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Group of Experts on Climate Change impacts and adaptation for international transport networks

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Climate Change and International Transport Networks: Overview of main concerns and considerations

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Note by the Secretariat

I. The Mandate

1. At its seventy-second session in February 2010 the United Nations Economic Commission for Europe (UNECE) Inland Transport Committee invited its subsidiary bodies to incorporate global warming and transport in their agendas (ECE/TRANS/208, para.94). In September 2010, UNECE and the United Nations Conference on Trade and Development (UNCTAD), drawing on their respective mandates and experience, jointly organized a workshop on "Climate Change Impacts on International Transport Networks", held under the auspices of the Working Party on Transport Trends and Economics (WP.5). The workshop raised awareness about the important challenges that climate change impacts and adaptation requirements present for international transport networks. It also demonstrated the urgent need to prepare appropriate policy actions, as well as the need to exchange information about best practices and concluded that there is considerable merit in establishing a new expert group to study the matter.

2. At its seventy-third session, in March 2011, the Inland Transport Committee, noting the results of the joint UNECE-UNCTAD workshop, agreed to establish a Group of Experts on climate change impacts and adaptation for international transport networks and to adopt its terms of reference. The UNECE Executive Committee at its forty-first meeting, in May 2011, approved the establishment of such an expert group. The Group of Experts is expected to complete its work and submit a final report within two years (May 2013).

3. This note, presented under agenda item 4 of the first session of the Group of Experts sets out key issues and examples for consideration by the Experts.

II. Introduction and Background

4. Climate Change is largely resulting from the emission of greenhouse gases (GHG) such as carbon dioxide, nitrous oxide, methane and fluorocarbons. Scientists warn that global emissions must peak within this decade or we will face grave consequences, particularly in the developing world, where the vast majority of humanity lives and where the vulnerability to climate impacts is greatest. If rising incomes in the developing world are to be achieved through high-emissions growth, such as that pursued by today's developed countries, our environmental fabric will be stretched to the breaking point. If we do not bring to this challenge the determination and sense of common cause, not only will the climate catastrophe feared by the scientific community occur, but recovering from it will be virtually impossible.

5. In 2007, scientists from the International Panel on Climate Change (IPCC) predicted that warming oceans and melting glaciers could cause sea levels to rise up to 5 meters by the year 2100. Worldwide, densely populated coastal communities and infrastructure that supports them would be affected. There is now also scientific evidence to substantiate the claim that climate change presents serious global risks for water resources, food security, biodiversity, human settlement, health, living conditions, and international peace and security. Climate Change, therefore, demands an urgent global and coordinated response on multiple levels.

6. Despite ongoing mitigation efforts, carbon dioxide (CO2) levels due to emissions from fossil fuel combustion are increasing, owing to investment in high-carbon infrastructure and increasing worldwide demand for energy and transport. Transport in particular is responsible for 23% of world energy-related greenhouse gas (GHG) emissions. Furthermore, the transport sector is the second largest (and second fastest growing) source of global GHG emissions. At the same time, the impacts of climate change affect transport infrastructure and services and disrupt global supply chains.

7. So far, the work of the UNECE on climate change has been focusing and continues to work on the mitigation of environmentally harmful effects of inland transport. In particular, activities of the UNECE have targeted the reduction of emissions of gaseous pollutants and greenhouse gases in the road transport sector through more stringent emission requirements for new vehicles elaborated by the World Forum for Harmonization of Vehicle Regulations (WP.29). The World Forum's Round Table on Climate Change and Transport in June 2010 identified potential scenarios. Taking that into account, WP.29 will develop its future work.

8. On the initiative of the UNECE and in cooperation with the other four Regional Commissions of the United Nations, the ForFITS climate change and transport project has been launched. The project is funded by the UN Development Account (UNDA) and aims at developing a uniform monitoring and assessment tool to evaluate the CO2 footprint of land transport, taking into account climate-relevant indicators and a set of potential actions, i.e. a package of transport policy measures (a transport policy converter). The use of this tool aims at facilitating climate change mitigation and adaptation and will pave the way for the future inland transport systems.

9. In addition, the joint programme "Transport, Health and Environment" of the UNECE and World Health Organization (WHO Europe), established in 2002, brings together key players from these sectors with a view to making policy integration for sustainable transport a reality. The programme pools capacities and skills from Europe,

Caucasus, Central Asia and North America, linking regional and grassroots players. The Third High-level Meeting on Transport, Health and Environment, prepared by the joint UNECE-WHO Europe programme adopted, in January 2009, the Amsterdam declaration that addresses the challenges posed by transport, health and environment and specifies priority goals, including the reduction of transport-related GHG emissions.

10. Now, UNECE is taking coordinated steps to address also climate change adaptation. The term adaptation refers to the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences. Adaptation responses have not been given, generally, as much priority as mitigation. It is however imperative that policy makers and stakeholders think also of this aspect of addressing the climate change challenge. A clear understanding of climate change potential impacts, risks and vulnerabilities are a pre-requisite for well designed, resilient systems and structures. Poor health of populations, lack of infrastructure, weakly diversified economies, missing institutions and soft governance structures expose poorer countries and communities not just to potentially catastrophic large-scale disasters but also to a more permanent state of economic stress from higher average temperatures, reduced water sources, more frequent flooding and intensified windstorms.

III. Climate Change Impacts on International Transport Networks

11. Climate Change presents a significant challenge for both freight and passenger transport. Demand for transport services grows in tandem with the global economy, trade and world population, and transport relies heavily on oil for propulsion. While the contribution of the transport sector to global GHG emissions is well understood, less is known about potential impacts of climatic changes on transport infrastructure, including ports, as well as on inland transport services and networks across the broader supply chain.

12. Rising sea levels, increased frequency and intensity of extreme storm surges and waves, droughts and/or river floods and increased temperatures, as well as extreme temperature variability and the melting of permafrost pose serious threats to both coastal and inland transport infrastructure and services. Direct threats include accelerated coastal erosion, port and coastal road inundation/submersion, water supply problems, access restrictions to docks and marinas, deterioration of the condition and structural integrity of road pavements, bridges and railway tracks. Indirect impacts are harder to assess and arise through changes in the population concentration and/or distribution, as well as through changes in production, trade and consumption patterns, which are likely to lead to considerable changes in demand for transport.

Table 1: Climate Change Impacts on Transport Infrastructure and Operations

(a) Road Surfaces and road infrastructure

Climatic Factor	*Impact*
Heat Waves	Melting asphalt
	Increased asphalt rutting due to material constraints under severe exposure to heat
	Thermal expansion on bridge expansion joints and paved surfaces

Climatic Factor	*Impact*
	Damage of bridge structure materials
Droughts	Degradation of road foundations due to increased variation in wet/dry spells
Rising sea levels and coastal erosion	Inundation and/or flooding of coastal road infrastructure and underground road tunnels
Increased frequency of extreme rainfall	Landslides and subsidence
	Higher waterways due to rainfall can submerge, undermine and wash away bridges
Flooding	Roads with limited foundations and poor or no drainage can be washed away or scoured
	More rapid degradation of subgrade material underneath roads or pavements, leading to loss of strength and bearing capacity
Storms	Damage to bridges, flyovers, street lighting, signs and service stations.
Extreme Heat and Cold variability that causes accelerated thawing	Damage to road surfaces, requiring more frequent maintenance

(b) Impacts on vehicles and driving conditions:

Increases in temperature are likely to lead to an increase in driver discomfort and exhaustion – increased road safety hazard
Use of more costly and more energy-intensive air conditioning systems
Melting tyres or wearing tread and overheating of equipment such as diesel engines – increased road safety hazard
More frequent occurrences of difficult driving conditions, or circumstances where driving becomes impossible – increased road safety hazard

(c) Rail Infrastructure and operations

Climatic Factor	*Impact*
More frequent and intense precipitation	Increased risk of flooding of rail lines
Wetter winters and dryer summers-Higher Temperatures	Increased scour of bridges, increased instability of embankments and increased rail buckling.
Heat waves	Degradation of electricity transmission, slope fires and overheating of rolling stock equipment
Storms, higher wind forces and thunderstorms	Damage to installations, over-voltage and effects on signaling

(d) Inland Waterway Infrastructure and Operations

Climatic Factor	*Impact*
Dry periods in combination with floods and increased rainfall	Changes in erosion and deposition patterns on river and canal banks
Increase in winter precipitation	Increased frequency of high flow, flooding and strong stream conditions (risk for safety)
	Difficulties in maneuvering through curved, narrow channels
Higher water levels and flood flows during the winter months	Threat to the structural integrity of infrastructure such as locks, dams and inland ports and harbors, as well as vessels and bridges (e.g. changes in shape and depth of channels and changes in bridge clearance).
Reduced summer precipitation	Low flow conditions – particularly in natural rivers – and water shortages affecting the supply for canals
Low water levels	Threat for structural integrity and functionality of infrastructure, such as hydraulic support systems on the waterside face
	Changes in loading depth (and therefore loading capacity)
Changes in water supply	Effects on sedimentation processes and maintenance dredging.

(e) Port and Hinterland port infrastructure and operations

Climatic Factor	*Impact*
Rising sea levels	Increase in corrosion rate and degradation over time of materials specifically designed for a particular range of sea level conditions
Change in wind conditions and higher waves	Effects on offshore loading and unloading operations
	Changes in overtopping and threat to stability of breakwaters
Erosion or accretion of beaches protecting port structures	Risks for safety of such structures and increased probability of flooding
Changes in storm duration and/or frequency	Decreased regularity of ports, increased downtime and the requirement for more storage capacity at container terminals for use in times of closure
	Increased construction and maintenance costs at ports and storage facilities

Climatic Factor	*Impact*
	Higher energy consumption in ports
	Service reliability will be challenged

IV. Climate Change Adaptation for International Transport Networks

13. Developing effective adaptation strategies for climate change impacts on international transport requires both policy action and collaborative research. Well targeted vulnerability studies, empirical studies and assessment of projected risks and related costs are a first step toward bridging the current knowledge gaps and identifying priority areas.

14. Adaptation action aims to reduce the vulnerabilities and increase the resilience of transport systems to climatic impacts. Resilience refers to the ability of a system to withstand negative impacts without losing its basic functions. In the transport context, it is not only about physical strength and durability of a structure, but more importantly it defines the ability of a system to recover from an incident quickly and at minimal cost. This means, in other words, that materials have to be cost-effective and easy to find, replace or repair. It follows that climate change impacts on infrastructure ought to be a key consideration in transport planning, design and construction, as well as in broader economic and development policies.

15. In identifying priority areas for adaptation, one of several factors to be considered would be classification of facilities that are harder to protect. Such an example would be ports because they are almost impossible to relocate and are crucial links in international supply chains. Facilities that face manageable risks would require risk management and emergency response planning while, finally, terminating the use of a facility would be a last resort if vulnerabilities are too complex to deal with, or if re-location would be less costly.

16. In addition, transport infrastructure is designed to be used over long periods of time, often exceeding 100 years. Therefore it stands to reason that anticipatory adaptation needs to be considered. A good example of relevant practice is the innovative engineering of railway lines to withstand the effect of melting permafrost. Permafrost is permanently frozen soil, sediment or rock and it is found in high latitudes in western North America, North-Eastern China, Siberia and the far east of Russia. The projected increase in temperature can cause permafrost to thaw, resulting in sinkholes that cause roads and railroads to crack and heave. The world's longest high-elevation railroad, the Qinghai-Tibet railway or "Permafrost Express", in China and the 800 mile long Trans-Alaska Pipeline both involved engineering and design techniques sensitive to the permafrost environment in which they were constructed.

17. Moreover, transport infrastructure and services are often highly regulated. In order to accommodate adaptation measures, institutional adaptation and requirements for governmental regulation that take climate change into consideration may also be necessary. In this respect a prime example is the 2007 European Council directive on the assessment and management of flood risks. According to the directive, EU member States were required to bring into force relevant laws, regulations and administrative procedures by November 2009, in order to prepare flood hazard maps and flood risk maps, flood risk management plans and related implementing measures for coastal areas and river basins in their territory. This directive creates an effective adaptation framework for the assessment and management of flood risks that is of great value for transport related policy instruments such as spatial planning.

18. Examples of other factors to be considered for adaptation of transport networks to climate change impacts include new technology solutions, public and private planning frameworks, monitoring, information provisions and education as well as strategic instruments for companies and transport operators.

Annex 1

Climate Change on the International Agenda: A note on the global UN Framework

1. The United Nations Framework Convention on Climate Change (UNFCCC) sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. The objective of the treaty is to “stabilize greenhouse gas concentrations in the atmosphere”. These actions were aimed primarily at industrialized countries, with the intention of stabilizing their emissions of greenhouse gases at 1990 levels by the year 2000. The parties agreed in general on the principle of "common but differentiated responsibilities," with greater responsibility for reducing greenhouse gas emissions on the part of developed/industrialized countries.

2. The treaty itself set no mandatory limits and contains no enforcement mechanisms. The parties to the convention have met annually from 1995 in Conferences of the Parties (COP) to assess progress in dealing with climate change. In 1997, the Kyoto Protocol established legally binding obligations for developed countries to reduce their greenhouse gas emissions. The Protocol allows for several "flexible mechanisms", such as emissions trading, the clean development mechanism (CDM) and joint implementation to allow countries to meet their GHG emission limitations by purchasing GHG emission reductions credits from elsewhere, through financial exchanges and projects that reduce emissions.

3. The target regarding greenhouse gas emissions that has been set in the Kyoto Protocol needs to be achieved within the period of 2008-2012. The Copenhagen summit, 15th annual conference of the UNFCCC parties (COP 15) did not deliver what was promised. What resulted was an agreement that seems much watered down, In effect, the main polluters (the industrialized nations) have managed to reduce their commitments while increasing those of the developing countries. However, in Cancun (COP 16), Governments agreed on a balanced package of measures that formalizes mitigation pledges from all countries and ensures increased accountability for them.

Under the UNFCCC framework, participating governments:

- • gather and share information on greenhouse gas emissions, national policies and best practices
- • launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries
- •cooperate in preparing for adaptation to the impacts of climate change

4. Cooperation with relevant international organizations, such as with scientific bodies, UN agencies and other conventions, is an important dimension of the Convention process. The aim is to ensure that the Convention process has the best scientific and other relevant information available. The COP and its subsidiary bodies also seek to ensure that the climate change related activities of other international organizations are coherent with the Convention process and respond to the needs of the Parties, and that potential linkages and synergies with climate change related matters are appropriately taken into account. Thus, it is imperative that the work undertaken by the expert group is appropriately aligned with this global framework, in order to achieve the best possible results.

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