EcoLogistics** project of **ICLEI–Local Governments for Sustainability** promotes low-carbon urban freight policies and practices.[93] For example, in 2022 Rosario (Argentina) added 20 cargo bikes to its public bike sharing scheme, targeting merchants, entrepreneurs and workers in the city centre.[94]
- In April 2022, the **International Association of Public Transport (UITP)**, the **World Bank** and the **World Resources Institute** supported India to bid more than 5,000 electric buses for five cities, in the world's largest tender for e-bus procurement. The process, supported under the government FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicle) scheme subsidy, aggregated demand across Delhi, Bangalore, Hyderabad, Kolkata and Surat and homogenised their procurement specifications. As a result of the large size of the tender, prices were the lowest ever (up to 48% below previous tenders), very close to those for diesel buses.[95] The government now plans to procure 50,000 e-buses by 2030 for other cities.[96]
- The **Institute for Transportation and Development Policy**, in partnership with the City of Kigali (Rwanda), developed a Non-Motorised Transport Master Plan in 2023 that identifies priority corridors for greenways and active transport in the city.[97]
- Since its launch in 2015, the **MobiliseYourCity** partnership has been supporting cities in different regions in developing and implementing SUMPs.[98] These include three cities in Africa, two cities in Asia, four cities in Eastern Europe and six cities in Latin America and the Caribbean that finalised their SUMPs between 2019-2022; as well as seven cities in Africa, seven cities in Asia and three cities in Latin America and the Caribbean that are currently developing their plans.[99]
- The **World Bank** is providing financial and/or technical assistance to bus rapid transit projects in eight African cities as part of their SUMPs: Abidjan (Côte d'Ivoire), Dakar (Senegal), Dar es Salaam (Tanzania; phases 3 and 4), Douala (Cameroon), Kampala (Uganda), Kumasi (Ghana), Maputo (Mozambique) and Ouagadougou (Burkina Faso).[100] In Dakar, the introduction of low- or zero-emission vehicles in this bus corridor could save an estimated 67,700 tonnes of CO_2 annually.[101]

MODULE 1 | 1.3.3

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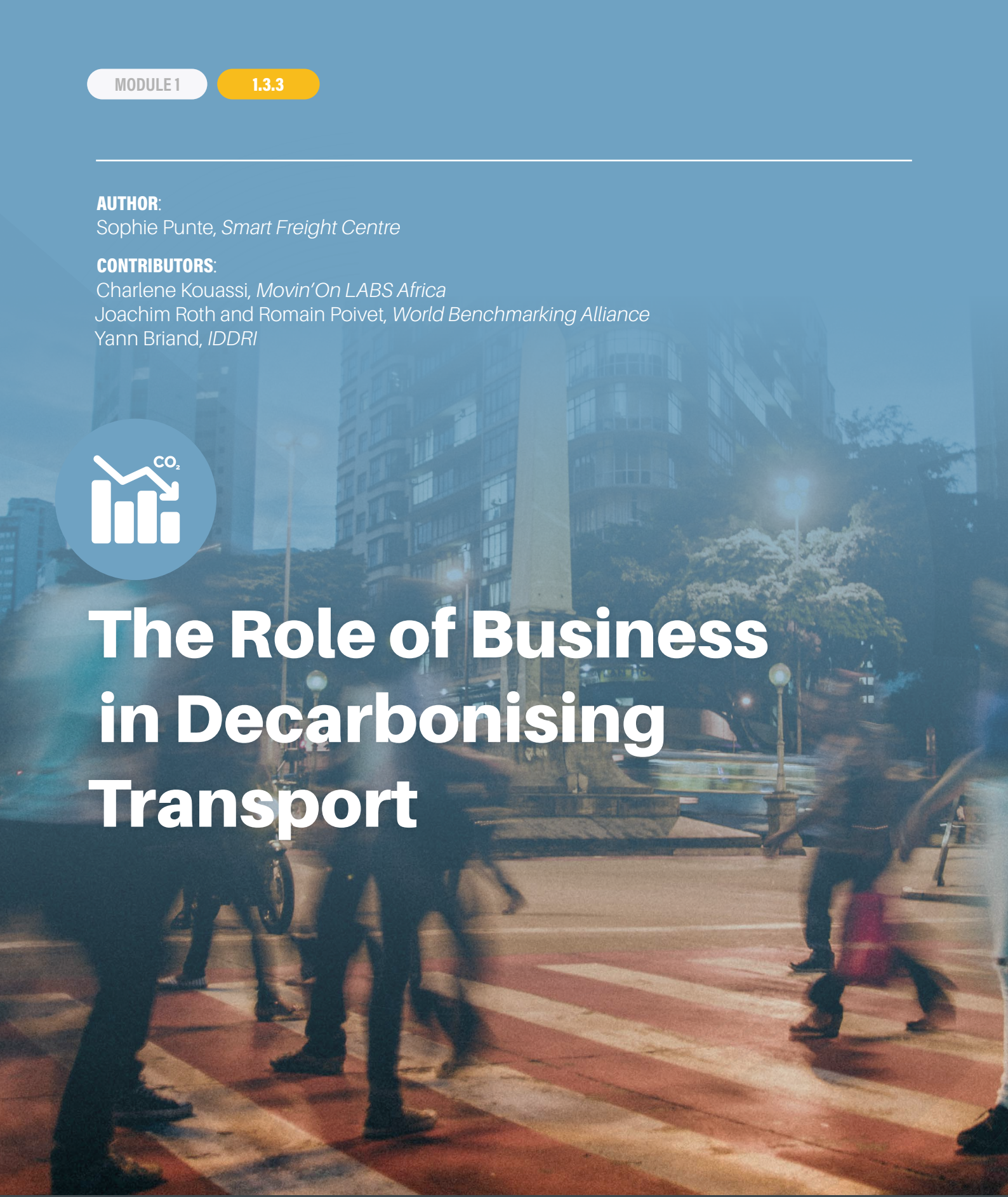


The Role of Business in Decarbonising Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Key findings

- To decarbonise transport, various types of businesses need to be involved, including transport manufacturers, public and freight transport service providers, and companies that use transport.
- Although businesses are demonstrating increasing climate leadership, collectively this remains insufficient to achieve a pathway consistent with limiting global temperature rise to below 1.5 degrees Celsius (°C).

Ambition

- While the climate ambition of transport manufacturers is increasing, targets are not enough to achieve a 1.5°C pathway.
- Transport-specific targets mostly focus on zero-emission vehicles, charging infrastructure, and renewable energy for shipping and aviation. Very few companies have set targets across all their business areas and markets and have committed to phasing out fossil fuels.
- A majority of transport companies have set goals and targets for reducing greenhouse gas emissions, but ambition must be raised. As of 2022, more than 58 countries and one-fifth of the world's largest companies had committed to reaching carbon neutrality.
- Transport companies need to commit to phasing out fossil fuels, as the transport sector relies on oil-derived products for over 90% of its energy, more than any other sector.
- Over 2,400 companies covering more than a third of the global economy's market capitalisation – including 43 transport manufacturers and 124 transport service providers – have approved science-based targets for reducing emissions.

Action

- Transport manufacturers have made significant progress on electric road vehicles, alternative fuels for ships and airplanes, and digital solutions.
- To reach the 1.5°C target, the global automotive sector needs to increase annual production of zero-emission vehicles to 52% of total vehicle production in 2029.
- Innovation has occurred in hard-to-decarbonise sub-sectors, such as zero-emission trucks, ships and planes; low carbon fuels; batteries and other technologies; and infrastructure. While policy has played a role, manufacturers also have responded to customer demand and collaborated with suppliers of infrastructure, fuel and batteries, and other technologies.
- A gap remains between transport companies' ambitions and the quality of their climate transition planning, with vast potential for improved action. Many companies may not have determined actions or allocated funding to meet their targets.
- Globally, transport companies under-perform on the social aspects of climate and sustainability, including human rights, just transition, decent work and ethical conduct, even though these are critical for the successful implementation of a climate transition plan.
- Companies have taken actions related to their own fleets, including electric vehicles, biking and working from home.
- Shippers hold the key to making structural changes to freight transport by shifting to low carbon modes and reducing demand.
- Many companies have shown greater advancement in general energy-related measures than in tackling transport.

Advocacy

- Businesses have been more supportive of infrastructure and incentives for alternative fuels and zero emissions, and more opposed to carbon dioxide targets, standards and accelerating the phase-out of internal combustion engines and fossil fuels.
- Many auto manufacturers and aviation companies advocate for climate action while simultaneously lobbying to weaken pro-climate policies. Automotive workers show greater unity on lobbying for a Just Transition.
- Transport companies' inconsistent policy advocacy risks delaying the climate action they need to meet their own emission reduction targets.
- Policy advocacy to accelerate the uptake of electric vehicles has been strong among companies that have fleets and use transport services.
- Industry associations that cover multiple sectors but also cover transport have tended to take a more conservative approach to climate policy advocacy.

Accountability

- Disclosure of companies' climate-relevant information is becoming mainstream – with over 18,000 companies disclosing to CDP in 2022, including 419 transport manufacturers and 930 transport service providers – but accountability gaps remain.
- Weaknesses include a lack of climate expertise at the board level in companies, and of financial incentives tied to emission reductions.
- The new ISO 14083 standard on quantification and reporting of greenhouse gas emissions from transport operations is expected to increase and improve disclosure.
- Little is known about the disclosure of companies (other than transport manufacturers and companies that provide transport services) on their transport emissions, targets and emission reduction efforts.

Opportunities to accelerate industry action

- Improving business climate leadership can help prevent greenwashing, as leaders must follow through on their ambition with credible action, advocacy and accountability.
- Companies can be leveraged for wider system change to complement technological changes and in responding to climate impacts.
- Companies can enhance their collaboration with other stakeholders in climate and sustainability, working with all partners in the value chain, supporting just transition pathways for transport and joining initiatives that truly help deliver the transition.

Overview

The private sector plays an essential role in climate action, as roughly 100 companies around the world were responsible for 71% of the global greenhouse gas emissions between 1998 and 2015.[1] Worldwide, a growing number of companies across all sectors, including transport, have committed to reducing their emissions.[2]

To realise transport decarbonisation, a wide range of businesses need to be involved, including original equipment manufacturers (i.e., transport manufacturers), providers of public and freight transport services, as well as companies that use transport. The contributions of these businesses can be assessed through the framework of the "4 A's of Climate Leadership" (see Figure 1).[3]

Across these areas, key collaboration and climate leadership opportunities exist to accelerate businesses action to decarbonise transport. The key private stakeholders in transport span businesses of all sizes, from global and national corporations, to state-owned enterprises, to small and medium enterprises, to individual contractors. Governments, civil society and research organisations, and customers other than companies all have an influence on these businesses (see Figure 2).

Businesses and companies can support conditions that enable transport decarbonisation at scale, by pursuing activities such as capacity building and awareness raising among company management and staff, technicians and professionals, policy makers and the public; and collaboration among businesses and with government, civil society and research.

FIGURE 1. 4 A's of Climate Leadership by the We Mean Business Coalition

Source: See endnote 3 for this section.

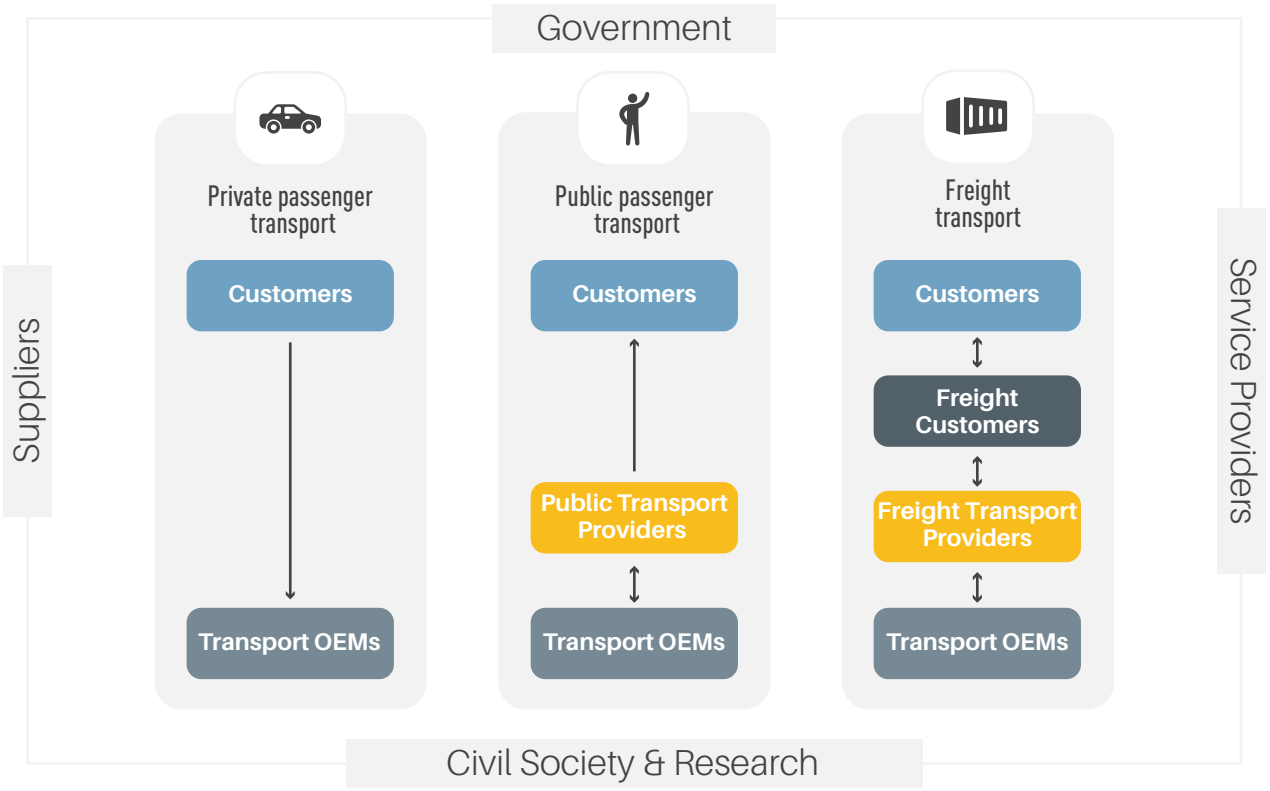
Ambition
Commit to net zero and set science-based targets in line with Paris Agreement goals and a just transition

Action
Take concrete action across the business value chain and involve employees, suppliers and customers

Advocacy
Speak up to secure wider change through ambitious government policy and aligned trade associations

Accountability
Disclose emissions, progress against targets and plans, risk management, policy engagement and governance

FIGURE 2. Transport stakeholders for passenger and freight transport



KEYWORDS

Customers
consumers, companies, organisations

Transport OEMs
original equipment manufacturers of vehicles, aircraft and marine/inland vessels and their engines, components and other equipment

Public transport providers
providers of public bus, metro, rail, taxi, bike, metro, ferry, aviation services

Freight transport providers
carriers, freight forwarders, logistics service providers covering all transport modes

Customers of freight
"shippers" including businesses, government and other organisations

Government
multilateral, national, state, local government and affiliated organisations

Suppliers
fuel/energy, technology, utilities, information technology, construction, other

Service providers
financiers, insurers, auditors, consultancies, other

Civil society & research
non-profit organisations, Indigenous groups, labour unions, professional associations, foundations, research institutes, universities

Business efforts to decarbonise transport

Different businesses – including transport manufacturers, public and freight transport providers, and companies that use transport – are taking different steps to decarbonise transport and to reduce emissions to contribute to international goals. **Although businesses are demonstrating momentum in climate leadership across the 4 A's, collectively this remains insufficient to achieve a pathway that is consistent with the goal of keeping global temperature rise below 1.5 degrees Celsius (°C).**[4]

Transport manufacturers

Original equipment manufacturers include manufacturers of vehicles, aircraft, and marine/inland vessels, as well as their engines, components and other equipment. These transport manufacturers are responsible for providing zero-emission solutions at scale to other business stakeholders.

While the climate ambition of transport manufacturers is increasing, targets are not ambitious enough to achieve a 1.5°C pathway, especially for land transport, shipping and aviation. Moreover, regional differences in these commitments are apparent, especially for medium- and heavy-duty trucks and buses.[5]

Ambition

Transport-specific targets tend to focus on zero-emission vehicles, charging infrastructure, and renewable energy for shipping and aviation. Very few companies have set targets across all of their business areas and markets and have committed to phasing out fossil fuels.

- Of the 114 transport manufacturers that had joined the Science Based Targets initiative (SBTi) as of March 2023, 62% (71 companies) had committed to targets to reduce greenhouse gas emissions, and 38% (43) had approved targets, with more likely to follow once the initiative releases sector-specific guidelines.[6]
- In a global benchmark of 30 auto manufacturers in 2021, 56% (17 companies) had set targets to reduce emissions and 83% (25) had set targets to increase sales of light-duty low carbon vehicles, including battery electric, fuel cell electric, and plug-in hybrid cars and vans.[7] However, no company had targets covering all of its business areas and fully aligning with the International Energy Agency's (IEA) 1.5°C pathway for light-duty electric vehicles.[8]
- Ford, General Motors, Mercedes Benz Group and Volvo Cars have all announced plans to fully phase out internal combustion engine vehicles in the 2030s and to shift to manufacturing light-duty zero-emission vehicles.[9]
- By market share, as of 2020, 97% of manufacturers in Europe and 94% of manufacturers in the United States had committed to a complete transition to zero-emission vehicles, compared to 34% in China, despite Chinese dominance in electric vehicle manufacturing (see Figure 3).[10]

Nearly all of the world's major **aviation** industry associations and largest aircraft and engine makers have committed to achieving net zero carbon emissions by 2050, supported by accelerated efficiency measures, energy transition, and innovation across the aviation sector, in partnership with governments around the world.[11]

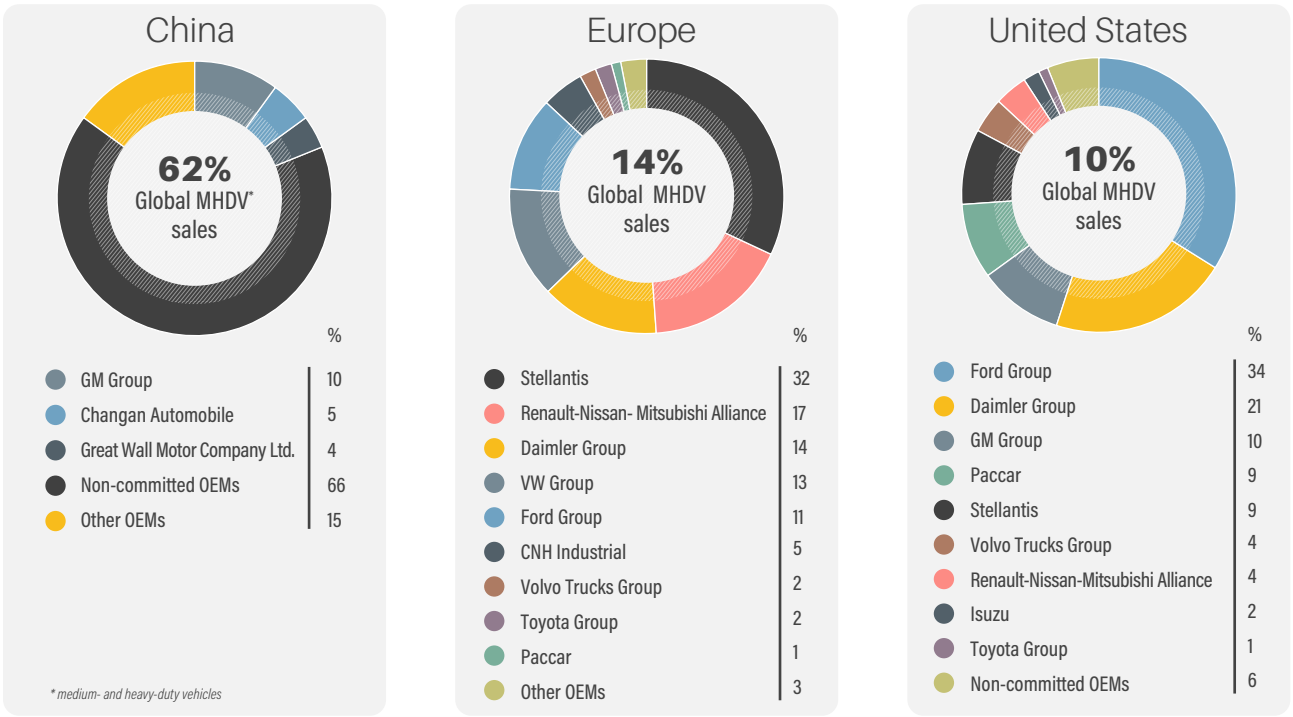
The global **shipping** industry, through the Getting to Zero Coalition, has committed to operating commercially viable zero-emission vessels by 2030, along with the associated infrastructure, with the goal of full decarbonisation by 2050.[12] The International Maritime Organization has targeted halving global shipping emissions by 2050 (from 2008 levels) and aimed to approve a revised greenhouse gas strategy in 2023.[13] Alignment with a 1.5°C pathway requires reducing emissions from international shipping at least 34% below 2008 levels by 2030 and achieving zero emissions by 2050.[14]

Weaknesses include a lack of climate expertise at the board level in companies, and of financial incentives tied to emission reductions for executives and employees. Of 30 benchmarked automotive companies, 90% (26 companies) had board-level oversight on climate change, but only 40% (12) had financial incentives tied to emission reductions for executives and 53% (16) had such incentives for employees; only 10% (3) had significant climate change expertise at the board level.[15] The benchmark also found that:

- Companies that have in place both financial incentives and board climate expertise, such as Renault and Volkswagen, scored higher for transition plans as well.

FIGURE 3. Regional market shares of original equipment manufacturers committed to zero-emission vehicles, 2020

Source: See endnote 10 for this section.



- Mahindra Group's Executive Chairman is also a board member of the UN Global Compact and has chaired the High-level Commission on Carbon Pricing and Competitiveness.
- Volkswagen established a sustainability board that includes a co-director for the Potsdam Institute for Climate Impact Research, a president of the European Green faction of the European Parliament, a founding director of the UN Global Compact and a former EU Commissioner for Climate Action.

Action

The strongest progress among transport manufacturers has been on electric road vehicles and alternative fuels for ships and airplanes, as well as increasingly on digital solutions offered by multi-modal transport companies.

To reach the IEA's 1.5°C target, the global automotive sector will need to increase annual production of zero-emission vehicles (battery electric and hydrogen) to 52% of total vehicle production in 2029 (see Figures 4 and 5).[16] Globally, electric vehicle sales (including plug-in hybrids) increased 55% in 2022 to exceed 10 million units, accounting for 14% of total vehicle sales *(see Section 4.2 Vehicle Technologies)*.[17] In low- and middle-income countries in Asia, such as India, electric two- and three-wheelers dominate electric vehicle sales.[18]

- Leaders in the automotive sector include BMW, Mercedes-Benz, and Tesla, whose production of light-duty zero-emission vehicles appears to be in line with the IEA's 1.5°C pathway requiring that at least 60% of car and van sales be zero emission by 2030.[19]
- Sport utility vehicles cancel out much of the expected emission reduction between 2022 and 2030 as their share of production is projected to increase from 41% in 2022 to 47% in 2029.[20]
- China is by far the largest electric vehicle market, accounting for 59% of global sales in 2022 and with one in four cars sold being electric.[21]
- Two- and three-wheelers (both passenger and freight) accounted for 95% of the estimated 430,000 zero-emission vehicles sold in India in the fiscal year ending in March 2022 – more than three times the number of the previous year.[22]
- Electric cars are rare in Mexico due to high upfront costs and a lack of charging infrastructure.[23]

Although minimal, some manufacturers have invested in additional measures to support the energy transition in vehicles, such as loans, leasing and sharing schemes for cars and scooters.

- Manufacturers that provided battery swapping and leasing services included Ample and Octillion Power Systems (United States), Gogoro (Indonesia), NIO (China) and Sun Mobility (India).[24]

Auto companies that produce electric buses and trucks, most of which are Chinese, have rapidly gained market share. At the start of 2023, 815 models of electric (battery or fuel cell) buses and trucks were available, up 34% from 2021 and 187% from 2019 (see Figure 6).[25]

- In 2022, the global **electric bus** stock reached 700,000 vehicles (battery electric), reflecting 3% of the worldwide bus fleet.[26] Nearly 66,000 electric buses were sold worldwide, representing 4.5% of all bus sales.[27]
- China again dominated electric bus sales in 2021, while sales in the European Union (EU) picked up due to national and municipal procurement targets as well as the EU Clean Vehicles Directive.[28]
- In Brazil, BYD's sales of electric buses increased greatly after the City of São Paolo mandated that all new public buses must be electric from 2022.[29] Renault launched new electric car models in combination with a Mobilize service focused on "Shift" solutions (i.e. actions to support a shift to more sustainable transport modes) and "Improve" solutions (i.e. actions to improve efficiency of transport modes).[30]
- **Electric truck** sales accounted for only 0.4% of total sales in 2022, resulting in 320,000 electric trucks on the roads in 2022.[31]

Innovation has occurred in hard-to-decarbonise sub-sectors, including on zero-emission trucks, ships and planes; low carbon fuels; batteries and other technologies; and infrastructure (see Table 1).[32] **While policy has played a role, manufacturers also have responded to customer demand and collaborated with suppliers of infrastructure, fuel and batteries, and other technologies.**[33]

For ships and airplanes, the emphasis has been more on alternative fuels than on zero-emission fleets. Sustainable aviation fuels (SAF) that can reduce CO_2 emissions from air travel up to 80% are expected to play a bigger role.[34]

- In 2018, Norway announced that only emission-free ships will be allowed to enter the country's two western World Heritage fjords from 2026, triggering Northern Xplorer to commission construction of a cruise ship that operates on hydrogen.[35]
- The US Inflation Reduction Act stimulates investments across decarbonisation technologies, while the EU's Alternative Fuels Infrastructure Regulations of March 2023 aims to fast-track the uptake of alternative fuels and vehicles.[36]
- SAF production reached at least an estimated 300 million litres in 2022, up 200% from 2021 (100 million litres), and more than 450,000 commercial flights used these fuels during the year.[37]
- However, SAF production in 2022 was still well below the 30 billion litres by 2030 and 450 billion litres by 2050 that are projected to be required annually under the 1.5°C and net zero pathways.[38]

FIGURE 4. Projected production of zero-emission vehicles versus targets set in the International Energy Agency's 1.5°C scenario, 2021-2029

Source: See endnote 16 for this section.

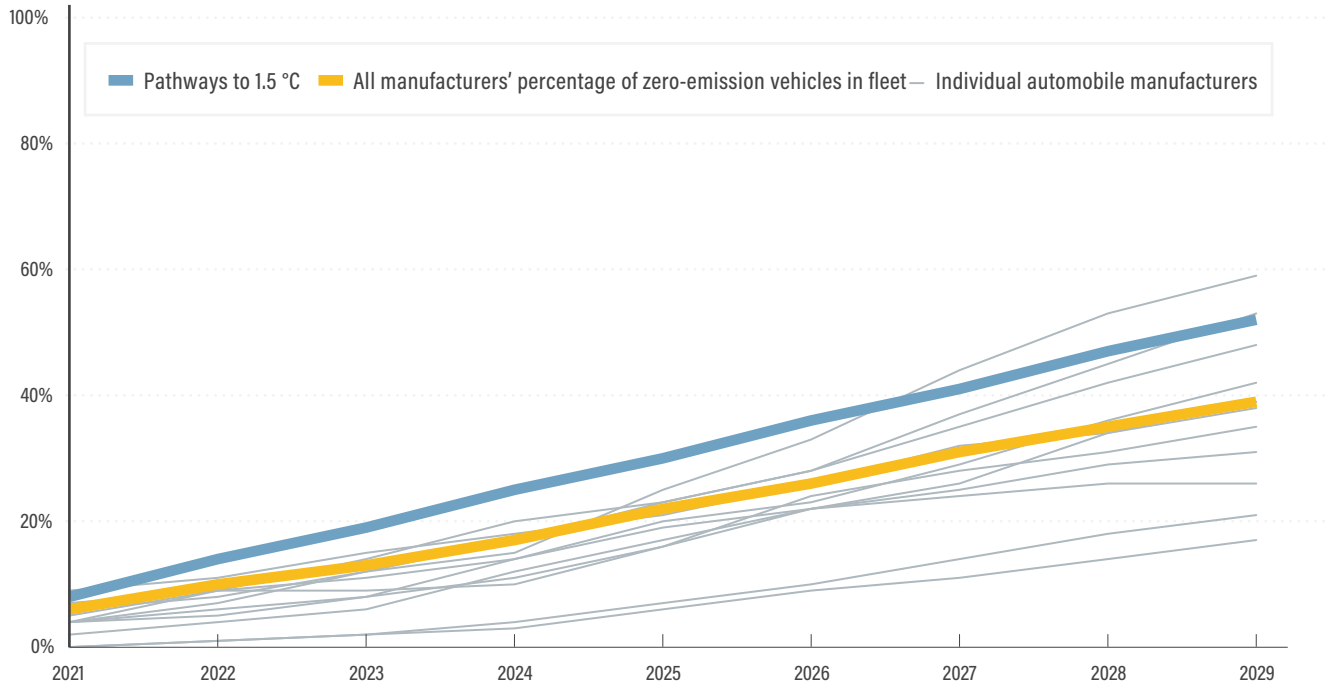


FIGURE 5. Projected composition of the global light-duty vehicle fleet, by technology, 2021-2029

Source: See endnote 16 for this section.

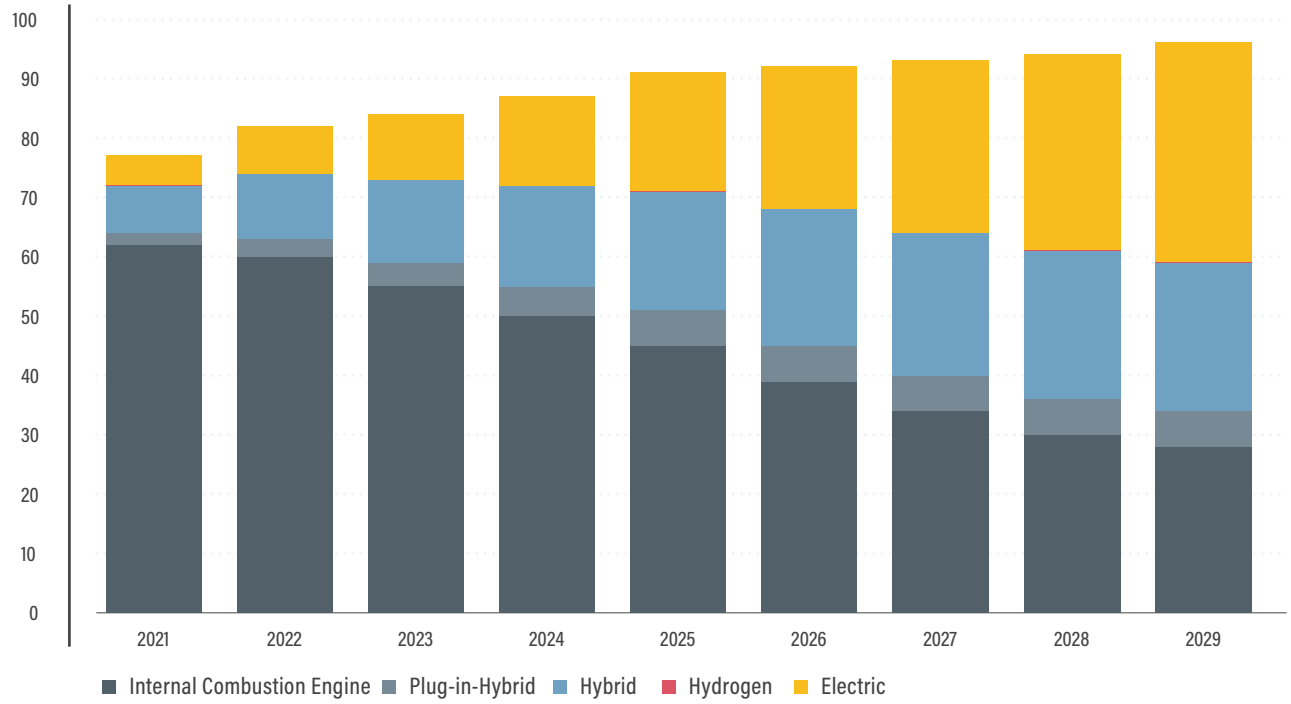


FIGURE 6. Global availability of zero-emission medium-and heavy-duty vehicles, by type, 2021-2023

Source: See endnote 25 for this section.

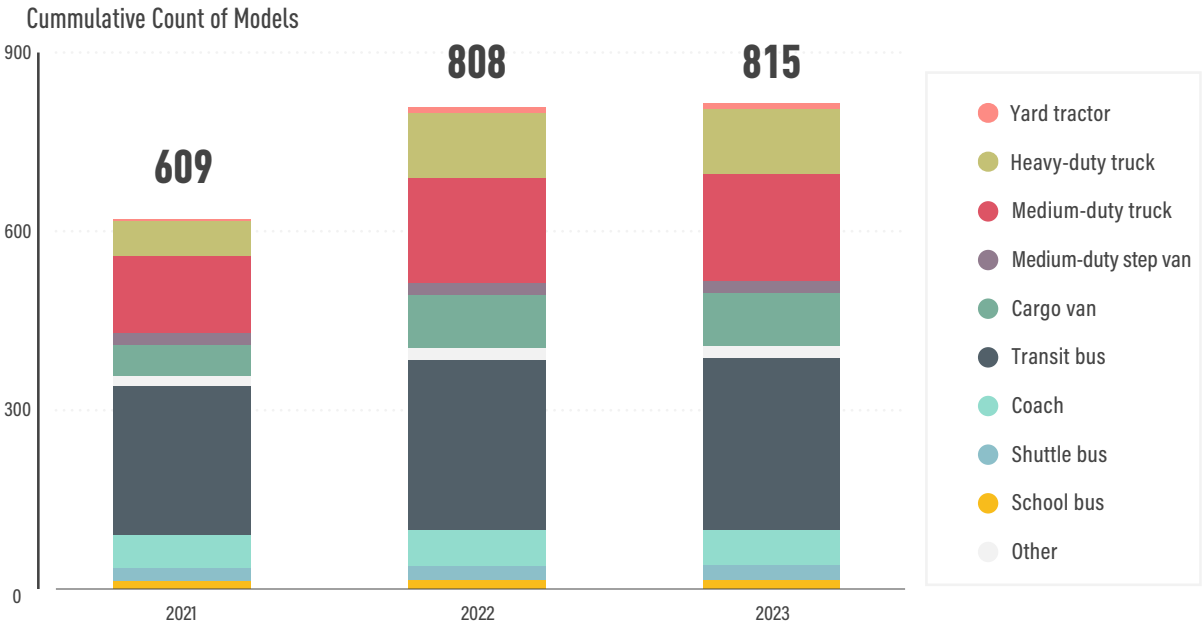


TABLE 1. Examples of innovation in hard-to-decarbonise transport sub-sectors

Source: See endnote 32 for this section.

Medium- and heavy-duty trucks

- Volvo and Man are providing battery-electric beer delivery trucks for Anheuser-Busch InBev to supply Belgian cafés.
- Volvo is testing battery-electric timber trucks with freight forwarder DFDS in Sweden.
- TEVVA is supplying UPS with battery-hydrogen delivery trucks for customers in UK cities.
- MG Motor India is manufacturing battery-electric trucks to transport finished steel rolls.
- Einride is deploying 300 electric trucks for Maersk's North American warehousing, distribution and transport business.
- Daimler, Volvo and Traton formed the joint-venture Milence to introduce public electric vehicle charging points for long-distance trucks in Europe.
- To overcome the investment barrier, Volta is introducing "Truck-as-as-Service" (TaaS), whereby customers lease an electric truck combined with charging and other services.
- Siemens, Vattenfal and Scania are collaborating on electric roads for trucks to charge on while driving, via overhead pantographs or electric coils on the road.

Shipping

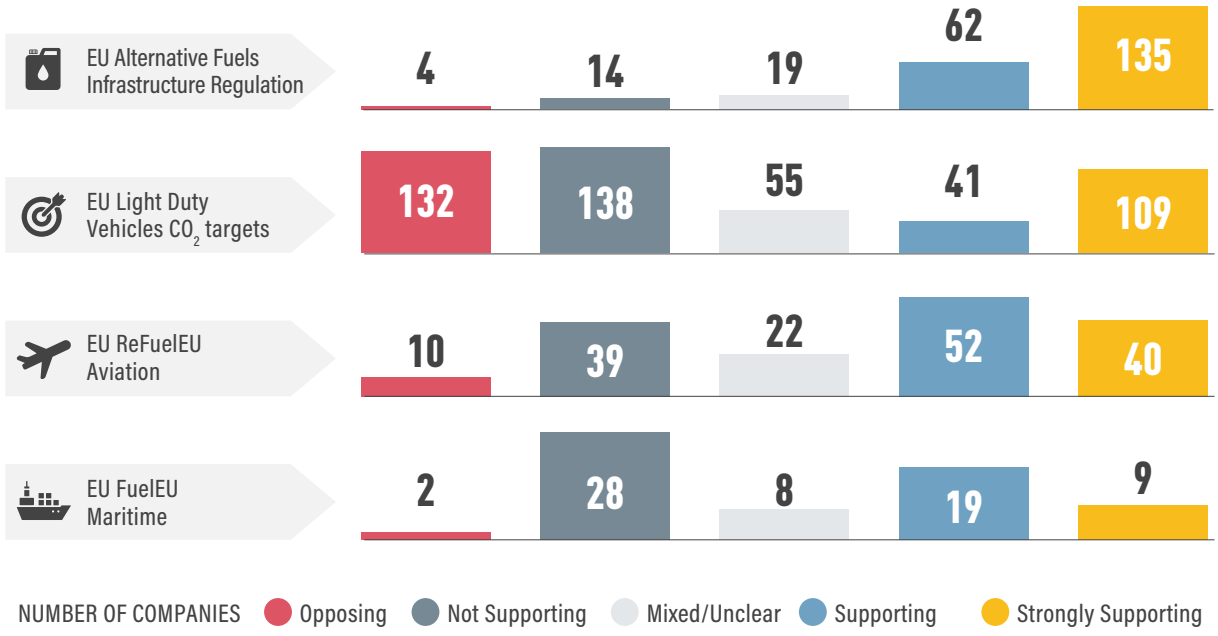
- AP Moller Maersk is exploring the use of methanol-powered ships.
- The E/S Orcelle ship for Wallenius combines electrical systems, wind and wave power, and fuel panels incorporating hydrogen.
- The container feeder vessel ZERO for GL Shipping Company is using liquid hydrogen and hydrogen-powered fuel panels.
- Futureship's zero-emission ferry concept for Scandilines uses hydrogen-powered fuel cells and Flettner rotors to capture wind.
- B9 Cargo Ships are operated through methane fuel (biogas) and wind-derived energy.
- White Orca is powered by wind and hydrogen and will carry aggregates from western to eastern Norway for HeidelbergCement Norway; on return voyages it will transport grain for Felleskjøpet AGRI.

Aviation

- Eviation Aircraft's has developed the electric passenger plane Alice.
- Universal Hydrogen launched a 40-person hydrogen-powered airplane.
- Pyka's autonomous electric Pelican Cargo plane is capable of transporting 400 pounds of cargo 322 kilometres in less than three hours.

FIGURE 7. Policy advocacy positions across transport modes in the EU, as of January 2023

Source: See endnote 39 for this section.



Advocacy

Businesses have been more supportive of infrastructure and incentives for alternative fuels and zero emissions, while being more opposed to carbon dioxide (CO_2) targets, standards and accelerating the phase-out of internal combustion engines and fossil fuels. As of January 2023, a mix of policy advocacy positions existed in the EU among manufacturers and others across transport modes, including strong opposition to CO_2 targets for light-duty vehicles (see Figure 7).[39]

A majority (57%) of 30 benchmarked auto companies in 2021 publicly supported climate policies.[40] Companies with high forecasted production of zero-emission vehicles have tended to be more positively engaged with climate policy as compared to companies that produce mainly internal combustion engine vehicles (see Figure 8).[41] **Meanwhile, many auto manufacturers from Europe, Japan, the Republic of Korea, and the United States, as well as aviation companies, have continued to advocate for climate action while simultaneously lobbying actively to weaken or delay pro-climate policies.**[42]

Companies have often lobbied via their industry associations, which tend to take a more conservative approach to climate policy engagement (see Table 2).[43] **Meanwhile, there is greater unity on lobbying for a Just Transition for automotive workers.**

- Volvo Cars left the European Automobile Manufacturers Association in 2022 over misalignment on climate goals, and other companies may follow, upon assessments of their respective industry associations.[44]
- In Europe, both non-governmental organisations and industry associations called for the EU to develop a Just Transition framework for automotive workers, arguing that "Alongside higher climate ambition, we want to see industrial transformation and innovation in Europe rather than deindustrialisation and social disruption".[45]
- The German government and several European organisations established the Just Transition in the European Car Industry project to support the sector in the just and climate-friendly transition.[46]

Accountability

Disclosure of climate-relevant information by companies is becoming mainstream – with more than 18,000 companies disclosing to CDP in 2022 – but gaps in accountability remain. In 2022, 419 transport manufacturers (including 251 automakers) responded to the 2022 CDP climate questionnaire, the results of which are used to inform investors and other stakeholders.[47]

FIGURE 8. Zero-emission vehicle production and climate policy engagement, by region

Source: See endnote 41 for this section.

The graphic below compares the climate policy engagement score (assessed by InfluenceMap) of major automakers with their forecasted percentage production of zero-emission vehicles by 2029 (InfluenceMap analysis of S&P Global Mobility data). The bubble size represents the relative proportion of vehicle production compared to other major global automakers.

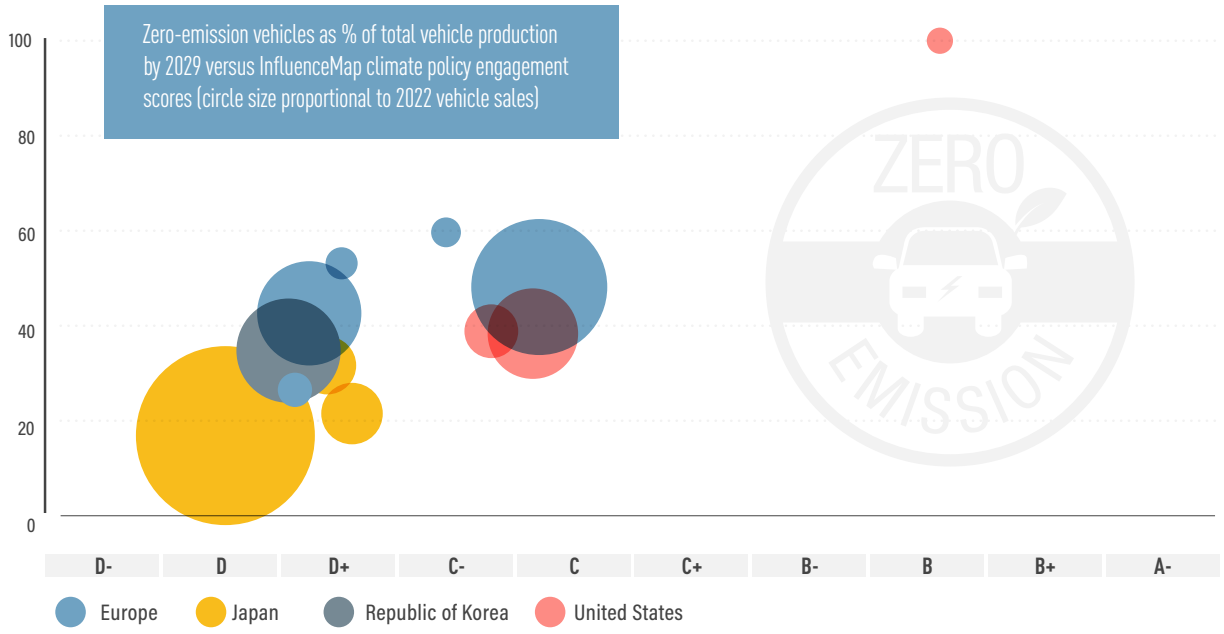


TABLE 2. Climate policy engagement among auto industry associations

Source: See endnote 43 for this section.

Auto industry association	Region	InfluenceMap rating	Engagement intensity
European Association for Electromobility (AVERE)	EU	B+	37%
European Automobile Manufacturers Association (ACEA)	Europe	C-	42%
Society of Motor Manufacturers and Traders (SMMT)	Europe	C-	17%
European Association of Automotive Suppliers (CLEPA)	Europe	D+	37%
German Association of the Automotive Industry (VDA)	Europe	D-	51%

Note: The rating (A+ to F) is a measure of how supportive or obstructive a member company's direct engagement is towards climate policy aligned with the Paris Agreement. Engagement intensity is a measure of the level of policy engagement by the company, whether positive or negative.

Providers of public and freight transport

Providers of public and freight transport include companies that provide public transport services, such as taxi, bus, rail companies and ferry operators, and companies that provide freight transport, delivery and logistics services including by road, rail, water and air.

Ambition

A majority of transport companies have set goals and targets for reducing greenhouse gas emissions, but ambition must be raised. As of 2022, more than 58 countries and one-fifth of the world's largest companies had committed to reaching carbon neutrality.[48]

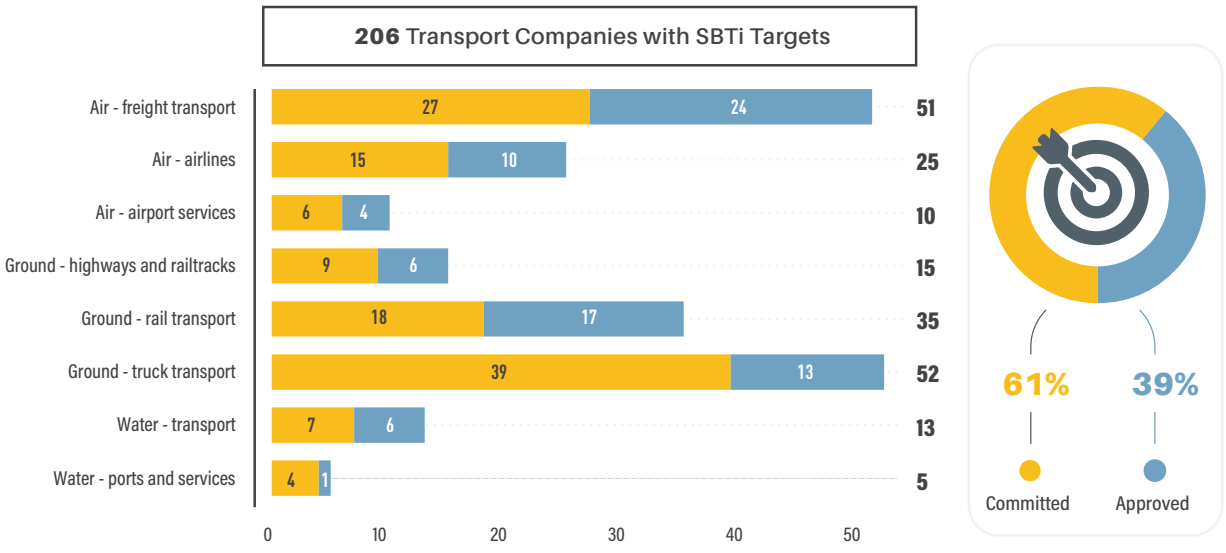
- As of March 2023, 206 transport companies had joined the Science Based Targets initiative (SBTi), of which 61% (125) had committed targets and 39% (81) had approved targets (see Figure 9).[49]
- However, a 2022 benchmark of 90 of the world's largest transport companies found that while 51% (46 companies) had set net zero goals, of those only 7% (6) had set interim targets between 2030 and their net zero year.[50]

A next frontier is for transport companies to commit to phasing out fossil fuels in the transport sector, which relies on oil-derived products for more than 90% of its energy and is more dependent than other sectors on the oil industry.[51]

- Of 90 benchmarked transport companies, only 7% (6 companies) have committed to phasing out fossil fuels: Deutsche Bahn, DSV, MSC Mediterranean Shipping Company, JD Logistics, NS Groep and ZTO Express.[52]
- Logistics firm DP-DHL has set a net zero target for 2050 as well as SBTi-approved 1.5°C-aligned targets for 2030, broken down between scope 1, 2 (42% reduction) and 3 (25% reduction) emissions; it has allocated EUR 7 billion (USD 7.5 billion), mainly for alternative fuels for air transport, expansion of the zero-emission electric vehicle fleet and climate-neutral buildings.[53]
- Dutch railway company NS Groep committed to both a net zero target and to phasing out fossil fuels, and has a business model for electrification and inter-modal transport to make this happen.[54]
- Singapore-based Comfortdel Gro, which offers car rentals, taxis, buses and light-rail transport, has SBTi-approved 1.5°C-aligned targets for scope 1, 2, and 3 emissions, backed by a detailed transition plan informed by scenario analysis; in addition, its board has climate change oversight and significant expertise related to the low carbon transition.[55]
- The UK's Royal Mail plc has set a 2045 new zero target along with executive incentives and a detailed low carbon transition plan informed by climate scenario analysis including a 1.5°C scenario.[56]
- Rail freight company ÖBB RCG has committed to carbon neutrality of its mobility sector by 2030 and of the entire company by 2040/50 through six key strategies; already, its rail operations in Austria, Germany and the Czech Republic are powered exclusively by green traction current.[57]

FIGURE 9. Transport companies with SBTi targets, by sector

Source: See endnote 49 for this section.



Action

A clear gap remains between transport companies' ambitions, as set in their targets, and the quality of their climate transition planning, with a variety of surveys and studies pointing to vast potential for improved action.

- Among the 930 transport services companies worldwide that disclosed to CDP in 2022, only 2 companies had climate transition plans that included all 21 of the indicators of a "credible plan"; meanwhile, 685 companies (74%) had plans that included fewer than 7 of the 21 indicators of a credible plan **(see Figure 10)**.[58]
- A transport benchmark that assessed 90 leading transport companies and the comprehensiveness of climate transition plans found that while most companies had elements of plans, half or less included specific targets, financial details or data around how to achieve them **(see Figure 11)**.[59]
- An assessment found that 2,000-plus transport companies scored an average of 48 out of 100 for environmental performance in 2022, with little difference between the scores of large companies (49.3) and small and medium-sized companies (47.7).[60]

Based on what companies have disclosed, it is evident that many may not have determined the actions or allocated the funding required to meet their targets. However, some companies have disclosed new business models and strategies that, if scaled across the sector, could have a significant impact.

- Of the 90 benchmarked transport companies, only 4 (4%) – CJ Logistics Corporations, MTR, Tokyu Corporation and NS Group – provided data on their current and future fleets, and only 5 (6%) provided information on research and development investments for low carbon technologies.[61]
- Of 27 benchmarked multi-modal companies, 22% (6 companies) have disclosed modal shifts.[62] The US Postal Service plans to switch its sub-contracted air operations to a ground fleet, and J.B. Hunt Transport Services has an agreement with a railway company to switch from road-only to inter-modal road and rail operations that are expected to be 2.5 times more fuel efficient.[63]
- Of the 90 benchmarked transport companies, 9% (8 companies) have disclosed plans to change demand patterns towards low carbon transport modes through, for example, route electrification or inter-modal transport; of these, 4 companies – Go-Ahead Group, J.B. Hunt Transport Services, NS Groep and UPS – have profitable and substantial business models.[64]
- In 2022, Amazon announced that it would invest more than EUR 1 billion (USD 1.1 billion) by 2027 towards fleet electrification, including tripling its electric fleet in Europe from 3,000 to more than 10,000 units by 2025.[65]
- Of 37 companies that offer multi-modal freight transport, 55% (20 companies) disclosed that they invest in **digital solutions** such as route optimisation and reducing empty kilometres, with UPS and Royal Mail plc reporting that these solutions reduce emissions.[66]

FIGURE 10. Transport companies with climate transition plans, by level of credible coverage

Source: See endnote 58 for this section.

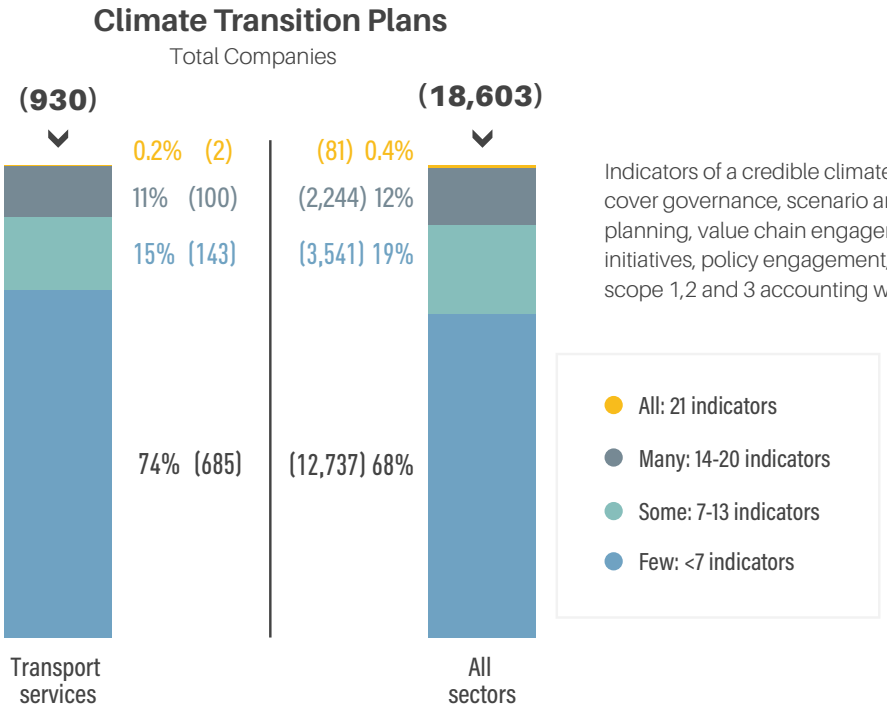


FIGURE 11. Comprehensiveness of climate transition plans of 90 transport companies

Source: See endnote 59 for this section.

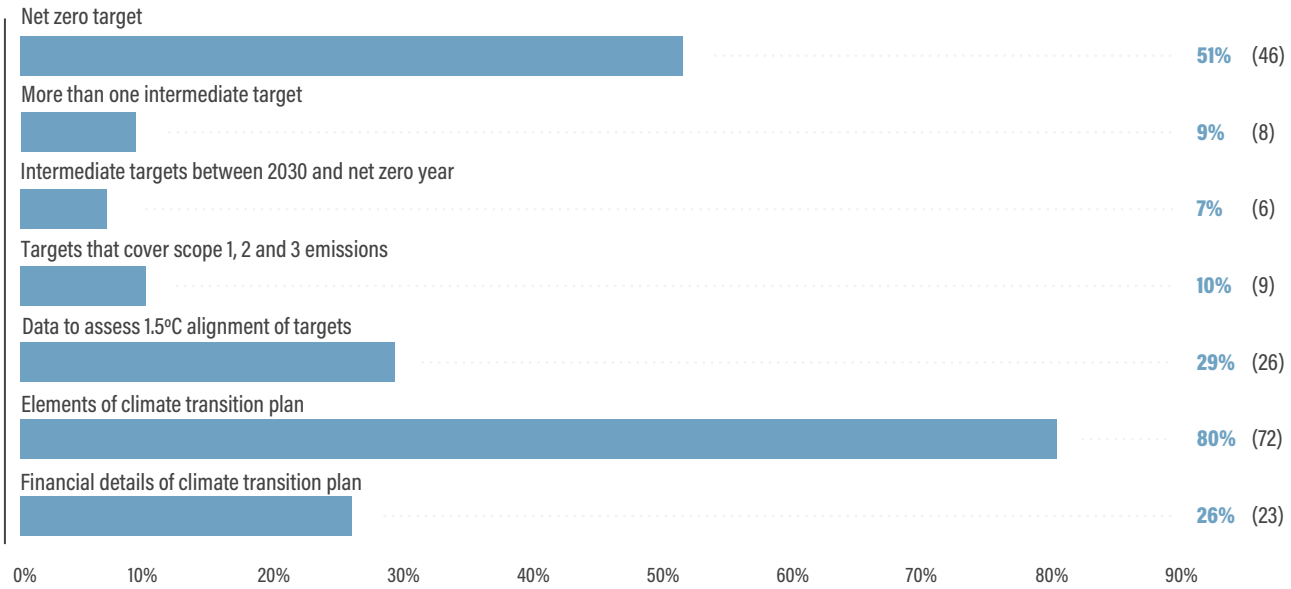
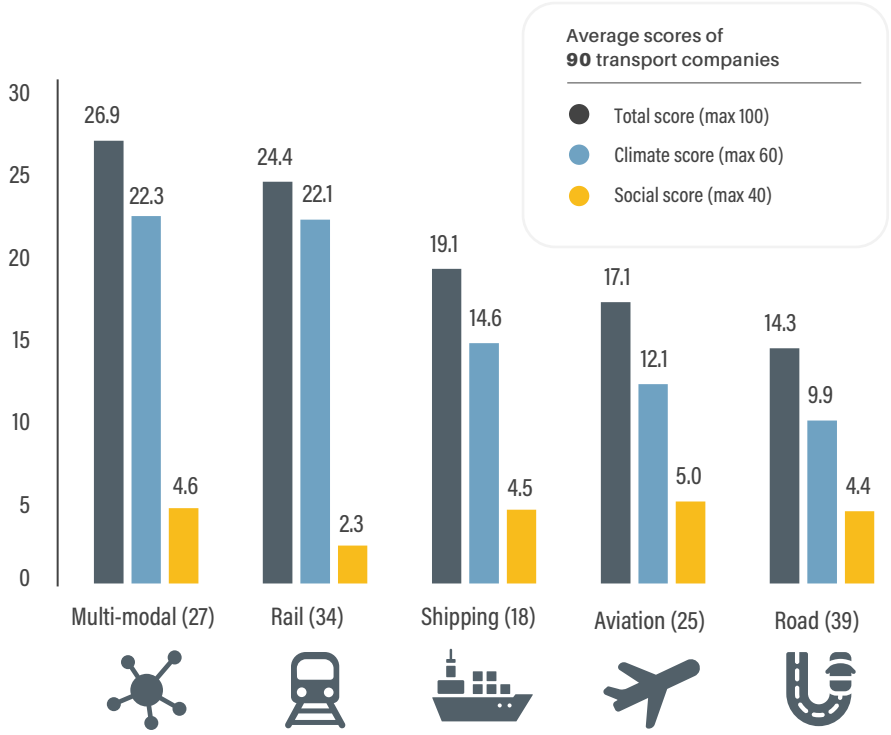


FIGURE 12. Average climate and social performance of 90 transport companies, by mode

Source: See endnote 67 for this section.



Globally, transport companies under-perform on the social side of climate and sustainability, including human rights, just transition, decent work and ethical conduct (see Figure 12), even though this is considered critical for the successful implementation of a climate transition plan.[67] Highlights in stakeholder engagement by 90 transport companies include the following.[68]

- None of the 90 companies cover planning for a **just transition** with time-bound targets, putting an estimated 10 million workers at risk.[69] However, 13% (12 companies) commit to **social dialogue** with workers, unions and other groups, and A.P. Moller Maersk notes its engagement with stakeholders including workers, unions, local communities, governments, civil society and multi-stakeholder initiatives.[70]
- In the survey, 38% (34) of companies undertake measures for **skills, training, and education**, including job opportunities for women and vulnerable groups (13%, 12 companies) and reskilling (7%, 6), with FirstGroup making a public commitment to reskilling and upskilling.[71]
- Among the 90 companies, 43% (39 companies) have **human rights policy** commitments, but only 3% (3) have a due diligence process covering human rights risks.[72] At the 2021 UN Climate Change Conference in Glasgow, UK (COP 26), the Maritime Just Transition Task Force was founded to look after seafarers in the transition towards a decarbonised shipping industry.[73]
- Among the 90 companies, 44% (31 companies) **engage with suppliers** on environmental issues that go beyond integrating climate considerations into the supplier code of conduct.[74] Of the 43 shipping and aviation companies surveyed, only 9% (4 companies) show evidence of working with manufacturers or fuel providers on low carbon vehicle research and development that has led to emission reductions.[75]
- Of the 44 companies with **sub-contracted activities**, 48% (21) have a strategy for working with sub-contractors to reduce emissions, despite 17 of these companies having a net zero target.[76] Deutsche Post DHL Group has a clear strategy for sub-contractors, including targets for alternative fuels and vehicles and a proven record of reducing emissions.[77]
- Of the total 90 companies, 48% (43 companies) have a strategy to **influence customers** to reduce emissions, for example through marketing campaigns or by offering customers low carbon alternatives; however, no company has set reduction targets for its customers.[78]

Advocacy

Inconsistent policy advocacy by transport companies risks delaying the climate action that companies need in order to meet their own emission reduction targets. Many of these companies are members of transport-related industry associations that tend to take a conservative approach to climate policy advocacy, particularly for shipping and aviation (see Table 3).[79]

- Around 54% (49 companies) of the 90 surveyed transport companies publicly support climate policies, but nearly half do not, despite many of them having climate targets and plans.[80]
- Only three companies – Maersk, Deutsche Bahn and Mediterranean Shipping Company – showed sufficient support for climate policy to be aligned with the low carbon transition.[81]

Accountability

Disclosure of climate-relevant information by large transport companies is becoming mainstream, with 930 transport service providers responding to CDP's climate change questionnaire in 2022.[82]

- Of 90 benchmarked transport companies, 84% (76 companies) had board-level oversight on climate change, but only 40% (36) had financial incentives tied to emission reductions for executives, and 10% (9) had such incentives for employees; only 6% (5) had significant climate change expertise at the board level.[83]
- The British transport service company FirstGroup offers incentives in the executive director's long-term incentive plan, with sustainability metrics accounting for 10% of this area of remuneration.[84]
- Hundreds of transport companies, as well as their customers, apply the **GLEC Framework**, the only globally recognised methodology to help companies harmonise the calculation and reporting of the logistics greenhouse gas footprint across the multi-modal supply chain.[85]
- **The new ISO 14083 standard on quantification and reporting of greenhouse gas emissions from transport operations, covering all transport modes, was released in March 2023 and is expected to increase and improve the quality of disclosure.**[86]

TABLE 3. Climate policy engagement among transport industry associations

Source: See endnote 79 for this section.

Industry association	Region	InfluenceMap rating	Engagement intensity
Airports Council International Europe (ACI Europe)	Europe	C-	26%
World Shipping Council (WSC)	North America	D+	33%
European Regions Airline Association (ERA)	Europe	D+	22%
European Community Shipowners' Associations (ECSA)	Europe	D	34%
Airlines For Europe (A4E)	Europe	D	49%

Note: The ranking (A+ to F) is a measure of how supportive or obstructive the company's direct engagement is towards climate policy aligned with the Paris Agreement. The engagement Intensity is a measure of the level of policy engagement by the company, whether positive or negative.

Companies that use transport

Companies are customers of transport through their own fleets and through public and freight transport services provided by third parties. Companies that have goods and products transported by third parties are also referred to as "shippers". These customers of freight can use their purchasing power to increase climate and sustainability ambition, advocacy, action and accountability for freight transport.

Ambition

More than 2,400 companies covering more than a third of the global economy's market capitalisation – including 43 transport manufacturers and 124 transport service providers – have approved science-based targets for reducing greenhouse gas emissions.[87] However, it is unclear how many of these companies have set specific transport-related emission reduction targets. Meanwhile, a growing number of companies have committed to decarbonising their fleets.

- **EV100** brings together more than 120 companies across 98 markets to transition their own or sub-contracted fleets of 5.5 million vehicles to electric vehicles, and to install charging infrastructure for employees and customers that will avoid 85 million tonnes of CO_2 by 2030.[88]
- In 2022, this was expanded with **EV100+** to cover zero-emission medium- and heavy-duty vehicles, sending a powerful demand signal to vehicle manufacturers and governments to accelerate the market scale-up worldwide.[89]
- The **Corporate Electric Vehicle Alliance (CEVA)** accelerates the deployment of zero-emission vehicles in the United States by aggregating demand, advocating for strong policies at multiple levels and sharing best practices on fleet electrification.[90] CEVA's 28 corporate members include Amazon, AT&T, IKEA, the National Grid and Uber, which collectively represent more than USD 1 trillion in annual revenue, and own, lease or operate more than 1.3 million on-road fleet vehicles in the United States alone.[91]
- Through the **First Movers Coalition**, shippers commit that by 2030 that they will: 1) use transport providers that only purchase zero-emission medium- and heavy-duty trucks; 2) ship at least 10% of goods internationally on ships using zero-emission fuels (and 100% by 2040); and 3) replace at least 5% of conventional jet fuel demand for air transport with SAF and/or zero-carbon emitting propulsion technologies.[92]

Photo: Ennis Schroeder / NREL

Action

Companies have taken actions related to their own fleets, including electric vehicles, biking and working from home.

- By 2022, **EV100** members had collectively deployed more than 200,000 electric vehicles and installed over 20,000 charging units at more than 3,000 locations, with 91% of members procuring at least some renewable energy for their chargers.[93]
- Research found that electric cars and vans could exceed 50% of new vehicle sales by 2032, with **electrified fleets** generating nearly half of those sales in certain more advanced geographic regions.[94]
- Companies have encouraged employees to **bike to work**, such as Tableau, Google, and Facebook in the United States, and an increasing number of companies are offering **work-from-home** opportunities, such as Amazon, Apple, Salesforce, and Wells Fargo.[95]

Shippers hold the key to making structural changes to freight transport by shifting to low carbon modes and reducing demand. Although statistics are lacking, numerous examples are available from leading shippers (see Table 4).[96]

Many companies have shown greater advancement in general energy-related measures than in tackling transport. In a survey of 129 supply chain executives, 71% stated that their business is undertaking environmental initiatives covering logistics warehousing, especially LED lighting (29%), followed by the use of alternative energy (22%), such as solar panels and ground-source heat pumps, but only 7% electric vehicles for delivery and distribution.[97]

TABLE 4. Strategies that shippers are using to "Shift" and "Avoid" emissions from freight transport

Source: See endnote 96 for this section.

Strategies	Examples from leading shippers
Revisit existing industrial processes and business models to reduce the number of freight movements.	■ **Interface** has been collecting and recycling post-consumer vinyl backed carpet tiles for over 20 years and produced its first 100%-recycled nylon carpet in 2010. ■ **Patagonia** introduced its Take-Back programme in 2021 to recycle old cotton products while supporting recycling chains for clothing waste.
Revamp industrial facilities and suppliers to reduce spatially fragmented supply chains.	■ **Cisco Systems, Schneider-Electric and Colgate-Palmolive** lead the Gartner Supply Chain Top 25 companies on excellence in supply chain management. ■ **LG Energy Solutions** (Republic of Korea) plans battery factories in Europe and US markets where demand is high.
Change logistics organisations and lower transport service levels to support the consolidation of flows and facilitate modal shift.	■ **IKEA** works with its transport providers and peers to reduce shipments and energy, replace with cleaner fuels and modes, and rethink the supply chain.

Advocacy

Policy advocacy to accelerate the uptake of electric vehicles has been strong among companies that have fleets and use transport services.

- Up to 78% of EV100 members believe that supportive policies from state, regional and city governments are vital to creating the right political climate for systemic change.16 Letters from EV100 members and supporting organisations to EU policy makers called for, among others, stronger CO_2 performance standards, sales of new buses to be zero emission by 2027 (and for new cars, vans and trucks by 2035), revision of the Alternative Fuels Infrastructure Directive to support more charging infrastructure, and exclusion of road transport from EU emission trading.[98]
- India's Ministry of Power issued guidelines for electric vehicle charging infrastructure in early 2022, which included four recommendations based on electric vehicle policy guidelines and an EV Ambition Statement initiated by the World Business Council for Sustainable Development (WBCSD) together with 30 companies.[99]
- Globally, nearly 800 companies called on government leaders to accelerate climate action, including the electrification of transport.[100]
- In Europe, it was mainly companies as transport customers that called for acceleration of the shift to electric fleets and for all new trucks sold to be net zero emissions by 2035.[101]

Industry associations that cover multiple sectors but also cover transport have tended to take a more conservative approach to climate policy advocacy, as shown for European associations **(see Table 5).**[102]

TABLE 5. Climate policy engagement among auto industry associations in Europe

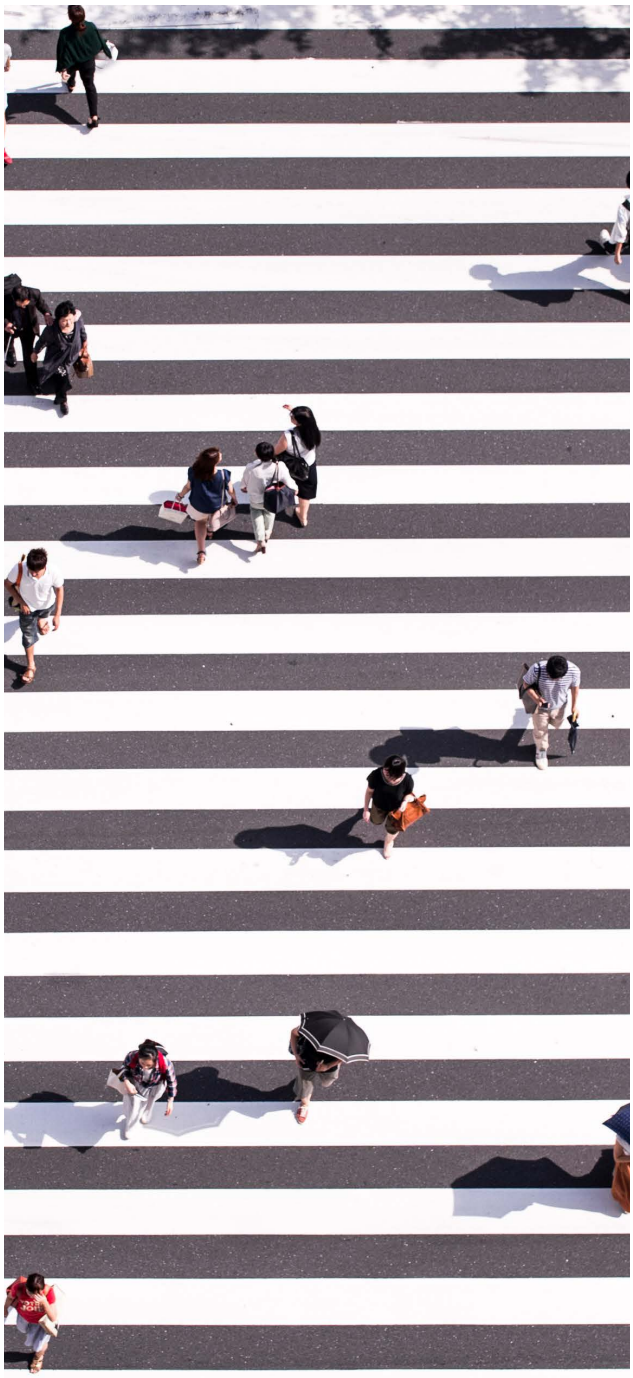
Source: See endnote 102 for this section.

Industry association	InfluenceMap rating	Engagement intensity
Corporate Leaders Group (CLG)	A	53%
Confederation of British Industry (CBI)	B+	36%
European Round Table for Industry (ERT)	C+	22%
Dutch Employers' Federation (VNO-NCW)	C-	27%
Mouvement des Entreprises de France (MEDEF)	D	38%
Spanish Confederation of Business Organizations (CEOE)	D	32%
Federation of German Industries (BDI)	D	60%
Confederation of Italian Industry (Confindustria)	D	54%
International Federation of Industrial Energy Consumers (IFIEC)	D-	34%

Note: The rating (A+ to F) is a measure of how supportive or obstructive the company's direct engagement is towards climate policy aligned with the Paris Agreement. Engagement Intensity is a measure of the level of policy engagement by the company, whether positive or negative.

Accountability

Although the disclosure of climate-relevant information by companies is becoming mainstream, little is known about the disclosure of companies (other than transport manufacturers and companies that provide transport services) on their transport emissions, targets and efforts to reduce emissions.[103] A 2019 survey of 2,604 companies concluded that disclosure is lacking, with just over 500 companies (around 20%) reporting scope 3 or supply chain emissions for transport, covering only 10% of global transport emissions.[104]



Opportunities to accelerate industry action

While many gaps remain to be addressed, there are three areas where the biggest opportunities lie to deliver on transport decarbonisation with strong support from businesses.

1

Improving business climate leadership can help prevent greenwashing, as leaders must follow through on their ambition with credible action, advocacy and accountability.

Setting science-based and other targets is not sufficient. The UN High Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities provided 10 recommendations for companies to ensure that pledges towards net zero do not lead to greenwashing.[105] Companies that do not have a plan yet can develop one using the ACT Step-by-Step methodology. To enhance the credibility of plans they can use CDP guidance to report on their plans, take part in global benchmarks and publish third-party reviews of plans.[106]

Companies can improve the comprehensiveness of their climate transition plans that detail emission reduction measures, how action is integrated in business governance and strategy, policy lobbying and advocacy efforts, and a just transition for the workforce, suppliers and communities.[107] For transport, actions should focus more on shifting and avoiding transport – through, for example, walking, cycling, public transport, fuller truck loads, local sourcing and working from home – while integrating gender considerations. Companies should balance out unabated emissions by purchasing only high-integrity carbon credits.

More companies should engage in policy advocacy, showing that business backs ambitious climate policy and bringing their expertise on what it will take to put it into practice. This includes:[108]

- Make a public commitment to advocate for ambitious climate policy and engage key stakeholders.
- Publicly advocate for bold science-based climate policies, and call out those that obstruct the 1.5°C pathway.
- Align the climate policy advocacy of a company's trade associations, alliances and coalitions with the goal of net zero by 2050.
- Allocate advocacy spending to advance climate policies, not obstruct them.
- Disclose how memberships, financial contributions and direct engagement on climate policy support own climate ambition and action, while reporting misalignments and plans to address them.

For enhanced accountability, companies should be pro-active in disclosing on climate before they are eventually forced by investors and regulators to do so.

- The **International Sustainability Standards Board (ISSB)** has a new climate disclosure standard to meet investors' needs for sustainability reporting, starting as early as 2024.[109]
- The **EU Corporate Sustainability Reporting Directive** will require large companies and all listed companies that operate in the EU to disclose on sustainability issues to inform investors and other stakeholders, from 2024 onwards.[110]

2

Companies can be leveraged for wider system change to complement technological changes and in responding to climate impacts.

There is an over-reliance on technology-focused "Improve" strategies, despite growing evidence that "Avoid" and "Shift" strategies can contribute to 40-60% of transport emission reductions at lower costs.[111] The Intergovernmental Panel on Climate Change has further identified 10 systemic changes for transport to complement technological changes that will also contribute to sustainable economies and societies more broadly: 1) changes in urban form, 2) investment in transit and active transport infrastructure, 3) changes in economic structures, 4) teleworking, 5) dematerialisation of the economy, 6) supply chain management, 7) e-commerce, 8) smart mobility, 9) shared mobility and 10) vehicle automation.[112]

Companies can bring unique expertise, innovation and financing to the table. For example, logistics companies are best placed to help redesign freight transport systems to facilitate a circular economy. In all of this, inclusivity is key, taking into account gender, race, and age and ensuring that small and medium-sized businesses in the transport sector are active participants in the transition.

Transport companies will be essential to help prepare the world for the impacts of climate change, in at least three main areas: 1) by supporting climate adaptation efforts through, for example, construction to strengthen infrastructure, or providing water with trucks/trains to drought-stricken cities; 2) by providing services for climate disaster relief, such as transporting food, medicines, and shelters, as well as transporting people to safer areas; and 3) by building resilience in supply chains to increasing disruptions, for example by switching from just-in-time to just-in-case supply chains.[113]

3

Companies can engage in more effective collaboration by complementing other stakeholders in climate and sustainability actions, working with all partners in the value chain, supporting just transition pathways for transport and joining initiatives that will truly help deliver the transition.

Several key opportunities exist for more effective collaboration.

First, companies should identify their unique roles alongside other stakeholders. The **Roadmap towards Zero Emission Logistics 2050** gives examples of complementing roles for different freight decarbonisation actions.[114]

Second, transport manufacturers and other companies should play to their strengths to mobilise change together with value chain partners:

- Support customers from transport, who cover virtually all sectors, to reduce their transport carbon footprint and to move towards circularity that includes the (re-)design of the transport system. Both manufacturers and logistics companies have hundreds of customers, both from industry and government, and virtually all small and medium-sized businesses are transport customers.
- Educate consumers about sustainability and climate to reduce transport emissions not only from (retail and online) purchases but also from the products they buy, as shops and online platforms provide a unique opportunity to communicate with consumers.
- Truly collaborate with suppliers in realising joint long-term climate and sustainability goals instead of allowing short-term contracts and lowest-cost suppliers to override sustainability decisions.

Third, companies should step up their role in the just transition through **Just Energy Transition Partnerships** (**JETPs**) or other country-level frameworks. In South Africa, the National Business Initiative led the development of just transition and climate pathways for transport together with the private sector and other relevant stakeholders.[115] South Africa's transport sector can decarbonise by 2050 via four key levers including improved spatial planning; mode-shift to rail and public transport; accelerated zero-emission technology adoption, coupled with the decarbonisation of the national grid; and use of green fuels for hard-to-abate aviation and shipping.

The IEA expects investments in clean energy to reach USD 1.7 trillion and to outpace the USD 1 trillion in fossil fuel investments in 2023, as investors turn to energy efficiency, electrification, and renewables, including in the transport sector. Factors contributing to this investment boom include the COVID-19 pandemic, the Russian Federation's war in Ukraine, and increasing concerns about energy security and climate change.[116]

Finally, ample coalitions, partnerships and initiatives on transport exist to support manufacturers, transport providers and customers on the road to a decarbonised transport sector. The key lies in pro-actively identifying those that can best help to deliver on a company's climate and sustainability goals.

Photo: ADB

BOX 1. The Role of Companies in Decarbonising Global Freight and Logistics

AUTHORS: Sandra Rothbard, Rik Arends and Tharsis Teoh – *Smart Freight Centre*

Achieving net zero greenhouse gas (GHG) emissions by 2050 will not be possible without major changes in global supply chains. Freight transport accounted for around 42% of the GHG emissions from transport in 2019, and these are projected to grow 22% between 2019 and 2050 under a business-as-usual scenario (if no further action is taken) (*see Section 1.1 Transforming Transport and Mobility to Achieve the Targets of the Paris Agreement and the Sustainable Development Goals*).[1] Freight transport is a key component of supply chains that connect businesses across the economy. Because nearly all companies have outsourced at least some of their logistics operations, their efforts to achieve net zero emissions would require assessing the entire value chain, which is a complex undertaking but could be achieved using existing programmes focused on operations.

Opportunities by transport mode

In the longer term, the decarbonisation of freight transport will be achieved mainly through the transition of the energy supply from fossil fuels to renewables. However, the development of sustainable fuels for maritime transport and aviation has been much more limited than for other modes. As of 2019, the GHG emissions from road and aviation freight – measured as well-to-wheel CO_2 equivalent emissions per tonne-kilometre – were higher than the emissions from rail, inland waterways and maritime shipping (see Figure 13).[2]

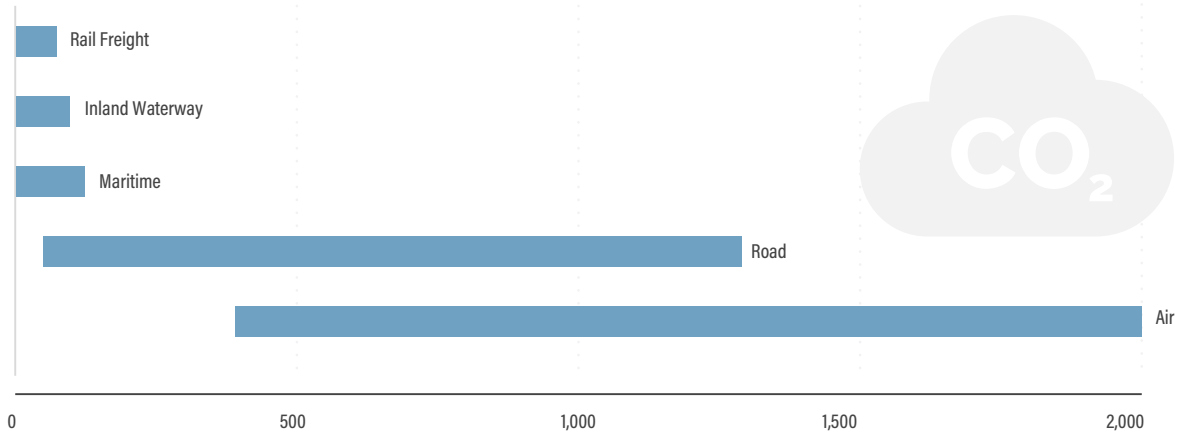
The International Energy Agency's scenario for net zero GHG emissions requires reducing transport CO_2 emissions (passenger and freight) 90% below 2020 levels by 2050, with the highest reductions being in road transport, followed by rail, shipping and aviation.[3] Freight transport emissions could be reduced 76% below 2020 levels by 2050 with policies that support higher operational efficiencies, optimised routing and asset sharing, freight consolidation, enhanced collaboration in supply chains, shifts to railways or inland waterways, standardisation and low-carbon solutions (*see Section 1.1 Transforming Transport and Mobility to Achieve the Targets of the Paris Agreement and the Sustainable Development Goals*).[4]

Rail: Already, around half of all rail freight activity is electrified (*see Section 3.5 Rail*).[5] Increasing the modal share of rail thus could be an opportunity to reduce overall emissions. Rail is expected to account for a growing share of non-urban freight activity, particularly over longer distances.[6] Companies can capitalise on existing rail freight networks by collaborating horizontally to consolidate shipments and by partnering with reliable intermodal operators. IKEA collaborated with partners on transporting goods on a 2,000-kilometre non-stop rail trip (round-trip from Poland to Spain), reducing the need for around 4,500 trucks.[7]

Road: Around 60,000 electric medium- and heavy-duty trucks were sold in 2022 (1.2% of all trucks globally), with around 85% of the sales taking place in China.[8] Electric light-duty vehicles made up 8.3% of global car sales in 2021.[9] By 2030, 40% of all new truck sales in Europe and the United States are projected to be zero emission, in line with the Global Memorandum of Understanding for Medium- and Heavy Duty Vehicles; this is more than the currently planned supply of vehicles.[10] Through the EV100 campaign, 121 companies worldwide committed to transitioning their fleets to electric by 2030, covering 5.5 million vehicles and

FIGURE 13. Indicative emission intensity ranges by transport mode (well-to-wheel grams of CO_2 equivalent per tonne-kilometre)

Source: See endnote 2 for this section.



potentially avoiding 85 million tonnes of CO_2.[11] Companies must begin now to develop the appropriate infrastructure, increase the sectoral expertise, and test new collaborative models with carriers, most of which are small and medium operators. Holcim, a company that creates building materials, announced a plan to deploy up to 1,000 electric trucks by 2030.[12]

Maritime: In 2023, the International Maritime Organization (IMO) adopted a revised strategy to reduce GHG emissions from international shipping at least 70% (and striving for 80%) below 2008 levels by 2040. This is a major improvement to the IMO's initial (2018) strategy that aimed only for a 50% reduction by 2050. Shipping lines must begin by calculating the Energy Efficiency Existing Ship Index and Carbon Intensity Indicator of their vessels. Deep reductions require the adoption of zero-emission fuels, which are not yet produced at scale. Companies should team up with carriers to swiftly implement efficiency measures such as slow steaming (slowing speeds to reduce fuel use), even if it affects product time-to-market, and prioritise the prompt deployment of low-emission fuels. Maersk is working to decarbonise its fleet by introducing carbon-neutral methanol-powered container vessels as of 2024.[13]

Aviation: In October 2021, the member airlines of the International Air Transport Association committed to achieving net zero emissions by 2050.[14] A year later, the International Civil Aviation Organization set a new long-term global aspirational goal of net zero carbon emissions by 2050.[15] Sustainable aviation fuels (SAF) and e-fuels have been promoted as solutions for achieving net zero emissions in the sector. SAF is produced from second-generation biogenic feedstocks (for example, waste products) but is constrained by limited availability, while e-fuels are produced synthetically and reduce CO_2 emissions up to 80%, although they are not yet produced at scale and remain costly.[16] Despite this, companies can make major changes now. Shipping companies should support the decarbonisation efforts of air freight carriers by choosing and paying premiums associated with carriers that use SAF, invest in fuel-efficient aircraft and optimise air traffic management. Boeing has launched a dashboard that tracks and projects SAF production.[17]

Approaches for companies to tackle emission reductions

Many companies today have a corporate social responsibility (CSR) plan – a business model developed in-house that outlines how the company will remain socially, economically and environmentally accountable. Despite good intentions, however, there is risk of simply "checking the box" and doing the minimum to comply with such standards and regulations. A disconnect is observed between the CSR targets of companies and their day-to-day operations focused on efficiency and cost.[18]

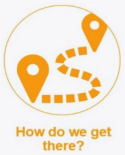
The Smart Freight Centre has developed a four-step framework to offer a systemic approach for companies to decarbonise global freight and logistics:

Report and calculate credible emissions across the multi-modal supply chain

Private sector entities, such as Unilever and DHL, understand their logistics footprint by using the guidance and calculation framework provided by the Global Logistics Emissions Council (GLEC) framework.[19] This is built on the GHG Protocol and meets legislative requirements, such as the monitoring, reporting and verification scheme from the IMO and the European Union's (EU) forthcoming Corporate Sustainability Reporting Directive requirements in 2024.[20]

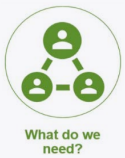
Set targets for emission reduction thatare sceince-based

Initiatives such as the Science Based Targets Initiative (SBTi) guide and vet the emission reduction targets of companies to ensure that they are consistent with the Paris Agreement.[21] Once targets are set, businesses can be held accountable and must adjust operations to achieve their goals. These external commitments also support internal alignment within the company to achieve said targets (see *Section 1.3.3 The Role of Business in Decarbonising Transport*).



Reduce emissions by implementing solutions as buyer or supplier

Across all modes of freight, companies are implementing operational changes to decarbonise supply chains by increasing filling rates, reducing empty kilometres and optimising their logistics systems. Currently, substantial under-utilisation of vehicle capacity exists, with 20% of truck-kilometres running empty in the EU.[22] By working together, multiple businesses can share vehicles to save space and money. Digitalisation and operational improvements can greatly reduce emissions and energy consumption through improvements in efficiency.



Collaborate and advocate for sector-wide and supportive policy

Decarbonisation of transport is a systemic change that will require alignment, co-operation and even active collaboration by shippers, logistics actors, solution providers and policy makers. Highlights of collaborations among SLOCAT partners to help freight businesses track and reduce their emissions include:

Smart Freight Centre's Clean Cargo advances the decarbonisation of container logistics through partnerships among ocean container carriers, freight forwarders and cargo owners.[23]

ICLEI EcoLogistics advances effective regulatory, planning and logistical instruments at all levels of government to support low-carbon urban freight.[24] Participating cities develop viable alternatives to low-quality, diesel-powered freight vehicles, particularly for last-mile logistics.

Polis Network's Urban Freight Working Group encourages public-private strategic dialogue to identify collaborative solutions for clean and efficient urban logistics, bringing together cities, countries and companies.[25]

Sustainable Freight Buyers Alliance brings together freight buyers and suppliers to provide exposure to projects, scale solutions, and streamline procurement, supported by regional programmes in China and India.[26]

MODULE 1 **SPOTLIGHT 4**

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Shortening Global Supply Chains as a Key to Decarbonising Transport

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Key findings

The historical development of global supply chains: past drivers

- In the past 50 years, the length and fragmentation of supply chains have exploded due to new manufacturing, transport and logistics, and communication technologies, as well as international economic regulations related to trade liberalisation.
- Today, international production is highly organised within global value chains, where the different stages of the production process are located across different countries. As of 2021, an estimated 70% of international trade involved global value chains.
- These drivers enabled an internationalization of supply chains in offering new business opportunities to increase profits, access new markets and reduce costs due to international trade competition.

Recent disruptions to global supply chains revealed vulnerabilities

- The global financial crisis of 2007-08 and the multiple recent events of 2020-22 such as the COVID-19 pandemic, the Russian Federation's invasion of Ukraine, and the blockage of the Suez Canal caused supply shortages, raising awareness of the fragility of global supply and logistics chains and their international dependencies. These disruptions resulted in the Global Supply Chain Pressure Index recording an all-time high value of 4.3 above the historical average of 1997 to 2022.
- These past drivers and system organisation led supply chains to become more vulnerable to external disruptions.

The future of global supply chains: a changing context

- In the future, an ongoing changing context could lead to more regional value chains that are closer to customers, corresponding to a shortening of global supply chains.
- Key structural changing drivers include a shift in economic policies towards protectionism of employment and industries; changes in the international security context to reinforce security of supply and value chain independence; rising pressures to reduce carbon emissions; and the continuous evolution of manufacturing technologies.

Perspectives for the international climate co-operation agenda

- A review of the long-term strategies of the five leading economies – China, India, Japan, the United States and the EU – published between 2020 and 2022 found that none of them mention phrases related to shortening supply chain distances, reducing freight movements or reducing long-distance freight, shifting supply chains closer and developing local production-consumption ecosystems. This reveals an important gap between science and policy.
- These changes are overlooked in existing international climate discussions and are not taken enough into account by companies in their long-term climate strategies.
- The possibility of a reduction of movements and distances should be considered as a core component of any realistic freight decarbonisation strategy to reach zero emissions by 2050. This demand-side component of the strategy should be articulated with necessary technological changes in a coherent systemic change.

- In the perspective of the first Global Stocktake (2022-23) and future revisions of countries' Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement, an international climate policy agenda on identifying barriers and enablers for strengthening international co-operation towards shorter and more resilient supply chains should be opened. Critical international co-operation activities should help to discuss opportunities and issues related to the changing context, and co-ordinate collective action to avoid unilateral and unfair decisions.

Introduction

Global freight transport activity, measured in tonne-kilometres, grew 68% between 2000 and 2015 and is projected to further increase 2.0 times from 2019 to 2050.[1] If unchecked, this growth poses a critical challenge to efforts to decarbonise freight transport.[2] Key to addressing this challenge is to consider the role of structural and systemic factors, and their interaction with technology factors, in the effort to reach net zero emissions.[3] International trade and the geographically long global supply chains of many industries have contributed greatly to the rapid increase in emissions from freight transport.[4]

This spotlight complements *Spotlight 4 - The Role of Companies in Decarbonising Global Freight and Logistics*. While Spotlight 4 delves into decarbonisation trends pertaining to global supply chains across different transport modes, this spotlight focuses on the historical evolution of global supply chains, recent disruptions and future outlooks.

In the wake of the global financial crisis of 2007-2008, the factors that have traditionally determined the geographical organisation of supply chains (see Box 1) have changed.[5] More recently, supply crises related to the COVID-19 pandemic and the Russian Federation's invasion of Ukraine have raised awareness about the interdependencies and resiliency challenges related to global supply chains. At the same time, ongoing shifts could accelerate reductions in the lengths of supply chains.

Given that technological solutions for reducing freight transport emissions – such as zero-emission vessels, aircraft and long-distance trucks – are still far from maturity, it will be necessary to give greater attention to the systemic reorganisation of global supply chains in the effort to reach net zero emissions, and to minimise risks to industry during the energy transition.[6]

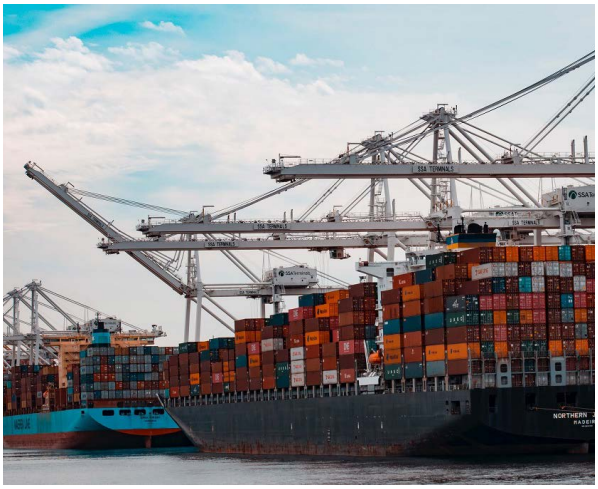
BOX 1. Five key determinants of the geographical organisation of supply chains

Traditionally, five key factors have determined the structure of supply chains, although these factors vary depending on the value chain as well as on the step of the value chain being considered. They are:

1. **Labour costs and other non-economic labour-related regulations**
2. **Sunk investment costs and public investment incentives**
3. **Trade and transaction costs and non-economic transaction-related regulations**
4. **Access to know-how/talents, technologies, infrastructure and supply sources**
5. **Access to distribution markets, transport and logistics costs and lead time.**

These five determinants also can depend on the relative cost structure and final price of the products, on the degree of reliance on extractive industries, and on the modularity of the production process, among others. Understand these five determinants makes it possible to better analyse the underlying changes that are affecting global supply chains.

The historical development of global supply chains: past drivers

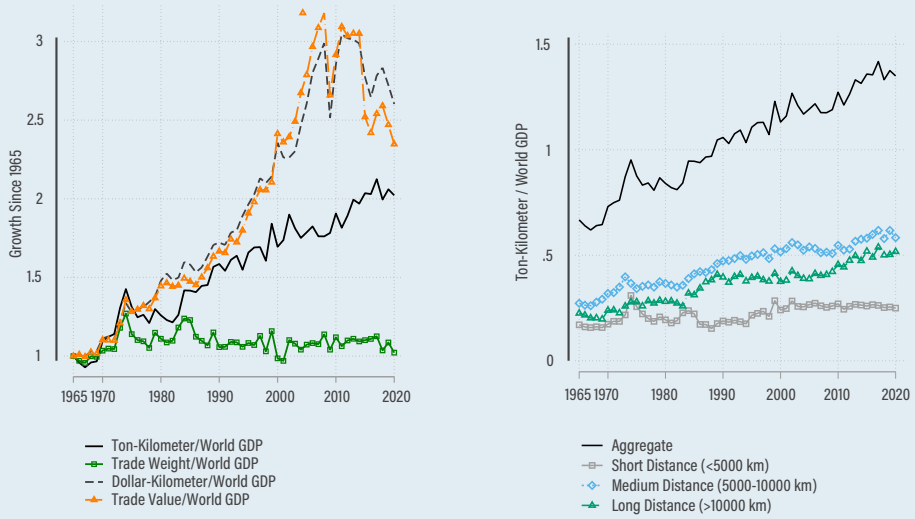


Historically, supply chains were shorter and simpler, typically located in a small geographic area and stretching only as far as a few kilometres. Longer-distance, international supply chains were needed only for specific processes that were not available in all countries, such as natural resource extraction or agricultural production. More recently, however, global supply chains have evolved dramatically (see Box 2)[7].

BOX 2. Historical development of global supply chains

Starting in the mid-1980s, the development of global value chains with very long and scattered supply exploded. Companies started to offshore parts of their supply, production, operations and service processes, adding longer distances, more steps and additional time zones to the production process. From 1965 to 2020, the average distance of one internationally traded tonne almost doubled (see Figure 1). During this period, the number of international tonne-kilometres traded grew 120% for longer distances (more than 5,000 kilometres), but it grew only 45% for shorter distances (less than 5,000 kilometres).

FIGURE 1. The role of longer distance trade, 1965-2020



Source: See endnote 7 for this section.

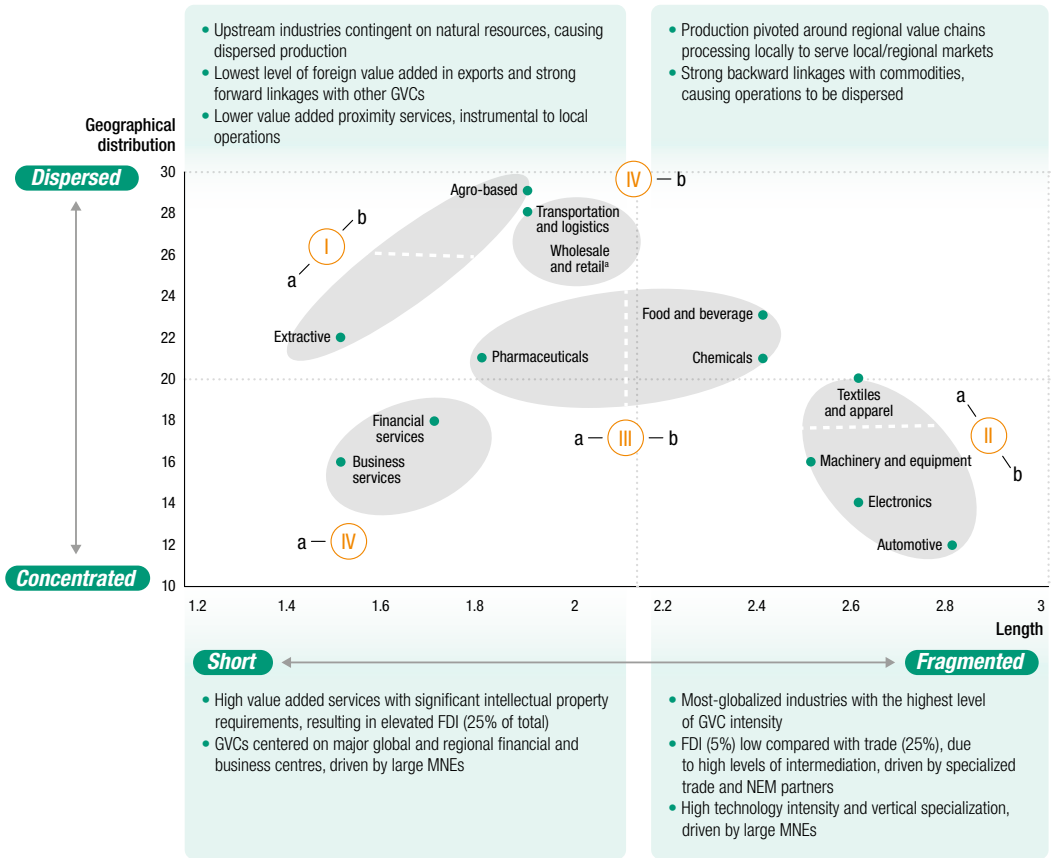
Today, international production is highly organised within global value chains, where the different stages of the production process are located across different countries.[8] As of 2021, an estimated 70% of international trade involved global value chains.[9] Figure 2 characterises the current organisation of value chains according to their geographical distribution and length. This helps to identify four main industry types (I to IV): primary industries (low or high capital intensive), global value chain-intensive industries (low or high tech), geographically distributed industries (global or regional hubs) and services industries (low or high value added).[10] The industries with the longest and most fragmented global value chains are chemicals, electronics, automotive, machinery and equipment, textiles and apparel, and food and beverages.[11]

Several important transformations have influenced the determinants of the geographical structure of supply chains (see Box 1). They include the development of new manufacturing, transport, and communication technologies, as well as international economic policies related to trade liberalisation.

- For example, advanced manufacturing technologies facilitated the scattering and offshoring of production processes; new communication technologies enabled complex cross-border co-ordination; and the containerisation of shipping contributed to lower transport costs.[12]
- On the policy side, economic liberalisation and the development of international and multilateral trade agreements after World War II contributed to the reduction or elimination of tariffs, quotas, preferences and other trade barriers.[13] The General Agreement on Tariffs and Trade (GATT) grew to cover more countries, goods, and activities, leading in the 1990s to the creation of the World Trade Organization, involving more than 125 countries. Global competition among firms and economies led to dedicated national investment policies and export-oriented industrial policies.[14]

FIGURE 2. Length and geographical distribution of international production, by key industry type

Source: See endnote 13 for this section.



Recent disruptions to global supply chains: revealed vulnerabilities

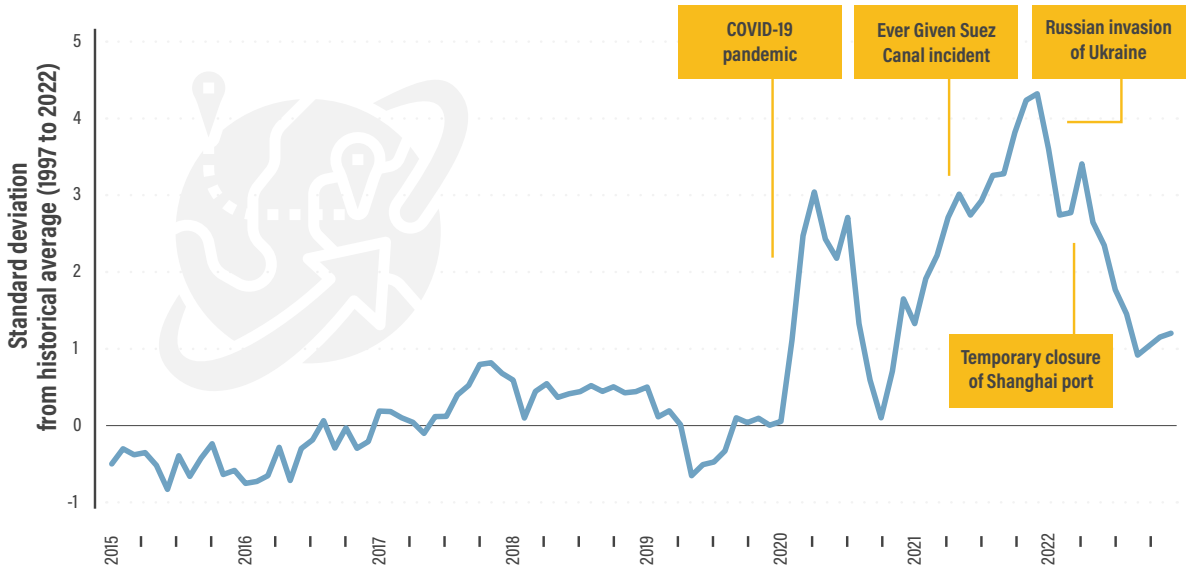
Business decisions to increase profits, reduce product costs and access new markets created additional complexity in the scattering of value chains and increased their physical distance. Combined with manufacturing innovations such as just-in-time inventory management, global supply chains have become more vulnerable to external disruptions.

In recent years, multiple crises such as the COVID-19 pandemic, the Russian Federation's invasion of Ukraine, and the blockage of the Suez Canal caused supply shortages, raising awareness of the fragility of global supply and logistics chains and their international dependencies. These disruptions resulted in the Global Supply Chain Pressure Index recording an all-time high value of 4.3 above the historical average of 1997 to 2022 (see Figure 3).[15]

- The COVID-19 pandemic created supply shortages related to higher demand for medical and pharmaceutical goods such as face masks, protective gear, respirators, tests, medications and vaccines. The crisis led many to question the locations where critical safety- and health-related products are made, and the commercial rules surrounding them, for national security reasons.[16]
- The pandemic also raised awareness about the huge role that China's economy and ports play in global supply, particularly after the entire port of Shanghai was shut down for two months in 2022 due to high COVID-19 incidence.[17]
- The Russian Federation's invasion of Ukraine led to a critical shortage in the global trade of cereals, revealing the strong dependency of grain markets on this region of the world.[18]
- The grounding of the *Ever Given* container ship, which blocked the Suez Canal for a week in March 2021, created delays in global supplies along the largest container route for Asia-Europe trade.[19] This incident, caused by a sand storm and strong wind, provided a reminder of the vulnerability of international trade to extreme weather. As climate change increases the frequency and intensity of extreme weather events, closures of key trade chokepoints could increase.[20]

FIGURE 3. Global supply chain pressure index (higher value means higher pressure), 2015 to 2022

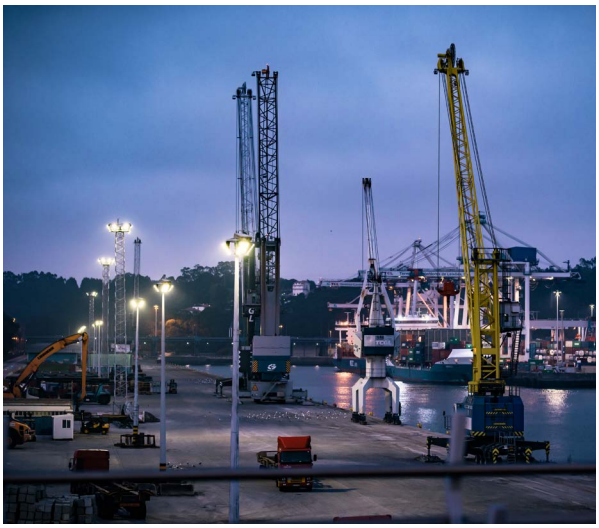
Source: See endnote 16 for this section.



The future of global supply chains: a changing context

As both companies and policy makers express rising concerns about resiliency, many are considering associated strategies to relocate production facilities and suppliers closer to customers.[21] A growing literature has emerged around reshoring (when manufacturing activities return to their initial country of origin) and nearshoring (when manufacturing is relocated to a country that is closer to "home").[22]

Increasingly, the key factors determining the geography of supply chains (see Box 1) are changing, which could lead to greater regionalisation of international trade and a shortening of supply chains. According to a 2019 analysis, a reduction in the average length of supply chains began in 2012.[23] Four structural changes are contributing to the reduced distances for value chains and international trade.



1

The shift in economic policies from market liberalisation towards protectionism

Since the global financial crisis of 2007-2008, the international economic policy agenda has shifted towards the development of protectionist measures among the G20 economies, contributing to the recent trade wars between the United States and China.[24] Between 2010 and 2020, at least 110 countries increased the adoption of both formal industrial policies and individual policy measures related to protectionism. These policies were aimed at job creation and economic development but also reflected efforts to support achievement of the Sustainable Development Goals.[25]

- In 2022, the US Inflation Reduction Act created tax credits for the domestic production of specific goods and for building and maintaining new factories in the United States.[26]
- Recent trade policies reflect the rapid proliferation of regional trade agreements that use local content requirements to require manufacturers in the region to source goods and services produced in member countries.[27]

2

Changes in the international security context to reinforce security of supply and ensure the independence of critical value chains

New investment restrictions or regulations in recent years have reflected concerns about national security and foreign ownership of technology firms, strategic assets, and land and natural resources.

- In the European Union (EU), the adoption of the Directive on Cross-Border Mobility expanded the screening of foreign investments in European companies and takeovers.[28]
- In 2017, the EU launched a USD 7 billion plan for German and French firms to jointly produce batteries based on the model of Airbus, including through USD 1.5 billion in public subsidies targeting this strategically important industry.[29]
- In the wake of the COVID-19 pandemic, governments re-launched national subsidies for specific pharmaceutical goods.[30]

3

Rising pressures to reduce emissions

Since the Paris Agreement in 2015, environmental concerns related to the impact of human activities on climate change and biodiversity loss have grown in importance. As of 2022, more than 58 countries and one-fifth of the world's largest companies had committed to reaching carbon neutrality.[31] Governments have been pushed to act by adopting more and better sustainability policies.

- In 2022, the European Commission adopted the European Carbon Border Adjustment Mechanism, the first climate-oriented border tariff on imports of carbon-intensive industrial products.[32]
- The EU regulation on deforestation-free supply chains, adopted in 2022, reinforces control and transparency in the value chains of specific agricultural products to ensure that they do not contribute to additional deforestation.[33]

Businesses are turning to life-cycle assessments to measure the environmental impacts along the value chain for each step of a product's life cycle, from production to transport, distribution and disposal. The Smart Freight Centre's Global Logistics Emission Council (GLEC) Framework is the only globally recognised methodology to help companies harmonise the calculation and reporting of the logistics greenhouse gas footprint across the multi-modal supply chain.[34]

4

New manufacturing technologies

Finally, new manufacturing technologies such as automation and additive manufacturing have impacted industrial production costs by favouring reshoring and nearshoring. However, innovations in communication technologies such as 5G, cloud computing and artificial intelligence could have the opposite effect on the length of value chains.[35]

Perspectives for the international climate co-operation agenda

The international scientific community has noted that "systemic changes" related to transformations in structural demand could play a large role in keeping global temperature rise below 1.5 degrees Celsius (°C). A key recommendation is for the transport sector to better articulate the needed transformations related to supply chain management, which include reducing movements and distances, alongside technological changes.[36] However, a review of the long-term strategies of the five leading economies – China, India, Japan, the United States and the EU – published between 2020 and 2022 found that none of them mention phrases related to shortening supply chain distances, reducing freight movements or reducing long-distance freight, shifting supply chains closer and developing local production-consumption ecosystems. This reveals an important gap between science and policy.

The international strategy for reducing maritime greenhouse gas emissions, which were responsible for 10% of all transport CO_2 emissions in 2019, is a good example of this disconnect.[37] The demand for international maritime transport has increased from around 4,000 million tonnes of goods transported in 1990 to more than 11,000 million tonnes in 2022, with an increasing average geographical distance of trips. Maritime transport emissions have increased proportionally and rapidly until 2010, and they now hover at around 1 gigatonne of CO_2 following a decade of energy efficiency gains; however, maritime emissions

have not yet begun to decrease in line with international targets to reduce them 50% between 2008 and 2050.[38] The International Maritime Organization is supposed to revise this target in 2023 with targets that are aligned to the Paris Agreement and can enable decarbonisation of the shipping sector.[39]

Despite the need to accelerate efforts to curb maritime emissions, current strategies in the sector are focused on the technological fuel shift as a silver bullet, after having acknowledged that operational and technical energy efficiency measures on ships were insufficient. Consequently, national and international policy action in 2021 and 2022 to tackle emissions was focused on the fuel shift and related investments, including changes to vessel motors, fuel supply at ports, and energy production and supply (Green Shipping Challenge, Clydebank declaration, Global Maritime Forum's call[40]).

However, as described in this spotlight, the context is changing and this may impact the future geographical configuration of supply chains. The possibility of a reduction of movements and distances should therefore be considered as a core component of any realistic freight decarbonisation strategy to reach zero emissions by 2050. This demand-side component of the strategy should be articulated with necessary technological changes in a coherent systemic change. Furthermore, failing to analyse and anticipate what will be the future of the international production organisation could be risky and raises questions for ports, ship owners and energy providers investing in the sector, including:

- What will be the future geographical structure of maritime routes? How will existing routes be affected?
- If the route lengths are changing, how will that affect the technological choices in ships and related energy supply?

If future routes are located elsewhere, how will that affect the estimation of traffics and investments in ports? There were very few explicit mentions of freight-related actions in both generations of the Nationally Determined Contributions (NDCs) towards reducing emissions that countries had submitted under the framework of the Paris Agreement as of 2022. Only 5% of all mitigation actions referred explicitly to freight transport[41]. The most popular freight actions in the second generation of NDCs included a shift from road transport to rail or inland waterways, freight efficiency improvements and freight vehicle improvements. An example on freight action in the United Arab Emirates' second NDC outlines plans to build the 1,200 kilometre Etihad Rail network, of which the first stage of 264 kilometres has been operational for freight since January 2016; it replaces around 300 trucks with a single train journey and reduces CO_2 emissions 70-80%.[42]

An international policy agenda is needed to work on identifying barriers and enablers for strengthening international co-operation towards shorter and more resilient supply chains. Critical international co-operation activities should help to discuss opportunities and issues related to the changing context, and co-ordinate collective action to avoid unilateral and unfair decisions.

In the perspective of the first Global Stocktake (2022-23) and future revisions of countries' Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement, the regionalisation of supply chains closer to customers should be better integrated.

Actions to Reduce Emissions and Boost the Resilience of Freight Transport and Global Supply Chains: SLOCAT Guidelines for NDCs[43]

To secure their place in the future net zero economy, countries can use their Nationally Determined Contributions submitted under the Paris Agreement to set their freight transport and logistics systems on track to become net zero and resilient. Some key elements of a NDC that enables impactful action on decarbonisation and resilience of freight transport and global supply chains include:

Set robust freight transport targets seeking to:

- Reduce freight transport emissions
- Ensure that a certain share of goods is transported via rail or waterways
- Mandate a share of fuels for trucks supported by renewable energy
- Transform infrastructure

Include mitigation actions for freight transport structured by the Avoid-Shift-Improve framework:

- Avoid and reduce the need for motorised travel
- Shift to more sustainable modes
- Improve transport modes

Adapt freight transport with measures that improve the resilience of infrastructure, including:

- All-weather roads and general flood protection
- Ports that account for sea-level rise and extreme weather events
- Early warning systems
- Multiple and shorter supply chains
- Plans for alternative freight transport

Feature actions to achieve more ambitious international maritime and aviation transport targets and measures.

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SPOTLIGHT 2 TRANSPORT ADAPTATION, RESILIENCE AND DECARBONISATION IN SMALL ISLAND DEVELOPING STATES

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SPOTLIGHT 4 SHORTENING GLOBAL SUPPLY CHAINS AS A KEY TO DECARBONISING TRANSPORT

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