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**Economic Commission for Europe**
**Inland Transport Committee**
**Working Party on Transport Trends and Economics**
**Group of Experts on Assessment of Climate Change  
 Impacts and Adaptation for Inland Transport**
**Twenty-fourth session**

Geneva, 9 and 10 March 2023

**Report of the Group of Experts on Assessment of Climate  
 Change Impacts and Adaptation for Inland Transport at its  
 twenty-fourth session**
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## **I. Attendance**

1. The Group of Experts on Assessment of Climate Change Impacts and Adaptation for Inland Transport (hereafter called GE.3) held its twenty fourth session (sixth session under its new mandate) on 9 and 10 March 2023. The session was co-chaired by Ms. S. Haensel (Germany), Ms. T Popescu (France) and Mr. J. Kleniewski (Poland). It was held as a hybrid meeting with virtual participation through Webex and in-person participation.
2. Representatives of the following United Nations Economic Commission for Europe (ECE) member States participated: Canada, France, Germany, Ireland, Netherlands (the Kingdom of), Poland, Portugal, Russian Federation and United Kingdom of Great Britain and Northern Ireland. Representatives of the European Union were present.
3. Representation of the following international organizations participated: European Investment Bank Joint Assistance to Support Projects in European Regions (EIB JASPERS), Trans-European Railway (TER) Project, United Nations Conference on Trade and Development (UNCTAD), World Association for Waterborne Transport Infrastructure (PIANC), World Road Association (PIARC) and World Meteorological Organization (WMO).
4. The following non-governmental organization was represented: International union of railways (UIC).
5. At the invitation of the secretariat, experts from the following organizations participated: Climate Sense, EUROCONTROL, National Center for Atmospheric Research, Research Applications Laboratory, Swiss Federal Institute of Technology in Zürich (ETHZ), University of the Aegean and University of Birmingham..

## **II. Adoption of the agenda (agenda item 1)**

6. GE.3 adopted its agenda as contained in ECE/TRANS/WP.5/GE.3/47.

### **Documentation**

ECE/TRANS/WP.5/GE.3/45

## **III. Initiatives in climate change impact assessment and adaptation for inland transport (agenda item 2)**

7. GE.3 continued its discussion on initiatives in climate change impact assessment and adaptation for inland transport with a view to understand if any new approaches, tools and/or methodologies exists or are being developed that could be integrated by GE.3 in its work. In particular GE.3 considered (a) information of technical guidance on the climate proofing of infrastructure in the period 2021–2027 and climate proofing provisions in the revised TEN-T regulation by the European Commission; (b) 2021 State of the Climate in Europe Report by WMO; (c) development of guidelines for climate risk assessment in European Union taxonomy by German Federal Agency for Environment; (d) PIANC’s technical notes on business case for adaptation; (e) updates from the UIC project Resilient Railways facing Climate Change: Heavy Rains (ReRa-Rain) and on the start of project Resilient Railways facing Climate Change: High Temperatures (ReRa-Temp); and (f) report on “Readiness for storms ahead? Critical national infrastructure in an age of climate change” by the United Kingdom Parliament Joint Committee.
8. University of Aegean updated GE.3 with regard to the existing state of knowledge on the evolution of the potential hazards for inland transportation under climate variability and change.
9. GE.3 appreciated the information provided and contributions made respectively by the European Commission, WMO, German Federal Agency for Environment, PIANC, UIC and the United Kingdom Parliament Joint Committee. In the discussion which ensued after the presentations, GE.3: (a) agreed to signpost relevant methods and methodologies for

climate risk and vulnerability assessments in its final report; (b) appreciated the outcomes of its work included in WMO 2021 State of Climate in Europe Report; (c) confirmed the importance of work on business case for adaptation to gain political attention to preventive adaptation programmes, and in this regard also noted insurance premiums and better access to financing as elements to be referred in business case material; (d) noted challenges with collection of cost and losses in transport due to extreme weather events from transport assets managers and a potential need to develop budget monitoring, such that all the costs related to climate change (investment, maintenance and damage response) are identified better; (e) acknowledged the difficulty to collect experience with adaptation due to different levels of involvement and interest for reporting on adaptation among the asset managers; (f) reiterated the value for asset managers from availability of transport-specific methodologies for conducting effective stress-testing of their assets and for identification of critical infrastructure, especially through local vulnerability or risk assessments combining climate and risk expertise with the infrastructure managers' knowledge on their assets and accounting for interdependencies; and (g) recognized the importance of developing regulations making such climate-proofing compulsory.

10. GE.3 acknowledged use of Representative Concentration Pathways (RCP) 4.5 and 8.5 for projecting the future impacts in recent assessments and analyses by various stakeholders and less so of RCP 2.6. It agreed to apply RCP 4.5 in its analysis in addition to RCP 8.5. GE.3 also agreed to consider the new climate scenario generation used in the latest IPCC report. These scenarios combine Shared Socioeconomic Pathways (SSPs) with the RCPs (SSP2-4.5 is comparable to RCP4.5 and SSP5-8.5, is an update of RCP8.5). GE.3 noted that SSPs so far have limited application for regional assessments which were in the group's interest, as regional climate model ensembles were not available. Moreover, GE.3 agreed to discuss the possibility of using Global warming levels (GWL) in its analysis of climate impacts on transport. In this regard, good practice in GWL application on a regional scale should be sought and presented at the next session.

11. GE.3 discussed then the annotated outline for its final report based on a proposal contained in Informal document (2023) No.1 elaborated by Chair and Vice-chairs supported by the secretariat. GE.3 made the following suggestions:

- add at the beginning of the report a summary for policy makers,
- in introduction, elaborate on motivation for acting upon climate change adaptation in transport and for understanding the costs and benefits of adaptation in comparison with the costs of inaction (importance of developing the business case for adaptation),
- in the chapter on Climate Variability and Change include a section addressing the available climate data for the future (RCP, SSP, GWL),
- add a new chapter (n. IV) on existing international and national policies and legislation for acting on adaptation of climate change in transport,
- transfer the chapter on business case for adaptation to become a section of the chapter on effective adaptation, and focus it on costs/losses of inaction and studies on return of investment in risk reduction and resilience. The general need for adaptation and for estimation of costs shall already become obvious in the introductory chapter,
- in the chapter on methodologies for assessing climate change hazards on transport systems, refer to national sectoral methodologies as well as methodologies developed by specific partners, and illustrate each methodology with a figure presenting its main steps,
- in the chapter on effective adaptation, signpost and illustrate with a figure presenting their main steps sectoral methodologies for evaluating adaptation measures and building adaptation plans as developed nationally or by specific partners, possibly also include a catalogue of adaptation measures for the different modes of transport or refer to such existing catalogues,
- add a new part in the chapter on effective adaptation that reflects the importance of monitoring (climate change, assets and effectiveness of measures) and review of adaptation action,

- in the chapter on lessons learned and recommendations, reflect on monitoring of adaptation measures (efficiency, costs, maladaptation, etc) and of costs related to climate events,
- define what is meant by risk (different concepts exist) – might be done in a box or as an annex,
- address the interdependencies and synergies between disaster risk reduction/early warning and climate adaptation.

12. GE.3 also expressed its preference to split the report in two parts, with part one containing the key chapters and being as concise as possible, and part two providing detailed case studies to chapters on methodologies and effective adaptation, and other relevant case studies for the statements and conclusions made in part one. GE.3 also agreed on defining, as far as possible, a common outline for all the case studies presented in the final report.

13. In the discussion, UNCTAD, Climate Sense and PIANC agreed to contribute respectively to chapters on policies and legislation, methodologies for assessing climate hazard and effective adaptation, and in this regard, to propose detailed outlines for these chapters for the next meeting.

#### **IV. Climate change and transport assets data (agenda item 3)**

14. The secretariat informed GE.3 on delay in preparation of the projection maps. The delay was due to challenges beyond the control of the secretariat. GE.3 noted this information and requested that every effort be invested to ensure that maps are developed for discussion and analysis at the next meeting.

15. GE.3 considered then information compiled by the University of Birmingham on evaluation of impacts from the wind hazard. In particular, a research study was discussed on prediction of weather-related incidents on the railway network in the United Kingdom taking into consideration the wind hazard and local environment. A prototype data model for wind-related delays in the United Kingdom developed within the research helps predict occurrence of rail incidents attributed to wind. The predicated probability of incident occurrence should, in principle, be applicable to any given rail subnetwork. Further review of the paper should help establish universal model applicability. It was also suggested that a catalogue of wind impacts be developed. Such impacts could potentially be also associated, as part of the catalogue, with measures to address these impacts.

16. Further to the discussion, GE.3 requested the Birmingham University to further review the study and make proposal on the model applicability. The Birmingham University should also make a more specific proposal on the catalogue of wind impacts. The proposed structure for the catalogue should possibly allow to use it for other hazard impacts such as heat or precipitation.

#### **V. National and sub-national projects on climate change impact assessment and transport asset adaptation needs (agenda item 4)**

17. Experts from EIB Jaspers and Infrastructure of Portugal presented on the work done in Portugal with support of Jaspers in developing climate change resilience plan for transport infrastructure in Portugal. Expert from ETH Zurich presented a case study for stress testing the road infrastructure in the region of Chur, Switzerland.

18. GE.3 appreciated the informative presentations. It agreed that these presentations, along the presentation from Jaspers at the earlier session on adaptation to climate change for national roads in Poland, offer a valuable material to be included in the final report as case studies to the chapter on methodologies for assessing climate change hazard on transport systems. GE.3 requested therefore the presenters to consider preparation of case studies for the final report.

19. The discussion on the presentations confirmed the need for the availability of advice on which methods and methodologies are available and when (in which situations) they should be used for assessing climate hazards and transport system's vulnerabilities, which GE.3 agreed to incorporate in its final report in the chapter on methodologies for assessing climate change hazards on transport systems. The discussion also confirmed the necessity for availability of a guideline on how to conduct stress test on transport infrastructure, which GE.3 has been working on as a framework for transport system stress test.

20. GE.3 requested then experts to present at the next sessions on further national and sub-national projects on climate change impact assessment and transport asset adaptation needs.

## **VI. Database on adaptation measures (agenda item 5)**

21. PIARC presented their report published in December 2022, based on more than 70 case studies on climate change, other hazards and resilience of road networks. PIARC explained on the approach used to classify the various case studies so that readers can easily identify case studies of their interest. PIARC also explained how the knowledge gained from the case studies is to be used for updating, if necessary, PIARC's methodological approaches to climate change hazards and the climate change adaptation framework.

22. PIARC also reported on their international seminar on climate change, resilience and disaster management for roads held in November 2022 in Yogyakarta, Indonesia. The seminar's discussion had shown that increased emphasis is put to adaptation action rather than recovery after extreme events, and that the full economic, social and environmental costs of recovery are recognized and documented. It is also recognized that investment in risk reduction and disaster-resilient infrastructure pay off as they save costs of disaster recovery and reconstruction. PIARC's seminar also identified areas for further consideration, including maladaptation, implementation of green adaptation solutions and how to address retreat in the face of rising sea levels.

23. GE.3 appreciated the informative presentation. GE.3 would find it interesting if collected case studies could be reviewed from the angle of return of investment on adaptation so that concrete examples of return of investments could be collated for presenting a business case for adaptation. GE.3 also suggested to examine the template used in the case studies of the PIARC report in order to propose a template for the case studies presented in GE.3's final report.

24. GE.3 welcomed the information on recognition and documentation of recovery costs which should allow to gather such information and present the knowledge material on the costs of inaction.

25. GE.3 also expressed interest in the areas for further consideration identified during the PIARC seminar and encouraged reporting and assessment of implemented adaptation measures, especially regarding maladaptation.

26. GE.3 considered then Informal document (2023) No.2, which contains a draft guidance on adaptation pathways in the transport sector and which was introduced by the University of Birmingham on behalf of the group of volunteers which prepared this draft guidance.

27. GE.3 welcomed the work done on the draft guidance and provided the following comments:

- add a statement in the introduction on the scope,
- reconsider the chapter on challenges associated with the adaptation pathways approach; the challenges should be rather referred in general in the beginning, specific examples of challenges should be then included at the end of the document,
- add definition of adaptive design,
- signpost available sectoral guidance which refer adaptation pathways, e.g. PIANC's pathways to adapt to water flooding for waterborne transport, ISO standards,

UNCTAD guidance, and when doing so shorten the section on prerequisites for the development of adaptation pathways,

- distinguish between critical thresholds (when a transformational change is required) and thresholds at which current capability is exceeded,
- avoid using a term ‘tipping point’ and use ‘threshold’ instead,
- in steps for developing adaptation pathways, include assessment of interdependencies as part of the step on reviewing vulnerabilities (step 1),
- apply IPPC structure for adaptation pathways measures and include sectoral examples of measures, and
- provide a more specific figure on the adaptation pathway plan.

28. GE.3 further agreed that additional comments in writing should be sent by 24 March 2023 to the secretariat.

29. GE.3 also invited experts to explore interest of transport asset managers in their countries in applying the guidance in a case study for a specific transport asset. Interested asset managers were requested to contact the secretariat.

## **VII. Guidelines for integrating climate change considerations in planning and operational processes (agenda item 6)**

30. France reported on the preparation and presented the programme for the conference on raising awareness on adaptation of transport infrastructure to climate change and on setting up an effective intervention programme for the countries in the Mediterranean region to be held in Marseille on 15 and 16 May 2023. GE.3 took note of the information provided.

31. ETH Zurich presented the Informal document (2023) No 3, which contains the draft framework for stress tests of transport assets as prepared by the intersessional group of volunteers.

32. GE.3 welcomed the work done by the intersessional group and the draft framework. It provided the following comments:

- add a graphical presentation of the stress test framework (steps),
- add explanation on how stress test links with or complements other vulnerability/risk assessment methodologies, and when it is advised to apply the stress test,
- elaborate more on what follows the completion of a stress test in section on the use of stress test as a step to determine needs for intervention programme,
- explain better the term ‘worse than expected’ in the section on the use of stress tests, by linking it to the exceeding of a threshold above which the system no longer has adaptive capacity,
- refer, in examples on possible interventions, to non-physical measures along physical measures for adaptation also in the section on the use of stress test,
- also refer to or provide examples of national codes or frameworks and European guidelines which list impact or traffic predication values as well as existing models which can be applied in stress testing.

33. GE.3 further agreed that additional comments in writing can be sent by 24 March 2023 to the secretariat.

34. GE.3 also invited experts to explore interest of transport asset managers in applying the framework to conduct specific transport asset stress test and prepare case studies which would describe the test and its results. Ideally, the case studies should illustrate both qualitative and quantitative approaches for stress-testing. Interested asset managers in conducting stress tests as per the framework would be requested to contact the secretariat.

35. Next, GE.3 discussed the Informal document (2023) No 4, which contains an annotated outline for the guide for assessing transport asset criticality and was prepared by the secretariat, together with the Chair and the Vice-chairs. GE.3 suggested that the following issues are covered in the future guide:

- explanation on how criticality varies with scale (the same asset may have different levels of criticality when considered at a national and at a local scale),
- inclusion in consequences of the loss of safety and security along loss of connectivity or performance, and reflection on the importance to be given to each of those consequences when assessing criticality (may depend on the situation of each asset, or of the scale at which the assessment is performed), and
- inclusion of references to existing international obligations for identification of critical assets and of the existing European definition of criticality.

36. GE.3 invited interested experts to join a small group for the development of the draft guide for the next session. Interested experts should contact the secretariat. The draft guide should be prepared and presented at the next session.

37. Further, GE.3 was informed on the distribution of the surveys on impacts of climate/weather related events on road/rail transport assets and collection of data on the events which led to incidents at the asset and resulted in traffic/operational disruption with or without infrastructure damage, which influenced the regular operation, and which may have required an intervention of an operation team to bring the service to the level before the incident. Through this survey also related costs of interventions and operational losses were expected to be collected.

38. The survey was circulated between October and December 2022 to focal points of the Working Parties on Road and Rail Transport and to Trans-European Motorway and Trans-European Railway projects as well as to UIC. The deadline for reporting was set for 31 March 2023. First responses were collected from Portugal, Slovenia and Türkiye.

39. Eurocontrol presented its experience and challenges with the costs of inaction regarding climate change from the work of the European Aviation Climate Change Adaptation Working Group. Several issues regarding cost collection were raised, including the selection of the climate effects, the climate scenarios, the type of costs and the time frame to cover, as well as the question to know to what extent costs observed in the past can be extrapolated to the future.

40. GE.3 further discussed experience in collection of cost/losses data and pointed generally at the absence of systematic registering by asset managers of costs as well as lack of linking the costs to the source/causes. Typically damage cost covered by insurance is well registered. Instead, intervention or clean-up costs covered through maintenance budget are in no way linked to the causes and so properly registered. Indeed, even when the asset managers are able to track the costs of the damage or the disruption occurred during extreme weather events, their data is generally insufficient to establish a certain causal link between the climatic event and the cost. Moreover, sometimes the cost data exists but is not systematically reported. GE.3 expressed therefore high interest in the results of the survey and whether they confirm the existing experience. In case they do, GE.3 could potentially think of elaborating a guide or material on how to systematically register costs, and how to improve available data to link them to source/cause so that it can be distinguished what was the regular and what was the extraordinary cost item.

41. Finally, the secretariat informed GE.3 about upcoming ECE and other events/conferences of potential interested to experts, among them:

- the round table on “Green, sustainable and resilient infrastructure” to be held on 30 March 2023 in the framework of the 2023 ECE Regional Forum “Ensuring the implementation of the 2030 Agenda for Sustainable Development in the ECE region at times of multiple crises”, during which aspects of resilience of transport infrastructure would be covered and during which the GE.3 Vice-Chair (France) would refer GE.3 activities,

- the side events of the seventieth session of the Commission to be held between 2 and 5 April, and in particular the event of 5 April on the Future of Regulation in the Pan-European Region: Horizon-Scanning for a Sustainable and Equitable Future, during which GE.3 Chair would refer GE.3 work, and
- PIARC XXVII World Road Congress on 2 to 6 October 2023, at which a foresight session on stress tests tool to assess the resilience of road asset to climate change hazard would be held.

42. GE.3 took note of the upcoming events and appreciated the fact that its activities can be presented and discussed at these events.

### **VIII. Other business (agenda item 7)**

43. UNCTAD informed GE.3 about its activities at the margins of the 27<sup>th</sup> United Nations Climate Change Conference (COP27) and issuance of a policy brief on financing for adaptation for developing countries (policy brief 104: Tackling debt and climate challenges in tandem: A policy agenda).

### **IX. Date and place of next meeting (agenda item 8)**

44. The secretariat informed GE.3 about the scheduled date for twenty-fifth session on 30 and 31 October 2023 in Geneva.

### **X. Summary of main decisions (agenda item 9)**

45. The secretariat summarized the decisions taken by GE.3. The full report of the session, prepared by the secretariat in consultation with the Chair and Vice-Chairs, would be shared electronically after the session for adoption.

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