



CLIMATE ACTION PATHWAY

TRANSPORT

Action Table

2021

ACTION TABLE STRUCTURE AND APPROACH

The Transport Action Table has been structured based on the mitigation concept of “Avoid-Shift-Improve”, which encompasses changes in transport demand and supply for both passenger and freight transport. “Avoid” refers to reductions in the need to travel, travel distance and number of trips, especially those made by private motorized vehicles, without compromising accessibility. “Shift” implies a shift to more sustainable modes, such as rail for freight, and walking, cycling and public transport for passenger transport, as well as maintaining existing sustainable mode shares. “Improve” includes substitution of all vehicles with zero-emission alternatives when possible, the improvement made to fuel and operational efficiency for unavoidable travel and improvement of systems efficiency. The six impact areas are categorized according to this concept, while also taking into account the sectoral needs for land transport, including road and rail, maritime transport and aviation, as well as a specific impact area for resilient transport focusing on adaptation (see figure 1). This recognizes that to be successful, any mitigation initiative must be resilient to future climate conditions, and that investments in Avoid-Shift-Improve actions can be thoughtfully designed to improve resilience as an integrated objective. Other cross-cutting issues, such as gender equality and finance, are also reflected in various impact areas. The Transport Pathway is closely linked to the other thematic pathways, and specific linkages are indicated in the impact areas. Although the Transport Pathway developed is not region-specific, it is important for Parties and non-Party stakeholders to recognize the need to tailor decarbonizing pathways according to their priorities and identify transport-decarbonizing strategies based on the economic and geographical realities of different country groups. The differences in existing transport services, infrastructure, challenges and needs are vast around the world. Hence, although the Pathway can be used as a guide for all countries, specific measures and their implementation will need to be further defined depending on the characteristics of each country. This Pathway can also be used to complement nationally determined contributions (NDCs). Although around 80 per cent of the submitted NDCs acknowledge transport’s role in carbon dioxide (CO₂) emission mitigation efforts, only 60 per cent of them proposed transport mitigation measures, and only 10 per cent defined a specific transport-sector CO₂ reduction target.^{1,2} If all countries implement their NDC transport pledges, transport CO₂ emissions in 2030 would still be around the 2015 level. In this case, transport CO₂ emissions would be 1,400 megatonnes less than in a baseline scenario that assumes some limited decarbonization action, but achieving a 2-degree scenario would require further reductions of around 600 megatonnes of CO₂, which clearly shows the need for more ambitious climate actions for transport.

For road transport, shipping and aviation, S-curves and system maps have been developed. They present potential adoption rates for important technological subsector innovations chosen by the Climate Champions, as well as applicable stakeholder relationships in the particular industries.

¹ <https://www.itf-oecd.org/sites/default/files/docs/transport-co2-paris-climate-agreement-ndcs.pdf>.

² <https://www.changing-transport.org/tracker>.

OVERVIEW – SECTOR STRUCTURE

Figure 1. Six Impact areas in the Transport Pathway

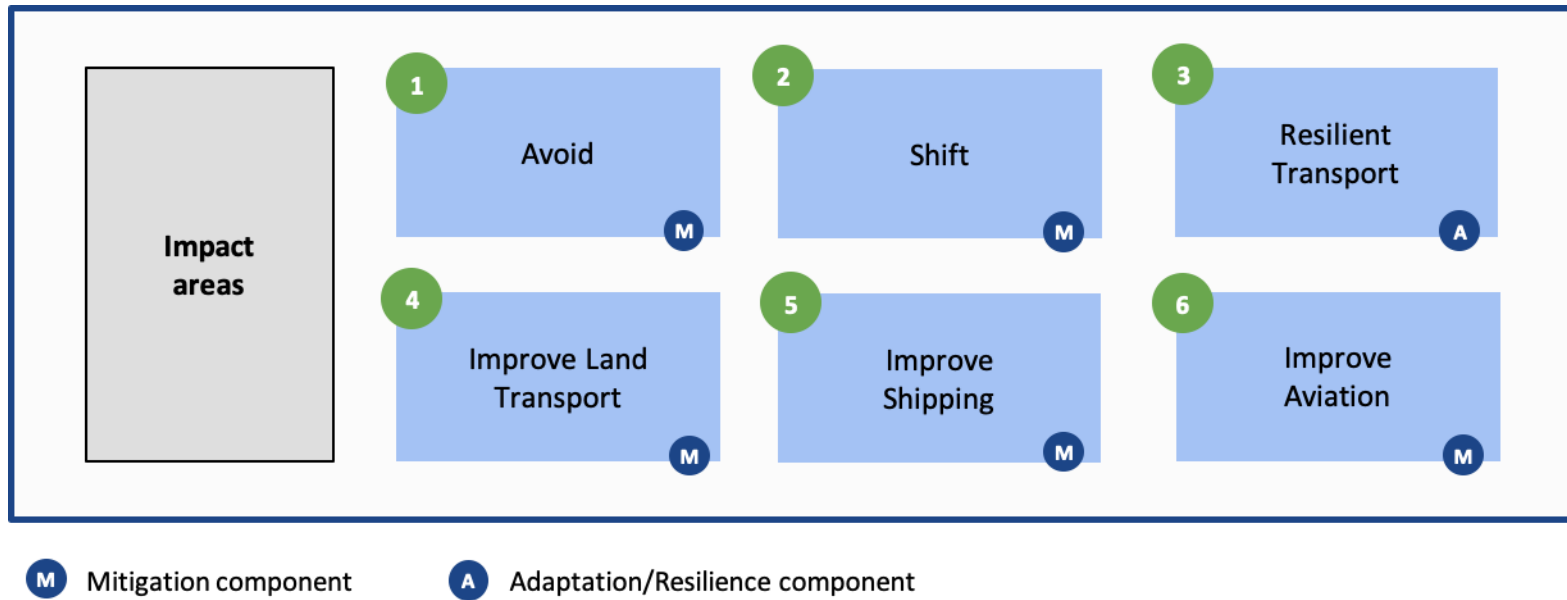


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LAND TRANSPORT CHANGE LEVERS

In land transport, the pathway to zero carbon is feasible. According to the International Council on Clean Transport's Vision 2050 report, it is estimated that about 85 per cent of CO₂ emission reductions that are 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 in distance travelled through the expansion of teleworking and integrated land-use and transport planning and shifts to more sustainable modes, such as walking, public transit and cycling. The International Transport Forum's analysis has also shown that in cities, 70 per cent of CO₂ emissions can be reduced through changes in technologies, while the other 30 per cent will require policies that change travel behavior, including car-sharing and pricing policies. The road to zero carbon for transport will require a smart combination of different 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 of America. Electric vehicles are a proven technology for light-duty vehicles, buses, small or medium-sized trucks used for urban logistics, and other short-distance or intra-city freight transport. Long-haul heavy transport decarbonization can likely be enabled by a broader portfolio of technology solutions combining electrification wherever feasible, including direct via battery or overhead wire and hydrogen fuel cells, together with improvements in operations and asset management. Modal shifts can be achieved with urban (re)development and investments in new infrastructure, such as multi-modal logistics hubs, linked with integrated urban land-use and transport planning, which includes transit-oriented development coupled with a compact urban form that supports public transport, walking and cycling. There is an urgent need to promote a global dialogue that will support a coordinated collective effort among all actors that are currently engaged in building the capacity of countries to take climate change action in this area. Doing so will help facilitate the design and implementation of effective public transport interventions to enable the sector to be zero-carbon and provide 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 setting of national, regional and city targets for the electrification of modes, providing financial incentives, developing zero-emission zones in cities and regions, and developing policy strategies that encourage behavioral change. 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 provide economic opportunities for new players, start-ups and small and medium-sized enterprises that develop e-mobility solutions. A level playing field across modes, pricing of externalities and financial incentives for modal shift will be necessary to make the significant change in modal choices for both passenger and freight transport.

By 2030, leading markets should aim to achieve zero carbon for 75 per cent of new light-duty vehicle sales. 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. Leading markets should also

target zero carbon for 100 per cent of new bus sales and 40 per cent of new truck sales by 2030 for the same reasons. At least 30 per cent of freight should be transported by rail, and high-speed passenger rail should double by 2030 in leading markets. Recommended actions to reach these targets are detailed in the action tables of the Transport Pathway for actors in policy, finance and investments, business, and civil society. Improvements in gender equality will also enable more rapid and more just climate actions. A gender-diverse sector will be more innovative, sustainable and inclusive, and will also lead to a just transition, as diverse teams are more responsive to the needs of disadvantaged groups.

ZERO-EMISSION LIGHT-DUTY VEHICLES S-CURVE

The S-curve illustrates the adoption rate of zero-emission light-duty vehicles in leading markets, reaching 15 per cent by 2025 and 75 per cent by 2030, after which adoption speed accelerates and levels off at 100 per cent by 2035. S-curves are commonly used to describe any change that involves gradual initial growth, exponential acceleration followed by tapered growth to a steady state, and are thus suited to model technology adoption. The S-curve for light duty vehicles is normative in nature and comes from a mix of analysis, campaigners and foundations. It could serve as a vision for leaders as a result of discussions with key organizations in the electric vehicle space in Europe and the United States of America. The targets shown are normative goals developed via a partnership of advocacy groups, research institutes and foundations, which included the Climate Champions team. To reach the targets set out in the Paris Agreement by 2050, and taking into account the average lifecycles of vehicles, these target dates presented in the S-curve are required to reach net-zero by 2050 (see figure 2).

ZERO-EMISSION LIGHT-DUTY VEHICLES S-CURVE

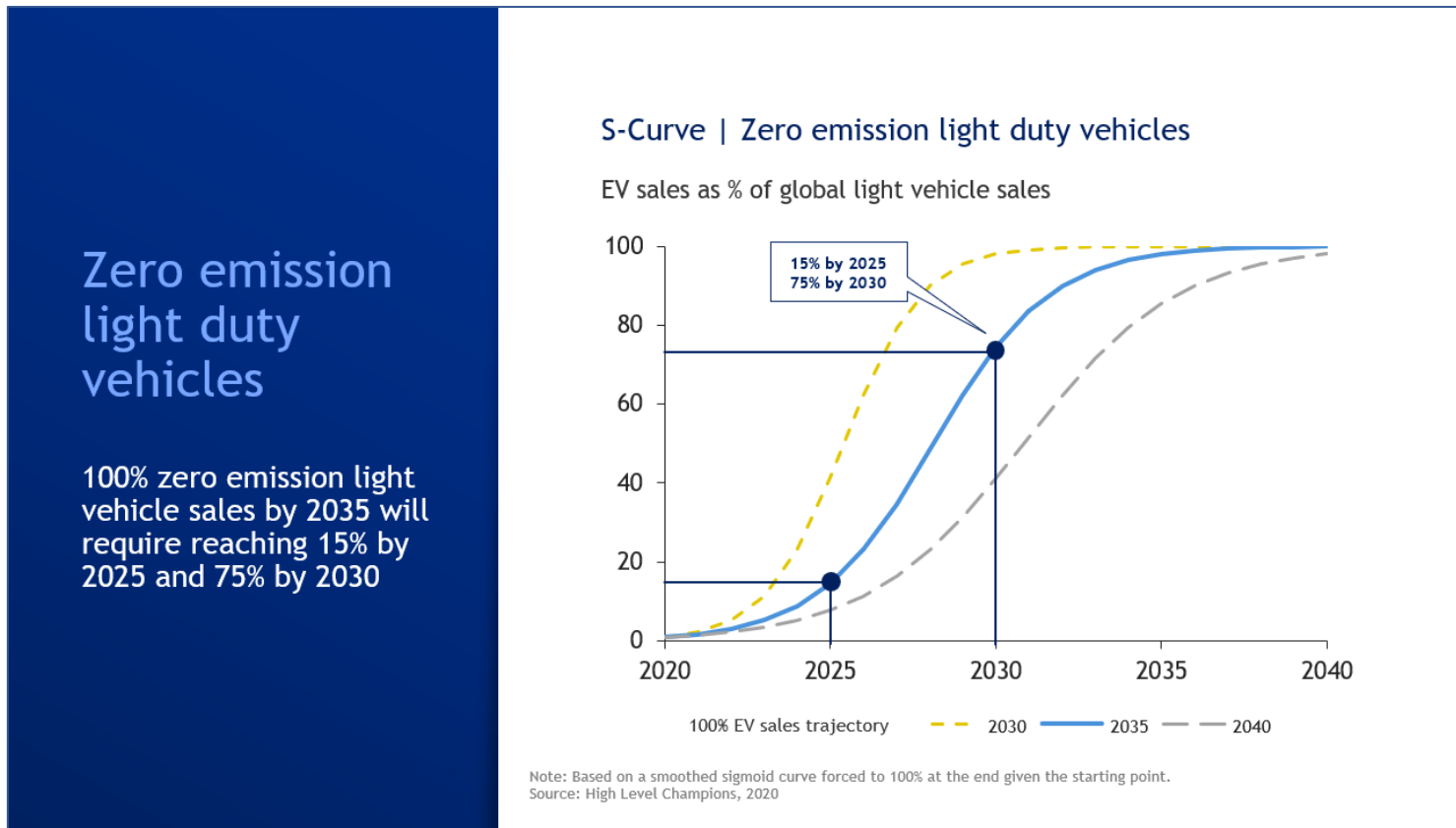
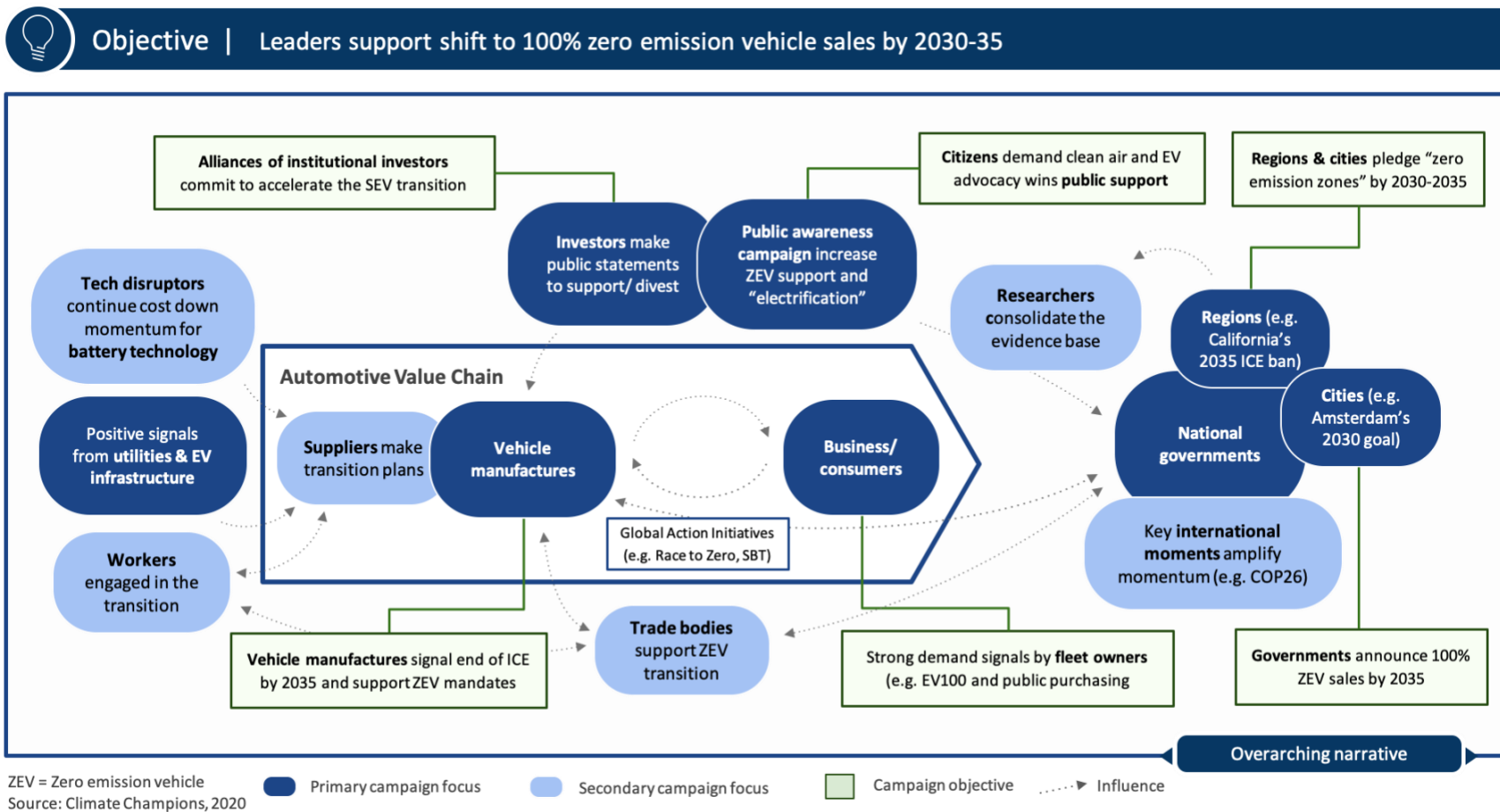


Figure 2. S-curve for zero emission light-duty vehicles

LAND TRANSPORT SYSTEMS MAP (ROAD TRANSPORT)

The systems map (see figure 3) shows the key stakeholder groups in the automotive industry and the proposed goals for leaders of each of these in order to achieve the objective. More details on actions per stakeholder group are included in Impact Areas 1, 2 and 4 in the following section.

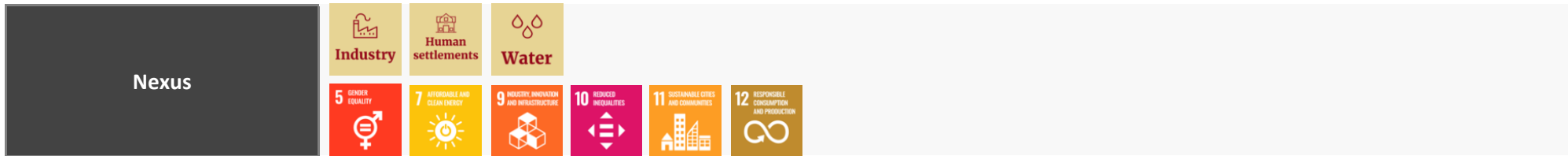
Figure 3. Automotive industry systems map.



Impact
1

REDUCE TRANSPORT DEMAND AND DISTANCE

MITIGATION



	By 2021	By 2025	By 2030	By 2040
<p>1. Policymakers (national, subnational, local levels)</p>	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> Implement transport demand management measures such as; <ul style="list-style-type: none"> Parking pricing and regulation Vehicle access regulation in cities Review and improve transport data, especially travel behavior, collection processes to ensure gender segregated data are appropriately collected, stored and analyzed <p><i>Transport Planning and Land Use</i></p> <ul style="list-style-type: none"> Update transport planning policies to: <ul style="list-style-type: none"> Enable stronger linkages between land use and transport planning towards higher density levels and mixed land use to increase accessibility & reduce travel distance for at least 200 cities without compromising the quality of life 	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> Widen the implementation of effective transport demand management measures, including the use of intelligent transport systems (ITS), for example <ul style="list-style-type: none"> Road pricing Congestion charging in urban areas Parking pricing Access regulations Mobility as a Service (MaaS) Company car tax <p><i>Transport Planning and Land Use</i></p> <ul style="list-style-type: none"> Develop inclusive, accessibility-oriented, compact and resilient cities to reduce trip lengths and the need for motorized travel by personal vehicles through; 	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> Further integrate ITS in urban transport policies where they could reduce distance traveled and/or vehicle used and thus reduce greenhouse gas emissions in transport. For example: <ul style="list-style-type: none"> In-vehicle devices that influence navigation Optimizing routing and driving dynamics Traffic management systems Auxiliaries for parking and deliveries <p><i>Behaviour Change</i></p> <ul style="list-style-type: none"> Modal shifts to be less car dependent, especially in urban areas. 	<ul style="list-style-type: none"> Ensure institutional structures and processes support integrated planning and promote sustainable urban transport. Ensure legal and regulatory frameworks are appropriate for inter-modal mobility solutions.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ● Reduce urban sprawl and improve connection of city and sub-urban areas to prevent dependence on the use of private vehicles over long travel distances ● Introduce motorized trip length or travel time reduction as a requirement for at least 200 cities ● Initiate a paradigm shift: replace the notion of “curbing mobility is not an option” (e.g. as set out in EU 2011 Transport White Paper) with “curbing avoidable trips with personal vehicles is a viable option for people/citizens” ● Introduce “decreasing or not increasing motorized transport activity” as a key success metric for economic growth scenarios with initiatives such as on-shoring of industrial activity <p><i>Behaviour Change</i></p> <ul style="list-style-type: none"> ○ Provide working regulations that allow employees to telework or have flexible working hours. 	<ul style="list-style-type: none"> ● Integrating land-use and transport planning processes ● Adopting mixed land-use planning to connect residential, industrial and commercial areas ● Implementing policies to address the differences in travel behavior and patterns across user groups, taking into account gender, age, income and physical accessibility needs <ul style="list-style-type: none"> ○ The top transport greenhouse gas (GHG) emitting countries to set targets and adopt national urban mobility plans that define the required institutional, legal and regulatory frameworks to promote and enable sustainable transport in cities. ○ Cities with more than 500,000 inhabitants to develop and deploy long-term sustainable and resilient urban mobility plans, that integrate land-use, include clear targets for reduced transport distance travelled and vehicle use, and are compliant with the Paris Agreement. ○ Re-allocate road space to sustainable modes, including bus, bicycle and light mobility lanes, as well as footpaths, especially post-COVID-19 to allow for physically-spaced walking and cycling. ○ Create stakeholder dialogues at a local level supporting the implementation of sustain. corporate mobility to improve accessibility, efficiency & safety 		

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> ○ Scale up and diversify funding for supportive and coherent fiscal frameworks to adopt transport demand policies, e.g. congestion charging, parking policies, company vehicles, etc. ○ Create a public and private funding framework for sustainable mobility that will support transport demand management. 	<p><i>Transport Planning and Land Use</i></p> <ul style="list-style-type: none"> ○ Utilize climate funds to help ensure that all transport funding (public and private) becomes more aligned with the Paris Agreement. 		
3. Technology Providers and Innovators	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> ○ Accelerate the development and endorsement of high-quality online conference facilities to reduce business travel needs. ○ Develop ITS tools that can contribute to the reduction of distance travelled in order to facilitate transport movement and flows that address citizens' needs. ○ Develop ITS tools, such as mobile phone apps to efficiently manage curbside or on-street parking, especially for last mile freight delivery. 	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> ○ Improve load factors and logistics for urban freight ○ Develop advanced ITS solutions that can enhance transport demand management measures, for example: <ul style="list-style-type: none"> ● dynamic ridesharing ● routing, smart parking ● predictive traveler information ○ Develop systems enabling pay-as-you-drive road and congestion charges – which may be time dependent and location specific – capable of integrating differentiations based on the emission performance of vehicles. 	<p><i>Transport Planning and Land Use</i></p> <ul style="list-style-type: none"> ○ Support development of seamless inter-modality between existing modes (public and private) by enabling door-to-door solutions in the case of passenger mobility, including dynamic use of loading and unloading urban areas. ○ Include urban freight movement in transport management and land use planning. ○ Integrate loading / unloading spaces and consolidation centres into building codes. ○ Include urban freight in sustainable urban mobility plans. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
4. Business and Service Providers	<p><i>Behaviour Change</i></p> <ul style="list-style-type: none"> ○ Employers encourage sustainable travel choices by: <ul style="list-style-type: none"> ● Promoting alternative work practices (e.g. remote working or telecommuting) and flexible work schedules based on learnings from COVID-19. ● Removing parking subsidies for employees. ● Adding e-bike subsidies. ● Providing financial incentives for commuting by active mobility, such as the purchase of bicycles. ● Providing financial incentives for seasonal public transport tickets and carpooling. 	<p><i>Transport Planning and Land Use</i></p> <ul style="list-style-type: none"> ○ Integrate sustainable transport planning efforts across freight operators. ○ Transport service providers to reduce barriers to intermodal public transport by improving journey planning and ticketing. ○ Forge new collaborations between relevant stakeholders, such as cities, public transport operators, ride-sharing services to integrate sustainable transport planning efforts across modes and sectors and address the sustainability challenges of urban passenger transport. ○ Transport service providers launch capacity planning strategies on a city level. ○ Online retailers and delivery companies to facilitate more sustainable deliveries, for example: <ul style="list-style-type: none"> ● Committing to streamlined, integrated delivery systems ● Using urban consolidation centers ● Facilitating pick-up/drop-off 	<p><i>Transport Demand Management</i></p> <ul style="list-style-type: none"> ○ Plan a sustainable reverse logistics system ○ Use tendering to regulate the sustainability of contracted fleet 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
5. Civil Society	<p><i>Behaviour Change</i></p> <ul style="list-style-type: none"> ○ Increase consumer demand and collaboration between businesses, service providers, and cities to reduce vehicle kilometers through changes in trip patterns and behavior and by making better informed choices. ○ Increase the inclusiveness of zero carbon transport development, to expand stakeholder engagement to include different user groups including vulnerable, marginalized and underserved populations, such as rural communities, older adults, women, lower income groups. Provide facts and policy guidelines for cities to harness the lessons learned during the pandemic beyond temporary measures. ○ Increase the awareness of zero carbon transport services and accountability. 	<p><i>Behaviour Change</i></p> <ul style="list-style-type: none"> ○ Continue advocating for the adoption of more sustainable consumption and travel patterns by consumers, businesses, service providers, cities and other relevant actors. ○ Provide facts and assessments on medium-term behavioral change impact in post pandemic recovery. ○ Formalise open dialogue and channels of communication between civil society and the government. 		

EXISTING INITIATIVES IMPACT AREA 1

Transformative Urban Mobility Initiative (TUMI)	Mobilize finance, build capacities and promote innovative approaches for urban mobility.
Commuting behavior change project (TUM - WBCSD)	Mobilize the private sector to adopt sustainable mobility policies, and catalyze actions in cities with corporate mobility pacts.
Digitalization and data in mobility project (TUM - WBCSD)	Support policy making for data-sharing helping to harness capacity available (people and goods) to minimize travel demand.
EcoMobility SHIFT (ICLEI)	EcoMobility SHIFT is a total quality management scheme that allows cities to access their mobility performance, establish a path of continuous improvement; analyze performance; and act to improve. This is the original scheme which was developed in 2013 for European cities.
EcoLogistics Principles (ICLEI)	EcoLogistics promotes clean, sustainable, efficient and safe urban freight through collaborative efforts in stakeholder engagement, technologies, policies and land use planning and inspires local governments to transform their urban freight system. It includes eight foundational principles local governments can follow to help lead the transition to sustainable urban freight.
Tracker of Climate Strategies for Transport (GIZ and SLOCAT)	The Tracker of Climate Strategies for Transport provides a clear picture of ambition, targets and policies in NDCs and Long-Term Strategies by countries to support sustainable transport. With the Tracker of Climate Strategies for Transport, countries can keep track of national-level climate policies and targets in transport. In particular, it provides information on the role of transport in Nationally Determined Contributions (NDCs) and Long-term Low Greenhouse Gas Emission Development Strategies (LTS) – the two most important instruments of the Paris Agreement to limit global warming to well below 2°C.
ITF Decarbonising Transport initiative	The Decarbonising Transport initiative promotes carbon-neutral mobility to help stop climate change. It provides decision makers with tools to select CO ₂ mitigation measures that deliver on their climate commitment.

FURTHER REFERENCES IMPACT AREA 1

[Transport Climate Action Directory](https://www.itf-oecd.org/transport-climate-action-directory-measures)

<https://www.itf-oecd.org/transport-climate-action-directory-measures>

[COVID-19 Transport Brief: Re-spacing Our Cities for Resilience](https://www.itf-oecd.org/sites/default/files/respacing-cities-resilience-covid-19.pdf)

<https://www.itf-oecd.org/sites/default/files/respacing-cities-resilience-covid-19.pdf>

[MobiliseYourCity Partnership. \(2021\). National Urban Mobility Policies and Investment Programmes \(NUMP\) Guidelines](https://www.changing-transport.org/publication/national-urban-mobility-policies-and-investment-programmes-nump-guidelines/)

<https://www.changing-transport.org/publication/national-urban-mobility-policies-and-investment-programmes-nump-guidelines/>

[GIZ. \(2020\). Enhancing Climate Ambition in Transport - Six Action Recommendations for Policymakers to Align Transport with the Paris Agreement and the Sustainable Development Agenda](https://www.changing-transport.org/publication/enhancing-climate-ambition-in-transport/)

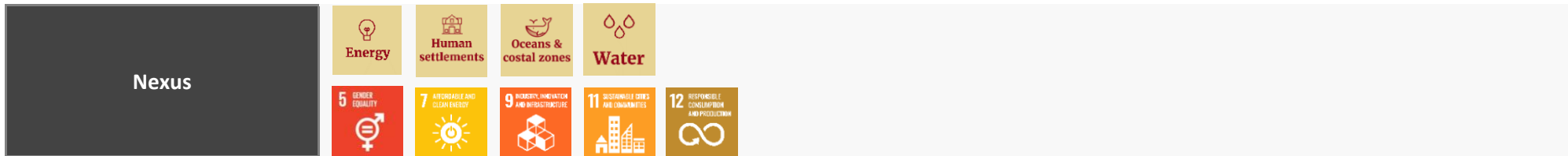
<https://www.changing-transport.org/publication/enhancing-climate-ambition-in-transport/>

Impact
2

SHIFT TO MORE ENVIRONMENT FRIENDLY AND LOWER CARBON MODES OF TRANSPORT

Shift

MITIGATION



	By 2021	By 2025	By 2030	By 2040
1. Policymakers (national, subnational, local levels)	<p><i>Public Transport</i></p> <ul style="list-style-type: none"> Significantly scale up capacity development programmes to train public officials on the development, management and operation of zero-carbon public transport systems. Provide safe and secure public transport services for all users, including women, children, persons with disabilities and older persons, through a more inclusive design of transport systems, including infrastructure and operational improvements, for example: <ul style="list-style-type: none"> Launch public awareness campaigns to address the pandemic-related stigmatization of public transport on the basis of science-based facts 	<ul style="list-style-type: none"> Set binding targets for modal shift (double by 2050) in freight and passenger mobility with fiscal policy that incentivizes low-carbon modal choices through pricing in externalities, e.g. carbon pricing. <p><i>Public Transport</i></p> <ul style="list-style-type: none"> Support and enable the centrality of public transport in green, resilient and equitable mobility systems through; <ul style="list-style-type: none"> Sustained, long-term investment in public transport improvements Increasing capacity, punctuality, frequency, speed, availability and options of public transport supply to encourage users to shift to public transport 	<p><i>Shared Mobility</i></p> <ul style="list-style-type: none"> Prioritize, scale up and invest in alternative, attractive sustainable transport solutions such as public, shared and on-demand transport services. Double high-speed rail in leading markets. Integrate shared mobility services in existing transport networks, as part of a MaaS approach. “MaaS for climate” will be deployed Europe-wide as standard package of zero-carbon on-demand collective transport services. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ● Train transport employees better and improve reporting systems ● Adopt a zero-tolerance approach to harassment (users and workers) <ul style="list-style-type: none"> ○ Rethink public transport post-COVID-19 to ensure health and safety of public transport users and workers and launch build back confidence campaigns for the travelling public. ○ Align COVID-19 recovery plans with investment in public transport. ○ Ensure that safety standards are ready for the large-scale deployment of zero-emission vehicles and low-carbon fuels for urban mobility modes such as mass transit, light rail, buses. ○ Identify temporary active mobility and tactical urbanism-enact measures learned during pandemic times that can be integrated in medium-long-term programming policy frameworks. ○ Promote more sustainable consumption and travel patterns (e.g. prioritizing public transportation, walking, cycling, and ride sharing, using and/or buying zero-emission vehicles etc.) through campaigns that highlight the benefits of more sustainable consumer behavior (e.g. cost/time savings, higher quality products). 	<ul style="list-style-type: none"> ● Projects that are centered on traffic restraint and the greater use of public transport in combination with sustainable & shared mobility modes ● Affordable public transport system ● Explore the possibility of using public transport for urban freight transport <ul style="list-style-type: none"> ○ Prioritize the development of public transport that secures a gender-responsive mobility system for all. ○ Integrate universal design for transport infrastructure and system, referring to UN Convention on the Rights of Persons of Disabilities. ○ Improve the customer experience and physical travel environment, improvements such as better lighting can be critical in changing the perception of safety and security around public transport. ○ Develop a combined service model that leverages technology to supplement fixed-route service with demand-response options for public transport users. ○ Enact policies to enable zero-carbon mobility options, while ensuring social equity at the same time, by providing maximum accessibility to all socio-economic groups, with the use of public transport and other services such as ride sharing and their integration. 	<p><i>Walking and Cycling</i></p> <ul style="list-style-type: none"> ○ Implement provisions to ensure the integration of active mobility requirements in all large-scale infrastructure projects planning. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ Improve public transport information through ITS and other platforms (e.g. smart phone applications) for easy planning, booking and utilization. ○ Begin development of new zero-carbon models of MaaS, (MaaS for climate) driven by mixed public-private governance, where demand-responsive transport can fill the gap between conventional public transport and unmet demand in suburban and rural areas; that uses only carbon-free transport means; where each vehicle journey can meet multiple mobility demands; and where a universal mobility planner can collect and combine all requests for transport for both people and things. <p><i>Walking and Cycling</i></p> <ul style="list-style-type: none"> ○ Cities to re-allocate space to allow for physically spaced walking and cycling and manage car traffic in the post-confinement phase of COVID-19, especially due to physical distancing requirements and potential shift from public transport to cycling, walking, and car travel. ○ Cities to explore long-term sustainability of the shift towards walking and cycling with COVID-19 as part of green recovery, including removing punitive taxes on shared micromobility (e.g. e-scooters) 	<ul style="list-style-type: none"> ○ First 100 pilot schemes for universal, zero-carbon mobility services (MaaS for climate) are up and running. <p><i>Shared Mobility</i></p> <ul style="list-style-type: none"> ○ Ensure regulation of app-based mobility services is appropriate and flexible to balance consumer and broader societal welfare, while addressing safety issues and negative externalities due to excess supply, without regulating in such an intrusive way as to choke off innovative business models at birth. ○ Integrate shared mobility into the first and last mile of trips served by public transport. <p><i>Walking and Cycling</i></p> <ul style="list-style-type: none"> ○ All socio-economic groups should have equitable access to all transport modes including MaaS e.g. rolling out affordable large-scale designed for all bike-share programs (with or without docking stations) Walking infrastructure must be safe. ○ Develop policy and planning schemes to roll out spatial planning approaches based on proximity (15 minute-city concept) and integration between tactical urbanism and mobility planning. ○ Deploy policy frameworks to improve provision for walking and cycling, for example with focus on: 		

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ [...] provided related regulations are in place and providing funding and guidance (including safety) for the deployment of light individual transport lanes. <p><i>Freight</i></p> <ul style="list-style-type: none"> ○ Create an even playing field for sustainable modes for freight, reducing administrative or financial burdens for rail freight, e.g. remove track access charges for rail freight carriers. ○ First discussions on integrating transport of parcels and goods in next-generation “MaaS for Climate” take place, leading to plans for first pilot realizations. 	<ul style="list-style-type: none"> ● Rehabilitation of sidewalks in the proximity of public transport hubs. Target 100,000 km of additional dedicated, safe, barrier free, sidewalks globally ● Enhanced complete streets schemes and attractive infrastructure and networks ● Separate and safe bicycle and light mobility lanes ● Improved availability of safe and efficient infrastructure for active mobility ● Develop policy frameworks allowing safe and secure data-sharing for the deployment of MaaS and multimodality solutions for freight transport <p><i>Freight</i></p> <ul style="list-style-type: none"> ○ Develop policy and planning schemes to create better linked multi-modal logistics hubs, supporting the shift towards a greater rail modal share. ○ Accelerate low-carbon last-mile delivery schemes. ○ Explore the possibility of shifting goods movement from road to railway and/or inland waterways where feasible. 		

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions	<p><i>Public Transport</i></p> <ul style="list-style-type: none"> ○ Scale up and diversify funding for supportive and coherent fiscal frameworks for public transport infrastructure and services. ○ Use post-pandemic recovery stimulus packages and sustainable finance products to support public transport investment in rolling stock/modern fleets and infrastructure. <p><i>Walking and Cycling</i></p> <ul style="list-style-type: none"> ○ Scale up and diversify funding for supportive and coherent fiscal frameworks for walking, cycling and bike-share infrastructure and services. ○ Review tax and incentive structure for corporate mobility to support behavior change towards lower emission mobility modes. 	<ul style="list-style-type: none"> ○ Increase local, national and international funding and climate support for sustainable and resilient urban transport (both public and private sources) through, for example new pricing mechanisms, innovative funding sources, enhancing creditworthiness and enabling greater access to local finance. <p><i>Transport Planning and Land Use</i></p> <ul style="list-style-type: none"> ○ Invest in business models that provide high-occupancy transport services. ○ Support the use of low emission last-mile delivery option, particularly by active mobility. ○ Implement the uptake of low emission delivery options and low emission fleet through procurements. 	<p><i>Public Transport</i></p> <ul style="list-style-type: none"> ○ Invest in public transport infrastructure where densities support it, for example: <ul style="list-style-type: none"> ● Bus rapid transit ● Enhancing rail ○ Support public transport operators and/or authorities for sustainable business models. 	
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ Increase network efficiency by enhancing seamless transfer of transport and payment across modes. ○ Develop technology that facilitates synchro-modality such as zero-carbon MaaS for climate development plans, data sharing agreements and associated governance arrangement. 	<p><i>Public Transport</i></p> <ul style="list-style-type: none"> ○ Digitalize transport information for personalized transport services that favors a modal shift to public transport and sustainable mobility. ○ Improve availability and accuracy of information on public transport services. 		



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
4. Business and Service Providers	<p><i>Behavior Change</i></p> <ul style="list-style-type: none"> ○ Provide incentives for employees to use public transport, walking or cycling more often, e.g. subsidies, public recognition. ○ Transport service providers integrate sustainable transport planning efforts and across modes and sectors to encourage a modal shift. ○ ITS industry and service providers include impacts of ITS and smart mobility products on GHG emissions, and include climate impacts in all product advertising. <p><i>Cross-cutting Theme: Gender</i></p> <ul style="list-style-type: none"> ○ Increase women’s participation in transport businesses and service providers by positive actions, gender sensitive working conditions and more sustainable and inclusive transport policies. ○ Eliminate unconscious bias with appropriate education and training, improved working environment, gender sensitive facilities. ○ All forms of discrimination, harassment or violence in the workplace must be eliminated. 	<p><i>Public Transport</i></p> <ul style="list-style-type: none"> ○ Reduce barriers to intermodal public transport by improving public transport integration, journey planning and ticketing. <p><i>Cross-cutting Theme: Gender</i></p> <ul style="list-style-type: none"> ○ Set stretch targets for diversity and gender equality in the workforce of all transport sectors and in decision making. <p><i>Freight</i></p> <ul style="list-style-type: none"> ○ Use sustainable standards and certifications for logistics service providers to commit to sustainable urban freight. 		<p><i>Cross-cutting Theme: Gender</i></p> <ul style="list-style-type: none"> ○ Achieve gender parity and equality in the transport workforce.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
5. Civil Society	<p><i>Public Transport</i></p> <ul style="list-style-type: none"> ○ Promote development of comprehensive sustainable and resilient urban mobility plans that are consistent with the Sustainable Development Goals (SDGs) (e.g. Goal 11.2 focused on ‘expanding public transport’). <p><i>Behavior Change</i></p> <ul style="list-style-type: none"> ○ Provide facts and policy guidelines for cities to harness the lessons being learned during the pandemic beyond temporary measures. ○ Increase consumer demand and collaboration between businesses, service providers, and cities for more sustainable travel choices. ○ Increase capacity building to raise the awareness of the environmental externality of last-mile delivery. 	<ul style="list-style-type: none"> ○ Build capacity of implementers through partnerships and organizations by sharing best practice and knowledge, notably through collaborative initiatives under the Non-State Actor Zone for Climate Action (NAZCA) Platform, such as the UITP Declaration on Climate Leadership. 		

EXISTING INITIATIVES IMPACT AREA 2

<p>UITP Declaration on Climate Leadership</p>	<p>The Declaration's goal to double the market share of public transport by 2025 would allow us to cater to ever increasing demand for urban transport while decreasing per capita urban transport emissions by 25 per cent (global average) – about half a billion tonnes, which is over and above what technological solutions can achieve alone and would ensure that we would move the transport sector in the direction of the Paris Agreement and SDGs. The Declaration was supported by over 350 pledges to climate action from more than 110 members of the international public transport community in more than 80 global cities. These actions are aimed at giving a greater role to public transport in mobility and help to decrease their carbon footprint, as well as reduce the corporate carbon footprint.</p>
<p>Global Sidewalk Challenge</p>	<p>The Global Sidewalk Challenge raises the voice and profile for walking internationally and sets a challenge to governments, private businesses and NGOs to collaborate and invest in walking infrastructure, especially dedicated, safe and barrier free sidewalks at transport hubs, to benefit the people who walk most by focusing on the places most walked in order to reduce GHG emissions, improve the efficiency of public transport and deliver better public health.</p>
<p>Transformative Urban Mobility Initiative (TUMI)</p>	<p>Mobilize finance, build capacities and promote innovative approaches for urban mobility.</p>
<p>Digitalization and Data in mobility project (TUM - (WBCSD)</p>	<p>Support policy making for data-sharing helping to harness capacity available (people and goods) to minimize travel demand.</p>
<p>ITS for Climate (TOPOS Digital Aquitaine, IRF)</p>	<p>Gathering evidence of climate impact reduction potential of ITS and smart mobility tools, and promotion of new and improved measures such as “MaaS for climate”.</p>
<p>Share the Road Programme (UNEP)</p>	<p>Share the Road Programme supports governments and other stakeholders in developing countries to move away from prioritizing the car-driving minority, towards investing in infrastructure for the majority: those who walk and cycle.</p>
<p>EcoMobility SHIFT (ICLEI)</p>	<p>EcoMobility SHIFT is a total quality management scheme that allows cities to access their mobility performance, establish a path of continuous improvement; analyze performance; and act to improve. This is the original scheme which was developed in 2013 for European cities.</p>

EcoLogistics Principles (ICLEI)	<p>EcoLogistics promotes clean, sustainable, efficient and safe urban freight through collaborative efforts in stakeholder engagement, technologies, policies and land use planning and inspires local governments to transform their urban freight system. It includes eight foundational principles local governments can follow to help lead the transition to sustainable urban freight.</p>
Tracker of Climate Strategies for Transport (GIZ and SLOCAT)	<p>The Tracker of Climate Strategies for Transport provides a clear picture of ambition, targets and policies in NDCs and Long-Term Strategies by countries to support sustainable transport. With the Tracker of Climate Strategies for Transport, countries can keep track of national-level climate policies and targets in transport. In particular, it provides information on the role of transport in Nationally Determined Contributions (NDCs) and Long-term Low Greenhouse Gas Emission Development Strategies (LTS) – the two most important instruments of the Paris Agreement to limit global warming to well below 2°C.</p>
ITF Decarbonising Transport initiative	<p>The Decarbonising Transport initiative promotes carbon-neutral mobility to help stop climate change. It provides decision makers with tools to select CO2 mitigation measures that deliver on their climate commitment.</p>

FURTHER REFERENCES IMPACT AREA 2

Transport Climate Action Directory	<p>https://www.itf-oecd.org/transport-climate-action-directory-measures</p>
Publications on Gender & Mobility	<p>https://womenmobilize.org/publications/</p>
The Gender Dimension of the Transport Workforce	<p>https://www.itf-oecd.org/gender-dimension-transport-workforce</p>
Understanding Urban Travel Behavior by Gender for Efficient and Equitable Transport Policies	<p>https://www.itf-oecd.org/sites/default/files/docs/urban-travel-behavior-gender.pdf</p>

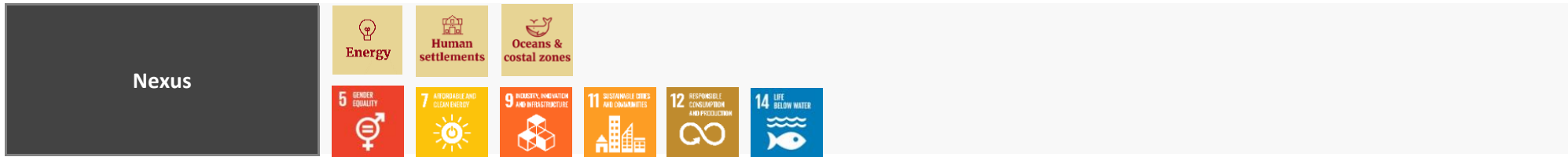


A Global High Shift Scenario: Impacts and Potential for More Public Transport, Walking, and Cycling with Lower Car Use	https://www.itdp.org/wp-content/uploads/2014/09/A-Global-High-Shift-Scenario_WEB.pdf
Rail Freight Forward	https://www.railfreightforward.eu/about-rail-freight-forward
ITF COVID-19 Transport Brief: Re-spacing Our Cities for Resilience	https://www.itf-oecd.org/sites/default/files/respacing-cities-resilience-covid-19.pdf
Regulating App-Based Mobility Services	https://www.itf-oecd.org/regulating-app-based-mobility-services
Women Leading Climate Action: A World Within Reach	https://www.womens-forum.com/wp-content/uploads/2020/06/Women4ClimateAction-report_2019.pdf
Women Leading the Green Recovery: Promoting Women in Entrepreneurship and STEM Will Help Build a Sustainable and Equal World	https://www.womens-forum.com/wp-content/uploads/2021/02/Women4ClimateAction_Report_220321_compressed.pdf
Sustainable Mobility for All	https://www.sum4all.org/
MobiliseYourCity Partnership. (2021). National Urban Mobility Policies and Investment Programmes (NUMP) Guidelines	https://www.changing-transport.org/publication/national-urban-mobility-policies-and-investment-programmes-nump-guidelines/
GIZ. (2020). Enhancing Climate Ambition in Transport - Six Action Recommendations for Policymakers to Align Transport with the Paris Agreement and the Sustainable Development Agenda	https://www.changing-transport.org/publication/enhancing-climate-ambition-in-transport/

Impact
3

Resilient Transport Systems, Infrastructure and Vehicles

ADAPTATION



	By 2021	By 2025	By 2030	By 2040
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> Accelerate support for institutional and human capacity-building to identify and manage climate risks to transport systems, infrastructure assets, services and vehicles³, across modes. Recommend that all entities with responsibilities for parts of the transport system undertake multi-hazard risk assessments and prepare adaptation strategies, disaster response and contingency plans. Review legal, policy and institutional frameworks for effective climate-risk assessment and adaptation planning for transport; ensure integration into land 	<ul style="list-style-type: none"> Prepare an overarching transport system resilience and adaption strategy considering the co-dependency and interlinked nature of mobility across modes and with other sectors (e.g. energy). Require all entities with responsibilities for parts of the transport system to undertake multi-hazard risk assessments and to prepare adaptation strategies, disaster response and contingency plans. Provide targeted financial support for risk assessments as part of the planning and project development process 	<ul style="list-style-type: none"> Foster education programmes that promote resilience, sustainability and multi-modality in transport network design, operation and management. 	<ul style="list-style-type: none"> Ensure that policies, governance, legal and institutional frameworks are in place to effectively support the climate-resilience of all critical transport infrastructure and systems to at least 2050. Ensure required human resources and capacity to maintain and operate critical transport systems and infrastructure assets at local levels. Support effective management of environmental resources for adaptation and resilience building.

³ For Impact Area 3: Resilient Transport Systems, Infrastructure and Vehicles, the term “vehicles” is used in respect of all modes of transport (road, rail, air, sea, inland waterway) and also includes craft and vessels.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ [...] use and marine spatial planning, national adaptation plans, and processes for implementation of international agreements, including the 2030 Agenda, Paris Agreement and Sendai Framework. ○ Build capacity for assessing climate-related impacts, vulnerability and adaptation for transport infrastructure and systems as a consolidated cross-cutting “single” area within UNFCCC assessment processes. ○ Support long-term investment in human skills, including at local levels and resources through education and training programmes, as well as technologies. ○ Introduce ‘build-back-better’ policies. ○ Coordinate with stakeholders to identify opportunities to align and reinforce policies on resilient infrastructure, including alignment of disaster management and climate risk management policies. ○ Introduce/strengthen policies and financing to promote climate-resilient vehicles for safe and efficient distribution of goods or transport of people with minimal disruption during severe weather (heat, flood, wind). 	<ul style="list-style-type: none"> ○ [...] where needed. ○ Enshrine requirement for integration of infrastructure resilience and adaptation into transport policy, investment plans and strategies. ○ Develop the legal and policy framework required to ensure provision is made, in new or replacement infrastructure and technologies, to accommodate adaptation and resilience-building. ○ Use policy instruments to encourage consideration of combinations of hard, soft (grey and nature-based) and behavioral, operational or institutional measures across systems and infrastructure assets. ○ Promote flexibility in infrastructure design through revised or new design standards and Codes of Practice e.g. through application of ISO 14090 Adaptation to Climate Change and its subservient standards. ○ Promote planning methodologies, risk assessment tools, and evaluation techniques that accommodate climate change uncertainties. ○ Use land-use planning and other strategic tools to encourage, facilitate or require relocation of new transport infrastructure out of high-risk areas. 		

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ Develop/strengthen the policy framework needed to promote redundancies within and across modes and networks and facilitate efficient, temporary modal shift during periods of disruption. ○ Coordinate with stakeholders to identify opportunities to align and reinforce policies on resilient infrastructure, including alignment of disaster management and climate risk management policies. ○ Put in place policies and regulations for public transport and logistics workers to be categorised as essential and provide health, safety and security measures. 	<ul style="list-style-type: none"> ○ Foster no-/low-carbon construction policies. ○ Enshrine and implement policies to promote redundancies within and across modes and networks and ensure efficient, temporary modal shift during periods of disruption. ○ Promote and strengthen systems thinking for climate resilience-building across modes and networks. ○ Consolidate institutional capacity with prioritized science-policy information exchange programmes. Put in place policies, governance, legal and institutional frameworks to support the climate-resilience (to at least 2050) of all critical transport infrastructure and systems (as well as vehicles, where necessary). 		
2. Financial Institutions	<ul style="list-style-type: none"> ○ Facilitate institutional and human capacity-building for assessment and management of climate risks to existing and new transport systems and infrastructure assets. ○ Review financing models and decision-making criteria to facilitate and prioritize the delivery of flexibility and adaptive capacity in transport systems, infrastructure and technologies. ○ Engage with stakeholders to identify financing priorities for improved interconnectivity, integration and efficiency. 	<ul style="list-style-type: none"> ○ Make finance for investment in transport infrastructure, systems and vehicles contingent on identifying and appropriately accommodating climate risks. ○ Link sectoral insurance premiums to demonstrated investment in resilient transport infrastructure assets, systems and vehicles. ○ Change emphasis from ‘financial’ returns to recognize sustainability principles and use very low or zero discount rates to promote climate-resilient infrastructure. 	<ul style="list-style-type: none"> ○ Consolidate institutional capacity with prioritized science-policy information exchange programmes. ○ Promote network resilience as a key determinant in business case and financing criteria for investment in transport systems. ○ Put financial and investment provisions in place to support the climate-resilience (to at least 2050) of all critical transport infrastructure and systems (as well as vehicles, where necessary). 	<ul style="list-style-type: none"> ○ Put finance and investment provisions in place to support climate-resilience of all critical transport infrastructure and systems to at least 2100.

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions	<ul style="list-style-type: none"> ○ Accelerate action for access to finance for transport systems and infrastructure resilience-building, in particular for most vulnerable groups of countries and regions (e.g. SIDS, LDCs, LLDCs). ○ Accelerate availability of finance for targeted impact and risk-assessment at facility level. ○ Raise awareness of economic and financial benefits of climate-resilient vehicles for safe, efficient and comfortable distribution of goods or transport of people. ○ Prioritize science-policy support and information exchange to accelerate development of climate-resilient vehicles (bus, trucks, trains, vessels). 	<ul style="list-style-type: none"> ○ Accelerate availability of innovative finance mechanisms for resilience building and adaptation, including Climate Bonds and Blue Bonds, in particular for most vulnerable groups of countries. ○ Accelerate financing for development and delivery of climate-resilient refurbishment, retrofitting or renewal programmes, using nature-based solutions where appropriate. ○ Promote climate-resilience as a key determinant in business case and financing criteria for transport investment. ○ Promote appropriate climate risk disclosure requirements to inform financing and investment decisions. ○ Make financial and investment provision to accelerate the development of climate-resilient vehicles for extreme conditions (e.g. windage-resilient maritime vessels; shallower drafted inland waterway vessels; flood/heat- proofed buses, trucks, trains). ○ Develop and introduce (public) procurement procedures that prioritize climate-resilient vehicles for health and safety and minimize disruption. ○ Put finance and investment provisions in place to effectively support climate-resilience for all critical transport infrastructure and systems 	<ul style="list-style-type: none"> ○ Provide required financing and capacity building (including strengthening human resources) to maintain and operate resilient transport infrastructure assets at local levels. ○ Support effective management of environmental resources for adaptation and resilience building. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions		<ul style="list-style-type: none"> ○ [...] (as well as vehicles, where necessary) to at least 2050. ○ Mainstream climate resilience in critical coastal transport infrastructure planning and operations, in particular in small island developing states (SIDS). 		
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ Develop mode-appropriate monitoring, modelling, forecasting and information management tools. ○ Research and develop innovative, flexible and adaptive engineering responses to climate hazards, including multi-hazard planning and response mechanisms. ○ Facilitate information exchange, share evolving good practice and feedback into industry guidelines and standards. ○ Develop and maintain inventories, databases (of assets, components, characteristics, environmental data) and GIS-based maps required for climate-risk assessment and priority setting for adaptation and resilience strengthening. ○ Facilitate knowledge transfer from regions/countries that already regularly encounter weather extremes e.g. heat/drought rainfall/flooding. ○ Research and develop mode-specific air conditioning and climate control technologies; floodwater- or wind-resilient vehicle, vessel, etc. designs. 	<ul style="list-style-type: none"> ○ Develop open-source platform used by governments, industry and the general public to share information during natural disasters to facilitate the movement of people and goods. ○ Refine real-time hydro-meteorological monitoring and early warning systems. ○ Develop new flexible/adaptive designs and associated industry standards where relevant to accommodate climate related risks. ○ Develop training and capacity building for transportation professionals in emerging strategies and technologies to integrate climate information, reduce risks, and promote resilience throughout the transportation development and management cycle. ○ Accelerate the development of technologies for enhanced vehicular climate-resilience to extreme conditions (e.g. windage-resilient maritime vessels; shallower drafted inland waterway vessels; flood/heat- proofed buses, trucks, trains). 	<ul style="list-style-type: none"> ○ Provide technology and related capacity building to support the climate-resilience of all critical transport infrastructure and systems (as well as vehicles, where necessary) to (at least) 2050. ○ Scale up established technologies in response to changing climate conditions. 	<ul style="list-style-type: none"> ○ Provide technology and related capacity building to support climate-resilience of all critical transport infrastructure and systems to at least 2100. ○

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ Conduct risk reduction research to improve freight and passenger transport safety in extreme conditions. 	<ul style="list-style-type: none"> ○ Develop new technologies that enable the integration of high-share renewable technologies to increase system resilience. ○ Design new vehicles (buses, trucks, trains, vessels, etc.) that incorporate any modifications needed to strengthen resilience to extreme weather conditions. 		
4. Business and Service Providers	<ul style="list-style-type: none"> ○ Review current supply chain networks to improve resiliency. ○ Carry out climate risk assessments and prepare adaptation strategies and contingency/disaster response plans for critical transport services, infrastructure and systems. Support these with awareness raising and training. ○ Develop and maintain inventories, databases (system components, assets, environmental data) and associated GIS to support risk assessment/priority setting. ○ Mainstream climate change considerations into planning, management, maintenance and operational decision-making for critical transport systems and assets. ○ Prioritize inspection and maintenance at both system and infrastructure asset level to maximize operational resilience. 	<ul style="list-style-type: none"> ○ Ensure that the movement of goods is uninterrupted through the collaboration among logistics services providers and across the supply chain. ○ Implement real-time monitoring, data management, forecasting and early warning systems for critical transport assets and systems to minimize business disruption, optimize aid distribution, etc. ○ Refine and disseminate disaster response or extreme weather contingency plans. ○ Modify operational procedures and working practices to introduce flexibility and improve adaptive capacity. ○ Incrementally reinforce, modify, raise or strengthen critical assets and systems. ○ Incorporate innovative design and engineered redundancy to optimize resilience. 	<ul style="list-style-type: none"> ○ Consolidate institutional capacity through continued professional development programmes drawing on latest scientific research. ○ Consolidate and improve real-time monitoring, forecasting and early warning systems to ensure continued functioning of the network during periods of disruption. ○ Initiate cross-modal programmes to improve the resilience of the network. ○ Work with vehicle designers and operators to modify systems, introduce flexibility and improve adaptive capacity between modes. ○ Ensure critical transport infrastructure and systems (as well as vehicles, where necessary) are climate resilient to (at least) 2050. 	<ul style="list-style-type: none"> ○ Ensure all critical transport infrastructure and systems are climate resilient to at least 2100. ○ Ensure climate change considerations are fully integrated into planning, management, maintenance and operational decision-making for critical transport infrastructure and systems. ○ Consolidate organizational capacity to identify and manage climate risks affecting existing transport infrastructure, systems and operations.

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
4. Business and Service Providers	<ul style="list-style-type: none"> ○ Implement strategic level, cross-modal monitoring and related information management systems. ○ Invest in training and technical capacity building. ○ Apply planning, design and evaluation techniques that accommodate climate change-related uncertainties using nature-based solutions where relevant. ○ Raise awareness of economic and financial benefits of climate-resilient vehicles for safe and efficient distribution of goods or transport of people. ○ Strengthen industry wide collaboration for resilience building across modes. 	<ul style="list-style-type: none"> ○ Consolidate institutional capacity through continued professional development programmes drawing on latest scientific research. ○ Invest in climate-resilient infrastructure designs to reduce risk of disruption due to extreme weather incidents (e.g. flooding, storms), or health and safety-induced industrial action (e.g. extreme heat). ○ Invest in technologies for enhanced climate-resilience of vehicles to extreme conditions (e.g. windage-resilient maritime vessels; shallower drafted inland waterway vessels; flood/heat- proofed buses, trucks, trains). ○ Ensure that all new transport infrastructure and systems (as well as vehicles, where necessary) are climate resilient to at least 2050. 	<ul style="list-style-type: none"> ○ Embrace flexibility, and apply adaptive management principles to develop and deliver programmes for climate-resilient renewal, refurbishment or retrofitting, using nature-based solutions where relevant. 	
5. Civil Society	<ul style="list-style-type: none"> ○ Ensure familiarity with disaster recovery and other contingency plans. ○ Facilitate information exchange and share evolving good practice. ○ Engage in relevant decisions on resilient transport infrastructure, systems and vehicles; help to identify and deliver no regret or win-win opportunities including nature-based solutions. 	<ul style="list-style-type: none"> ○ Promote civil society stakeholder engagement to support the climate-resilience of all new transport infrastructure and systems (as well as vehicles, where necessary) to at least 2050. 	<ul style="list-style-type: none"> ○ Promote civil society stakeholder engagement to support the climate-resilience of all critical transport infrastructure and systems (as well as vehicles, where necessary) to at least 2050. 	<ul style="list-style-type: none"> ○ Promote civil society stakeholder engagement to support the climate-resilience of all critical transport infrastructure and systems to at least 2100.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
5. Civil Society	<ul style="list-style-type: none"> ○ Ensure stakeholder engagement and consultations as part of climate change risk assessment and adaptation planning for transport infrastructure assets and operations. ○ Accelerate long-term investment in human skills and resources to maintain and operate resilient transport assets through education and training programmes. ○ Raise awareness of health, safety and (socio) economic issues if vehicles are not climate-resilient. 			

EXISTING INITIATIVES IMPACT AREA 3

<p>Navigating a Changing Climate</p>	<p>Navigating a Changing Climate is a multi-stakeholder coalition of nine associations with interests in waterborne transport infrastructure. The partners in PIANC’s Navigating a Changing Climate Partnership have committed to work together to support the inland and maritime navigation infrastructure sector as they respond to climate change.</p> <p>By furthering understanding, providing targeted technical support, and building capacity, the partnership will encourage the owners, operators and users of waterborne transport infrastructure to: (1) Reduce greenhouse gas emissions and shift to low-carbon maritime and inland navigation infrastructure and (2) act urgently to strengthen resilience and improve preparedness to adapt to the changing climate.</p> <p>https://navclimate.pianc.org/</p>
<p>Transformative Urban Mobility Initiative (TUMI)</p>	<p>Mobilize finance, build capacities and promote innovative approaches for urban mobility.</p>
<p>UIC Low-Carbon Sustainable Rail Transport Challenge</p>	<p>Improvement of rail sector energy efficiency, reductions in GHG emissions, resilience and a more sustainable balance between transport modes.</p>

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[Adapting Urban Transport to Climate Change - Changing Transport \(changing-transport.org\)](http://changing-transport.org)

Impact
4

SUBSTITUTE FUELS WITH ELECTRICITY AND IMPROVE VEHICLE, FUEL, AND OPERATIONAL EFFICIENCIES TO DECREASE EMISSIONS OF UNAVOIDABLE TRAVEL

Improve Land Transport

MITIGATION

Nexus

	By 2021	By 2025	By 2030	By 2040
<p>1. Policymakers (national, subnational, local levels)</p> <ul style="list-style-type: none"> Develop coherent zero-carbon mobility policies for the transition for light-duty vehicles, buses, and rail transport including infrastructure and incentives with the aim of 100 per cent new vehicles sales to be zero carbon by 2030 for buses, 2035 for light-duty vehicles, and 2040 for railway trains in leading markets. Policies should aim to decrease emissions during the transition by ensuring higher fuel efficiency and low-carbon fuel adoption. Introduce fuel economy or CO₂ emission standards in countries yet to adopt them: <ul style="list-style-type: none"> Cover both light and heavy-duty vehicles 	<ul style="list-style-type: none"> Encourage vehicle manufacturers and infrastructure providers to plan for reaching the tipping points in 2030 for zero-carbon vehicle sales with 75 per cent for light-duty vehicles, 40 per cent for heavy-duty vehicles, and 100 per cent for buses in leading markets. Tighten emission and fuel economy standards for light and heavy-duty vehicles. Tighten conditions for differentiated access, parking rules and road charges favoring low emission vehicles. Tighten requirement for the adoption of low or zero-emission vehicles. 	<ul style="list-style-type: none"> Assess and strengthen the plans to reach 100 per cent zero-carbon vehicle sales for new purchases of light-duty vehicles by 2035 and of rail by 2040 in leading markets. Tighten emission and fuel economy standards for light and heavy-duty vehicles. Eliminate carbon pricing gaps. Reduce restrictions on truck length and weight to maximize efficiencies from the introduction of high-capacity vehicles on certain corridors. Reduce administrative burden for the installation of new energy distribution infrastructure (e.g. chargers in parking lots and/or apartment buildings). 	<ul style="list-style-type: none"> Ensure 100 per cent ZEV sales for light and heavy-duty vehicles, buses, and rail by 2040 in leading markets triggered by political commitments and national and regional ambitions. For the remaining markets, set per kilometer CO₂ reduction target for light-duty vehicles to 90 per cent and for heavy-duty vehicles to 70 per cent (relative to 2005). Require the phase out of diesel only trains by 2040. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ● Set targets to improve average fuel economy with increasing ambition over time ● Introduce testing of real-world fuel efficiency to limit any divergence from laboratory tested values <ul style="list-style-type: none"> ○ Adopt measures that foster the energy efficiency and zero-carbon vehicles and low-carbon fuels for passenger and freight transport in cities. ○ Provide financial assistance to support the uptake of low or zero-emission vehicles via policies such as feebates and tax exemptions. ○ Reduce the carbon intensity of transport energy sources in the following ways: <ul style="list-style-type: none"> ● Increase the share of low-carbon fuel blending ● Increase the share of renewables in the electricity grid ● Fully integrate clean electricity and green hydrogen into regulatory policies on low-carbon fuels ○ Include requirements for zero-emission vehicles (e.g. electric buses) in public procurement programmes for public transport vehicles. ○ Differentiate access, parking rules and road charges favoring low emission vehicles, including through total or partial urban zoning restrictions and track access charging for rail. 	<ul style="list-style-type: none"> ○ Commit to reducing carbon pricing gaps in order to expedite the transition to sustainable transport technologies. ○ Eliminate fossil fuel subsidies. ○ Reduce the carbon intensity of new transport energy sources. ○ Continue to increase the share of renewables in the electricity grid. ○ Scale the production of low-carbon hydrogen. ○ Scale the production of advanced biofuels. <p>Outline a pathway for a gradual tax reform, involving a shift from taxes on fuel to taxes based on distances driven, location and environmental performance of vehicles, to ensure a sustainability for government revenues from transport taxation over the long term.</p>		



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ Start developing a framework allowing the application of differentiated road charges and access restrictions based on environmental performances of vehicles. ○ Make policy and investment decisions based on full life cycle analysis. ○ Explore policy options for vehicle weight and footprint reduction such as differentiated taxation. ○ Ensure that safety standards are ready for the large-scale deployment of zero-emission vehicles and low-carbon fuels. ○ Align economic stimulus packages with decarbonizing transport measures, including e-mobility to improve economic productivity and stimulate progress in battery technology in leading markets. ○ Define coherent (mobility, energy, real estate) policy measures allowing the fast deployment of charging infrastructure in urban and suburban landscape. ○ Require new MaaS schemes to use only zero-carbon vehicle transport modes. 			
2. Financial Institutions	<ul style="list-style-type: none"> ○ Invest in development, production and scaling up of sustainable, low and zero-carbon technologies for rail and road transport, prioritizing electrification of light-duty vehicles and buses, combination of electrification wherever feasible, including direct via battery or 	<ul style="list-style-type: none"> ○ Continue to invest in development, production and scaling up of sustainable, low-carbon energy (and related infrastructure) for rail and road transport. 	<ul style="list-style-type: none"> ○ Keep investing in sustainable transport technologies. 	<ul style="list-style-type: none"> ○ Keep investing in sustainable transport technologies.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions	<ul style="list-style-type: none"> ○ [...] overhead wire and hydrogen fuel cells for long-haul heavy transport, and related infrastructure. For example: <ul style="list-style-type: none"> ● Reduce costs for electric vehicles (EVs) powered by renewable electricity and increase the annual market share of EVs ● Reduce costs of drop-in biofuels ○ Influence portfolio companies to make more climate-conscious decisions for their transport strategies. ○ Develop tools to de-risk long-term investments in zero-carbon sustainable transport solutions (e.g. shorter amortization, innovative leasing models) to attract non-traditional investors to sustainable transport, such as insurance companies, pension funds and other institutional investors. 	<ul style="list-style-type: none"> ○ Move towards mileage-based taxation systems to limit reduced revenue from increased electrification of passenger cars. 		
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ Scale up research and development for vehicle and fuel efficiency improvements. ○ Scale up tested and low barrier decarbonization measures for freight transport, including; <ul style="list-style-type: none"> ● Aerodynamic retrofits ● Reduced-rolling resistance of tires ● Increased engine efficiency and hybridization ● Electrification of rail freight lines ○ Ensure that technical regulations and standards for safety and environmental 	<ul style="list-style-type: none"> ○ Use real-time traffic information to optimize routing and reduce congestion. ○ Facilitate information and data sharing among logistics service providers to reduce empty running. ○ Begin the large-scale deployment of infrastructure to decarbonize heavy-duty freight vehicles at scale (e.g. electric road systems, battery charging systems or green hydrogen refueling systems). ○ Ensure that technical regulations and standards of vehicle safety and 	<ul style="list-style-type: none"> ○ Continue to ensure that technical regulations and standards for clean vehicles and sustainable fuels remain up to date. 	<ul style="list-style-type: none"> ○ Continue to ensure that technical regulations and standards for clean vehicles and sustainable fuels remain up to date. ○ Ensure that all electricity is from renewable or low-carbon sources (manufacturing and transport).

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ [...] performance of electric and hydrogen vehicles (including trucks), electric road systems and low-carbon fuels are in place, especially for freight transport. ○ Ensure that sustainability criteria for low-carbon fuels are in place. ○ Address the environmental performance of vehicle manufacturing (including batteries) with regulatory innovation targeting their durability, carbon footprint and the sustainability of associated supply chains. ○ Fund demonstration projects for decarbonizing heavy-duty freight vehicles e.g. electric road systems, battery electric or green hydrogen vehicles. ○ Fund demonstrating projects focusing on major transport corridors and projects should be sponsored by leading companies from various segments (shippers, carriers, fuel providers, infrastructure providers, etc.). ○ Fund demonstration projects for decarbonizing trains for segments that are difficult to electrify e.g. battery electric or green hydrogen vehicles. ○ Accelerate the development of information technology tools to facilitate the pricing of transport systems and modes, such as mileage-based pricing. 	<ul style="list-style-type: none"> ○ [...] environmental performance, fuel and manufactured components properties and sustainable production remain up to date, following technology developments. ○ Development of Artificial Intelligence to improve customer experience and efficiency in areas such as predictive maintenance. ○ Development of 5G for efficient rail telecommunications. 		



	By 2021	By 2025	By 2030	By 2040
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ Increase ratio of blends of advanced biofuels achieved through innovations in production and supply chain. ○ Integrate green hydrogen supply chain into the segments of the transport sector, including long-haul trucking. 			
4. Business and Service Providers	<ul style="list-style-type: none"> ○ Increase production and distribution of renewable energy for all modes of motorized transport. ○ Original equipment manufacturers (OEMs) commit to and plan for 100 per cent of new vehicle sales to be zero carbon by 2030 for buses, 2035 for light-duty vehicles, and 2040 for railway trains in leading markets in collaboration with their suppliers and research partners on parts and infrastructure. ○ Fleet-owning businesses to develop decarbonization strategies for their transport operations by prioritizing electrification of light and heavy-duty vehicles and combination of electrification wherever feasible, including direct via battery or overhead wire and hydrogen fuel cells, for long-haul heavy transport. They should also collaborate and encourage policy leaders and key partners to set ambitious strategies and foster systemic change. 	<ul style="list-style-type: none"> ○ OEMs, suppliers, and infrastructure providers assess and strengthen plans to reach the tipping points in 2030 for zero-carbon vehicle sales with 75 per cent for light-duty vehicles, 40 per cent for heavy-duty vehicles, and 100 per cent for buses in leading markets. ○ Businesses increasingly adopt low and zero-emission vehicle fleets. ○ Businesses scale up the installation of EV charging infrastructure at workplaces and customer parking sites. ○ Train operators reduce energy consumption and CO₂ emissions through optimization of vehicle capacity. ○ Increase railway share of passenger transport and freight transport through enhanced customer experience, cost and time efficiency incentives. 	<ul style="list-style-type: none"> ○ OEMs, suppliers, and infrastructure providers assess and strengthen plans to reach 100 per cent zero-carbon vehicle sales for purchases of light-duty vehicles by 2035 and rail by 2040 in leading markets. ○ Businesses continue to adopt low and zero-emission vehicles and to scale up the deployment of vehicle charging infrastructure. ○ Integrate information and communication technologies (ICT) into sustainable transport operations allowing for optimized networks and improved system efficiencies. ○ Replace company vehicle fleets with zero-emission vehicles. 	

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
4. Business and Service Providers	<ul style="list-style-type: none"> ○ Support workforce capacity building, especially in developing countries, through partnerships with international organizations, multilateral development banks, and governments at all levels to promote decarbonizing transport. ○ Promote eco-driving training for freight vehicles. ○ Promote off-peak deliveries, route optimization or voluntary emissions reduction programmes with set targets. ○ In designing, building and renewing transport infrastructure and fleet, consider and reduce embodied and life cycle carbon impacts by adopting low carbon design and circular economy principles. 			
	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
5. Civil Society	<ul style="list-style-type: none"> ○ Increase capacity building and sharing of best practice knowledge among stakeholders. ○ Develop public information campaigns to promote sustainable transport behavior and counter 'greenwashing'. ○ Engage with investors, vehicle manufacturers, and policy makers in order to encourage them to switch to zero-carbon vehicles. 	<ul style="list-style-type: none"> ○ Continue capacity building and sharing of best practice knowledge among stakeholders. ○ Increase consumer awareness and demand for zero-carbon vehicles for both passenger and commercial use by showing impact and progress in leading markets. ○ Continue engagement with investors, vehicle manufacturers, and policy makers in order to encourage them to switch to zero-carbon vehicles. 	<ul style="list-style-type: none"> ○ Continue the capacity and awareness building efforts and key stakeholder engagements. 	<ul style="list-style-type: none"> ○ Continue the capacity and awareness building efforts and key stakeholder engagements.

EXISTING INITIATIVES IMPACT AREA 4

<p>Transport Decarbonisation Alliance (TDA)</p>	<p>The TDA brings together countries, cities/regions and companies, the “3Cs”, to achieve low-carbon mobility by setting up ambitious and tangible action plans for private and public actors for the sector’s transformation and influence political decision-makers in key international fora and through bilateral dialogues.</p>
<p>International Zero-Emission Vehicle Alliance (ZEV Alliance)</p>	<p>As a collaboration of national and subnational governments, ZEV Alliance works together to make all passenger vehicles in their jurisdictions ZEVs as fast as possible, and no later than 2050. Their commitments include promoting and incentivizing ZEV purchases, planning for and investing in the required infrastructure, placing necessary policies, removing any government barriers, and influencing the same movement in public sector fleets and medium- and heavy-duty vehicles.</p>
<p>Global Fuel Economy Initiative (GFEI)</p>	<p>The Global Fuel Economy Initiative (GFEI) was established to ensure that the world’s vehicle fleet is as clean and efficient as possible in response to global concerns about clean air and climate change. GFEI is a partnership between six organizations, including the International Energy Agency (IEA), International Transport Forum (ITF), United Nations Environment Programme (UNEP), International Council on Clean Transportation (ICCT), Institute for Transportation Studies at the University of California Davis, and the FIA Foundation, that promote further research, discussion and action to improve fuel economy worldwide and transition to low carbon, zero emission (at tailpipe) technologies. GFEI's core activities are data development and analysis of fuel economy potentials, support for national and regional policy-making efforts and outreach and awareness raising to stakeholders (e.g. vehicle manufacturers).</p>
<p>Global Green Freight Action Plan</p>	<p>Supported by over 50 organizations and countries, the UN-backed Global Green Freight Action Plan has as a 2030 goal that green freight programs will span all countries, modes and supply chains, and demonstrate substantial emission reductions from freight transport.</p> <p>http://globalgreenfreight.org/</p> <p>Expansion of green freight programs: SmartWay across Canada/US/Mexico; Latin America, Europe, Asia and Green Freight Strategy for Africa Northern Corridor (Kenya, Uganda, Rwanda, Burundi, South Sudan and DR Congo).</p> <p>Global methodology for calculating and reporting logistics emissions covering all modes and logistics sites: GLEC Framework https://www.smartfreightcentre.org/en/how-to-implement-items/what-is-glec-framework/58/, which is used by many green freight programs and is a basis for a future ISO standard 14083 https://www.smartfreightcentre.org/en/iso-standard-building-on-glec-framework/</p>

<p>World Economic Forum (WEF) Road Freight Zero</p>	<p>As part of the WEF's Shaping the Future of Global Public Goods and Shaping the Future of Mobility platforms, this initiative aims to fast-track zero emission fleets and infrastructure by 2030. It focuses on encouraging value chain leaders to commit to net-zero transition by 2030 at CEO level, demonstrating policy and business case learning and solutions for future scaling, and co-developing action plans for scaling up transition finance mechanism for all players in cooperation with relevant finance actions.</p>
<p>EV100</p>	<p>An initiative by the Climate Group, EV100 aims to accelerate the transition to ZEVs and deployment of the required infrastructure by leveraging the role of corporate demand. Member companies commit to transitioning their fleets to ZEVs and/or providing charging infrastructure at their premises by 2030.</p>
<p>Transformative Urban Mobility Initiative (TUMI)</p>	<p>Mobilize finance, build capacities and promote innovative approaches for urban mobility.</p>
<p>C40 Green and Healthy Streets</p>	<p>As part of C40, which consists of 97 cities taking climate action, this initiative aims to support its cities to have major zero-emission areas by 2030 by transitioning to "Fossil-Fuel-Free Streets". Committed actions include people-friendly city planning, increasing the rates of walking, cycling and the use of public and shared transport that is accessible to all citizens, reducing the number of polluting vehicles powered by fossil fuels and procuring zero emission vehicles for city fleets as well as fleet operators and businesses.</p>
<p>Action towards Climate-friendly Transport (ACT)</p>	<p>ACT promotes and accelerates transport action and zero-emission mobility in the fight against climate change.</p>
<p>UIC Low-Carbon Sustainable Rail Transport Challenge</p>	<p>Improvement of rail sector energy efficiency, reductions in GHG emissions, resilience and a more sustainable balance between transport modes.</p>
<p>ITF Decarbonising Transport initiative</p>	<p>The Decarbonising Transport initiative promotes carbon-neutral mobility to help stop climate change. It provides decision makers with tools to select CO2 mitigation measures that deliver on their climate commitment.</p>
<p>WBCSD Mobility Decarbonization Project</p>	<p>Develop guidance and policy recommendations for fast adoption of electric vehicles, including by creating a pathway for the fast deployment of a viable and sustainable battery EV charging infrastructure.</p>
<p>EcoMobility SHIFT (ICLEI)</p>	<p>EcoMobility SHIFT is a total quality management scheme that allows cities to access their mobility performance, establish a path of continuous improvement; analyze performance; and act to improve. This is the original scheme which was developed in 2013 for European cities.</p>

<p>EcoLogistics Principles (ICLEI)</p>	<p>EcoLogistics promotes clean, sustainable, efficient and safe urban freight through collaborative efforts in stakeholder engagement, technologies, policies and land use planning and inspires local governments to transform their urban freight system. It includes eight foundational principles local governments can follow to help lead the transition to sustainable urban freight.</p>
<p>Tracker of Climate Strategies for Transport (GIZ and SLOCAT)</p>	<p>The Tracker of Climate Strategies for Transport provides a clear picture of ambition, targets and policies in NDCs and Long-Term Strategies by countries to support sustainable transport. With the Tracker of Climate Strategies for Transport, countries can keep track of national-level climate policies and targets in transport. In particular, it provides information on the role of transport in Nationally Determined Contributions (NDCs) and Long-term Low Greenhouse Gas Emission Development Strategies (LTS) – the two most important instruments of the Paris Agreement to limit global warming to well below 2°C.</p>
<p>Mission Possible Partnership (MPP)</p>	<p>The Mission Possible Partnership (MPP) is an alliance of climate leaders focused on supercharging efforts to decarbonize some of the world’s highest emitting industries in the next 10 years. It builds on the foundation laid by the Mission Possible Platform, launched in 2019 by the Energy Transitions Commission and the World Economic Forum, by expanding and accelerating the work of seven nascent industry working groups in aluminum, aviation, cement and concrete, chemicals, shipping, steel, and trucking.</p>

FURTHER REFERENCES IMPACT AREA 4

<p>Transport Climate Action Directory</p>	<p>https://www.itf-oecd.org/transport-climate-action-directory-measures</p>
<p>IEA in collaboration with UIC</p>	<p>https://www.iea.org/reports/the-future-of-rail</p>
<p>Regulations and Standards for Clean Trucks and Buses On the Right Track?</p>	<p>https://www.itf-oecd.org/regulations-and-standards-clean-trucks-and-buses</p>
<p>ITF Covid-19 Transport Brief: Electric Mobility - Taking the Pulse in Times of Coronavirus</p>	<p>https://www.itf-oecd.org/sites/default/files/electric-vehicles-covid-19.pdf</p>

[GIZ. \(2020\). Enhancing Climate Ambition in Transport - Six Action Recommendations for Policymakers to Align Transport with the Paris Agreement and the Sustainable Development Agenda](https://www.changing-transport.org/publication/enhancing-climate-ambition-in-transport/)

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[MobiliseYourCity Partnership. \(2021\). National Urban Mobility Policies and Investment Programmes \(NUMP\) Guidelines](https://www.changing-transport.org/publication/national-urban-mobility-policies-and-investment-programmes-nump-guidelines/)

<https://www.changing-transport.org/publication/national-urban-mobility-policies-and-investment-programmes-nump-guidelines/>

SHIPPING CHANGE LEVERS

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 approx. 0.9 gigatonnes of CO₂ (almost 3 per cent of global CO₂ 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 so far having limited progress in decarbonization. Operational efficiency measures can reduce emissions by 30–50 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 early stages of development.

In **technology** and **supply**, there is therefore an urgent need for accelerated R&D to develop zero-carbon vessels and electrolysis technology to bring down the costs of green hydrogen. Large-scale system demonstrations are needed by 2025 to demonstrate viability and draw lessons learned. 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 pay for the negative societal effects of using more polluting modes, thereby incentivizing modal shift; they should support early system demonstrations and set a target for zero-carbon freight, for example, 5 per cent of the total freight volume by 2030. Actions made by freight purchasers are critical as they serve multi-modal markets and their impact goes beyond the shipping sector.

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 the emissions profiles of vessels. In **policy**, an International Maritime Organization (IMO) regulation in line with Paris Agreement targets is needed by 2023, focusing both on operational standards and zero-emission fuel adoption, while also ensuring an equitable transition through the application of the principle of common but differentiated responsibilities and respective capabilities. 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 catalyse consumer pressure on industry and freight purchasers so that they commit to quantified targets for zero-carbon freight. Also, labour organizations should emphasize the benefit 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 Australia and Japan, which both plan for significant green ammonia production). For **domestic shipping, the target should be 15 per cent**, which can be reached by 32 developed nations (who 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 following years. A critical step on this path is to have industrial-scale zero-carbon ship demonstration projects implemented by 2025, 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. There is a clear overlap between shipping and other sectors demanding low-carbon hydrogen and the use of hydrogen and its derivatives (ammonia) as an energy vector, including aluminum, steel and chemicals production, other modes of heavy transport, heating, and power storage. Integrating shipping decarbonization with these sectors can increase early adoption and economies of scale.

SHIPPING S-CURVE

The S-curve illustrates the adoption rate of zero-emission fuels, starting at 0 in 2020 and reaching 5 per cent for international shipping and 15 per cent for domestic shipping by 2030, after which adoption speed accelerates before leveling off at 100 per cent adoption by mid-century. S-curves are commonly used to describe any change that involves gradual initial growth, exponential acceleration followed by a tapered growth to steady state, and are thus suited to model technology adoption. The S-curve for international shipping is based on an analysis by the University Maritime Advisory Services (UMAS) from 2019 on the most technologically feasible paths to achieving decarbonization for international shipping by 2050. This study concluded that there is a need for zero-emission fuels to make up 27 per cent of energy by 2036 and 93 per cent by 2046. The adoption of zero-emission fuels in shipping is bound to follow an S-curve, as has been the case with all historical industrial transformations. To estimate the tipping point shipping needs to achieve by 2030 for a rapid diffusion of zero-emission technology thereafter, the S-curve shown in figure 4 was developed to fit the UMAS 2036 and 2046 milestones. The resulting curve indicates the need for a 5 per cent adoption rate of zero-emission fuels by 2030. This requires a significant increase in the availability of zero-emission fuels and vessels, which requires both substantial investment in fuel production, infrastructure and vessels, as well as an updated IMO regulation to enable the shift.

Domestic shipping can and must move faster. Developed nations make up 50 per cent of domestic shipping emissions and they should aim to achieve 30 per cent zero-emission propulsion by 2030 as electrification can play a substantial role. This would lead to 15 per cent zero-emission fuels in total.

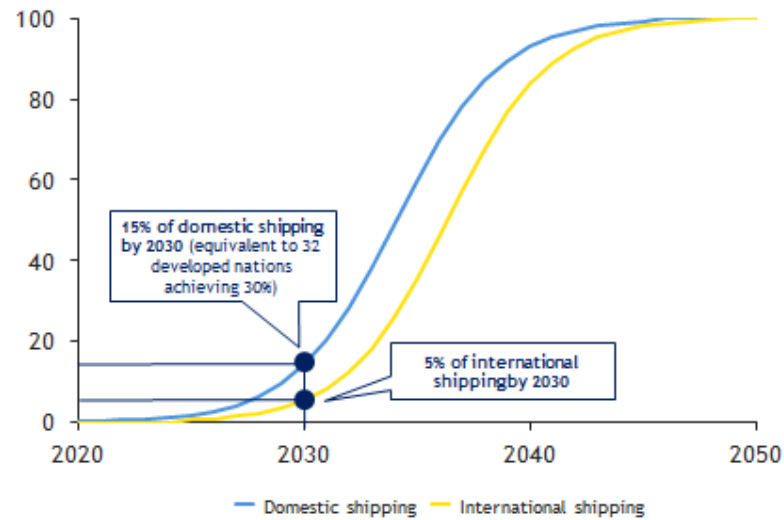
SHIPPING S-CURVE

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

S-Curve | Zero emission fuels for shipping propulsion energy

% of shipping propulsion energy from zero-emission fuels



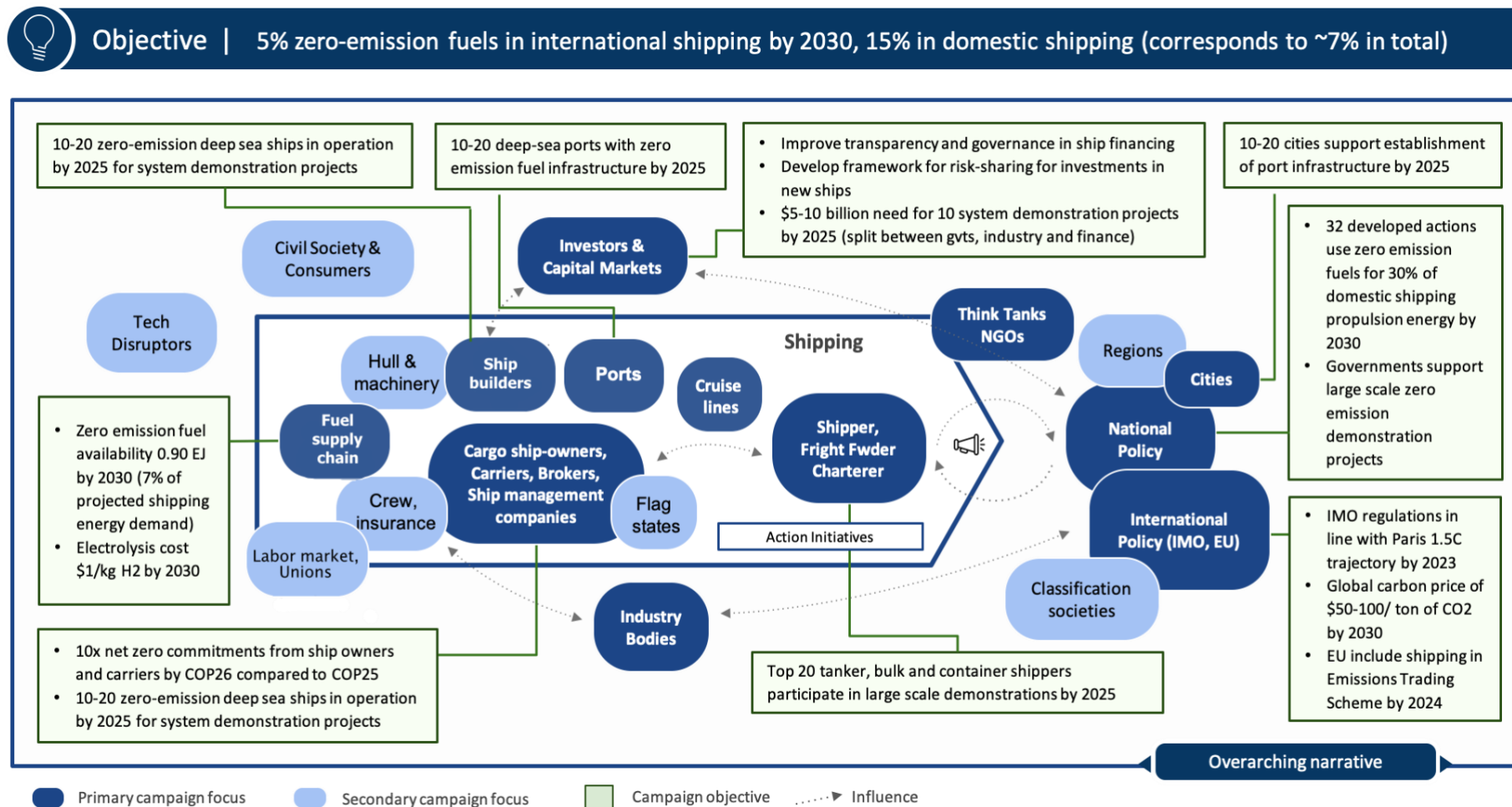
Note: Based on a smoothed sigmoid curve forced to 100% at the end given the starting point.
Source: High Level Champions, 2020

Figure 4: S-curve for zero-emission fuels for shipping propulsion energy

SHIPPING SYSTEMS MAP

The systems map (see figure 5) shows the key stakeholder groups in the shipping industry and the key requirements for each of these in order to achieve the objective. More details on actions per stakeholder are included in the action table in the following section.

Figure 5: Shipping System Map

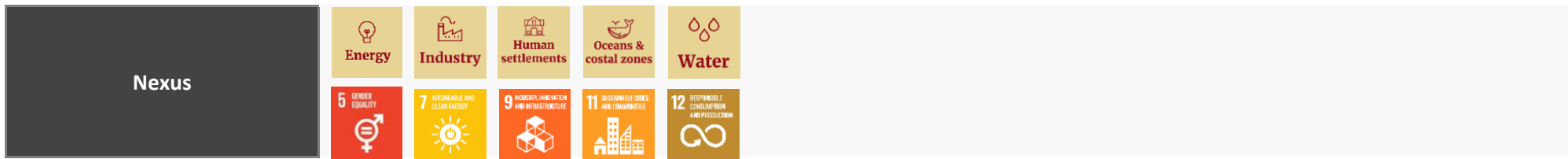


Impact
5

IMPROVE SHIPPING TECHNOLOGY, OPERATION AND FUEL EFFICIENCY

Improve Shipping

MITIGATION AND OR ADAPTATION



	By 2021	By 2025	By 2030	By 2040
1. Policymakers (national, subnational, local levels) <ul style="list-style-type: none"> Step up support for research and roll out demonstration projects for low-carbon fuels. Facilitate smoother maritime supply chains to reduce idling times through cooperation in the supply chain. Tighten the Efficiency Design Index (EEDI) and start working to make sure that it accounts for well to wheel emissions rather than just tank-to-wheel. Start developing sustainability criteria for low-carbon shipping fuels. Encourage ports to increase the availability of alternative energy supplies for shipping and port activities. 	<ul style="list-style-type: none"> Increase enforcement and stringency of mandatory operational goal-based measures with carbon intensity targets at the ship level. Develop a concrete proposal at the IMO to adopt market-based measures in the form of a carbon levy, an emissions trading scheme, a low-carbon fuel standard or a hybrid form. Redesign the Energy Efficiency Design Index (EEDI) formula to ensure that vessel design is optimized for minimized fuel consumption in real operation at sea and it does not contain a positive bias for fuels with low-carbon intensity only on a tank-to-wake basis (by 2023). 	<ul style="list-style-type: none"> Introduce an international carbon price to the order of USD 50-100/ton CO₂ to generate sufficient uptake of alternative fuels or renewable energy sources. Introduce blending mandates. Develop an International CO₂ Fund for shipping, with proceeds directed to further development of zero-carbon solutions. Fast-track regulations to allow safe and efficient bunkering of alternative low-carbon and zero-carbon fuels at main ports. 	<ul style="list-style-type: none"> Allow safe and efficient bunkering of zero-carbon fuels at all ports. Develop trade agreements based on environmentally led paradigms and specifically address GHG impacts. 	



	By 2021	By 2025	By 2030	By 2040
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ Include carbon targets in port terminal concessions. ○ Develop data and methods for assessing impacts on states (necessary to operationalize CDDRRC). ○ Develop policy mechanisms that can address impacts on states (necessary to operationalize CDDRRC). ○ Include shipping into regional policy packages (including EU ETS), with no/limited grandfathering, and revenues raised reinvested back into the sector's decarbonization. ○ Develop policies for enhanced mandatory operational goal-based regulation on carbon intensity of ships calling at regional ports. ○ Ten national governments with action plans to decarbonize shipping including national incentives (Sweden, Norway, Denmark, UK and Netherlands have published by 2020). ○ Align shipping activities more closely with other transport modes. 	<ul style="list-style-type: none"> ○ Adopt policy measures to go beyond Ship Energy Efficiency Management Plan (SEEMP) to incentivize the maximization of operational efficiency of new and existing ships, by formulating carbon intensity targets per ship (by 2023). ○ Adopt measures to reduce all GHG emissions of shipping, on a well to wake basis (e.g. methane, instead of only CO₂) and accounting for sustainability criteria. Adopt carbon intensity indicators, which factor in well-to-tank emissions (by 2023). ○ Commit to the timetable for shipping's transition to low- and zero-carbon fuels. ○ Guarantee shore power supply at main ports from renewable sources. ○ Promote modal shift from road to rail or water, and from air to rail and water, depending on commodity type. ○ Forty national governments with action plans to decarbonize shipping including national incentives. ○ Roll out environmentally differentiated port pricing factoring in both air pollutants and GHG emissions. ○ Government committed support for system demonstration projects (USD 2-4 billion). ○ EU Emissions Trading System for shipping operational. 	<ul style="list-style-type: none"> ○ Adopt environmental requirements for procurement of public services and electrify public ferry routes where technically feasible. ○ Ensure all direct and indirect subsidies for maritime transport are made conditional to environmental outcomes and phase out fossil fuel subsidies and tax breaks. ○ Support ship speed optimization and of port calls including removal of barriers to large-scale uptake of just-in-time arrival of ships. ○ Thirty-two developed nations use zero-emission fuels/electrification for 30 per cent of propulsion energy for domestic shipping (corresponds to 3 per cent of total shipping emissions). ○ High-and middle-income countries step up support to low-income countries, such as small island developing states, to decarbonize maritime transport, including compensating aid for carbon pricing effects on trade. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions	<ul style="list-style-type: none"> ○ Leverage the framework provided by the Poseidon Principles to scale up responsible Paris compliant financing in the maritime sector. ○ Package investment in new green tech in a manner that meets institutional investment criteria with regard to investment fund structure diversification. ○ Engage sovereign-backed or supranational investors (e.g. BBB, IFC) to provide capital to seed investment for e.g. new Green Tech and encourage investment from other external sources. 	<ul style="list-style-type: none"> ○ Tighten the ambition of instruments aiming to steer investment in the shipping sector towards assets that are compatible with the Paris agreement and the IMO GHG emission reduction strategy. ○ Redirect investments towards more energy efficient ships and infrastructure in ports (e.g. shore power facilities and bunkering facilities for lower carbon energy supplies). ○ Improve transparency in ship financing process and increase adoption of Environmental, Social and Governance (ESG) standards by ship owners and charterers. ○ Develop framework for risk-sharing for investments in new ships and retrofits between institutional investors, lenders, ship owners, governments and charterers. ○ Structure investments in zero-emission vessels with a guaranteed return over a longer period, e.g. with some form of residual value risk capping, government-related guarantees etc. ○ Incorporate the concept of stranded carbon assets into shipping finance. ○ Banks phase out investments in fossil fuel assets. ○ Industry and finance committed support for system demonstration projects (USD 3-6 billion). 	<ul style="list-style-type: none"> ○ Steer investment in the shipping sector towards assets that are compatible with the Paris agreement and the IMO GHG emission reduction strategy. ○ Total committed/ realized investment of ~USD 390 billion (20 per cent of USD 1.9 trillion needed by 2050 to succeed in reaching 20 per cent zero-emission fuels by 2035). 	<ul style="list-style-type: none"> ○ Total committed/realized investment of ~USD 1.6 trillion (85 per cent of USD 1.9 trillion need by 2050 to succeed in reaching 85 per cent zero-emission fuels by 2045).

	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
2. Financial Institutions		<ul style="list-style-type: none"> Total committed investment of ~USD 80 billion. 		
3. Technology Providers and Innovators	<ul style="list-style-type: none"> Ensure continuous research on ship design, including hull forms and propulsion, with a focus on reducing energy usage per freight unit transported. Increase focus on utilization of wind, waves, ocean currents, and sun to reduce use of externally provided energy, i.e., both the carbon and non-carbon-based fuels carried on board. Conduct research and development for new shipping technologies and fuels including: electric/hybrid powertrains, wind power, and powertrains using ammonia, hydrogen or sustainable biofuels. Commitment for industry, finance and governments for at least 10 large scale, cross-industry demonstration projects. Continued investment and development of zero-emission fuel production. Scaling up and expansion of low-carbon hydrogen production in existing applications (e.g. fertilizers) leading to reduction in electrolysis costs. 	<ul style="list-style-type: none"> Complete demonstration of new powertrain technologies and fuels, e.g. ammonia engines for ships. Safety approval processes for low-carbon fuels are in process at IMO covering both storage and handling as well as in internal combustion engines and fuel cells. Accelerate IGF code expansion for low and zero-carbon fuels. Scale up adoption of wind assistance and energy efficiency technologies. Develop more advanced weather routing systems to better utilize wind, waves, ocean currents, and tides to reduce the use of both carbon and non-carbon fuel carried on board. Scale up production of zero-carbon fuels from renewables with target of achieving electrolysis costs at USD 2/kg of green hydrogen. At least ten industrial-scale zero-carbon ship demonstrations projects in the water. Each project consisting of at least two ports with bunkering and refueling infrastructure, fuel production and at least one zero-carbon vessel. 	<ul style="list-style-type: none"> Additional scale up of zero-carbon fuels from renewables with target of reaching electrolysis costs of USD 1/kg of green hydrogen and zero-emission fuel availability 0.90 EJ (corresponding to 7 per cent of UMAS projection of total shipping energy need of 12.9 EJ in 2030. Targets for domestic and international shipping add up to 7 per cent of total emissions). 5 per cent of propulsion energy coming from zero-emission fuels for international shipping through a combination of container routes, niche vessel types, e.g. green ammonia and LPG tankers, and niche routes, e.g. to Japan and to Australia who both plan for significant green ammonia production. (corresponds to 4 per cent of total shipping emissions). 	<ul style="list-style-type: none"> Total ~80 per cent zero-emission shipping.

	By 2021	By 2025	By 2030	By 2040
4. Business and Service Providers	<ul style="list-style-type: none"> ○ Twenty shipping actors committed to zero emissions by 2050 (4 in 2020: Maersk, CMB, CMA CGM and Port of Rotterdam). ○ Top 20 container, bunker and tanker freight purchasers commit to supporting transition to zero-emission fuels by committing to participate in industry demonstrations and to pay a premium for zero-emission fuels. ○ Shipping companies increase the use of slow steaming to reduce emissions. ○ Shipping companies commit to increasing efficiency of operations e.g. through optimal voyage planning, weather routing, optimized port operation and speed reduction or optimization, among other measures. The Ship Energy Efficiency Management Plan (SEEMP) adopted by the IMO can serve as guidance for shipping companies. ○ Targeted actions on improving working conditions for women, among shipping companies to increase share of women in global maritime workforce. 	<ul style="list-style-type: none"> ○ Top one hundred shipping owners/operators by tonnage, committed to zero emissions by 2050. ○ Freight customers push decarbonization of the transport chain. ○ Top twenty container, bulk and tanker freight purchasers actively participating in demonstrations and paying premium for zero-emission fuel. ○ Top fifty container, bulk and tanker freight purchasers commercialize zero-emission shipping to end customers. ○ Shipping actors engage in voluntary schemes to share best practices, and to develop uniform tracking and accounting of fuel consumption and emissions and increases in efficiency. ○ Maritime transport actors engage in supply chain collaboration with the aim to create seamless maritime logistics chains. ○ Allow smooth data exchange and integration of ICT and planning systems of all stakeholders in the maritime supply chain, e.g. including Internet of Things (IoT) or Blockchain, single logistic windows and integrated data platforms. ○ Charterers and freight customers demand more energy efficient ships & agree on incentives with ship owners. ○ Shipping actors modernize charter contracts to reduce roadblocks to adopting energy efficient ships. 	<ul style="list-style-type: none"> ○ Classification societies actively push and develop standards for zero-emission ships, individual technologies and fuels in cooperation with regulators and companies. 	



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
5. Civil Society	<ul style="list-style-type: none"> ○ Key labor organizations (ITF and MFS) voice support for decarbonization. Increased safety requirements would require higher qualifications and training for crew which they would benefit from. ○ NGOs and researchers publish research and policy advice detailing pathways to reach zero-carbon shipping by 2050. 	<ul style="list-style-type: none"> ○ Civil society develops internationally recognized awards and certificates to acknowledge shipping actors' decarbonization progress, e.g. through voluntary eco-rating schemes of ships or accounting of emissions. 		

EXISTING INITIATIVES IMPACT AREA 5

ITF Decarbonising Transport initiative	<p>The Decarbonising Transport initiative promotes carbon-neutral mobility to help stop climate change. It provides decision makers with tools to select CO2 mitigation measures that deliver on their climate commitment.</p>
Getting to Zero Coalition	<p>Cross-industry initiative aiming to have zero-emission vessels in commercial operation by 2030.</p>
Poseidon Principles	<p>Initiative to get lenders to Include climate considerations into lending decisions to promote decarbonization in line with IMO targets.</p>
Climate Bonds Initiative	<p>Set criteria by which bond-issuers financing green new builds and retrofits of ships can seek Climate Bond Certification.</p>
Sea Cargo Charter	<p>The Sea Cargo Charter provides a global framework for aligning chartering activities with responsible environmental behavior to promote international shipping's decarbonization.</p>
International PtX Hub Berlin	<p>Center for technological innovation, creativity, and political leadership located in Berlin that believes that PtX can help defossilise a range of industries as well as modes of transport such as planes and ships that cannot directly use renewable electricity.</p>
Mission Possible Partnership (MPP)	<p>The Mission Possible Partnership (MPP) is an alliance of climate leaders focused on supercharging efforts to decarbonize some of the world's highest emitting industries in the next 10 years. It builds on the foundation laid by the Mission Possible Platform, launched in 2019 by the Energy Transitions Commission and the World Economic Forum, by expanding and accelerating the work of seven nascent industry working groups in aluminum, aviation, cement and concrete, chemicals, shipping, steel, and trucking.</p>

FURTHER REFERENCES IMPACT AREA 5

<p>ITF (2018a), Decarbonising Maritime Transport, https://www.itf-oecd.org/decarbonising-maritime-transport</p>	<p>ITF (2018b), Decarbonising Maritime Transport: The Case of Sweden, https://www.itf-oecd.org/decarbonising-maritime-transport-sweden</p>
<p>ITF (2020), Navigating Towards Cleaner Maritime Shipping: Lessons From the Nordic Region, https://www.itf-oecd.org/navigating-towards-cleaner-maritime-shipping</p>	<p>ITF, Transport Climate Action Directory, https://www.itf-oecd.org/transport-climate-action-directory-measures</p>
<p>IMO Third Greenhouse Gas Study (2014): https://glomeep.imo.org/wp-content/uploads/2016/06/GHG3-Executive-Summary-and-Report_web.pdf</p>	<p>IMO Fourth Greenhouse Gas Study (2020): https://docs.imo.org</p>
<p>Lloyd's Register and UMAS (2020) Technoeconomic Assessment of Zero Carbon Fuels: https://www.lr.org/en/insights/global-marine-trends-2030/techno-economic-assessment-of-zero-carbon-fuels/</p>	<p>Lloyd's Register and UMAS (2018) Zero Emission Vessels: https://www.lr.org/en-gb/insights/global-marine-trends-2030/zero-emission-vessels/</p>
<p>UK's Clean Maritime Plan (2019): https://www.gov.uk/government/publications/clean-maritime-plan-maritime-2050-environment-route-map</p>	

AVIATION CHANGE LEVERS

For aviation and the continued enjoyment of the benefits of air travel, accelerated investment and cross-stakeholder radical collaboration is critical to realize the most viable path to zero carbon. Aviation accounts for two per cent⁴ of global carbon emissions. Technological barriers associated with alternative propulsion and design are now being overcome, however difficult industry factors, such as low profit margins, job losses, stakeholder complexity and the need for international regulatory frameworks, make decarbonizing aviation challenging. An International Civil Aviation Organization (ICAO) analysis⁵ suggests that improved technology and operations can achieve up to a 33 per cent emission reduction versus a 2050 business-as-usual scenario. This analysis also considered the long-term availability of sustainable aviation fuels, finding that, by 2050, it would be physically possible to meet 100 per cent of international aviation jet fuel demand with sustainable aviation fuels, corresponding to a 63 per cent reduction in emissions. However, this level of fuel production could only be achieved with extremely large capital investments in sustainable aviation fuel production infrastructure, and substantial policy support. The effort required to reach these production volumes would have to significantly exceed historical precedent for other fuels, such as ethanol and biodiesel for road transportation.,

To be used in commercial flights, a SAF must comply with fuel standard ASTM D4054; currently, eight conversion processes have been approved for SAF production.⁶ The primary issues with SAFs are availability, high prices and low speed of adoption, currently making up less than 0.01 per cent of jet fuel demand. Potential actions to accelerate the adoption of these fuels include proposed national government mandates, such as in France, the 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, and stimulating investment in existing and new production plants.

To achieve complete decarbonization, **synfuels or e-fuels** (including electrification) are needed. Long-haul zero-emission aviation is a key challenge. Large 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 sufficiently stimulating innovations at the pace that is 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 (e.g. companies with large business travel

⁴ According to the Intergovernmental Panel on Climate Change (IPCC) AR4 Climate Change 2007: Mitigation of Climate Change (page 49) and the IPCC Special Report on Aviation and the Global Atmosphere (page 6), aviation (domestic and international) accounts for approximately two per cent of global CO₂ emissions produced by human activity. In 2015, approximately 65 per cent of global aviation fuel consumption was from international aviation (see ICAO 2019 Environmental Report).

⁵ ICAO Assembly Working Paper (A/40-WP/054), available at <https://www.icao.int/Meetings/a40/Documents/WP/wp_054_en.pdf>.

⁶ <https://www.icao.int/environmental-protection/GFAAF/Pages/Conversion-processes.aspx>.

volumes) agreeing to pay a premium for sustainable fuels, for example, or contributing in other ways to development efforts. Also, there is a need for short-haul aviation to be evaluated against other transport modes where existing infrastructures can avoid land-use change induced by the construction of new roads or railways.

In **policy**, ICAO has established an international framework to facilitate decarbonization, including the exploration of the feasibility of establishing a long-term CO₂ reduction goal for international aviation at the next ICAO Assembly in 2022. This framework encompasses a basket of measures, including aircraft technology and innovations, operational improvements, SAFs and a global market-based measure, i.e. the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). National governments can introduce regulations targeting domestic aviation. COVID-19 financial support packages for airlines should also be linked to the achievement of future emissions reductions targets and the uptake of SAFs, as seen in countries such as Austria and France. For SAFs to be eligible for use by airlines to reduce their offsetting requirements under CORSIA, SAFs must meet a set of sustainability criteria. More information on CORSIA-eligible fuels is available on the dedicated ICAO CORSIA webpage (www.icao.int/corsia).

In March 2018, the second [ICAO Conference on Aviation Alternative Fuels](#) (CAAF/2) agreed on the [2050 ICAO Vision for Sustainable Aviation Fuels](#). The ICAO Vision encourages states to act at national and international levels to further develop and deploy SAFs. It calls for a significant proportion of aviation fuels to be substituted with SAFs by 2050 based on the assumption of a progressive increased use of SAFs. As agreed during CAAF/2, ICAO is organizing regular stocktaking seminars to continuously assess progress on SAF development and deployment, and to coordinate with states and other stakeholders.

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.

It is the view of the Climate Champions that **by 2030**, the sector should achieve **a minimum of 10 per cent SAFs in use globally (2 per cent by 2025)**. Domestic aviation, whose emissions fall under the remit of the UNFCCC, can make a significant contribution given that it accounts for almost 40 per cent of total emissions and two thirds of total flights. The ICAO stocktaking and the long-term aviation goal⁷ development process, which includes SAFs but also technological and operational measures and innovations, for example electrification and hydrogen, will also contribute to the decarbonization of the aviation transport sector. It is also important to acknowledge the fact that although CO₂ is certainly the most important greenhouse gas in the transport sector to mitigate, the combined non-CO₂ climate impacts from aviation activities can be important too. Policies that would address both CO₂ and non-CO₂ effects of the aviation sector or complement each other would therefore need to be further investigated, on the basis of scientific research and universal consensus.

⁷ <https://www.icao.int/environmental-protection/Pages/LTAG.aspx>.

AVIATION S-CURVE

For net-zero carbon to be achieved by mid-century, the aviation S-curve (see figure 6) reflects the work of the Climate Champions regarding the necessary adoption rate of SAFs. A target of 10 per cent by 2030 (2 per cent by 2025) and 90 per cent by 2040 is recommended. S-curves are commonly used to describe any change that involves gradual initial growth, exponential acceleration followed by a tapered growth to steady state, and are thus suited to model technology adoption. Achieving zero-carbon aviation requires a combination of the adoption of electric flight for short-haul and decarbonized fuel for long-haul. These are currently in their infancy, but experience from other technology transitions shows that their adoption will not follow a straight line from the past. Like all such transformations, they will ultimately be adopted exponentially as policy changes and scale-up cost reductions transform the business case, leading to exponential growth through a sigmoid curve.

An analysis of a range of top-down and bottom-up forecasts for SAF suggests that within the next ten years, SAFs will form a significant part of the mix. This analysis notes that the key determining assumptions for what is possible by 2030 relate to the availability of biofuels, breakthroughs in synthetic fuels, and progress in the adoption of alternative technologies in other sectors currently adopting biofuels. The Climate Champions scenario represented here proposes that 2 per cent be reached by 2025 and 10 per cent by 2030.

AVIATION S-CURVE

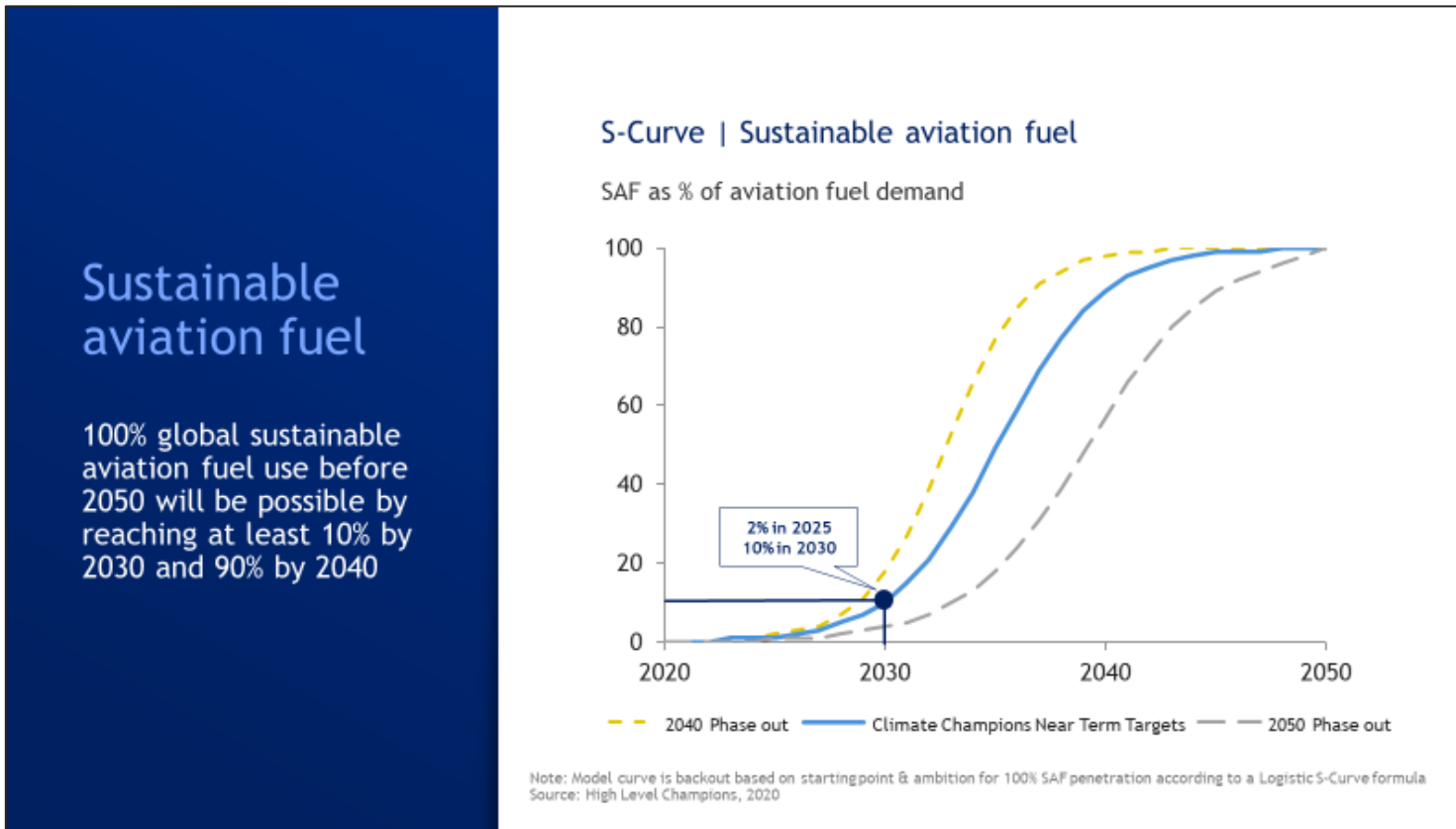


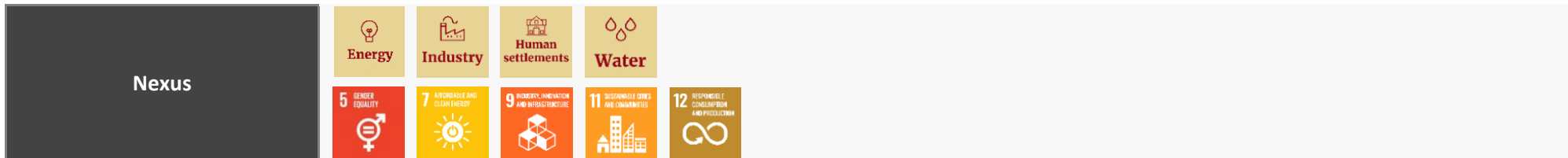
Figure 6: S-Curve for sustainable aviation fuel

Impact
6

IMPROVE AVIATION EFFICIENCY AND REDUCE THE CARBON INTENSITY OF AVIATION FUELS

Improve Aviation

MITIGATION AND OR ADAPTATION



	By 2021	By 2025	By 2030	By 2040
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> Collaborate closely with ICAO to help establish an updated international framework for driving net zero carbon goals. Implement the ICAO CORSIA and more volunteer States to participate in the scheme at national level. Contribute to ICAO’s work on the feasibility of a long term global aspirational goal for international aviation. Carbon Neutral Growth from 2020 onwards and annual fuel efficiency of 2 per cent for international aviation. Link financial support packages for airlines to the achievement of future emissions reduction targets via decarbonization technologies, 	<ul style="list-style-type: none"> Driven by a joined-up and comprehensive set of policy instruments, including mandates, to support the achievement of decarbonization targets envisaged by the Climate Champions, in coordination with other sectors, e.g., 2 per cent SAF by 2025. Carbon pricing and/or emissions trading for domestic aviation. Implement ICAO standard for the aviation sector. Market-pull policies accelerating the industry’s decarbonization, and goal-oriented research programs. Shift short-haul passenger and freight transport to mode of travel with lower climate impact. 	<ul style="list-style-type: none"> Review and adjust effectiveness of domestic policies in achieving overarching goal envisaged by the Climate Champions of minimum of 10 per cent SAF globally by 2030. National, regional and international case review. Leaders and Laggards improve cohesiveness. Split sustainable alternative fuels more clearly into bio-fuels and e-fuels. Introduce e-fuels to the market. 	<ul style="list-style-type: none"> Review and adjust effectiveness of policies in achieving overarching goal envisaged by the Climate Champions of minimum of 90 per cent SAF globally by 2040. Create the right policy and commercial environment to enable a complete energy transition away from fossil fuels and towards sustainable aviation fuels.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
1. Policymakers (national, subnational, local levels)	<ul style="list-style-type: none"> ○ [...] such as Sustainable Aviation Fuel (SAF) uptake. ○ Include clear and measurable national targets for domestic aviation, in line with the Paris Agreement, in National Plans. ○ Implement new policies for investing in and driving down costs of Zero-Emission Aircraft (ZEA) and SAF, e.g., Contracts for Difference (CFD). ○ Reduce all environmentally harmful subsidies in air transport and introduce SAF subsidies. ○ Implement carbon pricing for flights. ○ Monitor and include non-CO₂ emissions into CORSIA and Emissions Trading Systems (ETS) on the basis of universal scientific consensus. 	<ul style="list-style-type: none"> ○ Include climate efficient routing. 		
2. Financial Institutions	<ul style="list-style-type: none"> ○ Establish a framework for assessing and disclosing the alignment of aviation businesses with climate goals, along the lines of the Poseidon Principles for shipping. ○ Scale up public-private investment in SAF production facilities and projects. ○ Scale up investment in Zero-Emission Aircraft demonstration projects. 	<ul style="list-style-type: none"> ○ Similarly shift from gas to liquid hydrogen where gasification is derived from renewable sources. 	<ul style="list-style-type: none"> ○ As costs are driven down for SAF, shift support to hydrogen or electric aircrafts where appropriate. 	

	By 2021	By 2025	By 2030	By 2040
3. Technology Providers and Innovators	<ul style="list-style-type: none"> ○ Develop additional feedstock pathways for commercializing Sustainable Aviation Fuel and testing options. ○ Pilot efficiency improvement options both in Air Traffic Management (ATM) as well as engine/aircraft design. ○ Build investment in R&D for Hydrogen and Electric Aircraft as well as hybrid variations. 	<ul style="list-style-type: none"> ○ Align industry's action with policies that trigger market pull and technology push to accelerate the industry's decarbonization, and mission-oriented research programs. ○ Internationalize best practices. ○ Develop collaborative research programmes to investigate novel aircraft energy sources, such as hydrogen and electric. 		
4. Business and Service Providers	<ul style="list-style-type: none"> ○ Airports: incentivize sustainable surface access for passengers and staff (e.g., public transport, car sharing, cycling), through, for example, parking pricing, financial incentives for staff to car-share, and infrastructure provision (e.g., bicycle parking, EV parking with chargers); design airport landside in a way that minimizes surface access and aircraft congestion; explore opportunities from onsite renewable electricity production (e.g., solar, wind, geothermal). ○ Airlines: reduce weight on board (e.g., by optimizing water quantities, removing non-essential items and using lighter equipment and fittings); optimize and increase passenger load factors; incentivize passengers to carry lighter luggage (e.g., through pricing); maintain and clean aircraft and engines regularly to reduce drag; regulate economic fuel tankering; implement pilot training for eco-flying; plan and 	<ul style="list-style-type: none"> ○ Airports, in collaboration with airlines and ANSPs: Implement Airport Cooperative Decision-Making (A-CDM) to reduce emissions from congestion and operational efficiencies under airport control. ○ Airports: electrify all possible operations (e.g., ground handling services) and ensure electricity comes from renewable sources. ○ Airlines: retrofit more efficient engines on aircraft through redesign where feasible and cost efficient. ○ Airlines: use SAF. ○ Businesses: Improve social justice along with climate action; include gender equality across sector workforce and appropriate training and education, and improvement in working conditions for women as part of the development of more sustainable and inclusive measures. 		<ul style="list-style-type: none"> ○ Airports: Achieve zero CO₂ emissions from airport operations and those under airport control. ○ Airlines, airports, fuel producers and suppliers: use combination of SAF and ZEA to deliver 90per cent reduction on all pollutants.



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
4. Business and Service Providers	<ul style="list-style-type: none"> ○ optimize flight routes to take advantage of beneficial winds and air temperatures; retrofit winglets on appropriate aircraft; put the most inefficient aircraft into retirement where appropriate; implement voluntary schemes where passengers can opt in and pay to use SAF on their flight (e.g. BoardNow). ○ Enable collaboration between airports, airlines, air navigation service providers (ANSPs) and civil aviation authorities (CAAs) to ensure the most efficient flightpaths are flown, through the implementation of established technologies and concepts of operations in communications, navigation and surveillance (CNS). ○ Aircraft manufacturers: radically increase R&D investment in Zero Emission Aviation; step up collaboration between competitors; enhance the use of composites (including, but not limited to, carbon reinforced polymers), lighter metal alloys and novel manufacturing methods, including 3D printing; and prioritize the commercialization of energy-efficient aircraft designs. 			
5. Civil Society	<ul style="list-style-type: none"> ○ Raise public awareness of the carbon and energy intensity of air transport, mitigation actions taken by the aviation sector, and new innovations for net zero aviation. 			



	By 2021 ▼	By 2025 ▼	By 2030 ▼	By 2040 ▼
5. Civil Society	<ul style="list-style-type: none"> ○ Campaign for the introduction of policies improving consumer awareness and shifting behavior, such as carbon labelling on advertisements and online booking platforms. ○ Campaign for the implementation or strengthening of safeguards against “greenwashing”, i.e., misleading/deceptive environmental claims in advertisements. 			

EXISTING INITIATIVES IMPACT AREA 6

Transport Decarbonisation Alliance (TDA)	<p>The TDA brings together countries, cities/regions and companies, the “3Cs”, to achieve low-carbon mobility by setting up ambitious and tangible action plans for private and public actors for the sector’s transformation and influence political decision-makers in key international fora and through bilateral dialogues.</p>
ICAO Global Coalition for Sustainable Aviation	<p>The main objective of the ICAO Global Coalition for Sustainable Aviation is to promote the sustainable growth of international aviation.</p>
In-sector aviation CO2 emissions reduction initiatives - Tracker tool	<p>As part of the Coalition, the ICAO in-sector aviation CO2 emissions reduction initiatives tracker tool provides a variety of information related to initiatives to reduce the environmental footprint of aviation, including details on past and ongoing measures and initiatives.</p>
CORSIA	<p>Carbon Offsetting and Reduction Scheme for International Aviation</p>
ICAO Stocktaking & Green Recovery	<p>Convening Member States, industry, and civil society stakeholders to review progress against existing goals set by ICAO and collaborate around new long-term aspirational goals (LTAG) for international aviation.</p>
Mission Possible Platform: Clean Skies for Tomorrow	<p>The Clean Skies for Tomorrow Coalition provides a crucial mechanism for top executives and public leaders, across and beyond the aviation value-chain, to align on a transition to sustainable aviation fuels as part of a meaningful and proactive pathway for the industry to achieve carbon-neutral flying.</p>
ITF Decarbonising Transport initiative	<p>The Decarbonising Transport initiative promotes carbon-neutral mobility to help stop climate change. It provides decision makers with tools to select CO2 mitigation measures that deliver on their climate commitment.</p>
The Air Transport Gender Equality Initiative	<p>This Initiative includes the establishment of air transport gender indicators through the collection of workforce statistics as provided on a voluntary basis from States. Collaboration and ongoing discussion between ICAO with the International Labour Organization (ILO) and United Nations Educational, Scientific and Cultural Organization (UNESCO) will allow cross-organizational learning on best practices in collecting gender related data with the aim of incorporating the information in the “Global and Regional 20-Year Forecasts: Pilots. Maintenance Personnel. Air Traffic Controllers” and the creation of an online platform for sharing data on workforce statistics.</p>

International PtX Hub Berlin	<p>Center for technological innovation, creativity, and political leadership located in Berlin that believes that PtX can help defossilise a range of industries as well as modes of transport such as planes and ships that cannot directly use renewable electricity.</p>
Mission Possible Partnership (MPP)	<p>The Mission Possible Partnership (MPP) is an alliance of climate leaders focused on supercharging efforts to decarbonize some of the world’s highest emitting industries in the next 10 years. It builds on the foundation laid by the Mission Possible Platform, launched in 2019 by the Energy Transitions Commission and the World Economic Forum, by expanding and accelerating the work of seven nascent industry working groups in aluminum, aviation, cement and concrete, chemicals, shipping, steel, and trucking.</p>

FURTHER REFERENCES IMPACT AREA 6

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<p>IEA (2020), Energy Technology Perspectives 2020</p>	<p>ICAO – Climate Change</p>
<p>The Gender Dimension of the Transport Workforce</p>	<p>Women Leading Climate Action: A World Within Reach</p>
<p>Clean Skies for Tomorrow Sustainable Aviation Fuels as a Pathway to Net-Zero Aviation</p>	

CONTRIBUTIONS

Under the leadership of the High-Level Champions for Climate Action and through the Marrakech Partnership for Global Climate Action, the development of this Climate Action Pathway was led by the Champions Team, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the International Transport Forum and the Partnership on Sustainable, Low Carbon Transport (SLOCAT) in collaboration with the FIA Foundation, the International Association of Public Transport, the International Union of Railways, the MobiliseYourCity Partnership, Walk21 and the World Business Council for Sustainable Development. Inputs on transport resilience were provided by ICF International, the United Nations Conference on Trade and Development and the World Association for Waterborne Transport Infrastructure. Inputs on shipping were provided by Marine Capital, the Global Maritime Forum, the University Maritime Advisory Services of University College London and the World Economic Forum. Research studies conducted by the Energy Transitions Commission, the High-Level Panel for Sustainable Ocean Economy, the International Maritime Organization and the World Bank also contributed to the shipping measures. Inputs on aviation were drawn upon the work of the Aviation Environment Federation, the Energy Transitions Commission, the International Civil Aviation Organization, the Mission Possible Platform and the World Economic Forum. All stakeholders from the Marrakech Partnership Transport Thematic Group were consulted throughout the Pathway development process for all impact areas. Other contributors include the National Cheng Kung University, the Smart Freight Centre and independent consultant Heather Allen.