CLIMATE ACTION PATHWAY

TRANSPORT

Action Table

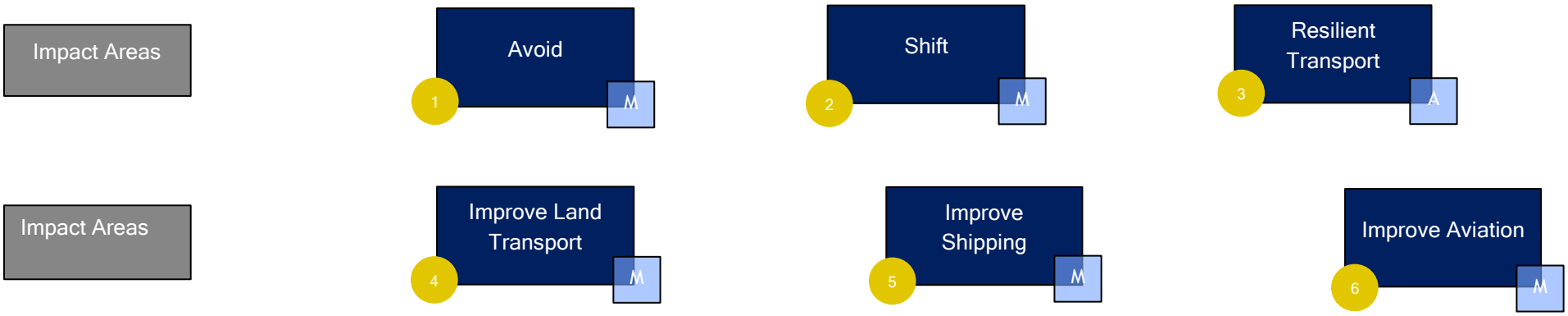
2020

Global Climate Action
United Nations Climate Change

Marrakech Partnership
Global Climate Action

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 the reduction of the need to travel, travel distance and number of trips, especially those made by private motorized vehicles. "Shift" implies modal shift to more sustainable modes, such as rail for freight, and walking, biking and public transport for passenger transport. "Improve" includes substitution of all vehicles with zero-emission alternatives when possible and the improvement made to fuel and operational efficiency for unavoidable travel. The 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. A special impact area was created for resilient transport and specific resilient measures can also be found in other impact areas. This recognizes that to be successful any mitigation initiative must in itself 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 Action Table is closely linked to the other six thematic pathways and indicated in specific 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.



Heading

Impact Area

Levers with both Mitigation and Adaptation/Resilience components

M=Mitigation component

A=Adaptation/Resilience component

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

Progress is under way, and achieving 100 per cent electric vehicles in new car sales is achievable by 2035 in leading markets such as China, Europe, Japan and the United States. Electric vehicles are a proven technology for light-duty vehicles, buses, small or medium trucks used for urban logistics, and other short-distance or intra-city freight transport. Long-haul heavy transport decarbonization is likely to be enabled by a broader portfolio of technology solutions combining electrification and hydrogen fuel cells. Modal shifts can be achieved with urban (re)development and investments in new infrastructure, linked with integrated urban land use and transport planning, which include transit-oriented development, coupled with a compact urban form that supports public transport, cycling and walking. 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 national, regional and city governments setting targets for electrification of modes, providing financial incentives, developing zero-emission zones in cities and regions, and developing strategies that encourage behavioral changes. Business decisions to accelerate the shift to zero-carbon options include original equipment manufacturers committing to the electrification of the sector, as well as investments to diversify the models and segments and to provide economic opportunities for new players, start-ups and small and medium-sized enterprises that develop e-mobility solutions.

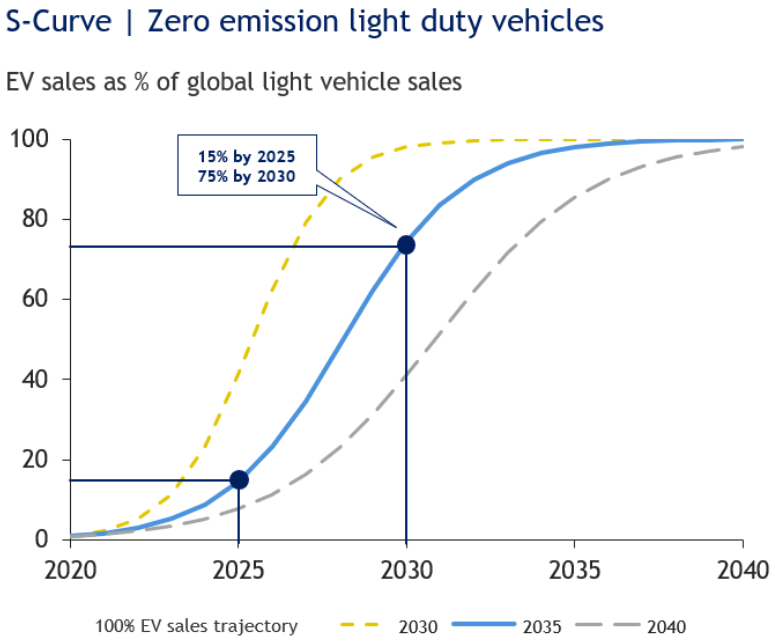
By 2030, the leading markets should aim to achieve 75 per cent of new light-duty vehicle sales to be zero carbon. This level of penetration is deemed to be the tipping point required to enable rapid adoption in the following years and full transition to zero-emission vehicles by 2035 in leading markets.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

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.

Zero emission light duty vehicles

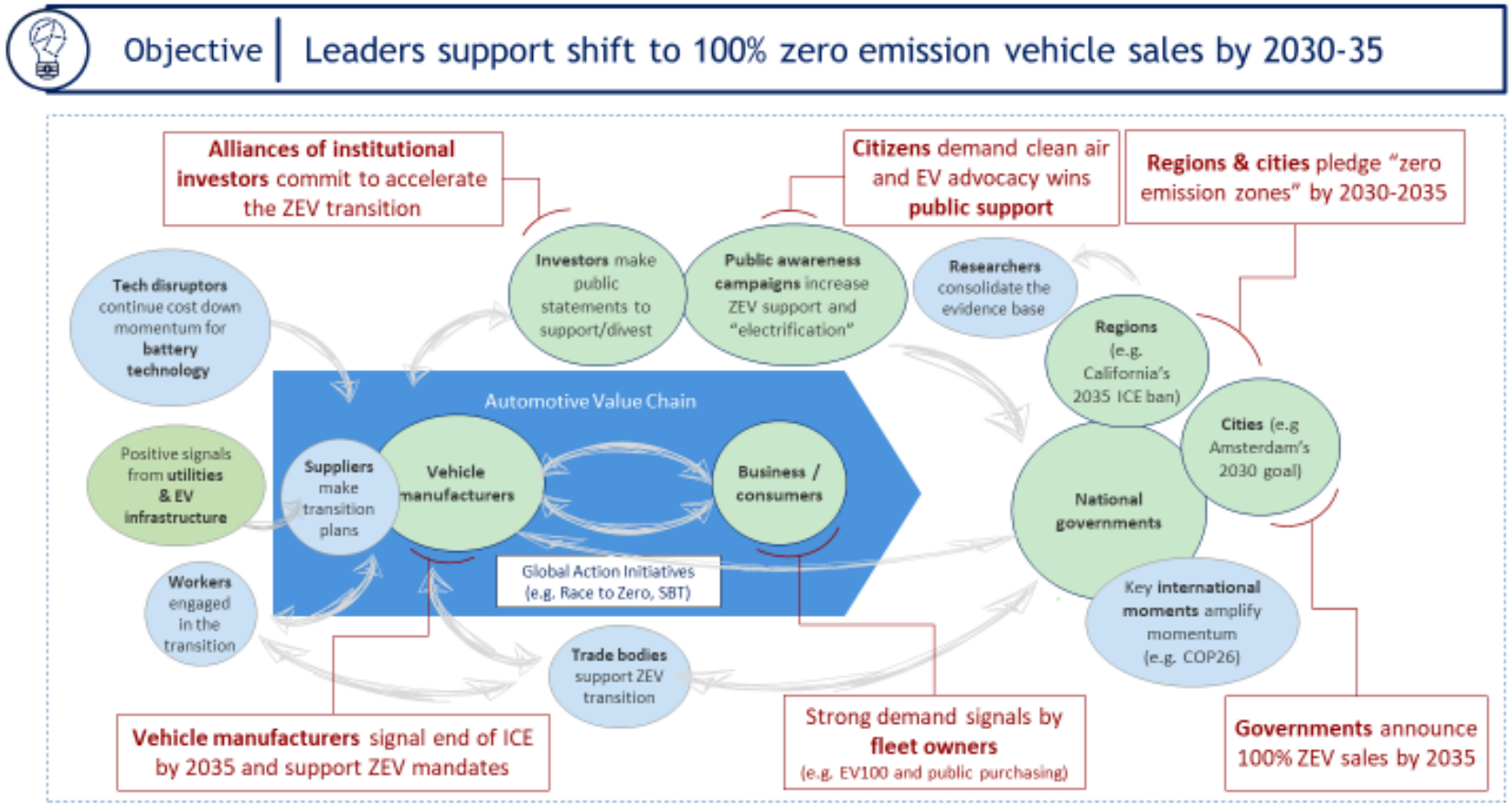
100% zero emission light vehicle sales by 2035 will require reaching 15% by 2025 and 75% by 2030



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

LAND TRANSPORT SYSTEM MAP

The systems map shows the key stakeholder groups in the automotive industry and the proposed goals for leaders of each of these in order to achieve the headline objective. More details on actions per stakeholder are included in action tables 1,2 and 4 in the following section.



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Impact 1

<REDUCE PERSONAL TRANSPORT DEMAND AND DISTANCE>

Avoid

MITIGATION

NEXUS

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	*Transport Demand Management* • Implement transport demand management measures such as; – Parking pricing and regulation – Vehicle access regulation in cities *Transport Planning and Land Use* • Update transport planning policies to:	*Transport Demand Management* • Widen the implementation of effective transport demand management measures, including the use of intelligent transport systems (ITS), for example – Road pricing – Congestion charging in urban areas – Parking pricing – Access regulations	*Transport Demand Management* • 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: – In-vehicle devices that influence navigation – Optimizing routing and driving dynamics	• 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

- Enable stronger linkages between land use and transport planning towards higher density levels and mixed land use to increase accessibility and reduce travel distance for at least 200 cities without compromising the quality of life
- 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"
  - Company car tax

Transport Planning and Land Use

- Develop inclusive, accessibility-oriented, compact and resilient cities to reduce trip lengths and the need for motorized travel by personal vehicles through;
  - 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
- 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
  - Traffic management systems
  - Auxiliaries for parking and deliveries.

	- 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 *Behavior Change* • Provide working regulations that allow employees to telework or have flexible working hours.	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.	
Financial Institutions	*Transport Demand Management* • Scale up and diversify funding for supportive and coherent fiscal frameworks to adopt transport demand policies, e.g. congestion charging, parking policies etc.	*Transport Planning and Land Use* • Utilize climate funds to help ensure that all transport funding (public and private) becomes more aligned with Paris Agreement.	
Technology Providers and Innovators	*Transport Demand Management* • 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	*Transport Demand Management* • Improve load factors and logistics for urban freight • Develop advanced ITS solutions that can enhance transport demand management measures, for example - dynamic ridesharing	*Transport Planning and Land Use* • Support development of seamless inter-modality between existing modes (public and private) by enabling door-to-door solutions in the case of passenger mobility.

	facilitate transport movement and flows that address citizens' needs.	- 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.
Business and Service Providers	*Behavior Change* • Employers encourage sustainable travel choices by; - 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.	*Transport Planning and Land Use* • 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 • Online retailers and delivery companies to facilitate more

		sustainable deliveries, for example: - Committing to streamlined, integrated delivery systems - Using urban consolidation centers - Facilitating pick-up / drop-off.	
Civil society	*Behavior Change* • 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 • Provide facts and policy guidelines for cities to harness the lessons being learned during the pandemic beyond temporary measures.	*Behavior Change* • Continue advocating for the adopt 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.	

EXISTING INITIATIVES IMPACT AREA 1

Transformative Urban Mobility Initiative (TUMI)	Mobilize finance, build capacities and promote innovative approaches for urban mobility

FURTHER REFERENCES IMPACT AREA 1

Transport Climate Action Directory	**https://www.itf-oecd.org/transport-climate-action-directory-measures**

Impact 2

<SHIFT TO MORE ENVIRONMENT FRIENDLY AND LOWER CARBON MODES OF TRANSPORT>

Shift

MITIGATION

NEXUS

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	*Public Transport* • Significantly scale up capacity development programmes to train public officials on the development of zero-carbon public transport systems • Provide safe and secure public transport services for all users, including women, children, people with disabilities and older people,	*Public Transport* • Support and enable the centrality of public transport in green, resilient and equitable mobility systems through; – Sustained, long-term investment in public transport improvements – Increasing frequency, speed and availability of public transport supply to	*Shared Mobility* • Prioritize, scale up and invest in alternative, attractive sustainable transport solutions such as public, shared and on-demand transport services • Integrate shared mobility services in existing transport networks, as part of Mobility as a Service (MaaS) approach	

through a more inclusive design of transport systems, including infrastructure and operational improvements, for example:

- Launch public awareness campaigns to address the pandemic-related stigmatization of public transport on the basis of science-based facts
- Train transport employees better and improve reporting systems
- Adopt a zero-tolerance approach to harassment

- Rethink public transport post-Covid-19 to ensure health and safety of public transport users and workers
- 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 measures learned during pandemic times that can be integrated in medium-long-encourage users to shift to public transport
  - Projects that are centered on traffic restraint and the greater use of public transport in combination with sustainable and shared mobility modes
- Prioritize the development of public transport that secures a gender-responsive mobility system for all
- Improve the physical travel environment, improvements such as better lighting can be critical in changing the perception of safety and security around public transport
- Enact policies to enable other low-carbon mobility options and ensure social equity through providing access to different socio-economic groups in the society through developing regulations that facilitate high occupancy shared mobility (e.g. public transport and ride-sharing)

Walking/Cycling

- Enact policies to enable other low-carbon mobility options and ensure social equity through providing access to

- 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

Walking and Cycling

- Implement provisions to ensure the integration of active mobility requirements in all large-scale infrastructure projects planning.

term programming policy frameworks

- Promote more sustainable consumption and travel patterns (e.g. prioritizing public transportation, biking, walking, 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)
- Improve public transport information through ITS and other platforms (e.g. smart phone applications) for easy planning, booking and utilization

Walking/Cycling

- Cities to re-allocate space to allow for physically spaced walking and cycling and manage excess 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

different socio-economic groups in the society e.g. rolling out large-scale bike-share programs (with or without docking stations)

- Develop policy and planning schemes to roll out spatial planning approaches based on proximity (15 minute-city notion) and integration between tactical urbanism and mobility planning
- Accelerate low-carbon last-mile delivery schemes
- Deploy policy frameworks to improve provision for walking and cycling, for example with focus on:
  - Rehabilitation 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 lanes
  - Improved availability of safe and efficient infrastructure for active mobility.

	• 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) and providing funding and guidance (including safety) for the deployment of light individual transport lanes.		
Financial Institutions	*Public Transport* • Scale up and diversify funding for supportive and coherent fiscal frameworks for public transport infrastructure and services *Walking and Cycling* • Scale up and diversify funding for supportive and coherent fiscal frameworks for walking, cycling and bike-share infrastructure and services.	• 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 *Transport Planning and Land Use* • Invest in business models that provide high-occupancy transport services.	• Invest in public transport infrastructure where densities support it, for example: - Bus rapid transit - Enhancing rail.
Technology Providers	• Increase network efficiency by enhancing seamless transfer of transport and payment across modes	*Public Transport* • Digitalize transport information for personalized transport	

and Innovators	• Develop MaaS development plans where appropriate.	services that favors a modal shift to public transport and sustainable mobility • Improve availability and accuracy of information on public transport services.	
Business and Service Providers	*Behavior Change* • 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 *Cross-cutting Theme: Gender* • Increase women's participation in transport businesses and service providers to enable the development of more sustainable and inclusive transport policies, through appropriate education and training, improved working conditions and environment, notably related to safety and security. Any form of discrimination, harassment or	*Public Transport* • Reduce barriers to intermodal public transport by improving public transport integration, journey planning and ticketing.	*Cross-cutting Theme: Gender* • Achieve gender parity and equality in the transport workforce especially in public transport.

	violence in the workplace must be eliminated.	
Civil society	*Public Transport* • 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') *Behavior Change* • 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	• 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

UITP Declaration on Climate Leadership	The Declaration's goal to double the market share of public transport by 2025 would allow us to cater for 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. Actions aimed at giving a greater role to public transport in mobility which will help to decrease the regions carbon footprint. Actions also aimed at reducing their corporate carbon footprint.
Global Sidewalk Challenge	The Global Sidewalk Challenge raises the voice and profile for walking internationally and sets a challenge to governments, private businesses and NGO's 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.
Transformative Urban Mobility Initiative (TUMI)	Mobilize finance, build capacities and promote innovative approaches for urban mobility.

FURTHER REFERENCES IMPACT AREA 2

Transport Climate Action Directory	**https://www.itf-oecd.org/transport-climate-action-directory-measures**
Publications on Gender & Mobility	**https://womenmobilize.org/publications/**

The Gender Dimension of the Transport Workforce	https://www.itf-oecd.org/gender-dimension-transport-workforce
Understanding Urban Travel Behavior by Gender for Efficient and Equitable Transport Policies	https://www.itf-oecd.org/sites/default/files/docs/urban-travel-behavior-gender.pdf
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

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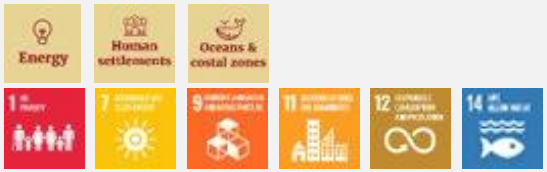
Impact 3

<RESILIENT TRANSPORT SYSTEMS, INFRASTRUCTURE AND VEHICLES>

ADAPTATION

NEXUS



	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	• Accelerate support for institutional and human capacity-building to identify and manage climate risks to transport systems, infrastructure assets, services and vehicles[1], across modes	• 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	• Foster education programmes that promote resilience, sustainability and multi-modality in transport network design, operation and management	• 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 2100

[1] 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.

- 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 use and marine spatial planning, national adaptation plans, and processes for implementation of international agreements, including 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
- Provide targeted financial support for risk assessments as part of the planning and project development process 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
- 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

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)
- 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
- 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 critical transport infrastructure out of high-risk areas
- 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

	climate risk management policies	systems (as well as vehicles, where necessary) behavior		
Financial Institutions	• 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 • 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, LLDCs LDCs) • Accelerate availability of finance for targeted impact and risk-assessment at facility level • Raise awareness of economic and financial benefits of	• 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 • 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	• 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). • 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	• Put finance and investment provisions in place to support climate-resilience of all critical transport infrastructure and systems to at least 2100

	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)	• 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 (as well as vehicles, where necessary) to at least 2050		
Technology Providers	• Develop mode-appropriate monitoring, modelling, forecasting and information management tools	• Refine real-time hydro-meteorological monitoring and early warning systems • Develop new flexible/adaptive designs and associated industry	• Provide technology and related capacity building to support the climate-resilience of all critical transport infrastructure and systems (as	• Provide technology and related capacity building to support climate-resilience of all critical transport infrastructure and systems to at least 2100

and Innovators

- 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
- Conduct risk reduction research to improve freight 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)
- Scaling up established technologies in response to changing climatic conditions

	and passenger transport safety in extreme conditions			
Business and Service Providers	• Carry out climate risk assessments and prepare adaptation strategies and contingency/disaster response plans for critical transport 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 • Implement strategic level, cross-modal monitoring and	• 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 • 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.	• 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 • Embrace flexibility, and apply adaptive management principles to develop and deliver programmes for climate-resilient renewal,	• 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

	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	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	refurbishment or retrofitting, using nature-based solutions where relevant	
Civil society	• 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	• 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	• 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	• Promote civil society stakeholder engagement to support the climate-resilience of all critical transport infrastructure and systems to at least 2100

- 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

Navigating a Changing Climate	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. 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 https://navclimate.pianc.org/
Transformative Urban Mobility Initiative (TUMI)	Mobilize finance, build capacities and promote innovative approaches for urban mobility
UIC Low-Carbon Sustainable Rail Transport Challenge	Improvement of rail sector energy efficiency, reductions in GHG emissions, resilience and a more sustainable balance between transport modes.

FURTHER REFERENCES IMPACT AREA 3

Australian Greenhouse Office (2006): Climate Change Impacts and Management, A Guide for Business and Government. Online: https://www.environment.gov.au/climate-change/adaptation/publications/climate-change-impact-risk-management

UNECE, 2013. Climate Change Impacts and Adaptation for International Transport Networks, United Nations Economic Commission for Europe, New York and Geneva, 2013, 248 pp. http://www.unece.org/fileadmin/DAM/trans/main/wp5/publications/climate_change_2014.pdf

Inter-American Development Bank, 2015. Climate Change Risk Management Options for the Transportation Sector. May. Inter-American Development Bank, available at: https://publications.iadb.org/bitstream/handle/11319/6937/Climate_Change_Risk_management_Options_for_the_Transportation_Sector.pdf?sequence=1

IPCC (2012) Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA.

IPCC, 2018. Summary for policy makers. In: V. Masson-Delmotte et al (eds.) Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels. World Meteorological Organization, Geneva, Switzerland. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_HR.pdf.

ISO, 2019. ISO 14090: 2019 Adaptation to climate change - Principles, requirements and guidelines. International Organization for Standardization.

Pulido, Daniel; Darido, Georges; Munoz-Raskin, Ramon; Moody, Joanna. 2018. The Urban Rail Development Handbook. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/30392 License: CC BY 3.0 IGO.

Standards Australia (2013): AS 5334-2013: Climate change adaptation for settlements and infrastructure – A risk based approach. https://infostore.saiglobal.com/en-gb/standards/as-5334-2013-119943_SAIG_AS_AS_251367/

Tröltzsch, J., Rouillard, J., Tarpey, J., Lago, M., Watkiss, P., Hunt, A. (2016) The economics of climate change adaptation: Insights into economic assessment methods. ECONADAPT Deliverable 10.2.

UNCTAD, 2017. Climate Change Impacts on Coastal Transportation Infrastructure in the Caribbean: Enhancing the Adaptive Capacity of Small Island Developing States (SIDS). SAINT LUCIA: A Case study. UNDA 1415O, available at: https://SIDSport-climateadapt.unctad.org.

UIC Rail Adapt project (https://uic.org/IMG/pdf/railadapt_final_report.pdf)

"Hallegatte, Stephane; Rentschler, Jun; Rozenberg, Julie. 2019. Lifelines : The Resilient Infrastructure Opportunity. Sustainable Infrastructure;. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/31805 License: CC BY 3.0 IGO."

UNCTAD, 2020. Climate Change Impacts and Adaptation for Coastal Transport Infrastructure: A Compilation of Policies and Practices

https://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=2631

UNCTAD. 2018. Port Industry Survey on Climate Change Impacts and Adaptation

https://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=1964

Becker, A.H., Acciaro, M., Asariotis, R. et al. A note on climate change adaptation for seaports: a challenge for global ports, a challenge for global society. Climatic Change 120, 683–695 (2013).

https://doi.org/10.1007/s10584-013-0843-z

Monioudi, I.N., Asariotis, R., Becker, A. et al. Reg Environ Change (2018) 18:2211–2225. Climate change impacts on critical international transportation assets of Caribbean Small Island Developing States (SIDS): The case of Jamaica and Saint Lucia. https://doi.org/10.1007/s10113-018-1360-4.

UNECE, 2020. Climate Change Impacts and Adaptation for Transport Networks and Nodes

https://www.unece.org/fileadmin/DAM/trans/doc/2020/wp5/ECE-TRANS-283e.pdf

UNECE, 2015. Transports for Sustainable Development - the case of inland transport

https://www.unece.org/fileadmin/DAM/trans/publications/Transport_for_Sustainable_Development_UNECE_2015.pdf

UNFCCC, 2020. POLICY BRIEF Technologies for Averting, Minimizing and Addressing Loss and Damage in Coastal Zones

https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/2020_coastalzones/cfecc85aaa8d43d38cd0f6ceae2b61e4/2bb696550804403fa08df8a924922c2e.pdf

PIANC, 2020. Guidance on Climate Change Adaptation Planning for Ports and Inland Waterways

https://www.pianc.org/publications/envicom/wg178

Hill, A., Mason, D., Potter, J.R., Hellmuth, M., Ayyub, B., Baker, J.B., 2019. Ready For Tomorrow: Seven Strategies For Climate-Resilient Infrastructure

https://www.hoover.org/research/ready-tomorrow-seven-strategies-climate-resilient-infrastructure

Global Climate Action
United Nations Climate Change

Marrakech Partnership

Impact 4

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

Improve Land Transport

MITIGATION

NEXUS

Policymakers (national, subnational, local levels)

By 2021

- 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

By 2025

- 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

By 2030

- 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

By 2040

- Ensure 100% ZEV for light and heavy-duty vehicles, buses, and rail by 2040 in leading markets
- For the remaining markets, set per kilometer CO_2 reduction target for light-duty vehicles to 90 per cent and for heavy-duty vehicles to 70 per cent (relative to 2005).

transition by ensuring higher fuel efficiency and low-carbon fuel adoption

- Introduce fuel economy or CO_2 emission standards in countries yet to adopt them:
  - Cover both light and heavy-duty vehicles
  - 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
- 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:
  - Increase the share of low-carbon fuel blending
- 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
- 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
- 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.

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).

  - 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
- 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.			
Financial Institutions	• 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 and hydrogen fuel cells for long-haul heavy transport, and related infrastructure. For example: - 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	• Continue to invest in development, production and scaling up of sustainable, low-carbon energy (and related infrastructure) for rail and road transport • Move towards mileage-based taxation systems to limit reduced revenue from increased electrification of passenger cars.	• Keep investing in sustainable transport technologies.	• Keep investing in sustainable transport technologies.

	• 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.			

Technology Providers and Innovators	• Scale up research and development for vehicle and fuel efficiency improvements
	• Scale up tested and low barrier decarbonization measures for freight transport, including;
	  - Aerodynamic retrofits,
	  - Reduced-rolling resistance of tires,
	  - Increased engine efficiency and hybridization
	• Ensure that technical regulations and standards for safety and environmental performance of electric and hydrogen vehicles (including trucks), electric road systems and low-carbon fuels are in place; develop pre-normative
		• 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 environmental performance, fuel and manufactured components properties and sustainable production remain up to date, following technology developments.
			• Continue to ensure that technical regulations and standards for clean vehicles and sustainable fuels remain up to date.	• 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).

activities where necessary to complete missing items in the norms

- 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 • Increased 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.		
Business and Service Providers	• 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	• 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 CO_2 emissions through optimization of vehicle capacity	• 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 vehicle 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

	and heavy-duty vehicles and combination of electrification 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 systematic change • 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.	• Increase railway share of passenger transport and freight transport through cost and time efficiency incentives.	• Replace company vehicle fleets with zero-emission vehicles.	
Civil society	• Increase capacity building and sharing of best practice knowledge among stakeholders • Develop public information campaigns to promote sustainable transport behavior and counter 'greenwashing'	• 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	• Continue the capacity and awareness building efforts and key stakeholder engagements	• Continue the capacity and awareness building efforts and key stakeholder engagements

	• Engage with investors, vehicle manufacturers, and policy makers in order to encourage them to switch to zero-carbon vehicles	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

EXISTING INITIATIVES IMPACT AREA 4

Transport Decarbonisation Alliance (TDA)	TDA brings together countries, cities/regions and companies, the "3 Cs", to achieve low-carbon mobility by setting up ambitions and tangible action plans for the private and public actors for the sector transformation, and influence political decision-makers in key international fora and through bilateral dialogues.
International Zero-Emission Vehicle Alliance (ZEV Alliance)	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.

Global Fuel Economy Initiative (GFEI)	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).
Global Green Freight Action Plan	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. http://globalgreenfreight.org/ 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) 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/
World Economic Forum (WEF) Road Freight Zero	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.
EV100	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.

Transformative Urban Mobility Initiative (TUMI)	Mobilize finance, build capacities and promote innovative approaches for urban mobility
C40 Green and Healthy Streets	As part of C40 that 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.
Action towards Climate-friendly Transport (ACT)	ACT promotes and accelerates transport action and zero-emission mobility in the fight against climate change
UIC Low-Carbon Sustainable Rail Transport Challenge	Improvement of rail sector energy efficiency, reductions in GHG emissions, resilience and a more sustainable balance between transport modes.
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 4

Transport Climate Action Directory	**https://www.itf-oecd.org/transport-climate-action-directory-measures**
IEA in collaboration with UIC	**https://www.iea.org/reports/the-future-of-rail**

Regulations and Standards for Clean Trucks and Buses On the Right Track?	https://www.itf-oecd.org/regulations-and-standards-clean-trucks-and-buses
ITF Covid-19 Transport Brief: Electric Mobility - Taking the Pulse in Times of Coronavirus	https://www.itf-oecd.org/sites/default/files/electric-vehicles-covid-19.pdf

SHIPPING CHANGE LEVERS

In shipping, feasible fuel pathways exist but accelerated action and cross-industry collaboration are needed to accelerate R&D and realize large scale system demonstrations by 2025. Emissions from shipping currently amount to ~0.9Gt CO_2, almost 3 per cent of global emissions, but could grow by 84 per cent under a business as usual scenario. Lack of regulation and growing demand from customers, as well as a fragmented industry, excess capacity and short investment horizons have led to the industry 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 is 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 in electrolysis technology to bring down the costs of green hydrogen. Large-scale system demonstrations are needed by 2025 to demonstrate viability and draw learnings. These will require collaboration between governments, industry and finance, with governments playing a larger role early on. This approach also applies to other modes, such as road and rail transport. **Freight purchasers** should commit to pay a premium for zero-carbon freight, support early system demonstrations and set a target for zero-carbon freight, e.g. 5 per cent of total by 2030.

In **finance**, actions are needed to improve transparency and governance and to de-risk investments to attract institutional investors. Lenders should provide differentiated interest rates based on emissions profile of vessels. In **policy**, IMO regulation in line with the Paris Agreement targets is

needed by 2023, focusing both on operational standards and zero-emission fuel adoption, while also ensuring an equitable transition through application of the principle of common but differentiated responsibilities and respective capabilities ("CBBDRC"). National governments can move independently of the IMO to regulate domestic shipping emissions and developed nations should move first. **Civil society** can develop internationally recognized awards and certificates to acknowledge shipping actors' decarbonization progress and work to catalyze consumer pressure on industry and freight purchasers to commit to quantified targets zero-carbon freight. Also, labor organizations should emphasize the benefit crews stand to gain from increased training and qualifications associated with the higher safety requirements of zero-carbon fuels.

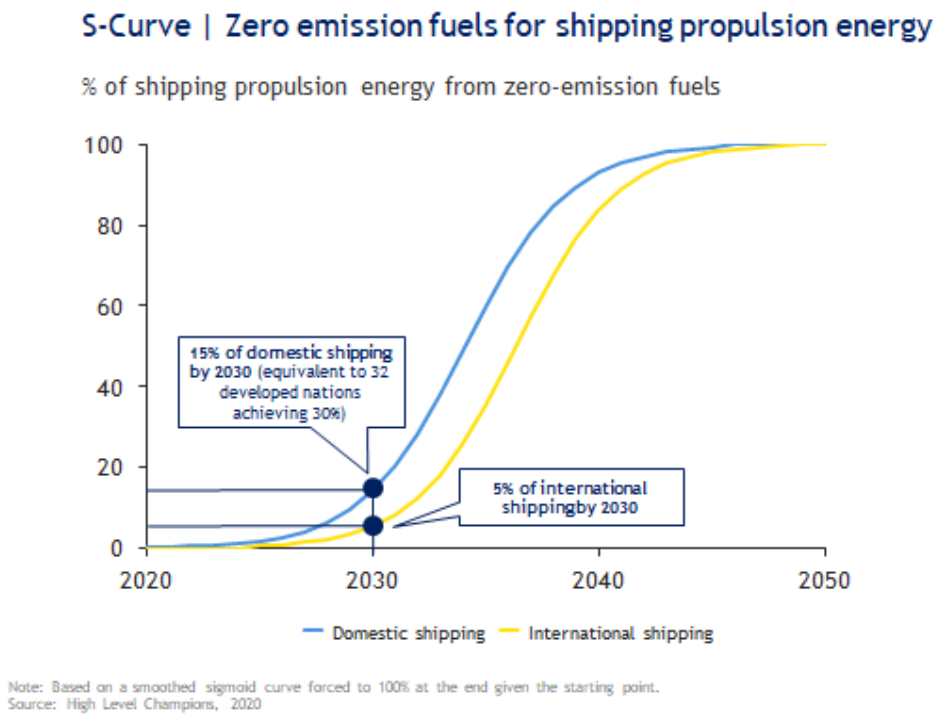
By 2030, the industry should aim to achieve **5 per cent of propulsion energy coming from zero-carbon fuels for international shipping** through a combination of container routes, niche vessel types (e.g. green ammonia and LPG tankers) and niche routes (e.g. to Japan and to Australia who both plan for 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's 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 zero in 2020, reaching 5 per cent for international shipping by 2030 and 15 per cent for domestic 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.

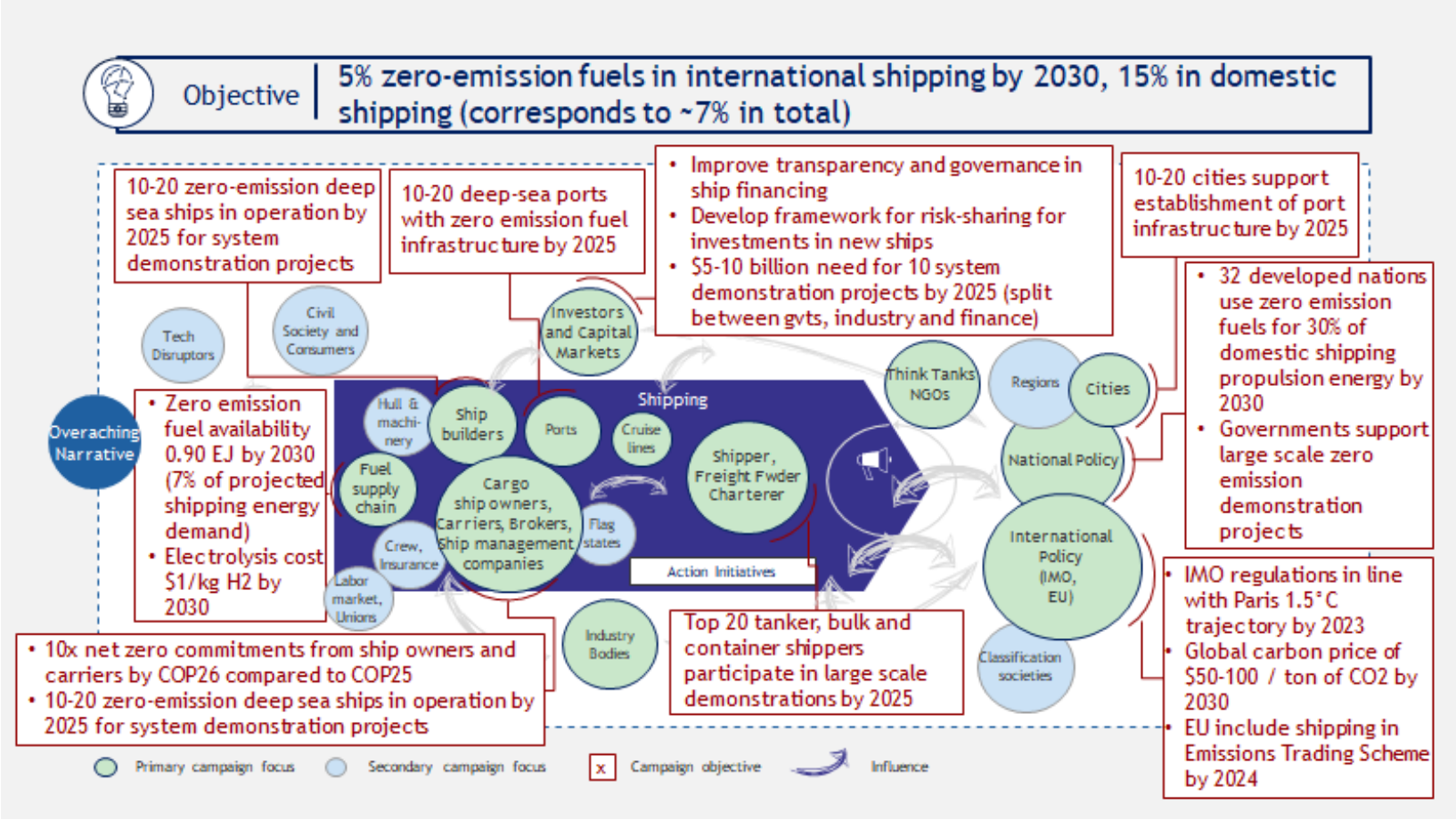
Zero emission fuels for shipping propulsion energy

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



SHIPPING SYSTEMS MAP

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



SHIPPING ACTION TABLE

The shipping action table provides a detailed account of the actions needed by stakeholder group or lever to achieve sector decarbonization in line with targets. Actions are split by 2021, 2025, 2030 and 2040 with emphasis on near term action.

Global Climate Action
United Nations Climate Change

Marrakech Partnership

Impact 5

<IMPROVE SHIPPING TECHNOLOGY, OPERATION AND FUEL EFFICIENCY>

Improve Shipping

MITIGATION &/OR ADAPTATION

NEXUS

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	• 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	• 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	• Introduce an international carbon price to the order of USD 50-100/ton CO_2 to generate sufficient uptake of alternative fuels or renewable energy sources • Introduce blending mandates • Develop an International CO_2 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	• 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

- Encourage ports to increase the availability of alternative energy supplies for shipping and port activities
- Include carbon targets in port terminal concessions
- Develop data and methods for assessing impacts on states (necessary to operationalize CBDRRC)
- Develop policy mechanisms that can address impacts on states (necessary to operationalize CBDRRC)
- 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)

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).

- 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 CO_2) 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

zero-carbon fuels at main ports

- 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

		• Roll out environmentally differentiated port pricing factoring in both air pollutants and GHG emissions • Government committed support for system demonstration projects $2-4 billion • EU Emissions Trading System for shipping operational		
Financial Institutions	• 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	• 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,	• 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 ~$390 billion (20 per cent of $1.9 trillion need by 2050 to succeed in reaching 20 per cent zero-emission fuels by 2035)	• Total committed/ realized investment of ~$1.6 trillion (85 per cent of $1.9 trillion need by 2050 to succeed in reaching 85 per cent zero-emission fuels by 2045)

		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 $3-6 billion • Total committed investment of ~$80 billion		
Technology Providers and Innovators	• 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	• 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 us in internal combustion engines and fuel cells • Accelerate IGF code expansion for low and zero-carbon fuels.	• Additional scale up of zero-carbon fuels from renewables with target of reaching electrolysis costs of $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)	• Total ~80 per cent zero-emission shipping

	• 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.	• 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 $2kg 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.	• 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).
Business and Service Providers	• 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	• 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	• Classification societies actively push and develop standards for zero-emission ships, individual technologies and fuels in cooperation with regulators and companies

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.
- Improve gender equality in the maritime transport sector, as women have stronger preferences for improving sustainability in the sector and are change agents who could challenge the dominant male norms and trigger changes in transport policies for greater levels of sustainability. An increase gender equality in maritime transport is necessary to develop more sustainable and inclusive measures.

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 and agree on incentives with shipowners
- Shipping actors modernize charter contracts to reduce

		roadblocks to adopting energy efficient ships
Civil society	• Key labour 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	• 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	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.
Getting to Zero Coalition	Cross-industry initiative aiming to have zero-emission vessels in commercial operation by 2030
Poseidon Principles	Initiative to get lenders to Include climate considerations into lending decisions to promote decarbonization in line with IMO targets
Climate Bonds Initiative	Set criteria by which bond-issuers financing green new builds and retrofits of ships can seek Climate Bond Certification

FURTHER REFERENCES IMPACT AREA 5

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

AVIATION CHANGE LEVERS

For aviation, in order to continue to enjoy the benefits of air travel, accelerated investment and cross-stakeholder *radical collaboration* is critical to realize the most viable path to zero carbon and removal of all pollutants. Aviation accounted for 3 per cent of global carbon emissions in 2019 (4 per cent including non-CO2 pollutants) but, in some projections, could grow to 25 per cent by 2050. Technological barriers associated with alternative propulsion and design are now being overcome, and difficult industry factors, such as low profit margins, job losses, stakeholder complexity and limited historic regulatory pressure, make decarbonizing aviation challenging. ICAO's analysis suggests that improved air travel efficiency can achieve up to 40 per cent emissions reduction versus a 2050 business-as-usual scenario, an additional 10-30 per cent coming from Jet Biofuels, while 30-50 per cent need to come from Synfuels or eFuels. Jet Biofuels and Synfuels/eFuels are jointly referred to as Sustainable Aviation Fuels (SAF).

There are four technically viable SAF pathways: Hydrogenated Esters and Fatty Acids (HEFA, made using waste oils), Gasification (Fischer Tropsch, made using forestry offcuts) and Alcohol-to-jet fuels and Synfuels. The primary issues with these are availability, high prices and low speed of adoption; currently at less than 0.01 per cent of jet fuel demand. Actions to accelerate adoption of these fuels include proposed national government mandates such as in the Netherlands, Norway and France; 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; terminating the Chicago Convention tax exemption on Kerosene; and stimulating investment in existing and new production plants.

To achieve complete decarbonization, **Synfuels or eFuels** (including electrification) are needed. Long haul zero-emission aviation is the key challenge. Large strides have been made in the development of short haul electric aircraft but limitations to battery energy density means 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 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 is needed. This should also include key **demand side** actors, such as companies with large business travel volumes, e.g., by agreeing

to pay a premium for sustainable fuels or contributing in other ways to development efforts. Also, there is large potential for short haul aviation to be replaced by high-speed rail and other more sustainable modes.

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

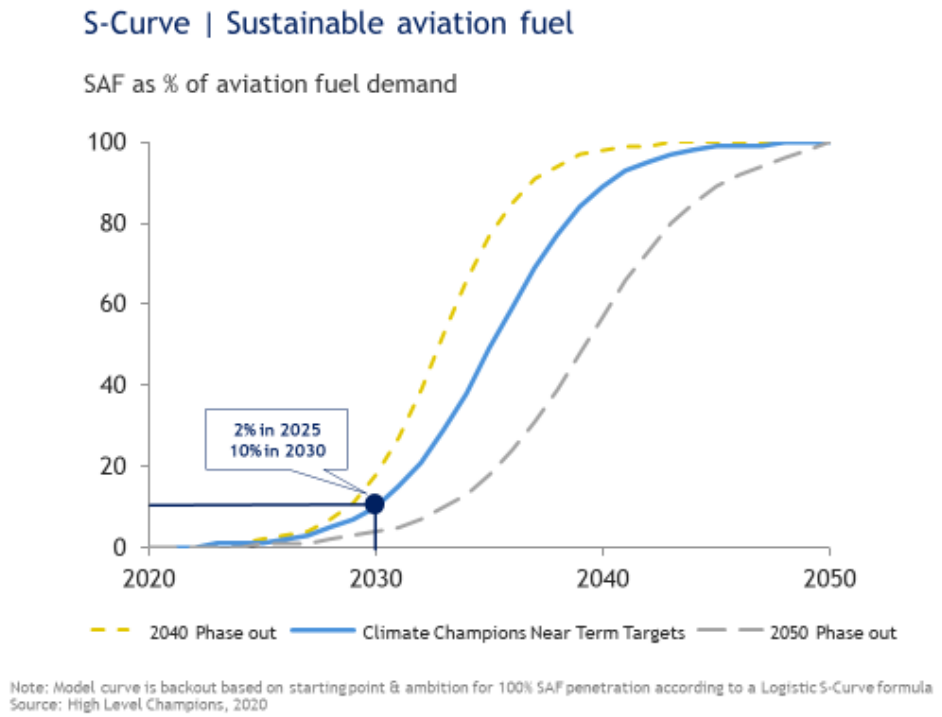
By 2030, the industry should achieve **a minimum of 10 per cent Sustainable Aviation Fuels globally (2 per cent by 2025)**. Domestic aviation, whose emissions fall under the remit of UNFCCC, can make a significant contribution given that it accounts for almost 40 per cent of total emissions and two thirds of total flights.

AVIATION S-CURVE

The S-curve illustrates the adoption rate of SAF 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.

Sustainable aviation fuel

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



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

AVIATION ACTION TABLE

Impact 6

<IMPROVE AVIATION EFFICIENCY AND REDUCE THE CARBON INTENSITY OF AVIATION FUELS>

Improve Aviation

MITIGATION &/OR ADAPTATION

NEXUS

	By 2021	By 2025	By 2030	By 2040
Policymakers (national, subnational, local levels)	• Link financial support packages for airlines to the achievement of future emissions reduction targets via decarbonization technologies, such as Sustainable Aviation Fuel (SAF) uptake. • Include clear and measurable national targets, in line with Paris Agreement, in National Plans.	• Driven by a joined-up and comprehensive set of policy instruments, including some mandates, to support the achievement of decarbonization targets, in coordination with other sectors, e.g., 2 per cent SAF by 2025: • Economy-wide carbon taxation and/or emissions trading, that includes Domestic and robust Carbon Pricing of over $50 per ton.	• Review and adjust effectiveness of policies in achieving overarching goal of minimum of 10 per cent SAF globally by 2030. • National, Regional and International case review • Leaders and Laggards improve cohesiveness	• Review and adjust effectiveness of policies in achieving overarching goal of minimum of 90 per cent SAF globally by 2040.

	• Implement new policies for investing in and driving down costs of Zero-Emission Aircraft (ZEA) and SAF, e.g., Contracts for Difference (CFD). • Collaborate closely with ICAO to help establish an updated international framework for driving zero carbon by 2050 climate ambition.	• Performance standards for the transport and aviation sector, e.g., efficiency and emissions. • Market-pull and technology-push policies accelerating the industry's decarbonization, and goal-oriented research programs. • Review the international tax exemption for Kerosene and consider carbon taxation options.
Financial Institutions	• Establish a framework for assessing and disclosing the alignment of aviation businesses with climate targets, 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.	• As costs are driven down for SAF, shift support to Hydrogen/Electric Aircraft • Similarly shift from Gas to Liquid Hydrogen where gasification is derived from renewable sources.
Technology Providers and Innovators	• Develop 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.	• 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.

	• Build investment in R&D for Hydrogen and Electric Aircraft as well as Hybrid variations.		
Business and Service Providers	• 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	• 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 existing aircraft where feasible. • Airlines: use SAF • Businesses: Improve social justice along with climate action; include gender equality across sector workforce through appropriate training and education, and improvement in working conditions for women as part of the development of more	• Airports: Achieve zero CO_2 emissions from airport operations and those under airport control. • Airlines, airports, fuel producers and suppliers: use combination of SAF and ZEA to deliver 90% reduction on all pollutants.

aircraft and engines regularly to reduce drag; regulate economic fuel tankering; implement pilot training for eco-flying; plan and optimize flight routes to take advantage of beneficial winds and air temperatures; retrofit winglets on appropriate aircraft; put the most inefficient aircraft intro 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

sustainable and inclusive measures.

	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.
Civil society	• Raise public awareness of the carbon and energy intensity of air transport. • 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

Mission Possible Platform: Clean Skies for Tomorrow	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.
ICAO Stocktaking & Green Recovery	Convening members and industry stakeholders to review progress against objectives set and collaborate around new objectives.
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 6

ITF, Transport Climate Action Directory	**ITF (forthcoming), Decarbonising Air Transport – Acting Now for the Future**
Airports Council International (2019), Sustainability Strategy for Airports	**ICAO (2014), Operational opportunities to reduce fuel burn and emissions**
ITF (2017), Capacity Building through Efficient Use of Existing Airport Infrastructure, Discussion Paper 2017–27, Egeland, J. and P. Smale	**Air Transportation Analytics Ltd and Ellondee Ltd (2018), Understanding the potential and costs for reducing UK aviation emissions, Report to the Committee on Climate Change and the Department for Transport**

ICCT (2015), Cost assessment of near and mid-term technologies to improve new aircraft fuel efficiency, Kharina, A., D. Rutherford and M. Zeinali

Schäfer, A. W., A. D. Evans, T. G. Reynolds and L. Dray (2016), Costs of mitigating CO_2 emissions from passenger aircraft, Nature Climate Change, Vol. 6, pp. 412-417, Springer Nature, London

Schäfer, A. W., S. R. H. Barrett, K. Doyme, L. M. Dray, A. R. Gnadt, R. Self, A. O'Sullivan, A. P. Synodinos and A. J. Torija (2019), Technological, economic and environmental prospects of all-electric aircraft, Nature Energy Vol. 4, No. 2, pp. 160-166

Poseidon Principles (n.d), https://www.poseidonprinciples.org/#home

IEA (2020a), *Aviation*, Tracking Report

IATA (2020), "Sustainable Aviation Fuel: Technical Certification", Fact Sheet 2

ICCT (2015), *Long-term aviation fuel decarbonization: Progress, roadblocks, and policy opportunities,* briefing, Searle, S., N. Pavlenko, A. Kharina and J. Giuntoli

IEA (2019), "Are aviation biofuels ready for take-off?", commentary, Lefeuvre, P.

IEA (2020), *Energy Technology Perspectives 2020*

CONTRIBUTIONS

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