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Group of Experts on Climate Change Impacts and Adaptation for Transport Networks and Nodes

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Item 4 of the provisional agenda
Discussions on the final report of the Group of Experts

Main transport networks and nodes

Note by the secretariat

I. Introduction

1. The Economic Commission for Europe (ECE) region is widely linked by interconnected networks of roads, railways and waterways. These networks and their nodes are instrumental to ensuring movement of people and goods. They are instrumental to ensuring markets access. They hence play an important role for the proper functioning of local, national or regional economies.

2. This document discusses the main transport networks and nodes in ECE region and illustrates them in maps produced in a geographical information system (GIS) environment. It provides information on the use of the networks and makes swift network assessments whether disruptions on the networks could trigger potential negative socioeconomic impacts. The Group of Experts requested the secretariat at its sixteenth session that this document is tabled as official document at the seventeenth session.

II. Main roads

A. E Roads network

3. A major road network in ECE region has been established in the framework of the European Agreement on Main International Traffic Arteries (AGR). The Agreement was done at Geneva on 15 November 1975 and entered into force on 15 March 1983. It lays down a coordinated plan for the construction and development of roads of international importance, the E Roads network.

4. The Agreement distinguishes between the reference roads and intermediate roads. The reference roads, also called class-A roads, have two-digit numbers assigned. Branch, link and connecting roads, also called class-B roads, are numbered with three digits.

5. The Agreement also classifies road as per their geographical orientation. North-south orientated reference roads have two-digit odd numbers terminating in the figure 5 and increasing from west to east. East-west orientated reference roads have two-digit even numbers terminating in the figure 0 and increasing from north to south. Intermediate roads have respectively two-digit odd and two-digit even numbers comprised within the numbers of the reference roads between which they are located. Class-B roads have three-digit numbers, the first digit being that of the nearest reference road to the north of the B-road concerned, and the second digit being that of the nearest reference road to the west of the B-road concerned; the third digit is a serial number.

6. The E Roads network has been put into GIS environment by the secretariat, using open source data coming from OpenStreetMap (figure I). The accuracy and correctness of the geographical location of E Roads presented in the map rely therefore on this data source. Basic data verification has been done to compare the E Roads network described in the AGR Agreement with the network available in OpenStreetMap data, however gaps may subsist: the AGR Agreement describes the roads as chains of cities, without giving information on the paths which connect these cities.

7. The OpenStreetMap data have been downloaded from Geofabrik[1] for Europe and Asia. The package data have been then extracted and filtered[2] in order to keep only motorways, primary roads and trunk roads, containing reference to "E Roads" in their attributes (field "int_ref").

[1] download.geofabrik.de/

[2] Using osmfilter.exe. Command line given here as example for a file named "fr.o5m": osmfilter fr.o5m --keep= --keep-ways="(highway=motorway =primary =trunk) and int_ref=*E*" --keep-tags="all highway int_ref" -o=fr.osm

Figure I
The E road network (source: ECE)

Source: ECE

B. Main roads network in North America

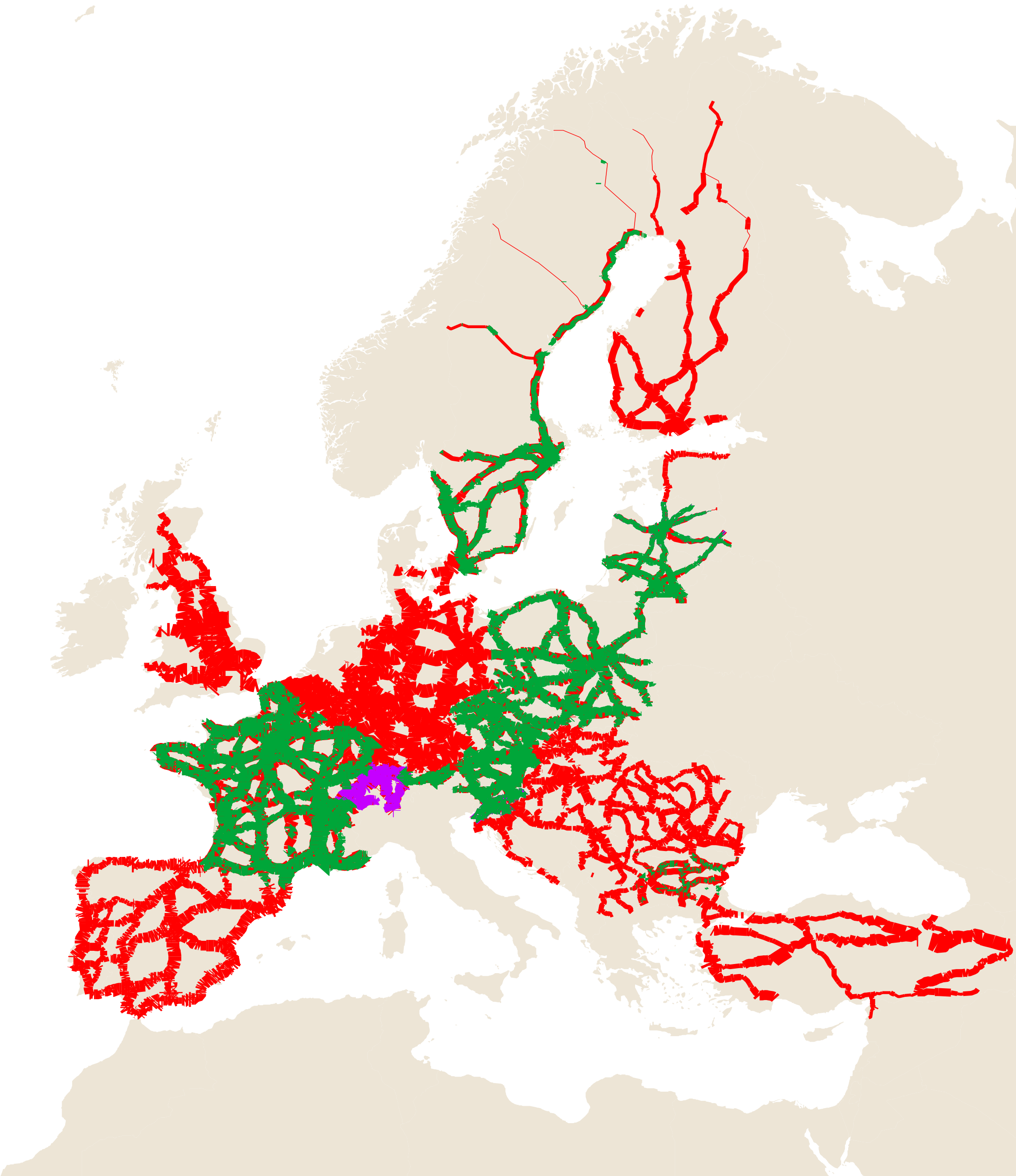
[place holder to inform about the main road network in North America/Canada]

C. Traffic flows on E Roads

8. The traffic on the E Roads is measured by means of a census by ECE. Such census is undertaken every five years. The 2005, 2010 and 2015 E Roads censuses are presented in this study. The data are collected for individual segments as defined by the member States, based on the standards set out in Annex II to the AGR Agreement. These data include infrastructure information such as number and size of lanes, and traffic information measured as the Annual Average Daily Traffic (AADT). This measure represents the total number of motorized vehicles passing through each particular segment of an E Road in a given year, divided by the number of days in the year. While this measure does not consider the type of vehicle, time of travel or seasonality factors, it is a useful headline measure of traffic, and potentially congestion, thus it can be considered as a proxy indicator to initially determine the criticality of the transport network (figure II).

9. The geographical location of the counting posts for sections of roads is communicated by the ECE member States in their answers to the census questionnaire, and the traffic flows figures are those measured at those counting posts. In consequence, the resulting map does not always show road segments that line up perfectly to the real network. It shows instead straight-line paths between counting posts. Moreover, the map represents data as collected by member States. In some cases, traffic counts have only been conducted on specific points and not on every segment, which creates missing segments.

Figure II
The E road network censuses: AADT for 2005 (red), 2010 (purple) and 2015 (green)



Source: ECE

D. Roads networks analysis

10. The E Roads constitute a dense network except for its northern and eastern parts (see figure I).

11. Where the road network is dense, it gives more flexibility to its users for a selection of routes between a trip origin and its destination. It should also allow for trip rerouting without considerable loss of time or causing additional costs.

12. Rerouting would work as long as roads to which vehicles are rerouted would continue to have the capacity to absorb them. At the same time, a road network will stop serve its function in a given region if a disruption on one road would cause overloading of its alternative roads and hence disrupt that network.

13. Where the network is sparse, users depend on a given road without the possibility of avoiding a time- and/or cost-intensive rerouting to other roads in case of disruption. An alternative choice in such a case could be a modal shift especially to rail if it is available.

14. The E Rail network discussed in section III below provides alternative rerouting possibility to a good number of E Roads also in the norther and eastern parts. For transport of big cargo units however, this applies only if rail-road terminals are provided. Again, rerouting will only be viable as long as the rail network and service will be able to absorb additional passenger and or/cargo unit.

15. Network stress tests should be performed to understand the disruption levels at which traffic would be affected to a degree that considerable socioeconomic impacts could not be prevented (possible reference to the case study on stress test scenario for Middle Rhine region).

16. Data on average daily traffic volumes may be assessed as proxies for selection of sections of the road network that should be prioritized for stress tests. Where the rail network should serve as alternative, the average daily traffic volumes/number of trains should be looked at for each network and analysed versus the network capacities.

17. The available average daily traffic volume data, as presented in section C above, show a rather intensive usage of the E Roads network in the transit countries. The sparse network is used less intensively. However, detailed local analyses are required to determine whether any road or part of the network would stop to serve its function in case of occasional disruption and hence trigger severe socioeconomic impacts. They will show how critical roads or sections of the networks are.

III. Railways

A. E Rail network and rail-road terminals

18. The rail network of international importance in ECE region has been developed in the framework of the European Agreement on Main International Railway Lines (AGC). The Agreement was done in Geneva on 31 May 1985 and entered into force on 27 April 1989. It identifies railway lines of major international importance, the E Rail network. It also provides the technical characteristics as a basis for further development of the European railway infrastructure.

19. The E Rail network has not been yet fully geo-coded and so is not available in GIS environment. For this study, data from the Trans-European Transport Network (TEN-T)[3] (figure III) and the EuroGlobalMap (figure IV) are used. The TEN-T network is a European Commission policy directed towards the implementation and development of a Europe-wide network of roads, railway lines, inland waterways, maritime shipping routes, ports, airports and rail-road terminals. The Trans-European Rail Network is made up of the Trans-European high-speed rail network as well as the Trans-European conventional rail network. The map is available from the European Commission.

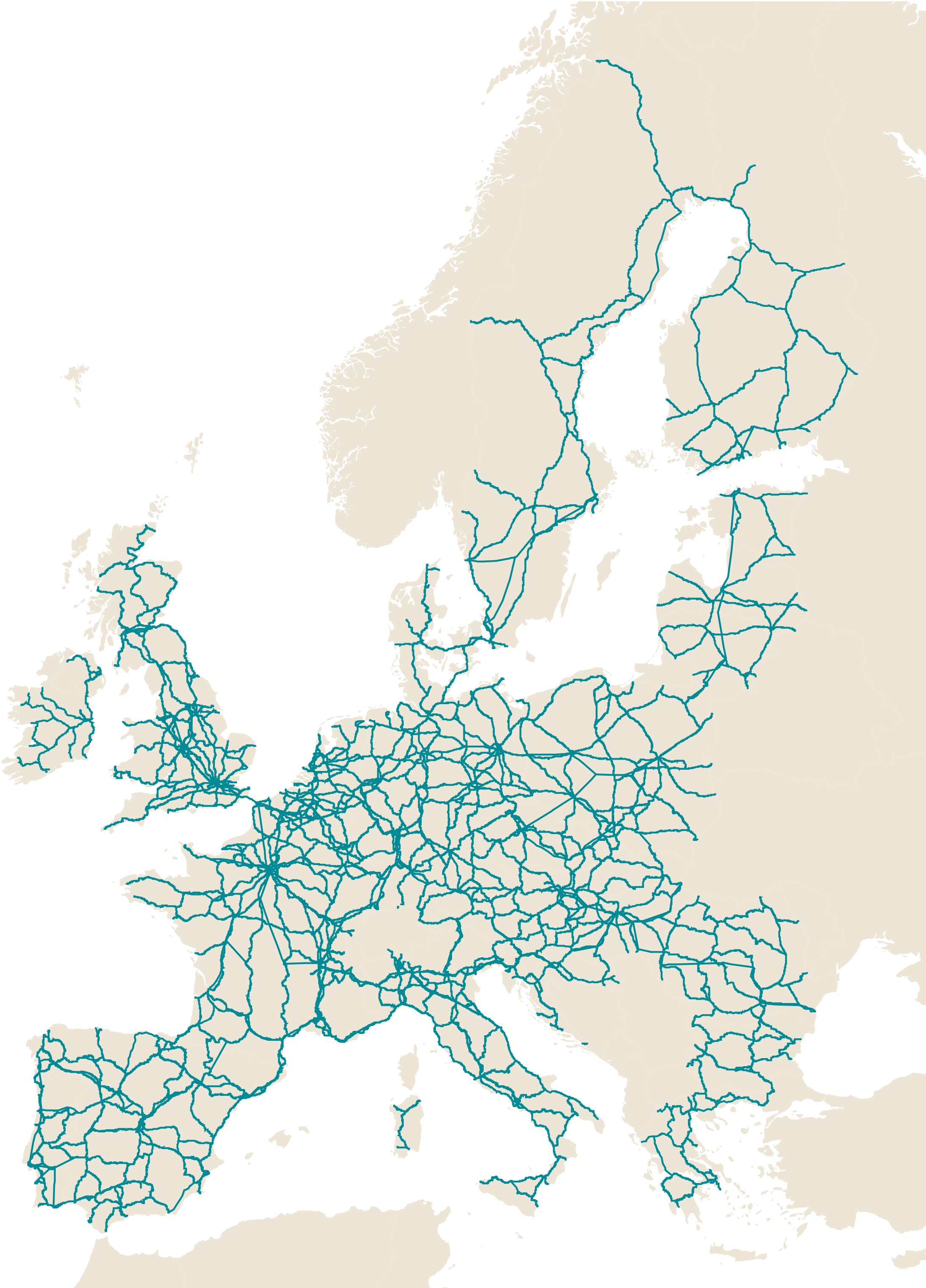
20. The EuroGlobalMap is a 1:1 million scale topographic dataset covering 45 countries and territories in the European region. It includes the TEN-T network but there are no data for Belarus, the Russian Federation, Turkey and some of the Western Balkans countries. It has been downloaded from the EuroGeographics website.[4]

21. Rail-road terminals important for international combined transport have been defined in the European Agreement on Important International Combined Transport Lines and Related Installations (AGTC). This Agreement was done in Geneva on 1 February 1991 and entered into force on 20 October 1993. As these terminals have not been geo-coded so far, data on TEN-T rail-road terminals are used for this study. These data have been extracted from the TEN-T Comprehensive Network, for European Union Member States and neighbouring countries (figure V).

[3] For more information, see ec.europa.eu/transport/themes/infrastructure_en

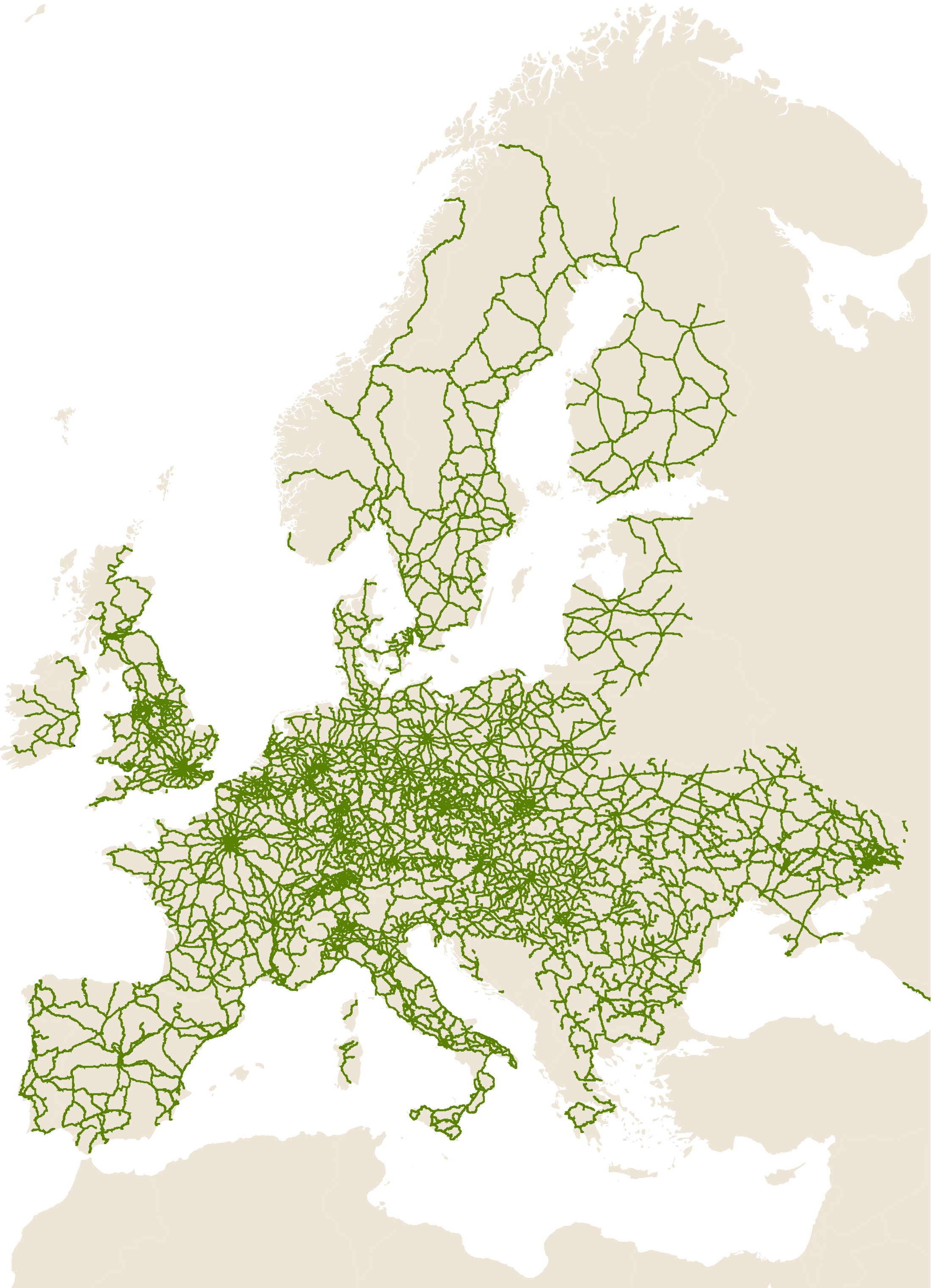
[4] For more information, see eurogeographics.org/products-and-services/open-data/. © EuroGeographics. Original product is freely available at eurogeoarchive.srgry.uk. Terms of the licence available at eurogeoarchive.srgry.uk/form/topographic-data-eurogeographics

Figure III
The TEN-T rail network



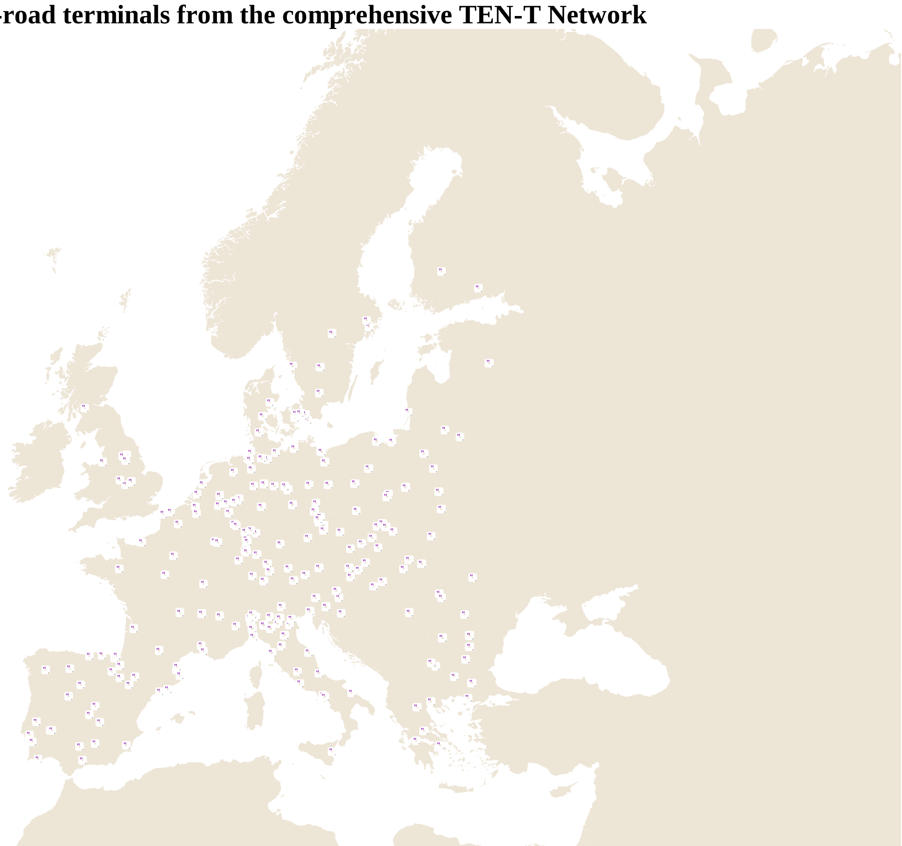
Source: European Commission

Figure IV
The EuroGlobalMap rail network



Source: EuroGeographics

Figure V
Rail-road terminals from the comprehensive TEN-T Network



Source: European Union, 2018

B. Main rail network in North America

[place holder to inform about the main rail network in North America/Canada]

C. Traffic flows on E Rail network and rail-road terminals

22. As for E Roads, to respond to new data requirements and changes in traffic patterns, censuses related to the E Rail network are conducted by ECE. Information on the extent to which various types of trains use different railway routes enables improved land use management and better integration of rail traffic in the planning processes of the country itself. It allows, at the international level, adequate maintenance, renewal and improvement programmes. This information also contributes to finding solutions to the problems raised by traffic congestion and facilitates the study of environmental issues, rail safety and energy consumption. Such censuses are undertaken every five years and for the purposes of the coverage of the E Rail Censuses, the rail network to be considered consists of lines that are included in Annex 1 of the AGC Agreement, lines that are included in AGTC Agreement and lines in the Trans-European Rail Network.

23. Two categories of trains are counted: passenger trains and goods trains. For each E railway line in ECE member State, the annual number of trains, per network segment, by direction and by train category is recorded. These data serve as a possible indicator defining the criticality of the rail transport network (figure VI).

24. The accuracy of the network presented depends on the geographical location of the rail segments communicated by the ECE member States in their answers to the census questionnaire. As for road census, the rail census map doesn't always show rail segments that line up perfectly to the real network and shows instead straight-line paths.

25. No public data are available for this study on the volumes of freight processed in the rail-road terminals

Figure VI
The E rail network censuses: number of trains (transport of goods) (combined for 2005 and 2010)

Source: ECE

D. E rail network analysis

26. Similarly to E Roads network, E Rail network is rather dense except for its northern and eastern parts (figure III). However, even where the network is dense, as trains follow their scheduled paths, rerouting is a much more difficult task in case of disruption on the rail network than for rerouting vehicles on the roads. In case rerouting is possible, same principle applies. The network segment to which the train traffic is rerouted should have the capacity to absorb the additional traffic. Modal change, in particular to road transport, can serve as viable option. For freight in transit, modal change can be an option if rail-road terminals are available on the route.

27. The data on the annual number of trains (section C above) show intensive use of the rail network in central part of the region (Austria, Germany, Poland and Switzerland) and a few other selected routes. Other segments appear to be used less intensively. Stress tests of specific routes or segments of the rail network should be performed to understand whether or not they are critical. At such routes or segments a disruption would trigger considerable socioeconomic impacts.

IV. Euro-Asian Transport Links network

28. As the inland links between Europe and Asia have been receiving an increasing attention in particular for transport of freight by block trains, and this transport should be increasing in volume, especially in view of the growth in e-commerce, Euro-Asian Transport Links (EATL), both EATL roads and EATL rail are included in this study. They have been identified in the Euro-Asian Transport Linkages project facilitated by ECE[5] (figure VII).

29. No data on annual number of trains or average daily traffic on respectively the EATL rail network and EATL roads are available for this study.

[5] More information about the project can be found at: http://www.unece.org/trans/main/eatl.html

Figure VII

The Euro-Asian Transport Links network (rail and road routes, inland and maritime ports.

Source: ECE

V. Waterways

A. E Waterway network and Ports

30. The Waterway network in ECE region has been developed in the framework of the European Agreement on Main Inland Waterways of International Importance (AGN). The Agreement was done in Geneva on 19 January 1996 and entered into force on 26 July 1999. It establishes a plan for the development and construction of E Waterway network and covers inland waterways, coastal routes and ports of international importance.

31. The European Inland Waterways of international importance are those belonging to classes IV to VII. The class of a waterway is determined by the horizontal dimensions of motor vessels, barges and pushed convoys, and primarily by the main standardized dimension, namely their beam or width. Main inland waterways which follow mainly north-south direction providing access to sea ports and connecting one sea basin to another are numbered 10, 20, 30, 40 and 50 in ascending order from west to east. Main inland waterways which follow mainly west-east direction are numbered 60, 70, 80 and 90 in ascending order from north to south.

32. The E Waterway network and E Ports have been put into GIS environment by ECE (figure VIII). Additional data from the ECE Inventory of Main Standards and Parameters of

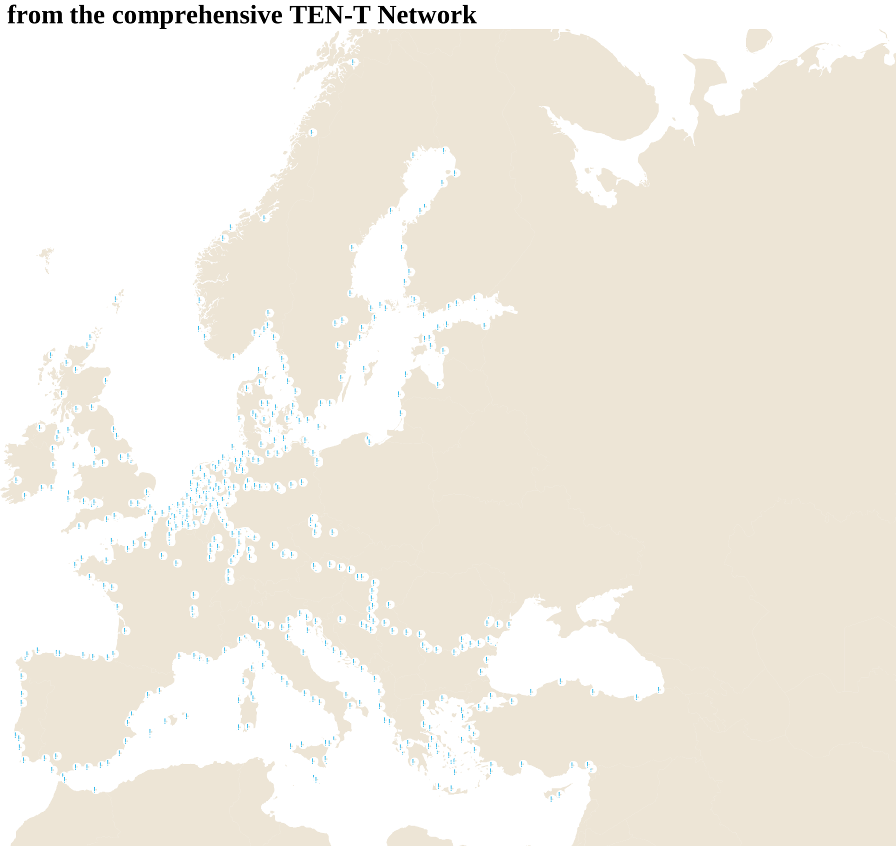
the Waterway Network (Blue Book) are also included and offer an inventory of existing and envisaged standards and parameters of E-Waterways and Ports.

Figure VIII
The E Waterways network (waterways and ports)

Source: ECE

33. The TEN-T data for ports have also been considered, in order to include ports which are not part of the E network. These data have been extracted from the TEN-T Comprehensive Network, for European Union Member States and neighbouring countries, and covers inland and maritime ports (figure IX).

Figure IX
Ports from the comprehensive TEN-T Network



Source: European Union, 2018

B. Traffic flows on E Waterway network

34. Currently there are no public data available on E Waterway traffic flows collected at the regional level. Nevertheless, the Working Party on Inland Water Transport considered the collection of inland waterway traffic data through a census similar to those existing for E Roads and E Rail network at its meeting in 2018. It was planned that the census could be held in 2020. In addition to AADT, particularities of inland waterways could be taken into account, such as their seasonal nature, low water periods or other periods when navigation is stopped or hindered. This information could also contribute to the modal shift from other inland transport modes and facilitate the study of environmental issues, safety and energy consumption of inland water transport. An additional objective of the E Waterway traffic census would be the measurement of the performance of the waterway network, expressed mainly in tonne-kilometres, by the different types of vessels counted.

35. No public data are available for this study on the volumes of freight processed in the E Ports.

C. E waterway network analysis

36. The E Waterway network is sparse compared to E Rail or E Roads networks. Its main objective is to provide alternative transport possibilities for freight on the main waterways in north-south and west-east directions. Disruptions on the network are

relatively rare. If they occur, socioeconomic losses are to be incurred. In such a case, the objective is to minimise the losses. The freight can be temporarily warehoused until normal operation is restored or alternatively modal change needs to be considered.

37. As for rail and road networks, stress test should be done locally on the E waterway network to understand possible impacts of the disruptions on routes.