



Economic Commission for Europe**Inland Transport Committee****Eighty-fifth session**

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Item 7 (e) (ii) of the provisional agenda

**Strategic Questions of a Horizontal and
Cross-Sectoral Policy or Regulatory Nature:****Environment, Climate Change and Transport:****Inland Transport Committee Acting on Climate Change
Adaptation and Mitigation****Climate change mitigation in inland transport at an inflection
point: the way forward****Note by the secretariat***Summary*

The worsening globally situation due to the increasing frequency and severity of climate change impacts, combined with the call for enhanced efforts to achieve the Sustainable Development Goals, including via mitigation policies and measures the limiting of global warming to below two degrees Celsius as set in the Paris Agreement on climate change, creates the most pressing demand for inland transport to become part of the strictest solutions. Particularly as inland transport is the main contributor to CO₂ emissions.

The Committee at its eighty-fourth session, recognized the critical role of inland transport in accelerating climate change mitigation worldwide and the urgency of stronger actions against climate change. It therefore requested the secretariat, in consultation with the Bureau, to prepare a comprehensive paper with these activities and action-oriented options for the Committee and Working Parties for consideration at the Committee's eighty-fifth plenary session (ECE/TRANS/316, para 51). This document has been prepared in direct implementation of this mandate.

The Committee may wish to:

(a) **request** the secretariat, in close cooperation with the Committee's Bureau and relevant subsidiary bodies, **to develop** an ambitious strategy document for reducing Green House Gas (GHG) emissions in inland transport based on international United Nations legal instruments under the Committee's purview with priority actions for The Inland Transport Committee (ITC) and all its relevant subsidiary bodies, supported by a strong action plan with milestones, for consideration and possible adoption by the Committee at its eighty-sixth plenary session;

(b) **request** its relevant subsidiary bodies and treaty bodies to accord priority to timely amendments to the United Nations inland transport legal instruments to support safe and efficient achievements of the targets, commitments and solutions on climate change;

(c) **request its** relevant subsidiary bodies to continue efforts towards harmonization of performance requirements and intelligent transport systems related legal instruments directly contributing to reduction of GHG emissions through improvement of fuel/energy use efficiency; efficient use of transport networks; shift from private cars to public transport when available; flexible load and storage resources for the power grid (electric cars) and automation;

(d) **request** its subsidiary bodies and treaty bodies to intensify efforts towards digitalization of main United Nations inland transport conventions;

(e) **invite** its relevant subsidiary bodies to reflect on environmental and energy efficiency considerations, while drafting a legal instrument on the use of automated vehicles in traffic;

(f) **express its strong and active support** towards the task initiated by the Working Party on Pollution and Energy (WP.29/GRPE) to develop a globally harmonized methodology to determine the life-cycle carbon footprint of road vehicles;

(g) **request the secretariat to report biennially through in-depth reports to the Committee** on climate change and inland transport, starting at the Committee's eighty-sixth session in 2024.

I. Introduction

1. The 2030 Agenda for Sustainable Development calls for urgent action to combat climate change and its impacts.¹ The Paris Agreement on climate change, adopted by 196 Parties at UNFCCC COP21 in Paris in 2015, sets its goal to limit global warming to well below two, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. Under the Agreement, the global peaking of greenhouse gas emissions needs to be reached as soon as possible to achieve a climate neutral world by mid-century.

2. In 2019, direct Green House Gas (GHG) emissions from the transport sector accounted for 23 per cent of global energy-related CO₂ emissions. Of these, 70 per cent came from road vehicles, while 1 per cent came from rail, 11 from shipping and 12 per cent from aviation². Transport-related emissions in developing regions of the world have increased more rapidly than in Europe or North America, a trend that is expected to continue in coming decades.³

3. It follows that inland transport as the main contributor to GHG emissions from the transport sector, bears a unique responsibility to help countries meet their climate mitigation goals. Tough ambitious targets have been set for the transport sector, in particular road, to cut CO₂ emissions. For example, in July 2021 the European Commission (EC) proposed a ban on new cars with internal combustion engines from 2035. In November 2020, the United Kingdom of Great Britain and Northern Ireland announced its plan to ban the sale of new petrol and diesel cars and vans from 2030 to cut emissions to net zero by 2050. Attaining these goals would require transformative changes in the transport sector, in particular for inland transport.

4. To help frame the scale of real transformation required, it is helpful to consider that the International Transport Forum (ITF) predicts that by 2050 passenger transport will

¹ Goal 13, United Nations General Assembly resolution 70/1 Transforming our world: the 2030 Agenda for Sustainable Development, 2015.

² 2022, "Climate Change 2022 - Mitigation of Climate Change", Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Working Group III: https://report.ipcc.ch/ar6/wg3/IPCC_AR6_WGIII_Full_Report.pdf

³ Ibid.

increase 2.3-fold and freight transport will grow 2.6-fold under the trajectory reflecting current efforts.⁴ CO₂ emissions from transport will increase by 16 per cent by 2050 even if today's commitments to decarbonise transport are fully implemented. ITF estimates that reduction of transport CO₂ emissions by almost 70 per cent in 2050 compared to 2015 would reach the goal of the Paris Agreement to limit global warming to 1.5° degrees Celsius.

5. Clearly, more ambitious decarbonisation policies and comprehensive measures are needed in the transport sector. The lessons from the example set by the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) in terms of goals for reduction of CO₂ emissions from civil aviation and maritime transport respectively are instructive. Section II offers an overview of those measures.

6. The Committee at its eighty-fourth session, recognized the critical role of inland transport in accelerating climate change mitigation worldwide and the urgency of stronger actions against climate change, and requested the secretariat, in consultation with the Bureau, to prepare a comprehensive paper with these activities and action-oriented options for the Committee and Working Parties for consideration at the Committee's eighty-fifth plenary session (ECE/TRANS/316, para 51). It also invited its Working Parties to submit to the secretariat their ongoing contributions, plans and suggestions in support of climate change mitigation. These submissions are reflected in full at the annexes to this document. Sections III and IV outline respectively key existing activities and critical areas for future accelerated work or new workstreams.

II. Overview of ICAO and IMO climate-change related actions⁵

A. International Civil Aviation Organization

7. The International Civil Aviation Organization (ICAO) Assembly at its fortieth session in 2019 reiterated the two global aspirational goals for the international aviation sector of two per cent annual fuel efficiency improvement through 2050 and carbon neutral growth from 2020 onwards. To achieve these goals and to promote sustainable growth of international aviation, ICAO is pursuing a basket of measures including aircraft technology improvements, operational improvements, sustainable aviation fuels (SAF), and market-based measures (CORSIA), a carbon offset and carbon reduction programme to lower CO₂ emissions for international flights. Furthermore, ICAO has established a global framework to facilitate the reduction in carbon footprint and explore the usefulness of targeting long-term CO₂ reduction.

8. Other ICAO initiatives include:

(a) A CO₂ emissions reduction initiatives tracker tool that offers information relevant to initiatives for reducing the environmental footprint of aviation. This tool is developed as part of the International Coalition for Sustainable Aviation, consisting of several non-profit organisations is working on reducing air travel pollution. This is the only environmental civil society group recognised as an observer by the ICAO;

(b) The State Action Plan initiative launched in 2010 with the aim to provide States with the capacity and tools to take action;

(c) The development of State Action Plans and the implementation of CORSIA are supported through the development and maintenance of several tools that are made available to States and the general public. They include the Carbon Emissions Calculator, the Green Meetings Calculator, and the Fuel Savings Estimation Tool.

⁴ International Transport Forum (ITF), Transport Outlook 2021, 2021.

⁵ This section draws heavily from Annex II to this document.

B. International Maritime Organization

9. The International Maritime Organization (IMO) has adopted mandatory measures to reduce emissions of greenhouse gases from international shipping, under the IMO pollution prevention treaty (MARPOL). In 2018, IMO adopted an initial strategy on the reduction of GHG emissions from ships that envisages, in particular, a reduction in carbon intensity of international shipping to reduce CO₂ emissions per transport work, as an average across international shipping, by at least 40 per cent by 2030, pursuing efforts towards 70 per cent by 2050, compared to 2008. Furthermore, total annual GHG emissions from international shipping should be reduced by at least 50 per cent by 2050 compared to 2008. The strategy envisages that a revised strategy will be adopted in 2023. To reach the climate targets set out in the IMO initial GHG strategy, the maritime transport sector must move towards implementing zero-carbon alternatives. Several fuel options are explored, including synthetic carbon-based fuels, biofuels, green hydrogen, and green ammonia, with the latter two having favourable features because of their GHG emissions, safety and technical implications, economics, scalability and overall wider environmental performance factors.

10. To support a strategy on reducing emissions across the maritime sector, IMO developed a Ship Emissions Toolkit, which offers a well-defined framework along with decision support tools. The first practical guide of the Ship Emissions Toolkit is based on the “Rapid assessment of ship emissions in the national context”. The second practical guide of the Ship Emissions Toolkit is based on the incorporation of MARPOL Annex VI into national law⁶. The third guide of Ship Emissions Toolkit discusses the crucial planning, development and implementation phases that are involved in the creation of a national ship emissions reduction strategy.

11. The IMO Energy Efficiency Design Index (EEDI) requires a minimum energy efficiency level per capacity mile for different vessels and has been made obligatory for all new ships.

III. Existing activities undertaken by the Inland Transport Committee, its subsidiary bodies and the secretariat

12. Climate change is considered a cross-cutting subject in the Inland Transport Committee Strategy until 2030⁷ (ECE/TRANS/288/Add.2). The Committee, its relevant Working Parties and the secretariat have been working to contribute to mitigation and adaptation measures of member States for climate change as shown in Annex I to this document. The activities are summarized as follows:

(a) High-level policy, regulatory and institutional support at the level of the Committee’s decisions and endorsed Ministerial Resolutions and Declaration;

(b) Assessment of impact on transport and adaptation measures, by the Working Party on Road Transport (SC.1), the Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation (SC.3/WP.3) and the Working Party on Transport Trends and Economics (WP.5);

(c) Regulatory framework for deployment of safe electric and hydrogen vehicles, by the Working Party on the Transport of Dangerous Goods (WP.15) and the World Forum for Harmonization of Vehicle Regulations (WP.29/GRSP);

(d) Regulatory framework by WP.29/GRPE (see Annex III to this document for a full list) for:

(i) measuring CO₂ emissions from road vehicles;

⁶ The 1997 Protocol to the International Convention for the Prevention of Pollution from Ships, known as MARPOL Annex VI. This protocol controls air emissions from more than 95 per cent of the world’s shipping tonnage and sets limits on Nitrogen Oxide emissions while imposing strict measures that require ships to make use of fuel with low sulphur content.

⁷ Paragraph 12, Page 6, Inland Transport Committee Strategy until 2030, 2019.

- (ii) the use of new technology to ensure minimum degradation from batteries;
- (iii) improving engine efficiency and reducing emissions, by WP.29;
- (iv) (under development) the Life-cycle Assessment (LCA) regulatory framework to measure the life-cycle emission of carbon of vehicles, including during manufacturing, use and end-of-life phases of the vehicle.
- (e) Regulatory framework for greening inland water transport fleet, infrastructure and operations by WP.3/SC.3 (see Annex IV to this document for more details);
- (f) Intermodal system and modal shift from road to more environmentally sound modes, by the Working Party on Rail Transport (SC.2) and the Working Party on Intermodal Transport and Logistics (WP.24) (See Annex V to this document for a more complete list);
- (g) Promotion and facilitation of green transport and mobility by WP.5 (see Annex II to this document for a full list) and the Transport, Health and Environment Pan-European Programme (THE PEP);
- (h) Studies and publications, by WP.5 and THE PEP;
- (i) Capacity building, by SC.3 and WP.5;
- (j) Development of tools, such as the For Future Inland Transport Systems model (ForFITS), the Intelligent Transport System Road Map and THE PEP handbook;
- (k) Inter-Working Party cooperation and coordination, between SC.1, WP.5, WP.15 and WP.29; and
- (l) Project on new energy, the secretariat.

IV. Preliminary analysis of further activities to be undertaken by ITC, its subsidiary bodies, and the secretariat

13. It is clear that the Committee plays a key role in combating climate change and has significantly contributed to the global agenda and member States' efforts. Based on the feedback received by the Committee's Working Parties, there are still areas to be explored further to support ITC members that could be grouped in five major areas:

- (a) Regulatory priorities for ITC and its subsidiary bodies;
- (b) Policy support priorities;
- (c) Institutional arrangements;
- (d) Intergovernmental support, with emphasis on regional/interregional priorities and needs;
- (e) (New) Partnerships.

A. Regulatory priorities for ITC and its subsidiary bodies

14. Several priorities have been suggested, including:

- (a) Decreasing carbon intensity over the vehicles' life; defining harmonized methodologies to determine the climate impact of vehicles during their lifetime that can then inform the corresponding regulatory framework; developing Carbon life cycle assessment (LCA) of vehicles a critical stepping stone;
- (b) Developing of the harmonized international regulatory framework for facilitating the transition to alternative fuels and greening;
- (c) support the acceleration of electrification. Enhancing vehicle fuel efficiency and increasing the adoption of EVs can play an essential role in combating climate emissions whilst improving air quality;

- (d) Ensuring safety in the transportation of batteries and hydrogen for vehicles, in light of the increased frequency, quantity and varied ways of these transports;
 - (e) Infrastructure to support deployment of electric and hydrogen vehicles;
 - (f) Additional regulatory areas, such as possible amendments to road signs and traffic rules for cycling;
 - (g) Mitigation measures for road and inland water transport;
 - (h) Accelerated regulatory framework for digitalization of the sector, and integration of innovations and new technologies.
15. For a fuller list of proposed priorities see Annexes II-V to this document.

B. Policy support priorities

16. The priorities suggested included:
- (a) Maintain regular high-level policy dialogue at the future Committee sessions on new targets, strategies, plans, challenges and solutions in the inland transport sector;
 - (b) Improvement of transport operations like better fleet management;
 - (c) setting up and implementing ambitious targets for market share of intermodal transport;
 - (d) supporting sectoral activity changes such as a reduced demand for fossil fuels, increased energy efficiency and circular economy;
 - (e) Innovating on ownership and usage behaviour;
 - (f) optimizing infrastructure and operations for countries which have already established advanced freight transport and logistics systems;
 - (g) assisting cities and countries on expanding their current cycling and walking facilities;
 - (h) increasing efficiencies in the freight transport and logistics systems;
 - (i) support investments in further electrification of rail transport (for both, passenger and freight transport);
 - (j) Development of more tools, such as:
 - (i) develop and deploy a CO₂ emissions reduction initiatives tracker tool for inland transport that would monitor and provide a wide range of information relevant to initiatives for reducing the environmental footprint of inland transport
 - (ii) develop an inland transport emissions toolkit, which would provide a structured framework along with decision support tools for the evaluation of emission reduction opportunities in the inland transport;
 - (k) lead the digitalisation effort as this can prove to be a powerful tool to provide multimodal integration;
 - (l) accelerate the incorporation of environmental and social lessons learned from the Covid-19 crisis to develop an approach that promotes initiatives such as working from home or avoiding unnecessary travel that can help reduce emissions.
17. For more details on proposed priorities see Annexes II-V to this document.

C. Institutional priorities ITC and its subsidiary bodies

18. The considered priorities include:

(a) Enhanced cooperation/coordination between working parties and review/assessment of current institutional support for the climate change mitigation workstream, including possible central coordination;

(b) Developing “Nexuses” of cross sectoral work within the Division and potentially with other subprogrammes or major players that could support accelerated work;

D. Intergovernmental support, with emphasis on regional and interregional priorities and needs

19. The priorities suggested included:

(a) Support to member States for accelerated modal shift;

(b) Promotion of cooperation between ITC members; development of cross-border cooperation in planning and timely introduction of the policy measures;

(c) Sharing experience and elaboration of best practices;

(d) Capacity building; and

(e) Projects to support ITC members.

E. Partnerships

20. To better link the technical work of the Committee with key stakeholders, it is suggested to explore enhanced partnerships. The priorities suggested included:

(a) Bodies such as the intergovernmental panel on climate change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC), to better connect climate scientific work with transport technical expertise;

(b) Get more transport companies and manufacturers involved. Since companies are now focusing more on the social and environmental issues of their businesses, as part of the triple bottom line, it will be a good idea to get these transport companies involved with ITC activities. For example, Electric Vehicle (EV) manufacturers, who are best suited to implement procedures which are carbon neutral and determine efficient ways to repurpose, reuse or recycle batteries at the end of life;

(c) More generally, providing a platform for successful collaborations between stakeholders inside and outside the inland transport sector to make use of the knowledge acquired in other sectors and to identify effective, innovative and tailored solutions for mitigating climate change by the inland transport sector;

(d) Finding and getting involved more academic researchers, who have an understanding of climate change, transportation resilience, and the need for mitigation, with the Committee’s group of experts.

V. Way forward

21. Inland transport, in particular road transport, is the core contributor to GHG emissions from the transport sector and hence is the single most important determinant in the success of transport-related climate change mitigation efforts globally. The Committee has a unique role to play in ensuring this success, as the United Nations centre providing a comprehensive platform for consideration of all aspects of inland transport development and cooperation, with special attention to interregional and intraregional regulatory governance through the United Nations transport conventions and other means.

22. The priority areas identified in this document in response to the Committee's decisions at its 84th session, show that the task is multifaceted and multi-layered. Furthermore, time is critical. To achieve effective coordination of all workstreams to achieve the desired results, the Committee may wish to:

(a) **request** the secretariat, in close cooperation with the Committee's Bureau and relevant subsidiary bodies, **to develop** an ambitious strategy document for reducing Green House Gas (GHG) emissions in inland transport based on international United Nations legal instruments under the Committee's purview with priority actions for The Inland Transport Committee (ITC) and all its relevant subsidiary bodies, supported by a strong action plan with milestones, for consideration and possible adoption by the Committee at its eighty-sixth plenary session;

(b) **request** its relevant subsidiary bodies and treaty bodies to accord priority to timely amendments to the United Nations inland transport legal instruments to support safe and efficient achievements of the targets, commitments and solutions on climate change;

(c) **request its** relevant subsidiary bodies to continue efforts towards harmonization of performance requirements and intelligent transport systems related legal instruments directly contributing to reduction of GHG emissions through improvement of fuel/energy use efficiency; efficient use of transport networks; shift from private cars to public transport when available; flexible load and storage resources for the power grid (electric cars) and automation;

(d) **request** its subsidiary bodies and treaty bodies to intensify efforts towards digitalization of main United Nations inland transport conventions;

(e) **invite** its relevant subsidiary bodies to reflect on environmental and energy efficiency considerations, while drafting a legal instrument on the use of automated vehicles in traffic;

(f) **express its strong and active support** towards the task initiated by the Working Party on Pollution and Energy (WP.29/GRPE) to develop a globally harmonized methodology to determine the life-cycle carbon footprint of road vehicles;

(g) **request the secretariat to report biennially through in-depth reports to the Committee** on climate change and inland transport, starting at the Committee's eighty-sixth session in 2024.

Annex I

Climate Change-Related Activities of the Inland Transport Committee, its Working Parties, and the Secretariat

I. Inland Transport Committee

The Inland Transport Committee (ITC) is the highest decision-making body of ECE on transport related matters. Climate change is a key cross-cutting area in the Inland Transport Committee Strategy until 2030 (ECE/TRANS/288/Add.2). Ministerial segments during its plenary meetings and high-level documents (Ministerial Resolutions and Declaration) derived from them and endorsed by the Committee have addressed the issue and created relevant mandates for further work in this area. The Committee has consistently advanced Climate Change as a key agenda item during its regular session and its decisions have contributed to establishing specialized intergovernmental platforms and advancing regulatory work, technical knowledge and tools with the aim of tackling the causes and consequences of Climate Change in the broader area of inland transport.

II. Working Party on Road Transport (SC.1)

SC.1 restructured its agenda with effect from its 115th session in October 2020 to better reflect an alignment with the Inland Transport Committee Strategy until 2030. This included the addition of an agenda item on “safe and sustainable road infrastructure” which includes interaction with the Group of Experts on Assessment of Climate Change Impacts and Adaptation for Inland Transport (WP.5/GE.3) through the sharing of information related to climate change impacts on transport infrastructure by the latter. One of SC.1’s key functions is to be a platform for the sharing of best practices and emerging trends for road transport and infrastructure.

III. Working Party on Rail Transport (SC.2)

SC.2 works on promoting the shift to rail as a tool to combat climate change. This is done through several areas. Firstly, through its main legal agreement, the European Agreement on Main International Railways Lines (AGC), providing for an international network of E-railways. Secondly through activities aimed at increasing the competitiveness of rail such as the development of the new convention on unified railway law aimed at breaking down the administrative barriers at the border between the two existing legal regimes in the movement of freight and in the promotion of international passenger rail transport to draw traffic away from more polluting modes of transport. Furthermore, work is ongoing on the preparation of rules for the permanent marking of railway rolling stock to make investment in railway equipment more secure and therefore cheaper, increasing the competitive position of operators. On the passenger front, member States are also developing a legal instrument to improve accessibility of stations with the aim of encouraging further modal shift. Thirdly through several other policy initiatives such as around innovation aimed at reducing the already low carbon impact of the rail sector.

IV. Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation (SC.3/WP.3)

SC.3/WP.3 at its fifty-eighth session held a workshop in February 2021 entitled “Climate change and the extreme water situation on European waterways and its impact on inland water transport”. The purpose of the workshop was to (a) highlight the impact of climate change and associated events on European waterways, ports and the operation of inland fleet; (b) address the data sources and methodologies for climate projections; (c) share experiences in risk assessment methodologies, actions, measures and strategies aimed to cope with

climate change impacts on inland navigation; (d) exchange best practices in this field; and (e) consider actions that could be undertaken by SC.3 to assist countries in addressing this challenge.

V. Working Party on Transport Trends and Economics (WP.5)

WP.5 provides inter-governmental dialogues on green urban mobility issues, such as the events in conjunction with the WP.5 sessions:

- Expert round table on economic analysis of the transformation of urban transport systems in September 2020, and
- Workshop on Green Urban Transport in September 2021 co-organized by the Sustainable Transport Division and the Forests, Land and Housing Division.

In 2020, WP.5 established a Group of Experts on Assessment of Climate Change Impacts and Adaptation for Inland Transport to further the work of the Group of Experts on Climate Change Impacts and Adaptation for Transport Networks and Nodes. The Group of Experts is tasked to continue to raise awareness, build capacity and integrate knowledge from countries and the scientific community on climate change impact assessment and adaptation for inland transport. It is also tasked to further advance the state of knowledge on, and the analysis of climate change impacts on inland transport, and the identification of suitable and cost-effective adaptation measures.

WP.5 proposed the establishment of a group of experts on cycling infrastructure module in September 2021 for approval by the Committee. The group of experts is tasked to advance the elaboration of the infrastructure module in close liaison with THE PEP Partnership on Cycling Promotion/Active Mobility. It will focus on:

- Collection of data on national cycling networks, data analysis and proposal of ECE routes based on national routes forming a ECE cycling network, and
- Elaboration of acceptable definitions for various types of cycling infrastructure as well as new road signs which in addition to existing signs of the 1968 Convention on Road Signs and Signals should be used for signposting the routes.

The secretariat issued the following publications in the framework of WP.5:

- In February 2020, the secretariat issued a publication in the framework of WP.5 on “Mobility as a Service (MaaS)”.
- In September 2020 the secretariat launched the Handbook on Sustainable Urban Mobility and Spatial Planning – Promoting Active Mobility.
- In December 2015, the secretariat issued a publication on Sustainable Urban Mobility and Public Transport.

VI. Working Party on the Transport of Dangerous Goods (WP.15)

WP.15 established a task force in 2020 to consider the use of battery electric vehicles and hydrogen fuel cell vehicles for the transport of dangerous goods, with the participation of the secretariat of the Working Party on Passive Safety (GRSP) and the Working Party on General Safety Provisions (GRSG) of the World Forum for Harmonization of Vehicle Regulations (WP.29). In May 2021, WP.15 decided to continue the work in an informal group led by the Netherlands. It adopted the terms of reference for the informal working group to develop, in full cooperation with other working parties (e.g. WP.29), appropriate provisions of the Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for the construction of the battery electric vehicles (BEV) and hydrogen fuel cell vehicles (HFCV) and their trailers with a view to ensuring the safe transport of dangerous goods in these vehicles. The provisions will particularly focus on: (i) the electrical equipment of these

vehicles; (ii) the prevention of fire risks; and (iii) the prevention of other risks caused by fuels.

The Safety Committee of the European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterway (AND) is assessing the need for additional provisions for the safe transport of dangerous goods with vessels using electric propulsion installations. The Recommended ADN Classification Societies have been invited to report back at the forthcoming session taking into account the ongoing work by the European Committee for the Development of Standards in the Field of Inland Navigation (CESNI) to avoid duplication. The discussion on the transport of hydrogen as a cargo will be addressed at a later stage, once requests for carriage of hydrogen are received. The informal working group on substances could start more detailed discussions on the transport conditions.

VII. Working Party on Intermodal Transport and Logistics (WP.24)

WP.24 promotes the shift to rail for freight transport. In this regard, WP.24 encourages implementation of the European Agreement on Important International Combined Transport Lines and Related Installations (AGTC) to create the network and related installations for enabling seamless intermodal transport – with long-distance freight carriage by rail and last mile carriage by road – across the ECE region. The Working Party also elaborated a book for national master plans for freight transport and logistics, whose aim is to assist national authorities in charge of freight transport and logistics with potential actions in accompanying the sector development to follow a sustainable and decarbonized path in support of national economic development.

VIII. World Forum for Harmonization of Vehicle Regulations (WP.29)

WP.29 and its subsidiary Working Parties, especially Working Party on Pollution and Energy (GRPE) () and Working Party on General Safety Provisions (GRSG), heavily contribute to climate change mitigation measures by elaborating the automotive related regulatory framework on both reduction of energy consumption and GHG and pollutant emissions of road and off-road vehicles as well as on the safety of alternative propulsion systems such as electric / hybrid-electric and hydrogen.

WP.29 activities also cover elements on circularity by not only UN Regulation No. 133 on recyclability of motor vehicles but also by United Nations Regulations Nos.108 and 109 on re-treaded tyres for cars and commercial vehicles or United Nations Regulations Nos. 103, 114 or 132 and 143 on replacement pollution control devices, replacement air bag modules or retrofitting emission control devices for cars and heavy-duty vehicles. An important element is provided by United Nations Regulation No. 156 on software updates, which allows vehicle performance adjustments to latest developments without the need to change the physical vehicle.

GRPE has developed worldwide harmonized test cycle for most vehicle categories (motorcycles, cars, vans and engines from trucks and buses) to be able to measure tailpipe CO₂ emissions in the most representative and realistic way, allowing the implementation of robust fuel economy improvement regulations by contracting parties.

GRPE is also working on zero-tailpipe technologies coming to the markets, as, for example, it just endorsed a new UN GTR on in-vehicle battery durability. This new UN GTR will ensure minimum degradation from batteries in electric vehicles reducing waste and need for raw material extraction and associated carbon emissions. Such regulation is also expected to increase the trust in electric cars, further supporting a fast and successful adoption of such technology by car owners.

GRSP, the Working Party on Passive Safety, contributed to the development of the regulatory framework for the deployment of safe electric/hybrid-electric and hydrogen and fuel-cells vehicles (HFCV). Since, the main hurdle for the deployment of these kind of vehicles is

safety, UN GTRs Nos. 13 (HFCV), 20 (EVS), United Nations Regulations Nos. 94 (Frontal collision), 95 (Lateral collision), 100 (Electric power trained vehicles), 134 (HFCV), 135 (Pole side impact), 136 (Electric Vehicle, L category), 137 (Frontal impact with focus on restraint systems), 146 (HFCV of category L) and 153 (Fuel system integrity and electric power train safety at rear-end collision) pave the way to the de-carbonization of road traffic in all categories of vehicles ensuring the effectiveness of their roadworthiness systems.

IX. The Transport, Health and Environment Pan-European Programme (THE PEP)

THE PEP has at its core the goal of making transport more sustainable and, as such, reducing its environmental impact, mainly in cities but also in rural communities. In supporting THE PEP activities related to climate change the Sustainable Transport Division has led studies on the creation of Green and Healthy Jobs in Transport, Recommendations for Green and Health Sustainable Transport, the development of Managed Mobility Solutions, as well as a Handbook on Best Practices in Urban Transport and Spatial Planning and the development of a Pan-European Cycling Infrastructure Plan to supplement the Cycling Promotion Masterplan finalised in 2021. The Division continues to drive a number of the mandated initiatives and partnerships in THE PEP with the aim of implementing the goals of the Vienna Declaration and supporting green transport.

X. For Future Inland Transport Systems (ForFITS)

ForFITS modelling is used in ECE Environmental Performance Reviews (EPRS) to analyse and quantify the potential impacts of a set of policies on GHG emissions. Low carbon scenarios are developed to show quantitatively what is needed at the country level and to mitigate carbon emissions and climate impacts from the transport sector.

Following a workshop held together with the Sustainable Energy Division on real-time upstream emissions of electric vehicles during recharge⁸ held in May 2021, the secretariat is developing a ForFITS add-on module to look at the real-time emission of Electric Vehicles (EV) during recharge, together with a paper looking at the potential impacts of time resolution and user behaviour on CO₂ emissions during EV recharge. As part of the climate change related activities the Division also contributes to the development of the Environmental Performance Reviews by preparing the transport chapter of the EPRs for each country.

XI. Other Activities of the Secretariat

The Division is also involved in the cross-Divisional nexus activities on “sustainable use of natural resources”, for which some activities are on-going in Ukraine from Regular Programme of Technical Cooperation (RPTC) funding to look at e-mobility, Mobility- as-a-Service and Resource-as-a-Service to lower the environmental and climate impacts from electric mobility over the whole supply chain.

⁸ <https://unece.org/sustainable-energy/events/online-workshop-real-time-upstream-emissions-electric-vehicles-during>

Annex II

Working Party on Transport Trends and Economics

I. Mandate

1. The ECE Inland Transport Committee (ITC), at its eighty-fourth session, in February 2022, welcomed document ECE/TRANS/2022/16 on the critical role of inland transport in accelerating climate change mitigation worldwide and on the overview of related activities by the Committee and its Working Parties.
2. In this regard, ITC expressed its resolve that its Working Parties should take further action to accelerate their work and impact for climate change mitigation and adaptation and to achieve that, invited them to submit to the by mid-October 2022 their ongoing contributions, future plans, and suggestions in support of climate change mitigation. ITC also requested the secretariat, in consultation with the Bureau, to prepare a comprehensive paper with these activities and action-oriented options for the Committee and Working Parties for consideration at the Committee's eighty-fifth plenary session in February 2023.
3. In response to this request the WP.5 secretariat, in order to initiate a specific discussion at WP.5 which serves as a think tank for ITC, has compiled the current document which provides an overview of what the aviation and maritime transport sectors are doing in reducing their environmental footprint and identifies lessons learnt and possible next steps for the inland transport sector to increase its own efforts.
4. WP.5 was invited to share its feedback on the proposals contained in the document and provide guidance on how it sees its own role and the role of ITC in further advancing the inland transport sector decarbonization agenda.

II. Introduction

A. Global environmental effects of transport sector

5. Transport plays a vital role in today's society and economy. However, transport is one of the key sources of environmental pressures around the world and contributes significantly to climate change, air pollution and noise. Generally, transport is known to have various environmental impacts. Transport emissions lead to climate change and air pollution, noise results in health risks and infrastructure developments have severe impacts on the ecosystems and the landscape. This includes emissions from both, passenger and freight transport [1].

1. Impact of aviation

6. Aviation refers to all forms of activities with regards to aircrafts that carry people along with goods. It is estimated that 4.56 billion people used some form of aviation pre Covid Pandemic in 2019. It is also estimated to have carried 221,496 million tons of freight between destinations [2]. Like all major forms of transport, aviation emits CO₂ through the usage of jet fuel and is considered a net positive driver towards climate change [3]. Modern innovations in both the technology and the fuel have significantly improved fuel consumption since the 1970's, however the total emission is predicted to keep rising for the foreseeable future. One of the key impacts of aviation on climate change is through aviation cloudiness. It is stated that 2.5 per cent of all CO₂ emissions globally and 1.9 per cent of GHG come from aviation [3, 4]. Aviation emissions are not attributed or included in the emission for a country by default; domestic flights are included whereas international flights are not, instead, they are assigned a special designation. The logic behind this is sound, as most international flights travel over multiple countries and it would not be feasible to assign it to one specific country.

2. Impact of maritime transport

7. Huge volumes of global maritime transportation result in negative and unintended effects on the environment including marine environment. Environmental effects of maritime transport include: air pollution, GHG emissions, releases of cargo residues, and many others [5]. Ship emissions tend to have substantial environmental effects with international shipping voyages contributing significantly to air and water pollution, mainly due to the long journey lengths. Emission of GHG and volatile organic compounds from maritime transport can lead to enhanced surface ozone formation and methane oxidation, depleting the ozone. Emissions from bunker fuel burned by the international cargo and passenger fleet represent a significant contribution to the global anthropogenic emissions, and particularly, for Nitrogen Oxides (NO_x) and Sulphur Oxides (SO_x) [6]. International shipping accounted for ~2per cent of global energy-related CO₂ emissions in 2020 and 3per cent of global greenhouse gas (GHG) emissions [7, 8, 9, 10].

3. Impact of inland transport

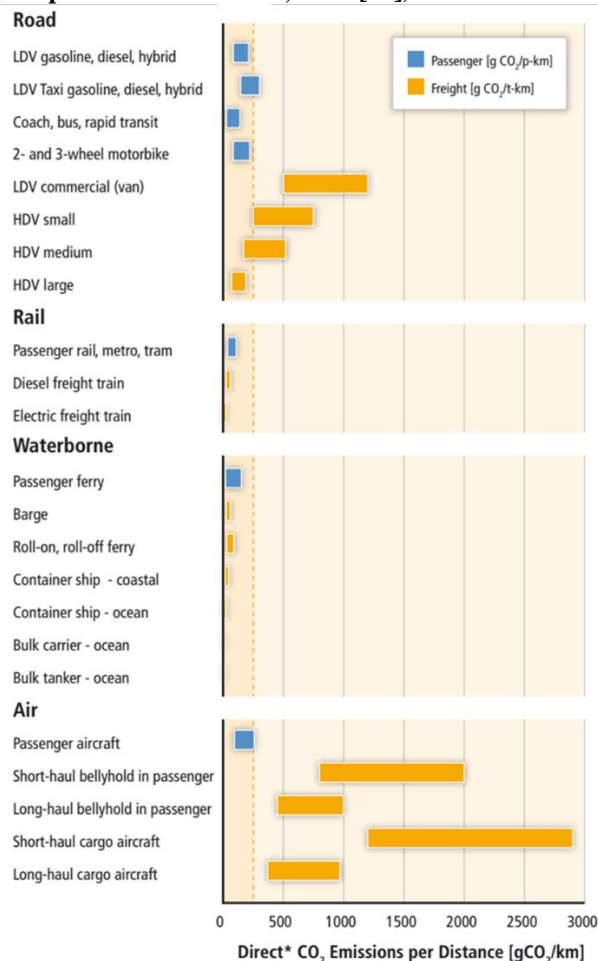
8. Inland transport refers to all transport activities that are performed on land and covers transport done by road, rail and inland waterways for the transfer of people and goods [11]. Road transportation is one of the main sources of atmospheric pollution in urbanised areas. Environmental issues start to arise in large cities mainly due to urbanism and mobility [12]. Road transport, mainly involving the use of cars, buses, trucks and vans, accounts for greater than 70per cent of the overall GHG emissions resulting from the transport sector in the European Union, thus being the main source of environmental pollution. Also, road transportation is known to be the main contributor to local air pollution [13, 14, 15].

9. Rail transportation sector encompasses multiple modes of urban travel (including electrified or non-electrified trains, trams, underground rail), medium and long-distance journeys (involving regional or highspeed trains), as well as goods transport (mainly freight) [16]. Amongst the environmental impacts due to rail transport, GHG emissions, air pollution and noise pollution are the most significant environmental impacts. Globally, rail is a mode of transport that does not emit much in the way of greenhouse gases (1per cent of global CO₂ emissions from transport). However, significant differences exist in the CO₂ emissions from the railway transport sector as emissions are based on the types of trains, their power requirements and further characteristics [17, 18]. In terms of the determining factors of GHG emissions in rail transport, these are a combination of rail travel demand along with factors such as the GHG emission intensity of energy consumed, rail traffic management procedures, number of passengers and the specific energy consumption of the passenger trains [19].

10. Inland waterway transport has a small participation in the total amount of emissions from transport (about 0.5per cent of total GHG from transport), but locally, this share can vary [20, 21]. One study showed that 30per cent of ships cause more than 80per cent of the total emissions [22]. It appears that this is the case due to engine longevity and less strict emission restrictions for inland shipping as compared to other land-based transport mods. In addition, the fairly specific and small market for inland vessels causes disadvantages of scale. Therefore, while it is concluded that inland waterway transport emits relatively few GHG emissions, these can have rather high values for pollutant emissions (NO_x), when compared to trucks and railways [21]. It is understood that although there are not many inland waterway vessels, the ones which are being currently used have old diesel engines that result in an increased pollution.

11. Figure 1 shows the typical ranges of direct CO₂ emissions per passenger kilometre and per tonne-kilometre for freight, for the main transport modes, when fuelled by fossil fuels including thermal electricity generation for rail. Based on the data presented in Figure 1, it appears that for each mode of transport, CO₂ emissions per kilometre of each vehicle vary widely. Inland transport, mainly road transportation contributes significantly to the global CO₂ emissions. For waterborne transport, the particularly wide range of boat sizes and types gives higher variance [23, 24].

Figure I
Typical ranges of direct CO₂ emissions per passenger kilometre and per tonne-kilometre for freight
 (Adapted from Sims et al., 2014 [24]).



B. Transport, the Sustainable Development Goals and Paris Agreement

1. Sustainable transport

12. Sustainable transport is a cross-cutting accelerator that can fast-track progress towards other crucial goals such as eliminating poverty in all its dimensions, lowering inequality, and combatting climate change. As a result, sustainable transport is crucial in achieving the 2030 Agenda for Sustainable Development as well as the Paris Agreement on Climate Change. These goals can only be realised if interlinkages between Sustainable Development Goals (SDGs) and sustainable transport, as demonstrated in Figure 2, are well understood along with recognising the targets of these goals [25, 26, 27].

Figure II
The Sustainable Development Goals and their interlinkages with the transport sector.



2. UNFCCC GHG mitigation target as defined in the Paris Agreement

13. The Paris Agreement is a legally binding global treaty on climate change which sets out a goal to limit global warming to well below 2°C, while engaging in efforts to limit it to 1.5°C. This agreement has been adopted by several Parties to the United Nations Framework Convention on Climate Change (UNFCCC). The treaty is also intended to reinforce the ability of involved countries in tackling the impacts of climate change, mainly through long-term temperature goal, global peaking and climate neutrality, and mitigation efforts. Appropriate mobilisation as well as the provision of financial resources along with the setup of a new technology framework and enhanced capacity-building is needed to reach these ambitious goals of the Paris Agreement [28, 29, 30].

3. Transport NDCs and contributions from inland vs maritime vs aviation

14. Nationally Determined Contributions (NDCs) are the centre of the Paris Agreement and represent each country's effort in reducing national emissions while adapting to the impacts of changing climate. As part of communicating their NDCs and as a contribution to the objectives of the Paris Agreement, involved Parties have submitted comprehensive national climate action plans [29, 30].

15. The Sustainable Low Carbon Transport (SLoCaT) review of NDCs confirmed that several countries around the world have acknowledged and identified the significance of their transport sector in achieving the national emission reduction targets while identifying that transport is an important source of GHG emissions. As a result, mitigation actions for the transport sector have been defined in more than 100 NDCs [31].

16. Analysis of the transport mitigation actions provided in the NDCs from emerging and developed countries demonstrate that the list of mitigation actions is strongly focused on fuels, vehicles and urban transport. Another area that was highly recognised was the road and railway infrastructure while only few countries noted the freight logistics.

17. With respect to the Avoid-Shift-Improve strategies, a closer look at the NDCs show that a majority (52per cent) of the mitigation measures listed in the NDCs correspond to 'improve' strategies, while only 38per cent represented 'Shift' strategies and a very few (10per cent) represented the 'Avoid' strategies [32, 33, 34].

18. Aviation and maritime are among the top ten recommendations provided for raising ambitions for the transport NDCs as these are considered the two fastest growing sectors. Using the full range of Avoid-Shift-Improve strategies is essential for addressing the rapidly growing emissions from the aviation and maritime transport sectors while also aiming to meet the objectives of the Paris Agreement. Examples of "avoiding" strategies for aviation include receiving support for aviation taxes and charges and providing teleworking arrangements. In terms of "shifting" strategies, these can include for example the attempt to shift to high-speed rail services that can help replace domestic flights or even international flights in some cases. "Improving" strategies look at the adoption of newer fuels, better operations and development of more efficient aircraft designs. It has been recommended that countries use the support of the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) in proposing and supporting goals on international aviation and maritime transport, respectively.

19. In terms of maritime transport, several countries have taken some initiatives for including domestic maritime emissions in their transport NDCs. These include [35]:

- Promoting the growth of coastal shipping and inland water transport;
- Improving maritime traffic management;
- Accelerating promotion of energy efficient measures for domestic fleet;
- Implementing projects on green ports.

20. Overall, some common examples from the NDCs for the transport sector include setting targets for increasing the size of fleets of electric vehicles, replacing domestic flights with high-speed rail services, phasing out the sale and usage of internal combustion engines, promoting and increasing the share of walking and expanding mileage of mass transit [31].

III. Overview of international transport sector initiatives and identification of lessons learned for inland transport

A. Aviation

1. International Civil Aviation Organization Carbon Offsetting and Reduction Scheme for International Aviation (ICAO CORSIA), including Sustainable Aviation Fuels (SAF)

21. To lessen the impact of aviation transport on climate change, a scheme known as CORSIA has been developed by ICAO. CORSIA, is a carbon offset and carbon reduction programme to lower CO₂ emissions for international flights. The scheme aims to have a carbon neutral growth from 2020. To do so, CORSIA makes use of market based environmental policy instruments for offsetting CO₂ emissions.

22. Long term sustainability in aviation will need to be supported by cross-stakeholder collaborations and technological improvements. With regards to technological innovations, key areas of focus need to be aviation design, alternative propulsion systems and long-term vision on the development of sustainable aviation fuels (SAF). The development of SAF will require multiple angles of attack such as capital investments in the production, distribution, policies on transporting them, and financial feasibility. The ICAO estimates that through technological advancements, 33 per cent of emissions can be reduced in lieu of business as usual scenario. It also estimates that 100per cent of the estimated demand can be met with SAF, which will in turn lead to a 63per cent reduction in global aviation emissions. As stated before, this will require massive levels of investment that exceed current levels for ethanol and biodiesel for road transportation.

23. Fuels for commercial flights have to meet a particular standard, and this also applies to SAFs. To accelerate the global market adoption for SAFs, governments of France and Netherlands are leading the way to position SAFs to have a competitive advantage. This is targeted to an ever-increasing segment of customers who seek environment and green initiatives in order to reduce the carbon footprint, green-fuel purchasing coalitions and propose investments for both new and existing production plants and refineries.

24. ICAO has established a global framework to facilitate the reduction in carbon footprint and explore the usefulness of targeting long-term CO₂ reduction. It will have a blend of key metrics and measures, which can include technology and innovations, performance measures, and CORSIA with a vision for 2050 by which most fuels used in aviation will be SAFs.

25. Domestic aviation is estimated to produce 40per cent of total emissions as they account for 2/3 of all flights. Policies implemented will need to focus on both CO₂ and non-CO₂ effects and further investigation is required to develop the right actions plans. With the vision of SAF adoption by 2050, Climate Champions are targeting a 10per cent adoption by 2030 and 90per cent by 2040, thus representing an S-curve. Current forecasts of the SAF range for top-down and bottom-up levels suggest that it will form a significant mix in the next decade. This analysis makes assumptions about the availability of bio-fuels, synthetic fuels and technological advancements [32, 36].

2. Other ICAO initiatives

26. The International Coalition for Sustainable Aviation, consisting of several non-profit organisations is working on reducing air travel pollution. It is the only environmental civil society group recognised as an observer by the ICAO. ICAO Global Coalition for Sustainable Aviation is a forum of stakeholders that look at promoting sustainable growth of international aviation. This is done by accelerating the progress of innovative concepts and solutions that can further reduce GHG emissions at source, on the ground or in the sky. Additionally, the Coalition can deliver critical inputs needed to make advance progress in the development and implementation of the basket of measures, as well as for the exploration of a long-term environmental objective for international aviation. Stakeholders part of this Coalition are involved with aviation infrastructure, operations, technology, and Sustainable Aviation

Fuels, along with the CORSIA as the complementary measure to achieve the environmental objective. As part of this Coalition, a CO₂ emissions reduction initiatives tracker tool is produced that offers a wide range of information relevant to initiatives for reducing the environmental footprint of aviation, including details on past and ongoing measures and initiatives [37, 38].

27. ICAO has also launched a State Action Plan initiative in 2010 to provide States with the capacity and tools to take action. The initiative is designed to enable all member States to determine a long-term strategy on climate change for the international aviation sector. Involved parties work together to find a quantified baseline scenario, select appropriate emissions mitigation measures from ICAO's basket of measures, and calculate the expected results of implementing those measures [39].

28. Another excellent initiative of ICAO is the development and maintenance of several environmental tools that are made available to States and the general public. These tools, which include the carbon emissions Calculator, the Green Meetings Calculator, Fuel Savings Estimation Tool amongst many other tools, are designed to support the development of State Action Plans, the implementation of CORSIA and to support initiatives to reduce aviation's carbon footprint [40].

B. Maritime

1. International Maritime Organization (IMO) Ship Emissions Toolkit

29. It has been estimated that over 80per cent of the international goods trade is carried by sea. However, due to the sheer scale of the international shipping industry as compared to other transport modes, emissions from the shipping sector remain a cause of concern. With the growth in international trade, shipping is also forecasted to grow.

30. Over the years, IMO has implemented and shown strong and decisive leadership skills in creating legal as well as technical frameworks within which the shipping industry can become progressively safer and cleaner. In 1997, great efforts were taken for reducing air emissions from ships, by adopting the 1997 Protocol to the International Convention for the Prevention of Pollution from Ships, known as MARPOL Annex VI. This protocol controls air emissions from more than 95per cent of the world's shipping tonnage and sets limits on Nitrogen Oxide emissions while imposing strict measures that require ships to make use of fuel with low sulphur content.

31. Quantification of ship emissions followed by a strategy on reducing them is needed for reducing emissions across the maritime sector. To tackle these issues, IMO has produced a Ship Emissions Toolkit, which offers a well-defined framework along with decision support tools [41].

(a) Rapid assessment of ship emissions in the national context

32. The first practical guide of the Ship Emissions Toolkit is based on the "Rapid assessment of ship emissions in the national context". This guide offers steps on gathering and analysing relevant qualitative and quantitative data that can be used to assess the overall maritime emissions from a country, followed by providing a foundation for developing and implementing a national ship emissions reduction strategy. The guide suggests the importance of comprehending the interlinkages between different institutions and ministries for the effective implementation of policies at the national level.

33. Countries are required to adopt laws and regulations for preventing, reducing and controlling pollution from the marine environment by taking necessary measures. Usually, regional collaborations tend to focus on the research, development and demonstration of low-carbon energy technologies along with the development of policy frameworks that can all be used for promoting the implementation of efficient technologies within various national contexts. The recommended rapid assessment must comprise of a list of key national, sub-national or local institutions as well as agencies that are deemed to have a part in this area.

34. The guide encourages the inspection of foreign ships in national ports. This can help in verifying the conditions of the ships and ensuring whether the relevant equipment comply with the international regulations, while making sure that the ships are equipped with the right personnel that comply with these rules. The guide also supports the application of various ship environmental evaluation schemes and port incentive schemes for monitoring a ship's air emissions and energy efficiency.

35. The rapid assessment guide also discusses the importance of assessing the volume, type and value of goods imported and exported internationally by a country along with identifying the main trading partners for each cargo category for better understanding of the importance of seaborne transportation in each country.

36. As part of the rapid assessment activity, it is advised to identify relevant stakeholders and why they are important and how they can contribute to either this activity or to the development and implementation of strategies in the future. It is also important to identify the ships that are of importance to the country and their respective characteristics. To do so, fleet components are considered and analysed based on registered fleet, domestic fleet, international fleet, fleet passing territorial waters and fleet owned by national shipowners. Thereafter, it will be easy to estimate emissions and fuel consumption of each of these components. For possible emission scenarios, the rapid assessment suggests looking at the predicted economic development levels of each country. Such data is most likely presented in the national development plans of each country [41].

(b) Incorporation of MARPOL Annex VI into national law

37. The second practical guide of the Ship Emissions Toolkit is based on the incorporation of MARPOL Annex VI into national law. The guide provides an outline of the different considerations a state needs to take in account when deciding to accede to the 1997 Protocol and to thus become a part of the MARPOL Annex VI. Prior to the accession process, it is suggested that the interested states form a good understanding of their shipping industry, based on the guidance provided in the first practical guide. Such information can be relevant in developing a strategy for reduction of national ship emissions. Thereafter, a series of actions may be taken for the incorporation of MARPOL Annex VI into national law. These can be achieved through conducting an evaluation of the existing policies, legal and institutional frameworks to establish the actions required for accession or for the incorporation. Surveys of existing legislation can also be performed to identify any barriers that may exist to the accession or full implementation of the obligations. Finally, periodic reviews and regular updates to the national legislation should be provided. Once again, consistent engagements and consultations with relevant stakeholders in all of these steps are strongly recommended. To do so, national workshops or any other consultation approaches may be utilised. Also, involved states may develop a broader national policy framework for addressing maritime emissions. On the other hand, broader government policies for addressing air emissions from all sectors may provide incentives to include maritime emissions as well [42].

(c) Development of a national ship emissions reduction strategy

38. The third guide of Ship Emissions Toolkit discusses the crucial planning, development and implementation phases that are involved in the creation of a national ship emissions reduction strategy. Although IMO has adopted MARPOL Annex VI for reducing air pollution from maritime transport while increasing the energy efficiency of ships, it seems that these and other international policies, regulations and strategies are often generic in nature and are usually designed to be applied as broadly as possible. Such approaches need to be operationalised within a national context, which includes looking at the local, national and regional issues.

39. For the process of developing and implementing an appropriate national strategy that includes consultations and collaborations with all relevant stakeholders and agencies, it is recommended that a lead agency is established, a task force is set up, and a national focal point and project coordinator is chosen. Also, securing political buy-in at the soonest is crucial throughout the process. To maintain regular participation of all stakeholders and government entities involved, it is important to have effective communication and

dissemination schemes. Development of any national strategy would require the aim, objectives and actions, and capabilities of the strategy to be aligned with the broader national interest. This is to be followed by the implementation plan [43].

(d) IMO's Energy Efficiency Design Index (EEDI)

40. IMO has taken numerous positive steps towards concentrating on reducing GHG emissions from ships. One such technical measure is the development of the Energy Efficiency Design Index (EEDI) that has been made obligatory for all new ships. This measure looks at encouraging the use of more energy efficient and less polluting equipment and engines by requiring a minimum energy efficiency level per capacity mile for different vessels.

41. The EEDI offers a precise value for each ship design, where the lesser the EEDI is, the more energy efficient is the ship design. EEDI is calculated using a specific formula based on the given ship's technical design parameters. The first phase's CO₂ reduction target is set at 10per cent, and this ratio will be adjusted every five years to keep up with technical advances in the new efficiency and reduction methods [44, 45].

(e) Other initiatives, including measures aimed at electrification and the use of green hydrogen to fuel vessels

42. The maritime transport sector must discontinue the use of fossil-based bunker fuels and move towards implementing zero-carbon alternatives in order to reach the climate targets set out in the IMO's initial GHG strategy. Such alternatives must look at emitting zero or at most very little GHG emissions throughout their lifecycles. A few research studies have examined a number of such zero-carbon bunker fuel options which include synthetic carbon-based fuels, hydrogen and ammonia and biofuels. Green hydrogen and green ammonia seem to demonstrate the best balance of favourable features because of their GHG emissions, safety and technical implications, economics, scalability and overall wider environmental factors. It also appears that many countries including developing countries have the potential to produce zero-carbon bunker fuels i.e., hydrogen and ammonia. However, to unlock these potentials, strategic policy interventions are required [46].

43. Furthermore, in accordance with the Paris Agreement's temperature goals and consistent with the IMO GHG strategy, work has been done to understand the role of liquefied natural gas (LNG) in the transition toward low- and zero-carbon shipping. LNG is commonly mentioned as a fuel pathway towards cleaner maritime transport because of its substantially lower air pollution and potential GHG benefits. However, there are also concerns regarding the ability of LNG in decarbonising the shipping industry. It appears that due to methane leakage issues, which could negate any GHG benefits of LNG, and based on the extra capital expenditures needed, LNG is unlikely to play a significant role in reducing emissions in the maritime transport sector. On the other hand, LNG is expected to be used only in niche shipping applications or in its non-liquefied form for feedstock to initiate the production of zero-carbon bunker fuels. It is also advised that new public policies supporting the use of LNG as a bunker fuel must be avoided, while any existing policies must be reconsidered, and methane emissions be regulated [47].

C. Cross-cutting

1. SLOCAT Partnership on Sustainable Low Carbon Transport

44. Sustainable, Low Carbon Transport (SLOCAT), as a multi-stakeholder international partnership is primarily focused on inland transport through three mutually reinforcing work packages, which are the knowledge and policy analysis; advocacy and engagement, and dialogue and networking.

45. The partnership involves engagements from more than 90 entities including transport sectors associations, academic organisations, governmental bodies, and several other industries as well as world-class experts and change-makers. The partnership looks at setting

new and ambitious global agendas and for catalysing innovative thinking towards finding solutions for the urgent need of transforming mobility systems.

46. This shall be achieved with the integration of sustainable, low carbon transport in global policies on sustainable development and climate change and through action in support of the adoption of these global policies [48].

47. The partnership also looks at synthesising and translating data and knowledge on combined transport, climate change, and sustainability issues by providing leadership and advocacy skills. As part of this initiative, a platform is also provided to individuals within and beyond the transport sector to collaborate, learn and exchange information [49].

2. European Commission – European Strategy for smart and sustainable mobility and the European Union Green Deal

48. To tackle transport-related emissions, in 2020, the European Commission presented its “Sustainable and Smart Mobility Strategy”, with the aim of accomplishing European Green Deal’s climate targets. To support the EU's goal of being the first climate-neutral continent, a significant goal of this strategy is to achieve a 90per cent reduction in transport related GHG emissions by 2050. The strategy looks at providing more cleaner, healthier, accessible and affordable transport alternatives. It also contributes to the mitigation of climate change impacts due to the transport sector by considering approaches on the reduction of air, noise and water pollution. The strategy lays foundation for the digital transformation of the EU transport system and highlights the significance of enhancing transport resilience. Overall, the strategy is aimed on making all modes of transports sustainable and ensuring sustainable alternatives are available in a multimodal transport system. To do so, the strategy also looks at placing the right incentives for driving the transition. In addition, the initiative discusses the need for investments in sustainable alternative fuels and cleaner technologies along with renewals of transport fleets by public authorities and companies to achieve the much-needed transition.

49. The strategy builds on the other Green Deal actions and initiatives that have already been deployed by the sector. Thereafter, a roadmap shall be set up towards a European mobility that is suitable for a digital, green and resilient future. A clear policy framework is to be set by the strategy that looks at the following points [50, 51]:

- By 2050, reduce the transport sector’s GHG emissions by 90per cent while significantly reducing air pollution and overall environmental footprint of transport sector by:
 - enhancing the uptake of zero-emission vehicles;
 - creating incentives for the deployment of large-scale new technologies, including usage of sustainable alternative fuels and associated infrastructure;
 - facilitating the shift towards low emission transport modes;
 - improving efficiency and multimodality;
 - creating incentives for sustainable consumer choices;
 - revamping the European agenda on sustainable urban and regional mobility, including cycling, intermodal transport and transport-on demand.
- Utilise the digitalisation and automation concepts fully for achieving sustainable, safe, smart and seamless transport mobility across all modes;
- Identify actions to revitalise and strengthen the Single Market for transport;
- Mobilise research and encourage innovative solutions for a leading European Union transport industry;
- Ensure a fair, affordable, accessible and attractive transition and mobility.

50. Overall, European Union Green Deal’s comprehensive strategy is an outstanding initiative that covers all modes of transport and imposes a target to reduce transport related GHG emissions. The objectives are some exceptional ideas that should be very effective in

accelerating a shift towards low emission passenger transport modes, if applied successfully. These policy proposals for zero-emission vehicles need to be adopted in a manner which allows regions and cities to keep pace with the essential expansion of various concepts such as fuelling and charging infrastructure, regional and local distribution networks, and renewable energy production.

3. COPERT model to estimate emissions from road transport

51. The Computer Programme to calculate Emissions from Road Transport (COPERT) model is the most advanced method to calculate emissions of almost all important pollutants from road transport, using data on vehicle population, mileage, speed and ambient temperature, among others. The use of the COPERT software tool allows for a transparent and standardized, hence consistent, and comparable data collecting and emissions reporting procedure. It incorporates results of several technology, research, and policy assessment projects and is continuously supported by the European Environment Agency through consecutive ETC budgets. The model covers all classes of vehicles and can be applied in all European countries, in Asia, South America and Oceania. In fact, the model can be used to produce emission estimates from 1970 to 2050 as well [52].

4. Transport Climate Action Directory of the International Transport Forum

52. The Transport Climate Action Directory of the International Transport Forum is a part of the Decarbonising Transport initiative. It covers almost all transport modes including aviation, maritime, rail, road, walking and cycling. It presents an online database of policy measures for reducing CO₂ emissions from the transport sector. The database consists of 80 mitigation measures as well as an evidence base required to evaluate the effectiveness of these measures. The directory is created with the aim of assisting decision makers with a range of options which can be used to deliver concrete decarbonisation outcomes and translate transport decarbonisation ambitions into actions while achieving climate objectives. The database also intends to help nations with their NDCs [53].

53. Decarbonisation measures in the directory are presented in the following categories:

- Improved design, operations and planning of transport systems;
- Electrification;
- Low-carbon fuels and energy vectors;
- Mode shift and demand management;
- Innovation and up-scaling.

54. The directory is created in partnership with more than 70 governmental bodies, companies, foundations, institutions and organisations under the umbrella of the International Transport Forum. The directory is an ongoing initiative, where additional measures are reviewed and added constantly [54]. It appears that this provision of a list of mitigation measures in a unique platform is an extremely beneficial idea as decision makers can filter the measures by geographic scope, transport mode, and type of measure.

55. Each measure in the directory features a concise overview that includes how the measure impacts CO₂ emissions as well as relevant benefits and costs of implementing the measure. Information on potential drawbacks can also be found that should help make the right choices.

5. GHG mitigation instruments in the Inland Transport Committee and its subsidiary bodies

56. The Inland Transport Committee (ITC), its Working Parties and the secretariat consider climate change as a cross-cutting subject and have been working to contribute to mitigation and adaptation measures for climate change. These activities supported by the ITC range from high-level policies and regulatory frameworks to assessment of impacts on transport and promotion of adaptation measures that include the sustainability aspect. The activities of some of ITC's Working Parties are summarised in Table 1[55]. A full overview of these activities is available in ECE/TRANS/2022/16.

57. In addition to the Working Parties, there are other programmes as well such as The Transport, Health and Environment Pan-European Programme (THE PEP) that aim to make transport more sustainable by reducing the environmental impacts of transport, mainly in cities but also in rural communities. THE PEP involves carrying out investigative studies on the adoption and support of green transport. Further work by the ITC also includes looking at understanding and implementing modelling approaches for analysing and quantifying potential impacts of a set of policies on GHG emissions.

58. To analyse and quantify the potential impacts of a set of policies on GHG emissions, For Future Inland Transport Systems (ForFITS) modelling is used in ECE Environmental Performance Reviews (EPRS). As part of the tool, low carbon scenarios are developed to show quantitatively what is needed at the country level and to mitigate carbon emissions and climate impacts from the transport sector. The ITC secretariat is now involved with the development of a ForFITS add-on module to look at the real-time emission of EV during recharge, together with a paper looking at the potential impacts of time resolution and user behaviour on CO₂ emissions during EV recharge [55]. Similarly, other activities of the secretariat include looking at e-mobility, Mobility-as-a-Service and Resource-as-a-Service to lower the environmental and climate impacts from electric mobility over the whole supply chain.

6. Other initiatives

59. Quite similar to the aviation and maritime transport sectors, the inland transport sector is also involved in producing several innovative and remarkable ideas for responding to climate change. TNO, the Netherlands Organisation for applied scientific research, has been looking at deploying numerical models for inland transport that can calculate CO₂ emissions for passenger as well as freight vehicles, based on a number of factors. For passenger vehicles, this includes looking at the CO₂ intensity of the vehicle and the mobility demand (activity). The former involves working out the fuel carbon intensity (i.e. looking at what fuel type is being used or if it is an Electric Vehicle), the efficiency of the vehicle (understanding the engine characteristics, weight, aerodynamics and other properties) and the number of occupants of the car (if the vehicle has a single user or multiple users). The latter, mobility demand, depends upon the distance the vehicle travels as well as the alternative options which are present with the vehicle. For freight vehicles, CO₂ emissions are to be calculated based on the CO₂ intensity of the transportation mode and the respective demand. The CO₂ intensity of the transportation mode can be calculated based on the carbon intensity of the vehicle, the efficiency of the vehicle and the load factor (i.e. looking at the modal share). Understanding the demand for the transport mode includes looking at the distance travelled by the vehicle (supply chain, the logistical systems and the urban planning aspect), different features (sustainability) and the size as well as scale (circular economy, longevity). Overall, these two numerical models, adopted by TNO for the inland transport sector are great initiatives that help obtain an understanding of the real-world emission performance of passenger as well as freight vehicles. A similar concept has also been suggested in Sims et al. (2014) that for each transport mode, direct GHG emissions can be decomposed into [24]:

$$\text{Total GHG Emissions} = \sum_{\text{Modal Shares}} \sum_{\text{Fuels}} \left[\text{Fuel Carbon intensity} * \text{Energy intensity} * \text{Activity} \right]$$

- System-infrastructure modal choice: urban form, transport infrastructure (roads, rail), behavioural choice between modes (speed, convenience, cost, comfort);
- Fuel carbon intensity (Hydrogen, electricity, biofuels, CNG/LPG, gasoline, diesel);
- Energy intensity of light and heavy-duty vehicles, occupancy/loading rate, cycling walking, trains);
- Activity: number of journeys, journey distance, journey avoidance;
- To discuss some other initiatives, it appears that most measures looking at emission reductions in the inland waterway transport sector are also aimed at reducing fuel consumption, thus providing both, economic as well as ecological benefits. Nevertheless, adopting single solutions for small vessels may have side effects mainly

because of the insufficient capacity or simply the size of the vessel. A new strategy in this sector is the use of electric power. It seems that conversion of inland ships to electric power is an interface between sustainability and technology. Moreover, digitalisation is also a powerful tool for providing multimodal integration [21].

60. To accelerate the worldwide transformation towards a net-zero emission mobility system, a unique collaboration known as the Transport Decarbonisation Alliance (TDA) is set-up among companies, cities, regions and countries. The alliance intends to design a common vision for 'front-runners' through substantiated scaled-up ambition for the overall transport sector along with setting up Communities of Interest (CoIs) as part of a tangible action. In addition, the alliance is determined on promoting effective advocacy which would include influencing political decision-makers in key international fora on climate change (e.g. UNFCCC), sustainable development (e.g. UN High Level Political Forum – SDGs), international political processes (e.g. European Union, G7, G20, B20) and through bilateral dialogues [56].

61. In COIs, members develop important policy recommendations, online courses, reports, and other products or outcomes. COIs benefit and contribute from networking, peer-to-peer learning, thought leadership, and shaping international ambition and action by means of participation and initiatives. Some best practices that have been identified by TDA include the example of France, Netherlands, and Portugal. France has committed over \$5 billion each to maintain a high level of investment and to develop new national railway services as part of the green stimulus packages. In addition, France has also announced a \$9 billion bailout for its auto industry, which includes imposing strict compliance with European Union CO₂ emission performance standards and commitments on enhancing the share of low and zero-emission engines. Quite similarly, the Dutch Environment Ministry along with several municipalities in Netherlands have signed a joint agreement to enact zero-emissions zones for delivery trucks by 2025. Some other excellent initiatives taken by countries include France and Portugal's policies which offer tax credits and rebates for the purchase of electric bikes, equipment and bicycles. Emissions can be significantly reduced with the incorporation of a bicycling infrastructure, funded by national and local-level investments. This is reflected by the Netherlands experience which demonstrates that an integration of policies and funding opportunities for road safety can lead to high rates of cycling usage [57].

62. Another similar initiative is the International Zero-Emission Vehicle Alliance (ZEV Alliance), which is a collaboration of national and subnational governments to accelerate the adoption of ZEVs (Fuel cell, plug-in hybrid, electric vehicles). Participants set ambitious yet achievable targets for the adoption of this initiative by taking appropriate actions to achieve individual and collective targets while encouraging and supporting other jurisdictions in setting and achieving ambitious ZEV targets. The initiative involves governments striving to make all passenger vehicles sales in their jurisdictions ZEVs by 2050 while also actively working on the design and assessment of current electric vehicle policy instruments [58, 59].

63. On the whole, some key developments in the inland transport sector include:

- Increase in number of electric vehicles and bus rapid transit systems;
- Increase in the use of sustainable fuels;
- Increased access to mobility services in developing countries;
- Reduced carbon intensity of operations by freight logistics companies;
- Enhanced conception of the importance of urban planning and expanding infrastructure for light-rail, buses, bicycles and pedestrians;
- Better analysis of comparative costs between passenger and freight transport modes;
- Emerging policies on the slowing of rapid growth of Light duty vehicles;
- Increased GHG emission vehicle performance standards and fuel economy standards;
- Widely implemented local transport management policies.

7. ITC and other ECE sectorial committees to help measure and monitor EV GHG emissions and its mitigation potential

64. The use of Electric Vehicles (EV) is expected to exponentially rise over the coming decades, where the industry is projected to reach \$800 billion by 2027. Companies such as Uber plan to have a fleet of 100 per cent EVs by 2030 in US, Canada and Europe [56]. Even though EVs have zero tailpipe emissions, the net carbon is not zero. Well to Wheel (WtW) analysis provides the means to interpret the true carbon emissions. A great initiative undertaken was the development of Electric Vehicles and the Environment (EVE IWG) which focuses on Life Cycle Costs (LCC), and Automated, Autonomous and Connected vehicles (AACV). This was hosted by ITC World Forum for harmonization of Vehicle Regulations. This initiative has led to the development of a tool to compare WtW emission of different powertrains [61].

65. ECE have successfully delivered multiple workshops to quickly set-up collaborations and partnerships to assist the stakeholders with understanding the measures introduced to reduce carbon emissions. By publicly reporting the CO₂ emissions, awareness is raised, and EV users are motivated to act [62].

66. Another sustainable strategy demonstrated at the ECE workshops is ECO charge systems. Real-time data upstream, artificial intelligence and machine learning can be implemented to deliver smart and economical charge systems. These can reduce load on the infrastructure by optimising charging times and implementing dynamic current limits. It has been suggested that new ideas such as vehicle to home or vehicle to grid can be used to implement better load sharing [63, 64].

IV. Proposals for accelerating climate change mitigation by the inland transport sector

67. In the context of the assessment provided above, this section discusses proposals which have been identified as several intersectional opportunities for the decarbonisation of inland transport.

- Provide multiple opportunities to fund research and development into emerging zero-emission fuels and technologies. ITC should set up clear targets and investment in clean research and development along with adoptability for zero-emission fuels.
 - ITC should encourage the blending of true low-carbon fuels for decarbonising heavy-duty road freight.
- ITC may assist with stabilising and reimagining public transport. This can be done with the support of local and national governments. For strong services, transit stakeholders will need to reimagine public-private partnerships, data and modal integration, priority infrastructure, finance and governance.
- ITC should assist cities and countries on expanding their current bicycling and walking facilities. This can be done by investigating prospects to integrate micro mobility services (such as bike sharing).
- ITC should support the acceleration of electrification. Enhancing vehicle fuel efficiency and increasing the adoption of EVs can play an essential role in combating climate emissions whilst improving air quality.
 - Production and adoption of EVs must parallel a transition to renewable energy generation and smarter vehicle-grid integration for achieving net-zero emissions.
 - To capture private sector EV investments and procurements, it is important to have public policy incentives and mandates.
 - Instituting zero-emission zones or installing public charging infrastructure are great examples for cross-sector collaboration.

- To improve the emissions, a heavy involvement of car manufactures is also required. Major EV manufactures like Tesla, BMW, Volkswagen, Nissan etc. could provide life cycle analysis on each component of the car to analyse true impact on emissions. Implement a continent wide (if possible, worldwide) standard for charging infrastructure.
- Most critical part of EVs is its traction battery, the impact of mining minerals to manufacture these should be considered in the long-term. Overall, EV manufacturers are best suited to implement procedures which are carbon neutral and determine efficient ways to repurpose, reuse or recycle batteries at the end of life.
- Investigate the infrastructure that is required for supporting the deployment of hydrogen and electric vehicles, as well as understanding the safety needs of transporting batteries.
- ITC should support investments in further electrification of rail transport (for both, passenger and freight transport) while also enhancing the shift from highly energy intensive passenger and freight modes, such as long-distance car and truck trips and short-distance air to rail transport.
 - A hassle-free cross-border rail travel would help strike a better balance between air and rail travel. Perhaps, initiatives such as integrated booking and ticketing across ECE countries can go a long way towards achieving this target.
 - Public-private participation opportunities must be leveraged through investors. For example, installation of amenities (Wi-Fi), franchise contracts and rail and railcar-sharing schemes.
- ITC could work out schemes for measures to incentivise use of more carbon-efficient modes. E.g. tax credits could be imposed on those automotive companies that have large volumes of goods to be transported at long distances. Such corporations could be asked to pay a premium that can be further reinvested for innovative solutions such as green technologies.
- ITC could develop and deploy a CO₂ emissions reduction initiatives tracker tool for inland transport that would monitor and provide a wide range of information relevant to initiatives for reducing the environmental footprint of inland transport, including details on past and ongoing measures and initiatives.
- ITC could develop an inland transport emissions toolkit, which would provide a structured framework along with decision support tools for the evaluation of emission reduction opportunities in the inland transport. The toolkit could offer guidance to countries around the world on how to design, develop and strengthen national policies and regulatory frameworks related to the reduction of GHG emissions and prevention of air pollution from inland transport modes.
 - A rapid assessment of the emissions from different inland transport modes could be done. This can include identifying those vehicles that are most significant sources of pollution and then imposing regulations on controlling emissions from such vehicles.
 - Stakeholder maps can be developed to identify and map the relevant stakeholders and for recognising different relationships.
 - Understanding and estimating emissions and fuel consumption for each type of inland vehicle or vessel is needed. Thereafter, key regulations on controlling emissions must be tightened.
 - For possible emission scenarios, predicted economic development levels of countries should be investigated, possibly through national development plans of each country.
 - Existing strategies, policies and regulations that look at reducing emissions are often generic. Such approaches should be operationalised by looking at local, national and regional issues.

- For developing appropriate national strategies, a lead agency must be established with a setup of a task force, national focal point and project coordinator.
- An Energy Efficiency Design Index could be made obligatory for all new trains and different road vehicles. The measure would require a minimum energy efficiency level per capacity mile for different vehicles.
- ITC should lead the digitalisation effort as this can prove to be a powerful tool to provide multimodal integration. It could incentivize a modal shift towards less polluting modes of transport such as rail or inland waterway transport.
- CO₂ emissions of international road freight transport are increasing all over the world. Yet, there is no sign that this trend is to be curbed shortly. A single measure will not be able to tackle this challenging problem. Thus, a mix of measures such as logistical improvements, alternative fuels and improving fuel efficiency of vehicles is required.
- ITC should consider how indirect GHG emissions, which arise from the transport infrastructure construction, vehicle manufacture and fuel provision, should be addressed through possible policies, regulations and initiatives.
- ITC could accelerate the incorporation of environmental and social lessons learned from the Covid-19 crisis to develop an approach that promotes initiatives such as working from home or avoiding unnecessary travel that can help reduce emissions.
- ITC must encourage efforts on improving skills of automotive personnel on emerging technologies as well as SDGs. There is a cross-cutting need for knowledge sharing and the development of capacities to gather and analyse reliable real-time data and statistics.
- ITC should investigate into developing online tools to provide real time monitoring and reporting of traffic congestions. Advising commuters to replan their journeys can reduce congestion on the roads.
- ITC can provide a platform for successful collaborations between stakeholders inside and outside the inland transport sector to make use of the knowledge acquired in other sectors and to identify effective, innovative and tailored solutions for mitigating climate change by the inland transport sector.
- ITC could look into finding and getting involved more academic researchers, who have an understanding of climate change, transportation resilience, and the need for mitigation, with the Committee's group of experts.
- In addition, ITC can try to get more transport companies and manufacturers involved. Since companies are now focusing more on the social and environmental issues of their businesses, as part of the triple bottom line, it will be a good idea to get these transport companies involved with ITC's activities.

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Annex III

GRPE contributions, future plans, and suggestions in support of climate change mitigation for the 85th session of ITC

Note by the Chair of the Working party on Pollution and Energy

I. Introduction

1. At its 84th session, ITC “Noted with appreciation the secretariat’s paper (ECE/TRANS/2022/16) on the critical role of inland transport in accelerating climate change mitigation worldwide and on the overview of related activities by the Committee and its Working Parties” (Decision 34) and “invited its Working Parties to submit to the secretariat until 14 October 2022 their ongoing contributions, future plans and suggestions in support of climate change mitigation”(Decision 34 (c)).
2. The Working party on Pollution and Energy (GRPE), within the World Forum for Harmonization of Vehicle Regulations (WP.29), has a long experience in delivering harmonized procedures to measure carbon dioxide (CO₂) and other greenhouse gas (GHG) emissions from wheeled vehicles.
3. GRPE is ready to tackle the climate impact from vehicles and stand ready to support and contribute to ITC’s vision “to accelerate the work of the Committee and its Working Parties and impact for climate change mitigation and adaptation” (Decision 34 (b)).

II. Existing activities undertaken by the World Forum for Harmonization of Vehicle Regulations and the Working Party on Pollution and Energy

4. WP.29 and its subsidiary Working Parties, especially GRPE (Working Party on Pollution and Energy), heavily contribute to climate change mitigation measures by elaborating the automotive related regulatory framework on both reduction of energy consumption, GHG and pollutant emissions of road and off-road vehicles as well as on the safety (usually tackled by GRSP) and durability of alternative propulsion systems such as electric / hybrid-electric and hydrogen powertrains.
5. WP.29 activities also cover elements on circularity (detailed in ECE/TRANS/2023/5) by setting recyclability targets (embedded in UN Regulation No. 133, developed by GRPE), and performance-based requirements on retrofit (UN Regulations Nos. 115, 132, 143 developed by GRPE and GRBP) and replacement parts (e.g. UN Regulation Nos. 59, 90, 92, 103). WP.29 also recently adopted provisions to deploy software updates (UN Regulation No. 156). This Regulation together with UN Regulation No. 155 (cyber security), developed by WP.29’s Working Party on Automated/Autonomous and Connected Vehicles (GRVA), set a milestone as they structure the automotive sector with regard to digitalization, and introduce ground-breaking lifecycle and lifetime requirements in the automotive regulatory framework. The implementation of these regulations by the Contracting Parties demonstrated the suitability of the regulatory framework developed by WP.29 to address lifetime/lifecycle issues and also the potential effectiveness of such activities.
6. Dedicated WP.29 activities related to climate change mitigation were initiated more than two decades ago, with the development of harmonized procedure to measure CO₂ emissions at the tailpipe. WP.29 also engaged in Intelligent Transport Systems related activities since 2002. Many of these activities were related to safety considerations, but there were also noteworthy activities related to climate change mitigation. These included the support of a ministerial round table chaired by the Commissioner V. Bulc (European Commission) and the State Secretary A. Vidalies (France), which was moderated by the director of the Sustainable Transport Division during the 2015 ITS World Congress in

Bordeaux (France). The ministers present endorsed a manifesto entitled "ITS addressing climate change" that contributed to the UNFCCC Conference of Parties 21, that took place in December 2015 in Paris. These considerations related to CO₂ emissions are underlying in many activities of WP.29. A recent example is given by the provisions developed by GRVA, that are included in UN Regulation No. 157. This regulation is the first regulation covering the safety of Automated Driving Systems (ADS). It includes provisions related to "String instability", aimed at minimizing negative impact on traffic by applying best eco-driving practices by avoiding unnecessary accelerations and decelerations.

7. GRPE has developed worldwide harmonized test cycle for most vehicle categories (motorcycles, cars, vans, and engines from trucks, buses and Non Road Mobile Machines) to be able to measure tailpipe CO₂ emissions and other GHG (such as particulates and methane) in the most representative and realistic way, allowing the implementation of robust fuel economy improvement regulations by contracting parties.

8. GRPE is also working on zero-tailpipe emission technologies coming to the markets, as, for example, UN GTR No. 22 on in-vehicle battery durability. This UN GTR ensures minimum degradation from batteries in electric vehicles reducing waste and need for raw material extraction and associated carbon emissions. Such regulation is also expected to increase the trust in electric cars, further supporting a fast and successful adoption of such technology by car owners.

9. At its June 2022 session, GRPE agreed to initiate dedicated activities on carbon life cycle assessment (LCA), to develop harmonized methodologies to calculate the life cycle emission of carbon (or the carbon footprint) of vehicles, including carbon emissions during manufacturing, use and end-of-life phases of the vehicle:

(a) Under the initiative of Japan and Korea, GRPE organized a workshop on carbon LCA of vehicles on 31 May 2022 in conjunction with the 86th session of GRPE. The purpose of the workshop was to exchange information on the latest initiatives happening in the field of vehicle LCA and to assess whether GRPE was an appropriate body to tackle such issue;

(b) Following the successful workshop, GRPE agreed to include LCA into its list of priorities and to initiate dedicated activities through the creation of an Informal Working Group (IWG) on LCA. Japan agreed to host the 1st meeting of the IWG on LCA, where leadership team and Terms of Reference were finalized;

(c) Including LCA into GRPE portfolio significantly broaden its scope, which traditionally focused on exhaust emissions; looking at the climate and environmental impacts of all phases of vehicles, many opportunities are expected together with challenges especially as GRPE will need to expand its expertise to cover these new topics.

(d) the IWG on LCA is expected to deliver on a harmonized methodology to determine carbon footprint of vehicle throughout their life; harmonized procedure would contribute to robust, repeatable, reproducible, and therefore comparable results for and between any given vehicle.

III. Regulatory tools to help mitigate carbon emissions from vehicles adopted by GRPE

10. GRPE has adopted many regulatory directly contributing to GHG measurement and reduction; GHG usually measured include CO₂, CH₄, PM (which for older engines include black carbon).

11. Under the 1958 Agreement, GRPE has adopted several UN Regulations that help measure carbon and other GHG emissions and mitigate climate impact

(a) UN Regulation No.24: procedure to measure smoke levels of diesel engines for light and heavy duty applications; smoke from diesel engines often contains black carbon which is a powerful GHG; the procedure provides a reference value which is also used at periodic technical inspections to assess the effectiveness of the emission control system of the vehicle to reduce particulate emissions

(b) UN Regulation No. 49: Definitions of Worldwide harmonized Heavy duty Steady Cycle (WHSC) and of Worldwide harmonized Heavy duty Transient Cycle (WHTC) to measure exhaust emissions from heavy duty vehicle engines, including CO₂, particulate matters and air pollution;

(c) UN Regulation No. 83 and 101: definition of harmonized test procedure for light duty vehicles (cars and vans) using New European Duty Cycle (NEDC) for air pollution and particulate matter (UN Regulation No. 83) and fuel economy / CO₂ (UN Regulation No. 101). UN Regulation No. 101 also contains provisions to measure range of electrified vehicles. UN regulation No. 154 gradually substitutes UN Regulations Nos. 83 and 101.

(d) UN Regulation No.96: Definitions of harmonized Non-Road Steady Cycle (NRSC) and Non-Road Transient Cycle (NRTC) for construction machinery, agricultural tractors, and all types of non-road mobile machinery. UN Regulation No.96 stipulates measurement procedures for CO₂, particulate matter and air pollution for engines fitted to those vehicles

(e) UN Regulation No. 115: defines performance requirement for CNG and LPG retrofit kits that should comply with procedures and limits on emissions defined in UN Regulations Nos. 49, 83, 101 for emissions and 67 (LPG) and 110 (CNG/LNG) for safety where appropriate.

(f) UN Regulation No. 132: Definitions of performance of Retrofit Emission Control devices (REC) for heavy duty vehicles, agricultural and forestry tractors and non-road mobile machinery diesel engines. Looks at particulate and NO_x emission reduction thanks to the REC device fitted to old engines.

(g) UN Regulation No. 133: Defines target for recyclability, recoverability and reusability of vehicles during their design phase, to improve material circularity and reduce natural resources extraction. No specific climate mitigation measures or target.

(h) UN Regulation No. 143: Provision specific for dual-fuel retrofit kits for engines operating with a mix of diesel and LPG or CNG/LNG; prescribes limits for particulate matter and air pollution following UN regulation No. 49 limits (in most cases)

(i) UN Regulation No. 154: definition of worldwide harmonized test procedure (WLTP) for cars and vans for CO₂, particulate matter, air pollution, electric range for electrified vehicles. Use as a basis for CO₂ emissions in many fuel economy standards across the globe. Gradually replaces UN Regulations No. 83 and 101.

12. Under the 1998 Agreement, GRPE has adopted several UN GTRs that help measure carbon and other GHG emissions and mitigate climate impact

(a) UN GTR No. 2: Defines Worldwide harmonized Motorcycle Test Cycle (WMTC) with CO₂, particulate matter and air pollution emission limits for two- and three-wheeled vehicles

(b) UN GTR No. 4: Provide harmonized definitions for test cycles, measurement equipment and procedure for CO₂, particulate matter and air pollution, similar to UN Regulation No. 49.

(c) UN GTR No. 10: defines emission allowance coefficient for emission events outside of the test cycle defined in UN GTR No. 4. Particulate matter and air pollution is included covering wider range of ambient temperature and atmospheric pressure.

(d) UN GTR No. 11: provides a methodology to measure emissions from non-road mobile machinery, similar to UN Regulation No. 96.

(e) UN GTR No. 15: Provides harmonized definitions for test cycles, measurement equipment and procedure for CO₂, particulate matter and air pollution, similar to UN Regulation No. 154.

(f) UN GTR No. 22: Provides performance requirement for the durability of batteries in electrified vehicles, to ensure only quality batteries are fitted to electrified vehicle, increase consumer trust in the durability of those batteries.

(g) UN GTR No. 23: Provides testing methodologies to measure the durability of emission control systems for two- and three- wheelers.

13. Under the 1997 Agreement, GRPE has developed UN Rules defining procedures to measure airborne emission and smoke level during periodic technical inspections and roadworthiness checks.

(a) UN Rule No. 1: Provides testing methodologies to measure exhaust gases from petrol and particulates from diesel vehicles during PTI testing.

IV. The need to look holistically to assess mobility's environmental impact

14. Improving the vehicle itself is an important step to mitigate climate impact from transport, but it is not sufficient to reach climate goals set by the Paris Agreement. Mobility demand management and mode choice should also be tackled simultaneously to mitigate transport sector emissions in proportions that can help meet internationally agreed climate targets, as stated in the key finding with a high confidence in the latest report from the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, Climate Change 2022: Mitigation of Climate Change on all transport matters⁹.

15. GRPE has a long experience and huge expertise to reduce climate impact from vehicles themselves and to transform vehicles to lower their carbon impact. The climate impact reduction potential from vehicles is significant, and GRPE is working hard to maximize this mitigation potential by improving the vehicle design, energy and GHG emissions efficiency during its use and lower its environmental impact at its end-of-life.

16. The Working Party on Pollution and Energy (GRPE) has contributed to UNECE's mobility podcast about "Circular Economy explained"¹⁰ that highlights the need to look at the product transformation (the vehicle itself) and also usage transition (how vehicles are owned and used) to have a more holistic approach to circularity, and emission mitigation (Figure 1).

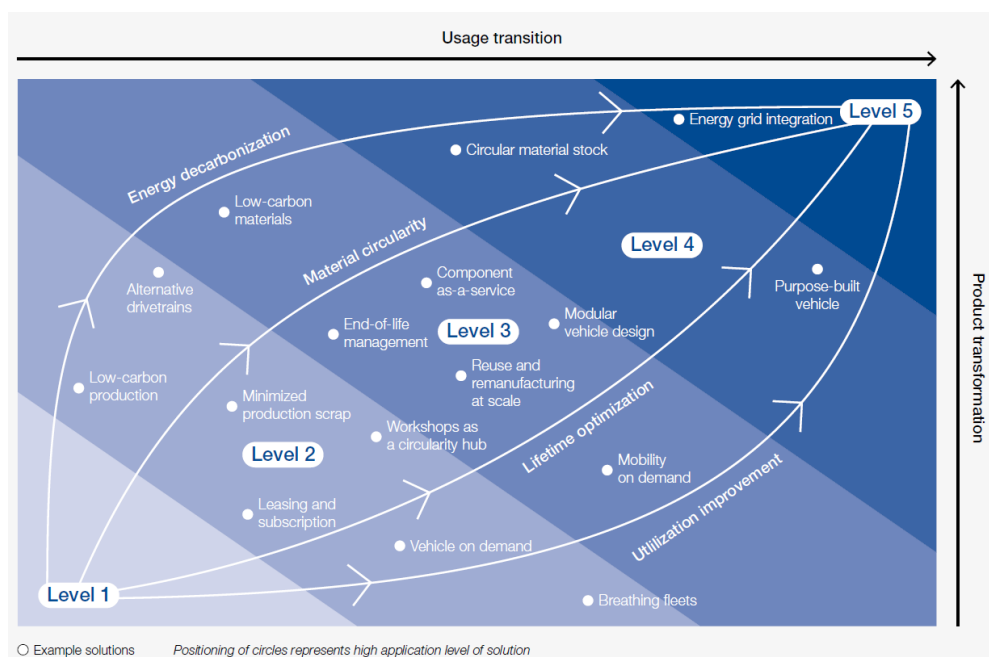
17. GRPE has nevertheless no mandate nor expertise to act on usage transition (such as incentivising modal shift towards lower carbon transport modes, car sharing or car pooling), nor vehicle ownership, and these issues also offer significant climate mitigation potential according to the latest report from the IPCC on climate change mitigation¹.

18. GRPE calls ITC to intensify its contribution to usage transformation and would happily contribute to closely working with other ITC subsidiary bodies to work together to deliver on climate impact mitigation from mobility.

⁹ IPCC AR6 WG3, Chapter 10, https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_Chapter10.pdf

¹⁰ <https://soundcloud.com/unece/mobility-one-world-zero-waste-the-circular-economy-explained>

Figure 1
Transformation pathways and potential solutions (WEF, 2020)¹¹



V. Suggestions to ITC to mitigate climate impact of road vehicles

19. GRPE has now decided to look at vehicle carbon LCA, to define harmonized methodologies to determine the climate impact of vehicles during their lifetime, from cradle to cradle. To take on this ambitious challenge within its purview, **GRPE asks for support from ITC in this task.**

20. Through its carbon LCA activity, GRPE will tackle the product transformation part to make sure vehicle are designed, produced, used, recycled and scrapped to minimize climate impact. The LCA approach at the vehicle scale is also expected to contribute to lower GHG-intensity rate during the use phase of the vehicle.

21. Mobility as a service, car sharing or carpooling are other elements which could have significant impacts on vehicle ownership, usage rates and therefore GHG emissions, which at the present time GRPE is not considering in its activities.

22. To maximize carbon mitigation:

(a) Vehicles should decrease its carbon intensity over its life, GRPE has continuously been working on this over the years, and

(b) Ownership and usage behaviour are complementary measures to reach climate goals according to latest literature from IPCC¹, where GRPE has no workstream at the present time.

23. To have a holistic approach, the **Committee may wish to take caution on vehicle ownership and usage transition** in the near future.

¹¹ https://www3.weforum.org/docs/WEF_Raising_Ambitions_2020.pdf

Annex IV

Working Party on Inland Water Transport

1. Inland water transport seems to be more vulnerable than other inland transport modes to climate change effects, as this results in the water level fluctuations that may bring to a reduced capacity of vessels, disruptions in the fleet operation, congestion in ports, thus affecting the costs and reliability as well as the sustainability of multimodal supply chains. Over the last years, the impact of climate change has resulted in long-term low water levels on the main European rivers, 2018, 2019 and 2022 being crucial for inland navigation.

2. Climate change mitigation and adaptation measures are directly linked to the activities of the Working Party on Inland Water Transport (SC.3) and its subsidiary body, the Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation (SC.3/WP.3). This concerns, in particular, measures aimed to facilitate greening of vessels, infrastructure and ports and adaptation measures aimed at improving the operability of this transport mode during low water periods. Both Working Parties encouraged member States to include this issue in national development strategies for the sector. In 2022, SC.3 welcomed with satisfaction the information from Belarus, Belgium and Slovakia on the national climate change mitigation measures (ECE/TRANS/SC.3/2022/5) in the context of realization of the Wroclaw Ministerial declaration.

3. One of the main tasks of SC.3 is promoting the modal shift to inland waterways to better use the advantages of inland water transport in terms of lower energy consumption and better environmental performance. SC.3 promotes the implementation of the European Agreement on Main Inland Waterways of International Importance (AGN), and contributes to promoting the Protocol on Combined Transport on Inland Waterways to the European Agreement on Important International Combined Transport Lines and Related Installations, which was the topic of the joint event by SC.3 and the Working Party on Intermodal Transport and Logistics (WP.24), held at the sixty-sixth session of SC.3.

4. SC.3 develops and regularly updates resolutions in the field of inland water transport, taking into account current trends and developments in climate change mitigation. In 2019–2022, SC.3 adopted (a) amendments to resolution No. 61, Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels, revision 2, that contain special provisions for vessels using liquefied natural gas (LNG) as a fuel and electric vessel propulsion; (b) the sixth revision of the European Code for Inland Waterways (CEVNI), which included provisions for vessels using LNG as a fuel and the obligation to use onshore power supply points for vessels in berthing areas and (c) updated resolutions on River Information Services (RIS), aimed at improving the availability and exchange of information between the stakeholders to allow better planning and preparedness for potential disruptions of navigation due to low water and other extreme weather events.

5. In 2022, SC.3 and SC.3/WP.3 held a number of workshops and round table discussions where various aspects of climate change mitigation and adaptation measures were addressed: (a) Prevention of pollution from inland waterway vessels and greening of the inland water transport sector on 16 February 2022; (b) Towards a modern, sustainable and resilient E Waterway Network on 29 June 2022, and (c) Innovative materials, equipment and technologies in inland water transport on 13 October 2022. The workshops addressed the recent and ongoing projects and pilots in the field of greening and retrofitting of vessels, alternative fuels, innovative technologies and greening of the infrastructure and ports. The outcome can be summarized as follows.

6. In terms of greening of the fleet, the following challenges and prospects were mentioned:¹²

¹² Including the outcome of the projects PLATINA 3, H2SHIPS (System-Based Solutions for Hydrogen-Fuelled Water Transport in North-West Europe), RIVER (Non-Carbon River Boat Powered by Combustion Engines), the activities of CESNI and projects in the Danube Region and the European Alternative Fuels Observatory.

- Transition to alternative fuels and renewable energy sources, including e-fuels and biofuels, LNG, hydrogen, electricity and solar power
 - New and improved vessel designs aimed at shifting from fossil fuels to other fuels, facilitation of commissioning vessels that use decarbonization measures and technologies
 - The deployment of alternative fuels infrastructure
 - Innovative technologies for reducing pollutants from internal combustion engines
 - Improved energy efficiency of vessels
 - Design and construction of new vessel types that can operate at lower water levels
 - Introduction of the label index system for energy and emission performance of inland vessels
 - Fostering investment in carbon zero vessels and renewable fuels, preferences and financial support for owners of zero emission vessels.
7. In terms of improving the resilience of inland waterway infrastructure to climate change, the following challenges, developments and prospects were addressed:¹³
- Modernization of the waterway infrastructure and its adaptation to low water periods
 - Proper maintenance and improved waterway management measures, improved navigation and traffic management
 - A greater focus on climate change for planning infrastructure projects
 - Reduction of the energy use and carbon emissions for pumping stations by optimizing pumping technologies and introducing smart control systems
 - Introduction of “smart maintenance” by developing data driven services based on Public Sector Information in the field of infrastructure and environment, thus making it possible to optimize the risk budget and performance of the networks
 - Introduction of “smart fairway” solutions, including innovative technologies for buoyage and marking of the fairway and RIS technologies
 - Provision and exchange of data related to climate change, such as information on water levels and the accessibility of the waterway infrastructure.
8. Greening of inland ports is another essential element of climate change mitigation and adaptation measures. Some conclusions can be made based on projects and initiatives in the Danube region relevant to the port infrastructure development, improvement of the port environmental performance and strengthening cooperation between ports, such as (a) the policy initiative “Green Deal for Danube River Transport”, initiated by Pro Danube in 2016, (b) GRENDEL (Green and Efficient Danube fleet), (c) DAPhNE (Danube Ports Network), (d) DIONYSUS (Integrating Danube Region into Smart and Sustainable, Multimodal and Intermodal Transport Chains), (e) GROwPORT (Green Container Terminal in the Port of Constanta as Access to the Danube Region) and (f) other relevant projects with the Danube stakeholders. Among the outputs of the project DAPhNE were the recommendations to measure and improve environmental performance of inland ports and the platform Danube Ports Network launched in July 2018.
9. Some general conclusions on the critical measures for ensuring a smooth transition of the sector to a zero emission transport mode are:
- Development of the harmonized international regulatory framework for facilitating the transition to alternative fuels and greening the sector

¹³ Including the outcome of the projects PLATINA 3, BE GOOD (Building an Ecosystem to Generate Opportunities in Open Data), Green WIN (Greener Waterway Infrastructure), project GRENDEL (Green and Efficient Danube fleet), Smart Fairway in Saimaa (Finland) under the framework of the EMMA Extension project and others.

- Development of cross-border cooperation in planning and timely introduction of the policy measures
- Long-term resilience planning and cooperation with other transport modes to mitigate the impact of climate change on the whole transport and logistics chains
- Sectoral activity changes such as a reduced demand for fossil fuels, increased energy efficiency and circular economy
- Digitalization of the sector
- Introduction of green fleet management strategies
- Adequate funding and the governmental and public support of initiatives in this field.

Annex V

Working Party on Intermodal Transport and Logistics

1. ITC requested that a comprehensive paper is developed by its secretariat to detail action in accelerating climate change mitigation worldwide that would cover as widely as possible inland transport.
2. In this regard, and as far as freight transport is concerned, WP.24 underlines the importance of intermodal freight transport to mitigating climate change from transport. In the end, intermodal freight transport offers the possibility for moving freight in an effective and efficient way by modes of transport whose use generates lower external costs for human health and the environment and thus also lowest greenhouse gas emissions (GHG).
3. WP.24 stresses the importance of setting up and implementing ambitious targets for market share of intermodal transport.
4. WP.24 also refers to actions aimed at increasing efficiencies in the freight transport and logistics systems as well as those aimed better protecting environment and minimizing GHG emissions. For the first set of actions, they are focused on optimizing infrastructure and operations for countries which have already established advanced freight transport and logistics systems. The following actions, which have been included in the WP.24 Handbook for national master plans for freight transport and logistics can be referred to:
 - (a) Infrastructure:
 - (i) optimization of infrastructure network by better utilization of Intelligent Transport Systems (ITS) and telematics by industry (traffic management systems and intelligent traffic information, image identification/recognition for directing vehicles),
 - (ii) segregation of freight transport from passenger transport (segregation on busy sections to reduce pathing conflicts, flexibilization of moving schedules or adjusting slots),
 - (iii) adjustment and development of infrastructure supporting new city logistics developments (micro hubs and last mile delivery by electric cargo cycles and electric vans)
 - (iv) adjustment of infrastructure to allow for optimization of transit traffic (loading gauges, sidings).
 - (b) Operations:
 - (i) optimization of shippers' operations (flexible cargo delivery times)
 - (ii) optimization of transit traffic (longer or double-decker cargo trains, standardized high-profile route),
 - (iii) development and application of technologies and policy solutions for minimization of empty runs,
 - (iv) internalization of external costs for supporting environmental and social optimization (intelligent tolling systems based on emissions and route/time of the day, differentiation of track access charges on routes/time of the day),
 - (v) incentives for use of low emission vehicles.