CLIMATE ACTION PATHWAY

Transport

Executive Summary

2020

Global Climate Action
United Nations Climate Change

Marrakech Partnership
Global Climate Action

VISION STATEMENT

By 2050, transport will be decarbonized by shifting to a more sustainable and diverse range of modes and vehicle technologies for both passenger and freight movement. The shifts will be made in a phased manner over a number of milestones, including higher market shares of low- and zero-emission vehicles and modes (such as rail, public transport, walking and cycling), vessels and aircraft (including electric, hydrogen and hybrids), leading to all transport modes being completely decarbonized by 2050. Light-duty vehicles and railway trains are completely electrified, whereas heavy-duty vehicles use a mix of batteries and liquid zero-emission fuels. For shipping and aviation, electrification is employed on short routes whereas liquid fuels are used on longer routes. The production of zero-emission fuels has resulted in significant economic development for numerous nations worldwide, with “clean and quiet” replacing “noisy and polluting”, for the benefit of all.

Society is thriving due to the improved efficiency and inclusivity of transport systems, which have not only increased mobility and accessibility, but have also decreased road fatalities, injuries and local air pollution. Improved systems have increased gender equality in transport infrastructure design and services to cater to different travel patterns and behaviour, such as improving safety measures for women using public transport to limit harassment faced by almost 100 per cent of women users, introducing operation times that meet women’s travel times which are not the conventional peak hours, removing barriers for women to non-motorized transport modes, and creating flexible modes that address the fact that women travel shorter distances and make more trips. These actions will be enabled through a more diverse and gender- balanced workforce in land, aviation and maritime transport. Society will also see an increase in physical activity and health benefits due to high usage of non-motorized transport. Optimized supply chain networks have improved the efficiency of freight transport. Institutional, legal and regulatory frameworks are in place to drive sustainable and climate-resilient mobility technologies and generate outcome-oriented investments and incentives.

On a systematic level, the challenges of the first and last mile of transport have been resolved with affordable and accessible door-to-door mobility services for both freight and passenger transport. Seamless transport solutions, enabled by the advancement of technology, will facilitate multi-modality for a more interconnected transport system. Accessibility is further enhanced in urban and rural areas, as well as in rural–urban connectivity.

In cities, walking, cycling and other forms of active mobility, along with existing and novel forms of public transport and app-based mobility services, such as shared mobility, account for large shares of urban mobility due to significant changes in travel patterns, behaviours, investments and policies. The latter are enabled by the integration of land-use and transport planning that has reduced per-capita travel distance. Car ownership decreases significantly in urban areas, triggered by the implementation of economic instruments and regulations alongside investments in quality public transport and other forms of mobility services. Urban fleets and logistics are zero-emission.

By 2050, appropriate financing and funding frameworks will be developed. Financing for sustainable transport will be significantly scaled up, together with the promotion of diversified funding sources, incentives and coherent fiscal frameworks to advance sustainable transport at all levels. These will also include the availability of international funding, especially for developing countries, as well as the engagement of the private sector to develop innovative business models. It is critical for individual countries to identify their own pathway to decarbonize their transport sector, based on their existing or potential constraints, challenges and policy priorities.

New and existing transport infrastructures have been made resilient to the impacts of climate change in line with projections and are more resilient to extreme weather conditions and other forms of disruptions, including health pandemics or changes in technology. Maintenance is prioritized to maximize operational resilience; extreme weather warning systems and contingency plans are in place; and flexible and adaptive infrastructure allows modification as conditions change. In addition, appropriate governance structure is in place to share information, knowledge and data in times of crisis. Monitoring systems and effective data management inform timely and effective management. Interdependencies are understood and addressed to reduce exposure. Embedded system-level resilience supports a smooth transition to another mode if conditions preclude use of the intended mode. Particularly vulnerable communities will benefit from appropriate capacity-building, as well as access to finance and technology for climate change adaptation and resilience-building.

SYSTEM TRANSFORMATION SUMMARY

In transport, decarbonization can occur through a mix of actions that focus on avoiding unnecessary trips and reducing travel distance, shifting to zero-carbon modes, and improving vehicle, aircraft or vessel and fuel efficiencies, such as the electrification of modes and the use of liquid-based zero-carbon fuels. Ensuring the resilience of transport systems is also a key priority. Rail transport is already largely and increasingly electrified, but further innovation and investment will still be needed to make it fully zero-carbon, with both battery and green hydrogen cells technology being part of the solution. The electrification of light-duty vehicles is progressing rapidly, and more affordable and advanced battery technology will play a role for heavy-duty vehicles and short-haul shipping and aviation. A mix of different fuel technologies is expected to be used by different countries based on their preferences and priorities.

In land transport, the pathway to zero carbon is feasible. It is estimated that about 85 per cent of CO_2 emission reductions needed to meet the 1.5°C target can be achieved with existing and emerging policies and technologies, such as electrification and efficiency improvement. Approximately 15 per cent can be met with changes in behaviour, such as reductions of distance travelled, through the expansion of teleworking and integrated land-use and transport planning, and by shifting to more sustainable modes, such as walking, public transit and biking. Therefore, the road to zero carbon will require a smart combination of these strategies.

Progress is under way, and achieving 100 per cent electric vehicles in new car sales is achievable by 2035 in leading markets such as China, Europe, Japan, and the United States. Electric vehicles are a proven technology for light-duty vehicles, buses, small or medium trucks used for urban logistics, and other short-distance or intra-city freight transport. Long-haul heavy transport decarbonization is likely to be enabled by a broader portfolio of technology solutions combining electrification and hydrogen fuel cells. Modal shifts can be achieved with urban (re)development and investments in new infrastructure, linked with integrated urban planning, transit-oriented development, and more compact urban form that supports public transport, cycling and walking. There is an urgent need to promote a global dialogue among all actors that are currently engaged in building the capacity of countries to take climate change action in this area. In doing so, it will help facilitate the design and implementation of effective public transport interventions to enable the sector to be zero carbon and provide an inspiration for action to scale up local and national efforts by 2040.

In finance, there is a need for increased local, national and international funding and climate support for sustainable transport. Institutional investors can also play a role in accelerating the shift to zero-carbon options. To trigger changes in the development of zero-carbon technologies, policy measures include national, regional and city governments setting targets for electrification of modes including a shift to 100 per cent zero-emission vehicle sales in leading markets, providing financial incentives, developing zero-emission zones in cities and regions, and developing strategies that encourage behavioural changes. Business decisions to accelerate the shift to zero-carbon options include original equipment manufacturers (OEMs) committing to the electrification of the sector, as well as investments to diversify the models and segments and to provide economic opportunities for new players, start-ups and small and medium-sized enterprises developing e-mobility solutions.

By 2030, the leading markets should aim to achieve 75 per cent of new light-duty vehicle sales to be zero carbon. This level of penetration is deemed to be the tipping point required to enable rapid adoption in the following years and full transition to zero emission vehicles by 2035 in leading markets. The leading markets should also target 100 per cent of new bus sales and 40 per cent of new truck sales to be zero carbon by 2030 for the same reasons. Recommended actions to reach these targets are detailed out in the action tables of Transport pathway for actors in policy, finance and investments, business, and civil society.

In shipping, feasible fuel pathways exist, but accelerated action and cross-industry collaboration are needed to accelerate research and development (R&D) and realize large-scale system demonstrations by 2025. Emissions from shipping currently amount to ~0.9Gt CO_2, almost 3 per cent of global emissions, but could grow by 84 per cent under a "business as usual" scenario. Lack of regulation and growing demand from customers, as well as a fragmented industry, excess capacity and short investment horizons, have led to the industry making limited progress to date in decarbonization. Operational efficiency measures can reduce emissions by 30 to 50 per cent, but zero- carbon fuels are needed for full decarbonization. There is growing evidence that green ammonia produced from green hydrogen is the most feasible candidate for deep-sea shipping, but the industry has yet to reach consensus on the decarbonization pathway, and zero-carbon vessel technology is still in its early stages of development.

In technology and supply, there is an urgent need for accelerated R&D to develop zero-carbon vessels and, in electrolysis technology, to bring down the costs of green hydrogen. Large-scale system demonstrations are needed by 2025 to demonstrate viability and draw learnings. These will require collaboration between governments, industry and finance, with governments playing a larger role early on. This approach also applies to other modes, such as road and rail transport. Freight purchasers should commit to pay a premium for zero-carbon freight, support early system demonstrations and set a target for zero-carbon freight, e.g. 5 per cent of total by 2030.

In finance, actions are needed to improve transparency and governance and to de-risk investments to attract institutional investors. Lenders should provide differentiated interest rates based on emissions profiles of vessels. In policy, regulation from the International Maritime Organization (IMO) in line with the Paris Agreement targets is needed by 2023, focusing on both operational standards and zero-emission fuel adoption. National governments can move independently of the IMO to regulate domestic shipping emissions, and developed nations should move first. Civil society can develop internationally recognized awards and certificates to acknowledge shipping actors' decarbonization progress and work to catalyze consumer pressure on industry and freight purchasers to commit to quantified targets for zero-carbon freight. Also, labour organizations should emphasize the benefit that crews stand to gain from increased training and qualifications associated with the higher safety requirements of zero-carbon fuels.

By 2030, the industry should aim to achieve 5 per cent of propulsion energy coming from zero-carbon fuels for international shipping through a combination of container routes, niche vessel types (e.g., green ammonia and liquefied petroleum gas tankers) and niche routes (e.g., to Japan and to Australia, both of which plan for significant green ammonia production). For domestic shipping, the target should be 15 per cent, which can be reached by 32 developed nations (which account for 50 per cent of domestic emissions) achieving 30 per cent decarbonization. This level of zero-carbon fuel penetration is deemed to be the tipping point required to enable rapid adoption in the years that follow. A critical step on this path is to have industrial-scale zero-carbon ship demonstration projects implemented by 2025, with each project consisting of at least two ports with the necessary bunkering and refueling infrastructure and at least one zero-carbon vessel in operation between the ports.

In aviation, accelerated investment and cross-stakeholder collaboration are needed to realize the most viable path to zero carbon. Aviation accounted for 2 per cent of global carbon emissions in 2019; in some projections, this could grow to as much as 25 per cent by 2050. Technical barriers associated with removing or replacing jet fuel are now being overcome, and difficult industry fundamentals, such as low profit margins, job losses, stakeholder complexity and limited historic regulatory pressure, make decarbonizing aviation particularly challenging. International Civil Aviation Organization's (ICAO) analysis suggests that improved air travel efficiency can achieve up to 40 per cent emission reductions versus a 2050 business-as-usual scenario, an additional 10 to 30 per cent coming from Jet Biofuels, while 30 to 50 per cent need to come from Synfuels or eFuels. Jet Biofuels and Synfuels/eFuels are jointly referred to as Sustainable Aviation Fuels (SAF).

The Clean Skies for Tomorrow Coalition focus on four primary SAF technology pathways: Hydrogenated Esters and Fatty Acids (HEFA, made using waste oils); Gasification (Fischer Tropsch, made using forestry offcuts); Alcohol-to-jet fuels; and Power-to-liquid/ Synfuels. The primary issues with these are availability, high prices and low speed of adoption (currently at less than 0.01 per cent of jet fuel demand). Actions to accelerate adoption of these fuels include: national government mandates such as in the France, Netherlands, and Norway; positioning SAF as a competitive advantage for the fast-growing segment of environmentally conscious customers; developing consumer opt-in schemes; building green-fuel-purchasing business coalitions; reviewing the Chicago Convention tax exemption on kerosene; and stimulating investment in existing and new production plants.

To achieve complete decarbonization, Synfuels or eFuels (including electrification) are needed. Long-haul zero-carbon aviation is the key challenge. Significant strides have been made in the development of short- haul electric aircraft, but limitations to battery energy density mean that long haul e-aviation is still many decades away. Synthetic fuel technology is still nascent, and additional research is needed to determine the most feasible option. Accelerating the development of emerging technologies requires industry collaboration and capital. Although some capital is available today, it is not stimulating innovations at the pace required. A consortium is needed that sets a clear roadmap for technology prioritization for aircraft and fuel, focuses capital on the highest-impact investments, and accelerates commercialization (and later adoption) of new technologies. This should also include key demand-side actors, such as companies with large business travel volumes, e.g., by agreeing to pay a premium for sustainable fuels or contributing in other ways to development efforts. Also, there is large potential for short-haul aviation to be replaced by high-speed rail and other more sustainable modes.

In policy, ICAO has established an international framework to facilitate decarbonization. Meanwhile, national governments must introduce regulations targeting domestic aviation, and COVID-19 financial support packages for airlines should be linked to the achievement of future emission reduction targets and the uptake of SAF. Civil society can help to raise public awareness of the carbon and energy intensity of air transport and campaign for the introduction of policies improving consumer awareness and shifting behaviour, such as carbon taxation, carbon-labelling on advertisements, and online greener-choice booking platforms.

By 2030, the breakthrough recommended in this pathway is a minimum of 10 per cent SAF globally. Domestic aviation, whose emissions fall under the remit of UNFCCC, can make a significant contribution given that it accounts for almost 40 per cent of total emissions and two thirds of total flights.

Finally, there is a need to improve the adaptation and resilience of all modes of transport systems, requiring changes to planning practices, adoption of new technology and changes to finance and insurance decisions. In policy, land-use planning and other tools should be used to require relocation of critical transport infrastructure out of high-risk areas. There is also a need for institutional and human capacity-building in identifying and managing climate risks to transport systems. Public and private transport system operators need to undertake risk assessments and prepare adaptation strategies for transport infrastructure systems, involving relevant civil society stakeholders. Civil society can support public awareness campaigns to increase familiarity with disaster recovery and other contingency plans and engage in relevant decisions on resilient transport infrastructure. Multistakeholder engagement is thus required not just across sectors but also among line ministries.

Further climate-risk assessment and adaptation planning for transport need to be integrated into national adaptation plans and into processes for the implementation of international agreements, including the 2030 Agenda and Paris Agreement.

In technology, there is a need for mode-appropriate monitoring, modelling, forecasting and information management tools, R&D in adaptive engineering responses to climate hazards and to develop and maintain inventories, databases and GIS-based maps required for climate-risk assessment and priority- setting for adaptation and resilience-strengthening. Also, it is important to facilitate knowledge transfer from regions/countries that already regularly encounter extreme weather conditions (e.g. heat, drought, heavy rainfall, flooding).

In finance and insurance, action for access to finance for transport networks, especially for the most vulnerable regions, must be accelerated. Sectoral insurance premiums should be linked to demonstrated investment in resilient transport infrastructure, and network resilience should be promoted as a key determinant in business-case and financing criteria. It is acknowledged that countries across the world have different levels of development, challenges and priorities concerning the decarbonization of their transport sector. Therefore, the milestones presented in the following section and the actions included in the Pathway Action Table may be followed by different countries in varying pace and sequence.

MILESTONES TOWARDS 2050

	By 2021	By 2025	By 2030	By 2040
Land transport	• Leading markets commit to 100% zero-emission vehicles (ZEV) by 2035 • 3 OEMs agree to switch to ZEV manufacturing prior to 2040 • Countries with national railway to develop a full strategy for rail to reach zero carbon by 2050, specifying the investments and/or subsidies that they will provide to get there	• Cities with >1 million inhabitants have urban mobility plans in line with the Paris Agreement	• 75% ZEV sales for light-duty vehicles in leading markets • 40% ZEV sales for heavy goods vehicles in leading markets • 100% ZEV sales for buses in leading markets • All cities with >0.5 million inhabitants have urban mobility plans in line with the Paris Agreement	• 100% ZEV sales for light-duty vehicles and heavy goods vehicles by 2035 in leading markets • 100% electrification of railway trains
Shipping	• Industry consensus on future zero carbon fuel mix • Tenfold increase in net zero commitments from ship owners and carriers compared to COP25	• By 2023, IMO regulation in line with Paris targets • 10 industrial-scale zero carbon ship demonstration projects realized	• Global carbon price of \$50-100 / ton of CO_2 • Electrolysis cost \$1/kg Hydrogen • 5% zero-emission fuels in international shipping • 15% zero-emission fuels in domestic shipping	• 80% zero-emission fuels in international shipping • 90% zero-emission fuels in domestic shipping
Aviation	• Tenfold increase in zero commitments from airlines compared to COP25	• 2% SAF globally	• 10% SAF globally	• 90% SAF globally
Resilient Transport	• Climate risk assessments, adaptation strategies and contingency/disaster response plans are prepared and implemented for all critical transport infrastructure and systems • Review of legal, policy and institutional frameworks for	• Climate resilience of all new transport infrastructure and systems (as well as vehicles, where necessary) to at least 2050 • Innovative adaptation finance mechanisms are available; finance for new transport infrastructure and systems requires	• Climate resilience of all critical transport infrastructure and systems (as well as vehicles, where necessary) to at least 2050 • Design of new vehicles (buses, trucks, trains, and vessels) incorporates any modifications needed to strengthen resilience to extreme weather	• Climate-resilience of all critical transport infrastructure and systems to at least 2100

	effective climate-risk assessment and adaptation planning for transport •	consideration of climate risks • Nature-based solutions are mainstreamed into transport infrastructure provision and improvement wherever practicable		

PROGRESS

In transport, the decarbonization of land transport has made progress in recent years, especially for urban transport due to the range of policies implemented that have encouraged technology advancement on systematic, infrastructure and modal levels, as well as changes in personal mobility behaviour; shipping and aviation are still in early stages of decarbonization. In both shipping and aviation, coordinated action across the industry ecosystem is needed to mobilize resources for R&D and system demonstrations. As the level of decarbonization requirements and policy priorities vary by country, different countries need to identify and develop their own pathway. As part of its Decarbonizing Transport initiative, the International Transport Forum launched a Transport Climate Action Directory in 2020, which is an online database of transport CO2 reduction policy measures that contains more than 60 different mitigation measures along with the evidence base needed to assess their effectiveness. Such tools will help decision-makers translate their decarbonization ambitions into actions and achieve their climate objectives. It provides them with a range of options that can deliver concrete decarbonization outcomes for transport in their specific context.

On a systematic level, the transport sector is still fragmented and needs to be further improved in areas of multi-modality, e.g., rail and road for freight transport, personal vehicle and public transport for passenger transport, in order to increase sustainability and improve resiliency. Technology has been shown to enable seamless transport through the application of Mobility as a Service (MaaS), which provides a more user-oriented approach to travel by offering a smooth transition of information, booking and payment across multiple modes. Successful examples in Finland have led to other cities developing their own MaaS platform and even the creation of MaaS Alliance, which now has 100 partners from the public and private sectors.

Land transport has seen significant progress in accelerating the transition toward zero emission, in particular electric mobility. In policy, 17 countries have made or are planning to make commitments to full transition to ZEVs for at least new car sales, with 14 of them aiming for 2035 or earlier. California, one of the world's largest vehicle markets and vehicle regulators, is committed to phase out petrol and diesel cars by 2035. Meanwhile, the European Union has indicated interest in coming up with an internal combustion engine phase-out plan, and Latin America has started to discuss electric mobility opportunities to join the movement. In response to policy signals, vehicle manufacturers are shifting toward zero-emission options. For example, the supply of new models is on the rise, 400 new electric vehicle models are expected by 2025. Daimler has made announcements to discontinue R&D for all new internal combustion engines, and Volkswagen Group has started retrofitting traditional plants to produce electric versions only. In 2020, electric vehicle charging infrastructure reached a milestone when public chargers hit the one million mark. A tipping point in the market is expected around 2025, when price parity between conventional cars and electric vehicles is achieved. This depends on the price of battery packs, which have decreased about 90 per cent in the last decade.

The demand for electric vehicles continues to rise, reaching 4.8 million sales and accounting for 2.6 per cent of new car sales in 2019. Despite its low global share, this represents a compounded annual growth rate of 64 per cent over the past five years. Additionally, a growing number of global fleet owners have joined EV100 (88 companies as of October 2020), a global initiative that seeks to electrify fleets by 2030. Amazon has announced that it will buy 100,000 electric delivery vans – the world's largest electric vehicle order. The "Drive to Zero" campaign run by the technology accelerator Calstart aims to increase demand for zero- and near-zero-emission commercial vehicle segments in key markets.

The progress on electrification and market creation for road transport goes beyond cars and includes new segments such as vans, buses and trucks. The market for electric buses is expanding, with about 420,000 electric buses in operation in China, about 4,000 in Europe, 600 in the United States, and 455 in Chile. Cities are at the forefront of these changes. Amsterdam is executing a plan to have zero emissions by 2030. Through the Healthy and Green Street Declaration, about 35 C40 mayors in different continents have now committed to purchase zero-emission buses by 2025. Bogotá in Colombia has announced a bidding process for 594 electric buses. Uganda has started building Africa's first electric bus plant, with the goal to sell in the domestic market and later export to other parts of Africa.

The market for zero-emission trucks is growing as well, with civil society and policy support to accelerate demand. The Zero Emission Freight Alliance has emerged to support the cause, led by the

Transport Decarbonization Alliance, The Climate Group and Calstart. World Economic Forum has launched the Road Freight Zero initiative while the European Climate Foundation has co-founded the European Clean Trucking Alliance. In June 2020, California passed the world's first rule to accelerate demand for zero-emission trucks, requiring about 50 per cent of sales in California to be zero emissions by 2035.

For public transportation, in support of the Champion's Race to Zero Campaign, both International Union of Railways's (UIC) carbon neutrality pledge and International Association of Public Transport's Declaration on Climate Leadership aim at addressing the know-how sharing gap among cities from around the world by creating a collaborative platform to exchange best practices and lessons learned from delivering low-emissions public transport projects.

For rail transport, the top priority has been to increase energy efficiency and reduce its CO2 emissions. For example, 28 European UIC members have collectively committed to reducing CO2 emissions per passenger-kilometre and per tonne-kilometre by 50 per cent by 2030, and are well on track to meet this target. Railway companies are using a combination of technical and non-technical means to improve energy efficiency. Technical measures include using more modern rolling stock with lower energy consumption, or innovative technologies such as regenerative braking – a system that harnesses the energy produced during braking, transferring it back into the rail system so that other trains can use it. Non-technical measures include energy-efficient driving techniques, which focus on developing train drivers' expertise to save energy or diesel fuel costs. Linked to both of these points is the installation of energy-metering on trains so that operators can monitor their energy consumption and assess which approaches save the most energy.

For shipping, decarbonization is starting to gain momentum, but increased ambition is needed across all industry stakeholders. In policy, in 2018 the IMO adopted a strategy to at least halve global emissions by 2050 and reach zero carbon as soon as possible this century. An updated strategy will be developed by 2023. The European Union is planning to include shipping emissions in their Emissions Trading System by 2024. Five national governments have published decarbonization plans for domestic shipping.

Some industry actors have announced net-zero commitments, e.g., Maersk, CMB, CMA CGM and the Port of Rotterdam. Also, a large number of freight purchasers have committed to decarbonization in line with the Paris Agreement. The Getting to Zero Coalition, an industry alliance of 120 companies across the shipping industry, was launched in 2019 and aims to have commercially viable zero-carbon vessels operating by 2030. In 2020, a separate decarbonization alliance was launched by CMA CGM, including 11 European partners. In Oct 2020, the Global Maritime Forum launched the Sea Cargo Charter, which provides a global framework for assessing and disclosing the climate alignment of chartering activities. As a result, 17 charterers were signed up from various segments of bulk shipping. In technology, 2020 saw the opening of the Maersk Mc-Kinney Møller Center for Zero Carbon Shipping, with initial funding by the A.P. Møller Foundation. Also, there are a number of research projects and new actors exploring operational improvements such as wind propulsion and using ammonia as a fuel. In finance, the Poseidon Principles, an initiative to include climate considerations into lending decisions, currently includes 18 lenders making up more than 33 per cent of the global ship finance portfolio.

There is an urgent need for increased ambition from industry actors that is aligned with the Paris Agreement targets, and international and national regulations. There is also an urgent need for mobilization of governments, industry and finance to fund the R&D and infrastructure required to decarbonize shipping, with a short-term focus on realizing industrial-scale, zero-carbon ship demonstration projects by 2025.

In aviation, consumer pressure for decarbonization is growing; some airlines have announced net- zero commitments but more is needed. In policy, ICAO has so far endorsed a target of 2 per cent yearly fuel efficiency improvements does not end in 2020 and a limit of net aviation CO2 emissions after 2020. International Air Transport Association, a major trade body, has gone further, aiming for a 50 per cent reduction in net aviation CO2 emissions by 2050, relative to 2005 levels. Some industry actors have committed to Net Zero by 2050, including Rolls Royce, IAG, Heathrow, and the Oneworld Alliance of 13 global airlines. Airbus recently announced ZEROe Hydrogen zero emission aircraft in service by 2035, Mission Possible Platform's Clean Skies for Tomorrow, an international platform for sectoral decarbonization, was launched in 2019 and currently has 55 members. At the national level, at least three countries have mandated the uptake of SAF fuels, and the European Union is currently debating a regional mandate. The United Kingdom has established the Jet Zero Council to drive its leadership on the commercialization of SAF plants, as well as investment in R&D for Zero Emission Aircraft.

In the immediate term, airlines need to define a sustainability strategy with clear targets and defined roadmaps, including near-term levers for both efficiency improvements and offsets. Airlines also need to deepen industry collaboration to tackle the challenges that are too large and complex for any individual airline to solve on its own.

Regarding resilience, modal shifts are a cornerstone feature of adaptive future transport systems. This applies to urban land and long-haul shipping/aviation systems. For example, an increase in the diversity of modes used to include both road and rail transport will prevent overloading of road infrastructure (e.g., highways) during disruptive periods under extreme weather conditions. Shifts within urban centres towards MaaS models are reducing the need for individuals to own a car. A major barrier to modal shift is the lack of adaptivity of existing infrastructure systems. Higher levels of infrastructure integration, versatility and modularity should be mandated by policymakers and developers in the future. Ports are particularly vulnerable to climate change impacts, and their importance to global trade is a key driver of developing resilience strategies. In 2015, the World Association for Waterborne Transport Infrastructure launched the Navigating a Changing Climate initiative to support inland and maritime navigation infrastructure in reducing greenhouse gas emissions and strengthening resilience. It is a multi-stakeholder coalition of nine associations with interests in waterborne transport infrastructure.

Companies are increasingly investing in new technologies to protect their transport assets from climate change. Ultrasound wave technologies are being leveraged in the Americas to detect cracks along railway networks caused primarily by temperature changes associated with climate change. Both land and air vehicles are integrating climate change risk via product design efficiency measures, with new developments able to accept alternative fuels or technologies such as fuel cells. Advancements in extreme weather warning systems are increasing lead times in areas not used to such events. However, more work is required by policymakers and civil society to increase familiarity with recovery and contingency plans. A number of bilateral and multilateral development organizations are working on adaptation-focused transport projects. The Association of Southeast Asian Nations Infrastructure Fund and the three African trading blocs are exploring measures to raise funds for improving transport infrastructure in their regions. Companies are increasingly purchasing business interruption insurance to help against supply chain risks associated with transport infrastructure. This will be especially relevant post-COVID-19 as countries start to recover.

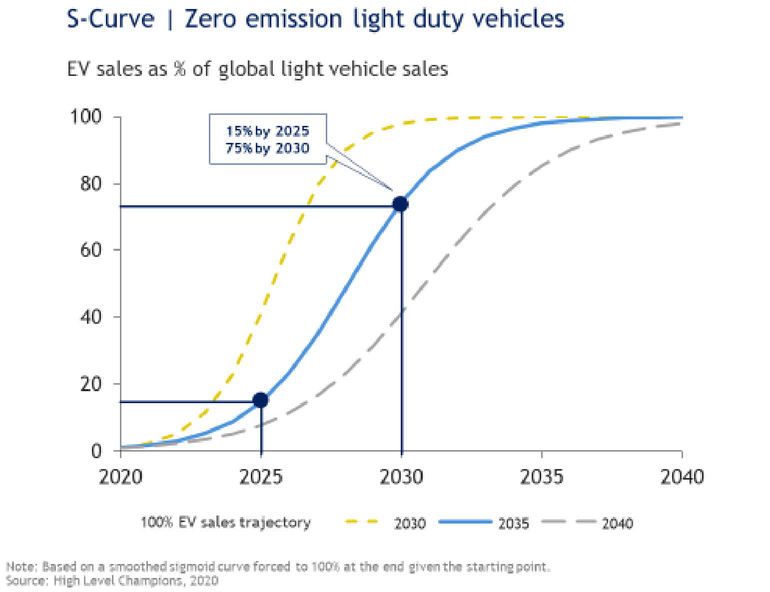
Creating resilient transport systems of the future requires further work and investment. Progress is slow despite the growing understanding of the climate-related risks. This is particularly concerning due to the interconnectivity of transport with other sectors.

FACTS & FIGURES

History has shown that sectoral transformations, whether they be horse and cart to automobile, coal power to gas or adoption of telecommunication technologies, do not occur linearly, but rather slowly in an emergence phase, and then exponentially in a diffusion phase. This dynamic process can be captured in an 'S-curve'. S-curves in zero emission light vehicles, sustainable aviation fuel, and zero emission fuels for shipping propulsion energy are presented below and covered in further detail in the respective Action Tables.

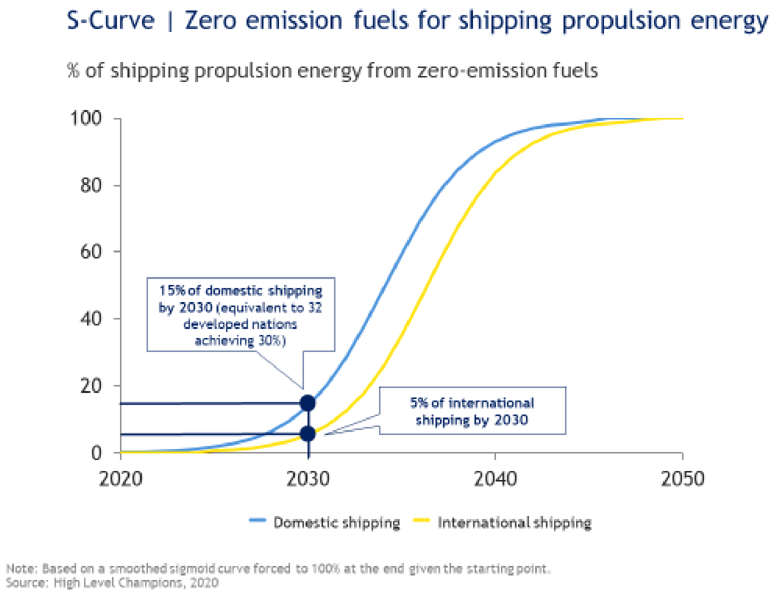
Zero emission light duty vehicles

100% zero emission light vehicle sales by 2035 will require reaching 15% by 2025 and 75% by 2030



Zero emission fuels for shipping propulsion energy

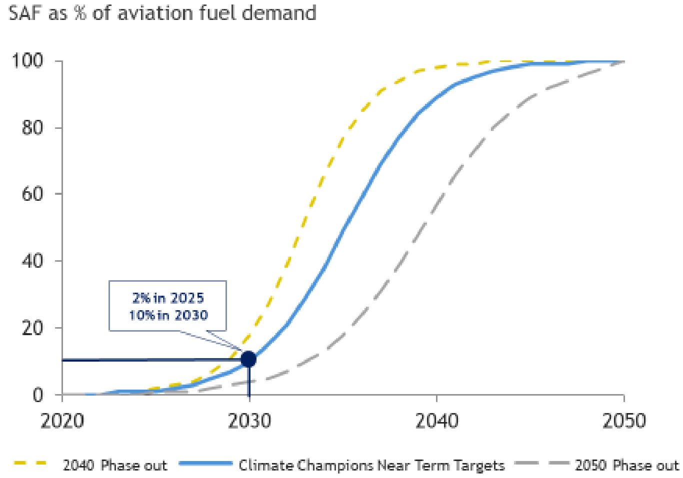
For full decarbonization in line with Paris, the 2030 target for zero emission fuels should be 5% for international shipping and 15% for domestic



Sustainable aviation fuel

100% global sustainable aviation fuel use before 2050 will be possible by reaching at least 10% by 2030 and 90% by 2040

S-Curve | Sustainable aviation fuel



Note: Model curve is backout based on startingpoint & ambition for 100% SAF penetration according to a Logistic S-Curve formula
Source: High Level Champions, 2020

CLIMATE ACTION TABLE - STRUCTURE