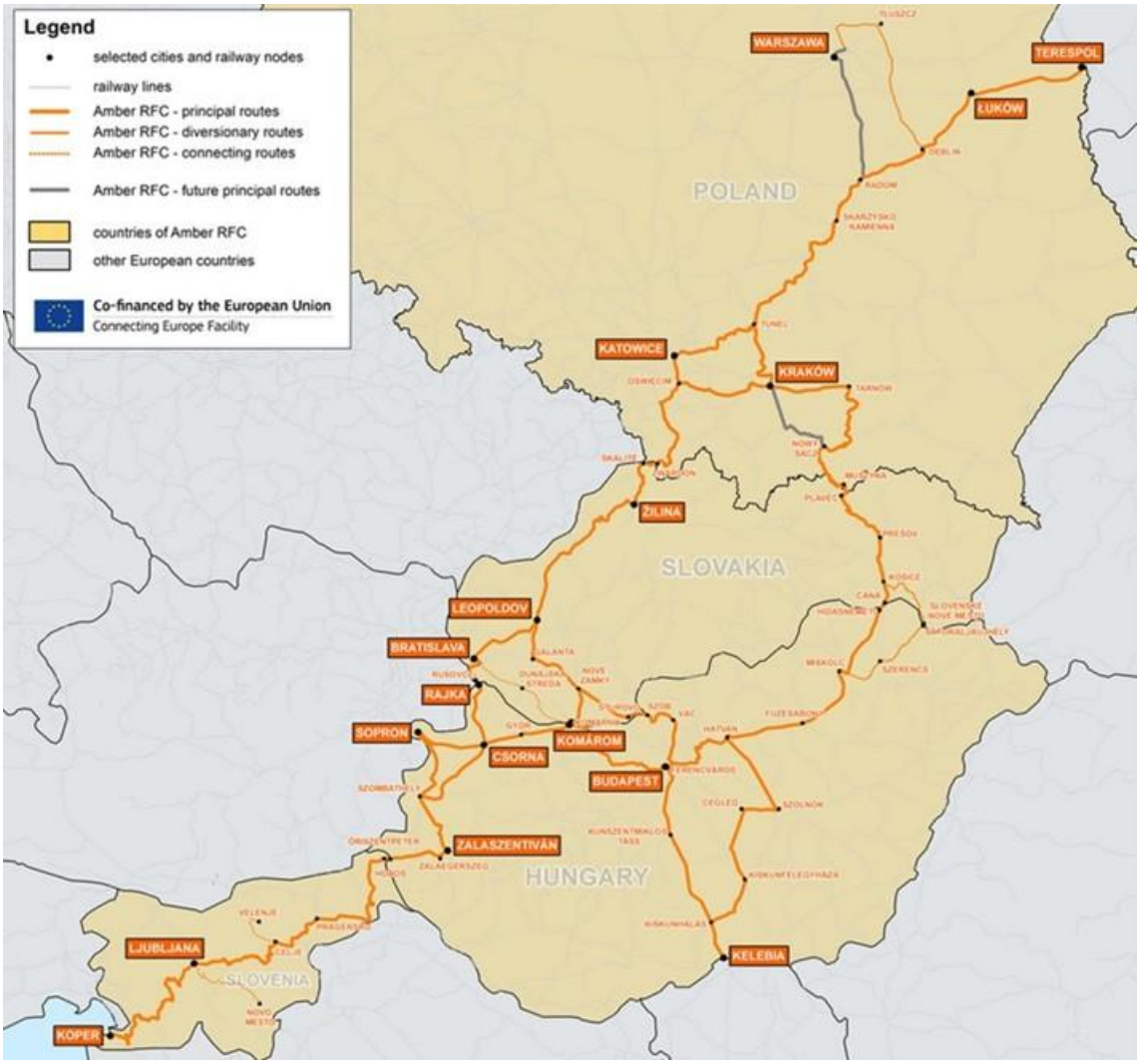
Amber RAIL FREIGHT CORRIDOR

TRANSPORT MARKET STUDY

2024 UPDATE



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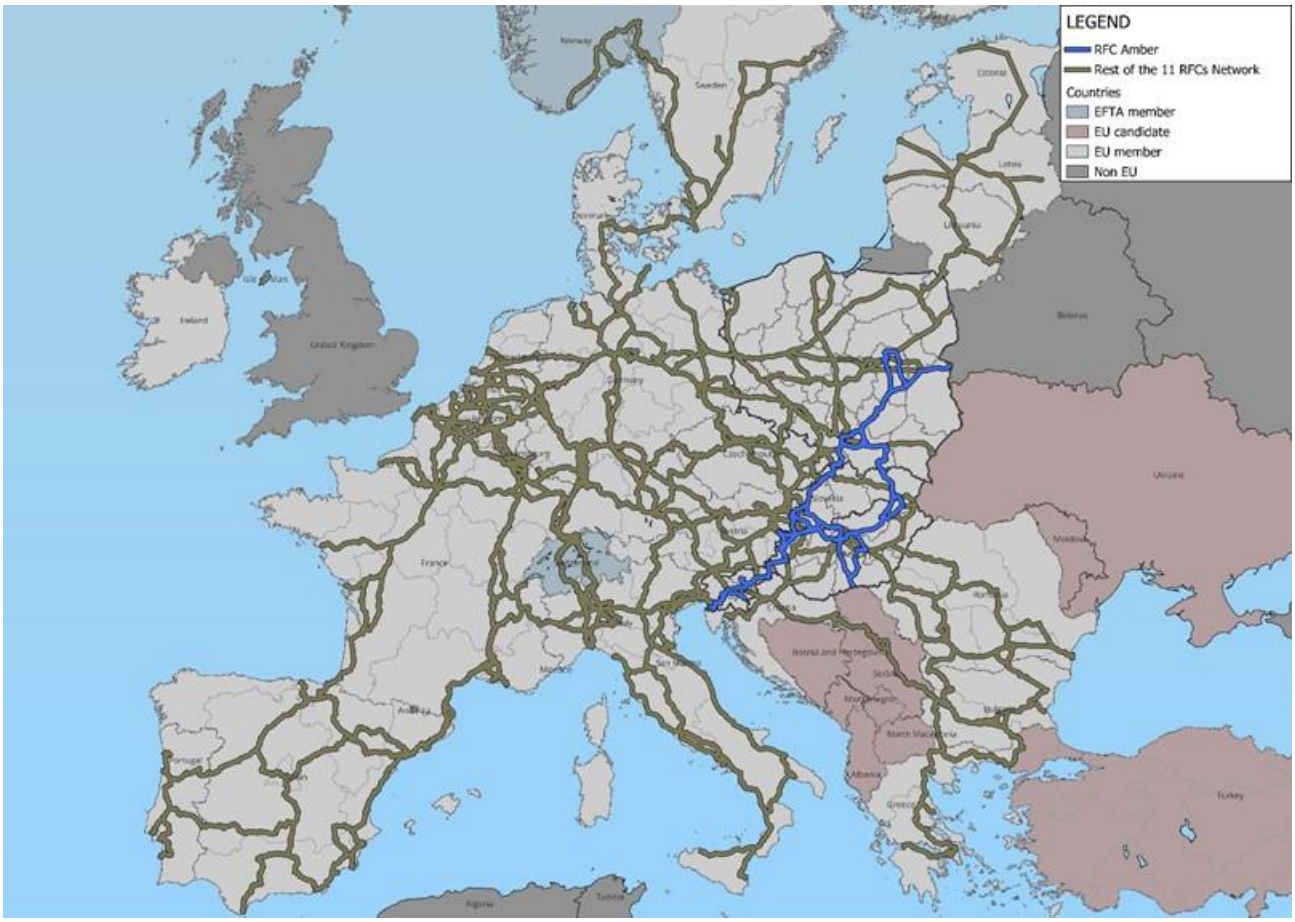
EXECUTIVE SUMMARY

RFC AMBER 2024 TMS UPDATE RESULTS WITHIN THE 2024 JOINT TMS UPDATE OF THE 11 RFCS BELONGING TO THE EUROPEAN RAIL NETWORK FOR COMPETITIVE FREIGHT

The Rail Freight Corridor North Sea-Mediterranean (RFC Amber) is one of the 11 RFCs currently in operation, established under the scope Regulation (EU) 913/2010 concerning a *European rail network for competitive freight*. According to Article 9.3 of Regulation (EU) 913/2010, the Management Board of the RFC shall carry out and periodically update a Transport Market Study (TMS) related to the observed and expected changes in the traffic on the freight corridor as a consequence of the RFC being established.

Over the past decade, RFCs elaborated first TMSs and, in most cases, TMS updates. However, these studies were carried out without a common approach or a shared methodological framework. To support the RFCs in achieving compliance with the above requirement in a coordinated and harmonised manner, the Management Boards of the 11 RFCs decided to execute a Joint TMS Update under the coordination of RailNetEurope (RNE). The main findings and results of the 2024 TMS Update for the RFC Amber are summarised in the following paragraphs.

The RFC Amber within the 11 RFCs network



Source: Authors based on CIP

For the analysis of the current and future transport markets along the 11 RFCs, a European-wide transport model has been used – the NEAC Model – which combines socio-economic, trade and transport statistics

with traffic flows for different transport modes. The geographic scope of the model covers the European Union and the non-EU countries crossed by the 11 RFCs and involved in their catchment areas. The model has been calibrated to the year 2022 (Model Base Year). Future scenarios have been elaborated for the 2030 time horizon.

Due to the adoption of a common, network-wide approach and use of an EU-wide network model, the analysis of the individual RFCs has been performed within the framework of the 11 RFCs network and overall European policy and market trends. This approach is also appropriate considering that the 11 RFCs share many infrastructure components, i.e. corridor lines, logistics nodes and Border Crossing Points, as well as their catchment areas. Also, regulatory, policy and economic backgrounds and developments, as well as most available statistics on the sector, generally concern the country or EU territorial scale.

Specifically concerning the study policy background, the 2024 11 RFCs Joint TMS Update has been conducted in the framework of the rail sector specific milestones introduced by the European Commission in its Smart and Sustainable Mobility Strategy to support the achievement of the ambitious target of the European Green Deal, of reducing transport emissions by 90% by 2050 (compared to 1990 levels), i.e., doubling passenger high-speed rail traffic by 2030 and tripling it by 2050, while increasing rail freight by 50% by 2030 and doubling it by 2050 (compared to 2015 levels). With reference to the 50% target growth set in the EU policies for the period 2015-2030, the following table provides transport volume figures in million tkm for the EU27 in 2015, and 2022. Data show that the gap to be filled between 2023 and 2030 is significant, especially for the international segment.

Freight volume (million tkm) in 2015 and 2022

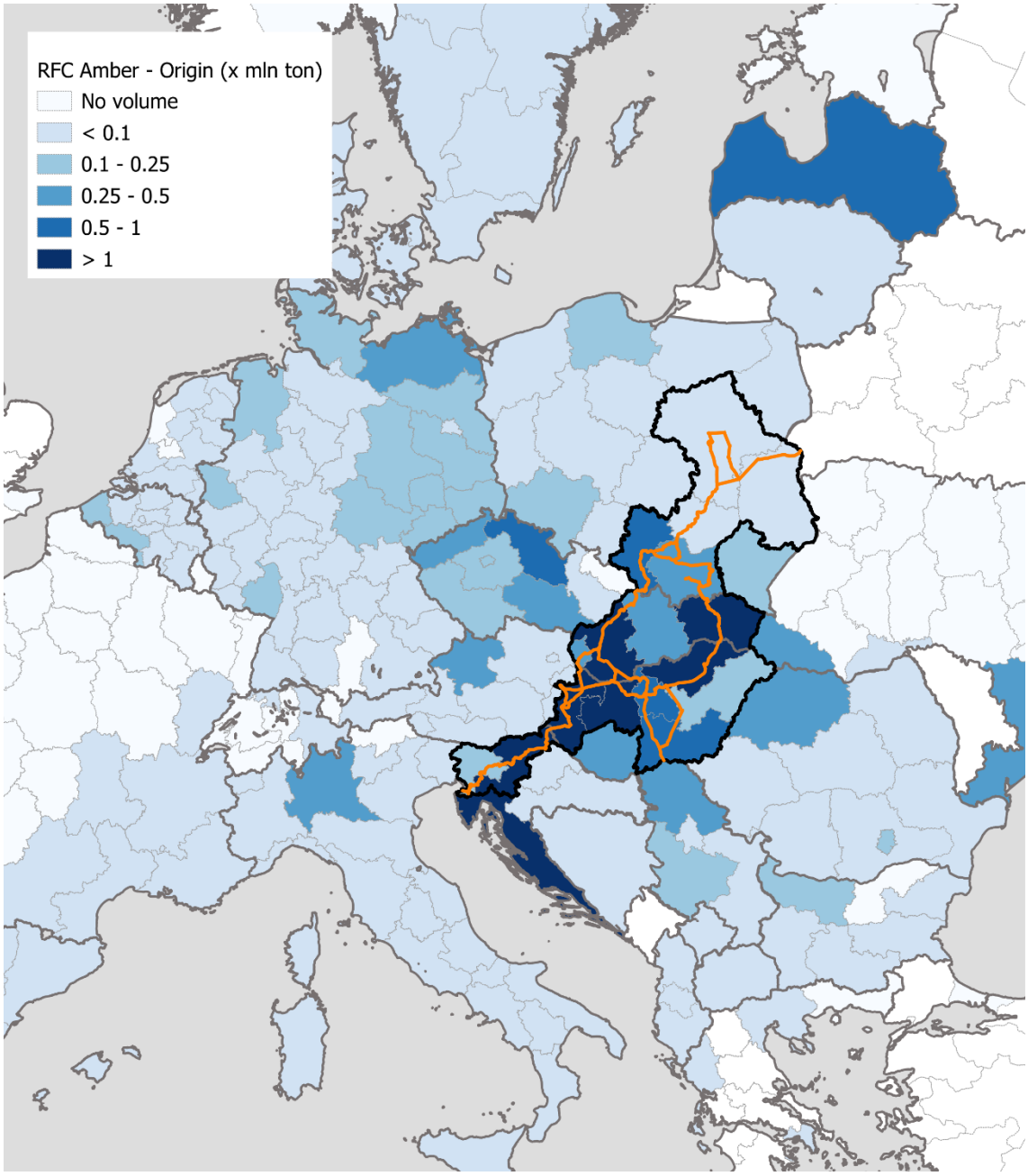
	2015	2022	Var. % '15-22
International rail freight transport	155,289	149,032	-4%
National rail freight transport	181,811	199,830	10%
Total rail freight transport	337,100	348,862	3%

Source: Eurostat [rail_go_typepas]; Notes: (1) Data for Belgium are excluded from the total as they are not available for 2015 and 2022. (2) Data are limited to main undertakings

For the analysis of the current market (Base year scenario), train data from the Train Information System (TIS) managed by RNE have been used, which combined with available trade and economic data available at the NUTS 2 area, served as a basis to define the RFC Amber catchment area and main origin and destinations, prior to estimate the volumes of the transported goods and the modal share by land transport mode.

The catchment area for international rail freight transport of the RFC Amber exceeds the corridor area. It captures (large parts of) Poland, Slovakia, Hungary and Slovenia. A large proportion of the rail freight transport uses the RFC Amber, and its border crossing points, to ship freight by rail from different origins to different destinations (see overview in the next figures). The picture below shows the origins of the RFC Amber, with important origins such as the port of Koper, as well as other inland locations such as Bratislava, Budapest, Central Transdanubia (HU) and Western Transdanubia (HU). Also, outside the corridor area of the RFC Amber, different zones can be seen that contribute to rail freight transport of the RFC Amber, such as Milan or Latvia. Note that outside the corridor it often concerns small amounts of volume.

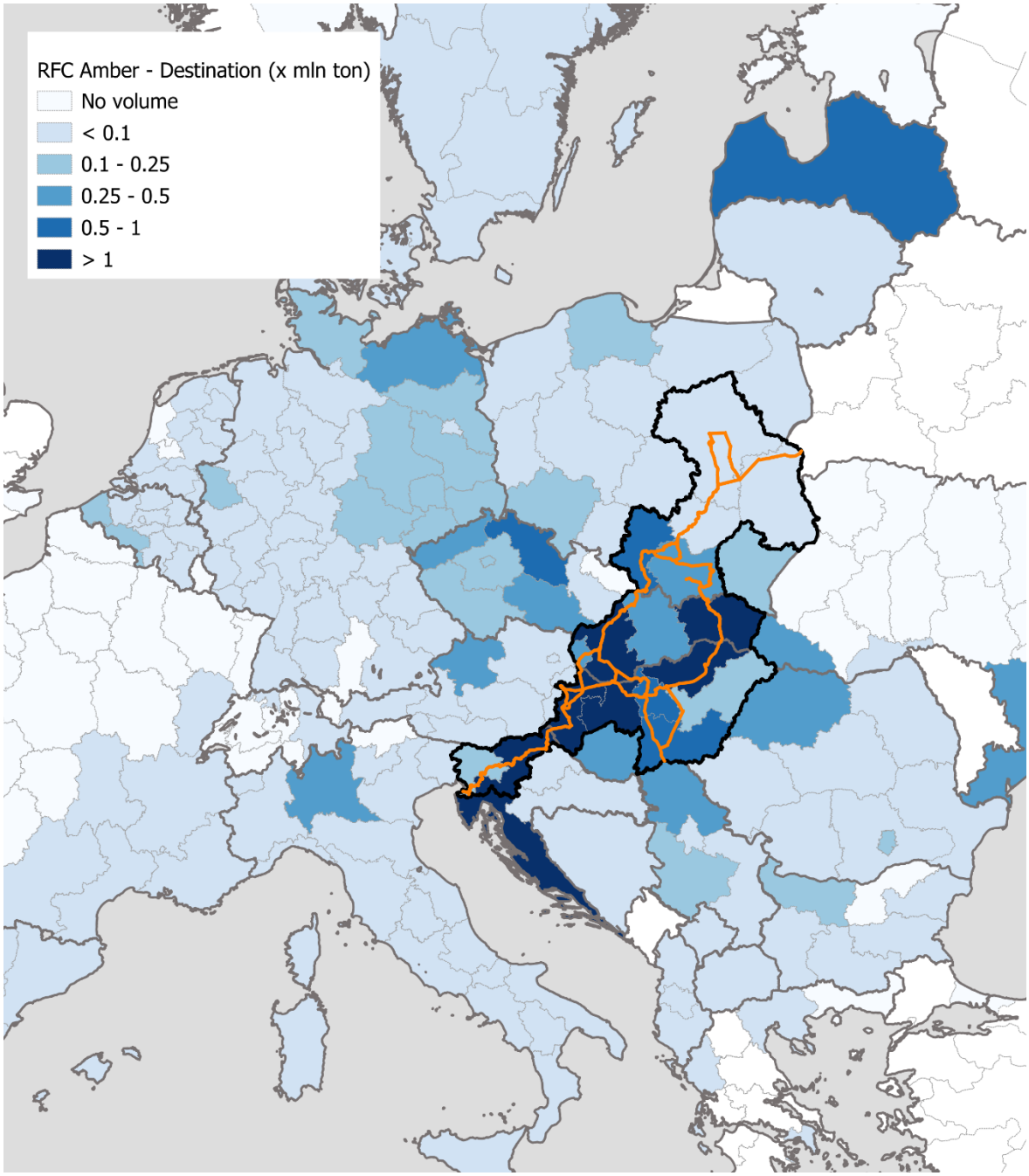
Origins of international rail freight volume (in million tonnes) that use the RFC Amber rail network and the delineation of the potential RFC Amber catchment area



Source: NEAC. Legend: Orange = rail tracks of RFC Amber. Blue = Volume by origin. Black = Delineation of corridor area

The next figure presents the destinations within the RFC Amber catchment area. The figure highlights similar zones as the origins that exhibit the high freight volumes dispatched from these destinations. It is evident from the figure that numerous zones benefiting from RFC Amber's services fall outside the corridor area, such as areas in the Germany, Poland, Spain, and Italy.

Destinations of international rail freight volume (in million tonnes) that use the RFC Amber rail network and the delineation of the potential RFC Amber catchment area



Source: NEAC. Legend: Orange = rail tracks of RFC Amber. Blue = Volume by origin. Black = Delineation of corridor area

For the purposes of the 2024 Joint TMS Update, future scenarios have been built only considering socio-economic and infrastructure developments. This solution reflects the decision to develop only short-term forecasts up to 2030 and adopt a pragmatic and as far as possible, concrete approach, thus omitting the simulation of the possible effects associated with policy developments such as:

- The proposed weights and dimensions directive and electrification of Heavy Goods Vehicles;
- The internalization of external costs of road transport (road pricing);
- Incentives to rail/combined transport operations;

- Technological/operational improvements of intermodal transport solutions and logistics chains;
- Market sensitivity to climate and energy transition.

In line with this approach, the following scenarios have been defined, all of them at the 2030 time horizon:

- *Reference or background scenario*: It describes the economic developments (in terms of GDP changes), which have the most important impacts on the future of rail transport. The base for this is the EU reference 2020-2050 scenario and the World Economic Outlook 2023.
- *Projects scenario*: It provides an overview of the impacts resulting from the expected developments in the rail transport system. Actually, a number of projects are ongoing and/or planned for the improvement of the railway infrastructure belonging to the 11 RFCs network. Such projects were first identified in the 11 RFCs Implementation Plans, which were further confirmed by the 11 RFCs. Furthermore, the list of the investments planned for the development of the 9 TEN-T Core Network Corridors was consulted to integrate the information available from the RFCs. The ongoing and planned investments differ in size. Some are big projects such as Rail Baltica or the Fehmarnbelt. But there are also many investments related to the modernisation and rehabilitation of railway lines to meet the TEN-T standards, improve network interoperability or increase capacity by upgrading railway lines and nodes. Not all projects have been considered for future scenarios simulation purposes. First of all projects have been selected which are assumed to be completed before or in 2030. Second, only major projects were considered which should be able to 'translate' into a time gain or cost reduction. This approach reflects the purpose of the study and nature of the model, limited to freight market analysis and thus transport volumes and modal share estimation by land transport mode, excluding network capacity simulation and assessment, and looking at the short-term time horizon.
- *Sensitivity scenario: an 11 RFC Network in line with TEN_T standards*: It provides an overview of what would happen if – in addition to the investments included in the Projects scenario - ERTMS is fully introduced, 740 meter long trains are allowed to operate anywhere on the whole network, 22.5 tonnes axle load is achieved on the entire network, intermodal loading gauge is also possible along the RFCs and if the rail gauge in Spain and Portugal meets European standards (the Rail Baltica initiative, providing UIC and more generally TEN-T standard interconnectivity to the three Baltic States with Europe is already considered in the *Projects scenario*). This TEN-T completion scenario should be considered as a sensitivity analysis, as the projects required to reach the TEN-T standards will not be fully implemented before 2030.

In the absence of a consistent historical series of data and information on the operations along the 11 RFCs – worth also considering that the RFCs were established and entered into operation in different years between 2013 and 2020, and their alignment adjusted over time to reflect market needs – an e-survey was conducted as part of the 2024 Joint TMS Update – *2023 11 RFCs Joint TMS Update Survey* – to assess the occurred and expected changes associated with their establishment on three main areas: occurred and expected impact of the RFCs, occurred and expected market developments along the RFCs, and market drivers. The survey involved the Railway Undertakings Advisory Groups (RAGs) and Terminal Advisory Groups (TAGs) of the 11 RFCs.

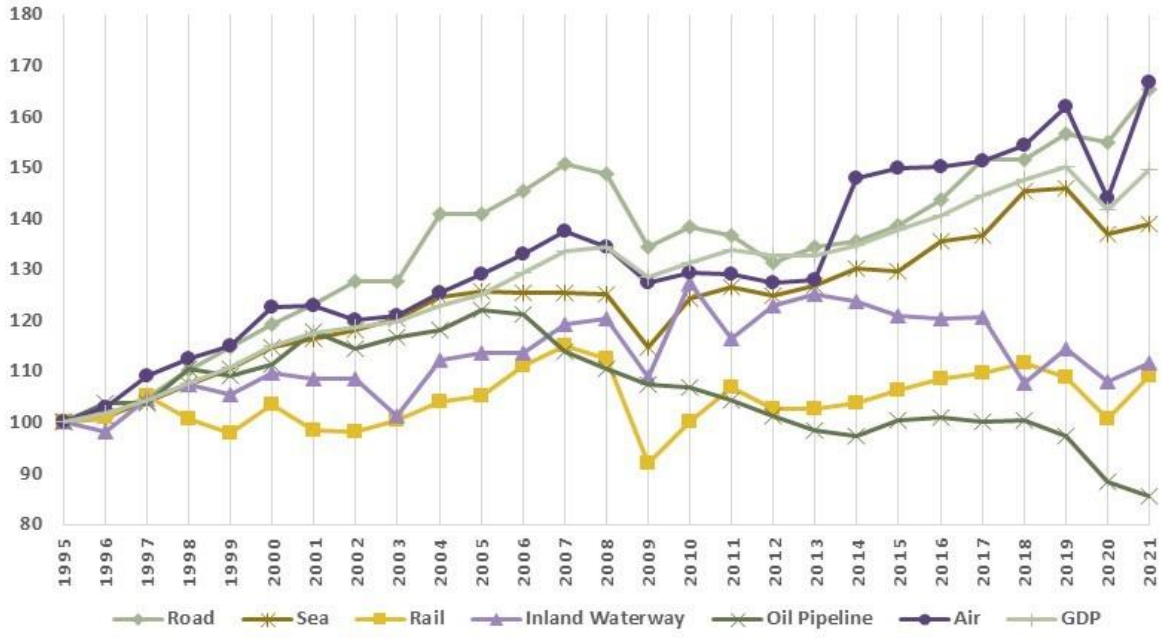
KEY STUDY FINDINGS ON RAIL FREIGHT MARKET IN EUROPE AND ALONG THE RFC AMBER

OVERALL MARKET TRENDS AND SECTOR DEVELOPMENTS

The data available from the European Commission DG MOVE/Eurostat (Statistical Pocketbook 2023 and Rail Market Monitoring Report) and from the Independent Regulators Group (IRG) (Rail Market Monitoring Reports) provide an overview of the development of the European rail freight sector since mid of the 1990s when the rail freight market liberalization started, allowing monitoring trends before and after the 2008 credit crunch, which is considered the second major financial crisis after the 1930s Great Depression, and which was followed by additional adverse events during the past 10-15 years when the 11 RFCs were gradually established and entered into operation. Key findings from the statistical analysis are as follows:

- The period between the entry into force of the rail freight regulation has indeed been marked by a number of socio-economic, health and geopolitical events, which negatively impacted trade and transport flows at the global and European scale. The statistical review shows that the above-mentioned 2008 financial crisis basically altered the economic and transport developments experienced by Europe over the previous decades. EU27 long-term series over the past 30 years show that the effects of this crisis are persisting: albeit positive, the trend of GDP and most transport modes of the following period stands indeed at lower growth rates. Overall, the European rail freight market grew modestly over the last decade, contrasting with the strong development experienced between 2001 and 2008. The EU economy and transport markets were more recently further impacted by the 2020-2021 COVID-19 pandemic and by the current geopolitical crisis that started in 2022 with the Russian war of aggression against Ukraine and deteriorated with the Israel-Gaza conflict and Red Sea crisis.

Transport trends in billion tkm EU27 (1995=100)



Source: EC – DG MOVE – Statistical Pocketbook 2023

- Rail freight transport between 2013 and 2021 marginally grew in the EU27 from about 385 billion tkm to 410 billion tkm, i.e. 7%, which is only half the rate of growth of total transport volumes and GDP. However, over the same period combined transport more than doubled from about 41 billion tkm to 100 billion tkm. Trends for the RFC Amber concerned countries are similar to the EU ones. In the RFC Amber concerned countries rail freight transport grew indeed from about 73 to 79 billion tkm, i.e. 8%.
- The Amber RFC countries are among the ones registering a higher rail modal share in the EU. All Amber RFC countries are indeed positioned within the ten first-ranking EU countries for rail modal share in 2022. However, Poland and Slovakia are also among the ones that have registered a high decline in rail modal share over time. A trend that is likely related to the change in the commodity basket trade. At both EU 27 and RFC Amber concerned country levels, there is an underlying stagnation or decline of dry and liquid bulk commodities (originating even from before the mid of the 1990s), associated with a growth of intermodal transport, a market segment that is apparently growing with the gradual opening of the rail freight market and greening of logistics chains.

Share of rail in total freight transport in % (based on tkm)

	2008	2013	2015	2019	2022	Var. '19-'13	Var. '22-'13	Var. '22-'08
Lithuania	64.5	57.2	56.4	56.8	37.2	-0.4	-20	-27.3
Switzerland	35.3	36.0	37.2	34.1	33.4	-1.9	-2.6	-1.9
Slovakia	**40.0**	**38.6**	**36.3**	**30.7**	**30.1**	**-7.9**	**-8.5**	**-9.9**
Austria	33.3	31.9	32.3	30.6	30.0	-1.3	-1.9	-3.3
Slovenia	**26.7**	**30.5**	**30.9**	**31.4**	**28.8**	**0.9**	**-1.7**	**2.1**
Hungary	**24.9**	**30.3**	**29.1**	**26**	**26.3**	**-4.3**	**-4.0**	**1.4**
Latvia	47.9	43.1	42.3	37.4	26.0	-5.7	-17.1	-21.9
Czechia	**31.9**	**28.0**	**26.1**	**25.9**	**22.0**	**-2.1**	**-6.0**	**-9.9**
Romania	19.9	23.3	25.0	20.5	21.0	-2.8	-2.3	1.1
Poland	**30.5**	**24.2**	**23.3**	**21.5**	**20.8**	**-2.7**	**-3.4**	**-9.7**
Germany	14.6	13.9	14.1	13.7	14.9	-0.2	1.0	0.3
Bulgaria	10.3	7.5	8.7	8.5	11.2	1.0	3.7	0.9
Finland	13.1	12.7	10.9	11.8	10.8	-0.9	-1.9	-2.3
Sweden	10.3	9.6	8.6	9.4	10.5	-0.2	0.9	0.2
Belgium	8.2	6.8	6.9	7.2	7.3	0.4	0.5	-0.9
Luxembourg	9.8	7.2	7.0	6.8	6.1	-0.4	-1.1	-3.7
European Union - 27 countries (from 2020)	6.0	5.7	5.7	5.3	5.5	-0.4	-0.2	-0.5
Croatia	4.5	3.1	3.2	3.5	4.1	0.4	1.0	-0.4
France	4.2	3.6	4.1	3.5	3.7	-0.1	0.1	-0.5
Italy	2.6	2.4	2.6	2.3	2.7	-0.1	0.3	0.1
Estonia	10.4	7.6	4.5	3.3	2.4	-4.3	-5.2	-8.0
Norway	2.0	1.9	1.6	1.6	2.1	-0.3	0.2	0.1
Netherlands	2.0	1.7	1.8	1.8	1.9	0.1	0.2	-0.1
Denmark	1.4	1.8	1.9	1.7	1.6	-0.1	-0.2	0.2
Spain	0.8	0.8	0.9	0.8	0.8	0.0	0.0	0.0
Portugal	0.3	0.3	0.3	0.3	0.2	0.0	-0.1	-0.1
Ireland	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Greece	0.2	0.0	0.1	0.1	0.1	0.1	0.1	-0.1

Source: Eurostat [tran_hv_ms_frmod]

- The COVID-19 pandemic seems to have had different impacts at the EU27 scale on rail freight traffic measured in net tkm, with either increases or decreases in transport volumes between 2019 and 2021. Except Hungary, the RFC Amber concerned countries seem to have registered positive variations during the pandemic period. Baltic States, in particular, also experienced a significant drop in traffic since the start of the Russian war of aggression against Ukraine in 2022. In fact, EU sanctions implemented with Belarus and Russia following the start of the Russian war of aggression against Ukraine impacted negatively on rail freight traffic in the Baltic States, whereas train traffic between Ukraine/Moldova and the EU has increased, particularly through Poland and Romania.
- Since the start of the rail freight liberalisation process late 1990's and 2000's, the market share of the domestic incumbent railway undertakings gradually declined in most EU Member States, whereas the market share of non-incumbents increased together with the operations of foreign incumbents. As a general pattern, common to the EU27 and RFC Amber concerned countries, the trend of the market share by domestic incumbents continued to decline in the period 2013-2021. In the RFC Amber concerned countries, the market share of the domestic incumbent in 2021 was about 60% on average, 63% considering national and international incumbents.

ANALYSIS OF THE CURRENT AND FUTURE FREIGHT TRANSPORT MARKET ALONG THE 11 RFCS NETWORK

The total volume of international freight transport over land for the 11 RFCs network catchment area is 1,439 million tonnes. The volume of international rail freight transport is 265 million tonnes (about 442 thousand international trains[1]), which is 18% of the total amount of transport to, from, and within the catchment area of the 11 RFCs network. The share and volume of inland shipping (IWW) is 17% (240 million tonnes), and the share of road transport is 65% (934 million tonnes).

Concerning the cargo types[2], the category *Other* (general cargo, including intermodal transport and container) dominates the international freight transport for the 11 RFCs network, by 845 million tonnes of volume. This is about 59% of all international freight transport. This cargo type is mostly transported by road (about 69%). *Dry bulk* is the second largest cargo type at 32% (465 million tonnes). *Liquid bulk* has as share of 9% (128 million tonnes) in the total volume of international freight transport over all land modes.

[1] Using an average of 600 tonnes per train

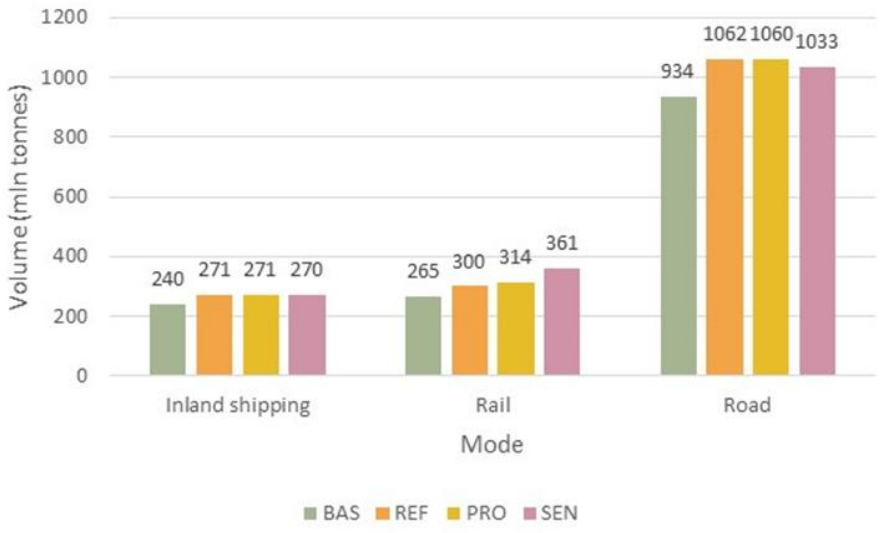
[2] We distinguish dry bulk, liquid bulk, and other (general cargo and container). Dry bulk comprises commodities such as sand, ores and coal. Liquid bulk comprises mainly oil(products) and liquid chemicals. General cargo concerns a broad range of products such as cars, machinery, and electronics. Containers concern intermodal transport. The content is often unknown.

Estimated volume (million tonnes) and share of international freight transport over land by mode and cargo type within the catchment area of the 11 RFCs network

Source: NEAC estimations

The three future scenarios (Reference, Projects and Sensitivity) show an increase in international freight transport in general. Within the 11 RFCs network catchment area, due to economic growth (EU Reference and UN), the increase in general is about 13%. This is in line with the GDP growth for the EU27, which is 17%. Inland shipping shows a growth of 13% (from 240 to 271 million tonnes), road has a growth of 14% (from 934 to 1062 million tonnes) and rail transport of 13% (from 265 to 300 million tonnes). In the absence of further developments, the rail freight market is expected to grow at a slower pace compared to GDP and to the overall transport sector, therefore losing market share. This is due to the changing trends in the basket of transported commodities and differentiated geographic demand growth distribution. For all land freight transport, the Projects scenario and the Sensitivity scenario have a limited impact on the overall growth of international freight transport.

Development of volume (in million tonnes) by mode and scenario for the 11 RFCs network catchment area



Source: NEAC estimations; Legend: BAS Base year scenario; REF Reference scenario, PRO Projects scenario; SEN: Sensitivity scenario

Focusing on international rail freight transport, the Reference scenario expects a growth of 13%, which is approximately 35 million tonnes extra in Europe compared to the 2022 situation. Both the Projects scenario and the Sensitivity scenario show the impact of the different rail projects and rail measures. In the Projects scenario, rail transport grows an extra 5% compared to the Reference scenario (300 million tonnes to 314 million tonnes) due to projects. In total this is approximately 14 million tonnes of extra international rail freight transport.

The hypothetical Sensitivity scenario shows that compared to the Reference, there is a potential of 61 million tonnes extra rail freight transport due to longer trains, intermodal loading gauge, ERTMS, and European standard track gauge along the RFCs network. The total expected rail freight transport volumes in this scenario reaches 361 million tonnes, corresponding to a 20% growth compared to the Reference scenario.

Considering both economic and infrastructure developments, the Sensitivity scenario can be regarded as a potential maximum growth for rail transport across the 11 RFCs network area. Compared to the 2022 base year, transport volumes would increase from 265 to 361million tonnes i.e. by 36%, out of which around 1/3 is due to economic development and 2/3 to infrastructure investments.

As a result of the analysis performed, it is possible to conclude that the major planned projects along the 11 RFCs network area assumed to be completed by 2030, and the modernisation of railway lines and cross-border sections in the Eastern European corridor countries, are fundamental to removing infrastructure bottlenecks and reducing travel times and transport costs. Such initiatives are expected to increase competitiveness of rail transport on the 11 RFCs network area, and thus on each RFC. Further to these projects, completing the 11 RFCs network in line with the TEN-T requirements is key to increase the rail market share.

With reference to the 50% growth set in the EU policies for the period 2015-2030, the combined observed growth for the period 2015-2022 and expected for the time frame 2023-2030 (+36%) still lags below the target. Therefore, the development of a high-quality and interoperable network does not seem to be sufficient to achieve the ambitious targets set in the relevant European transport policies, an outcome that would hardly change even assuming additional mega cross-border projects would be completed like Brenner and Turin-Lyon.

Such targets remain challenging to meet in the absence of a significant change in the structure of the costs of road and rail transport. Internalising external costs of road transport, and or incentives to reduce the costs of rail transport might be needed. The potentially negative impacts on rail market share of measures such as improving the efficiency of road transport shall also be considered, as also reported in a recent study by the Community of European Railway and Infrastructure Companies (CER) – *Study on Weights and Dimensions: Impacts of the Proposed Amendments to the Weights and Dimensions Directive on Combined Transport and Rail Freight Transport*[3]. Market opening appears also to be relevant in increasing the competitiveness of rail transport. A recent study by the European Rail Freight Association (ERFA) – *The European Rail Freight Market; Competitive Analysis and Recommendations*[4] – considers how non-incumbent operators, focussing on the fast-growing intermodal and logistics train segments, are likely to experience further growth in market share in the 2020s. According to the study, competition amongst railway undertakings has made rail more attractive compared with road, which can be partially explained by the business model of non-incumbents, more

[3] https://www.cer.be/cer-reports/study-on-weights-and-dimensions
[4] https://erfarail.eu/news/the-european-rail-freight-market-competitive-analysis-and-recommendations

focused (i.e., intermodal and logistics, block trains, and international traffic), lean and agile, and cost competitive, able to offer better service levels consistently.

ANALYSIS OF THE CURRENT AND FUTURE FREIGHT TRANSPORT MARKET ALONG THE RFC AMBER

The total volume of international freight transport in the *catchment* area of the RFC Amber is estimated at 139 million tonnes in 2022, transported by road, rail, inland shipping and sea shipping. The international rail freight transport volume in this area is estimated at 43 million tonnes (about 72,000 trains). This is 31% of the total amount of freight transport for the RFC Amber. The share of road transport 41%. Sea shipping has a share of 27%. Inland shipping is not relevant for the RFC Amber.

Concerning the cargo types, *Other* (General cargo, including intermodal transport and container) is the most important one at 68 million tonnes (49%). *Dry bulk* is second in the international freight transport within the catchment area of the RFC Amber, with a volume of 52 million tonnes (37%). Liquid bulk has a share of 14% in the total volume of international freight transport over all modes in the corridor area of the RFC Amber.

Estimated volume (million tonnes) and share of *all* international freight transport by mode and cargo type in the *catchment* area of RFC Amber

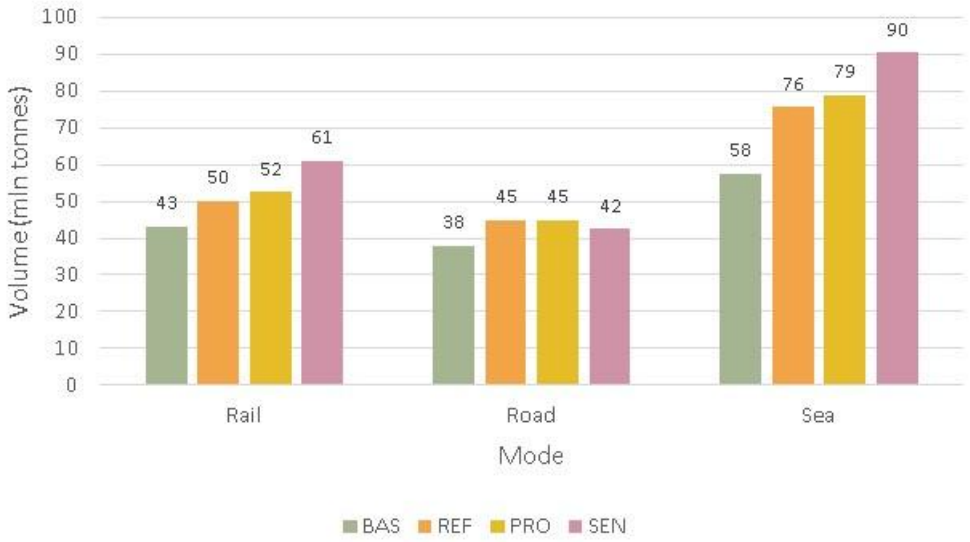
Source: NEAC estimations

The most important *rail* transport origins and destinations can be found in Hungary, Slovakia, Poland, Germany, and Ukraine in locations such as Budapest and Bratislava. The port of Koper serve as a gateway to the hinterland in the RFC Amber. Several other locations outside of the corridor area of RFC Amber are important as well such as Milan or Linz. The most important relation in the RFC Amber is between Koper and Budapest.

Between the 2022 Base year and 2030 Reference scenarios, all modes grow due to economic developments, in general by 23%. Rail transport grows by 16% (7 million tonnes) from 43 to 50 million tonnes. Road by 19% and sea shipping by 31%. In absolute terms, international freight transport by sea shipping grows most by 18 million tonnes. Road increases in volume from 38 to 45 million tonnes.

The Projects scenario does not lead to a significant growth of rail transport (2% extra, +2 million tonnes) in the RFC Amber compare to the Reference scenario. There is a minimal shift between road and rail (not visible in the graph). On the RFC Amber, large and smaller projects across the rail network account for this shift. Also, infrastructure projects outside the RFC Amber contribute to a modal shift or rerouting.

Development of volume (in million tonnes) by mode and scenario for the corridor area of RFC Amber



Source: NEAC estimations; Legend: BAS Base year scenario; REF Reference scenario, PRO Projects scenario; SEN: Sensitivity scenario

As mentioned, the growth in the Reference scenario of international rail transport is expected at 16%, which is approximately 7 million tonnes extra compared to the 2022 situation. This would be (rounded) 11,000 extra international freight trains in the RFC Amber. The total number of international trains would then be some 83,000 trains in the Reference situation in 2030.

The Projects scenario shows the impact of the different rail projects and rail measures. Rail transport grows an extra 2% compared to the Reference scenario. In total it is estimated that this is approximately 2 million tonnes of extra international rail freight transport. This gives (rounded) 2,000 extra trains in the RFC Amber compared to the Reference scenario. This would be approximately 87,000 trains within the RFC Amber.

For the RFC Amber, the Sensitivity scenario shows that there is another potential of 11 million tonnes extra rail freight transport. The total number of unique international freight trains would then be around 88,000. Compared to the 72,000 unique trains in 2022, this is a growth of around 22%. This figure can be regarded as a potential maximum growth.

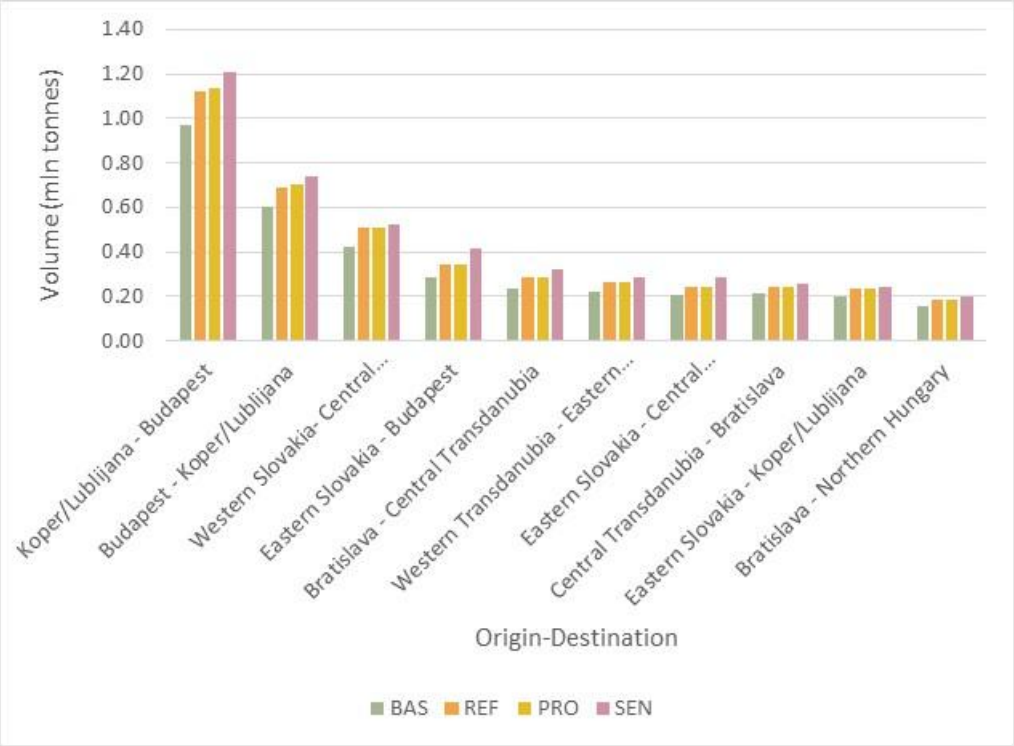
Overall, the Sensitivity scenario can be regarded as a potential maximum growth for rail, considering both economic and infrastructure developments. Compared to the 2022 base year, transport volumes would increase from 43 to 61 million tonnes i.e. by 41%.

The figure below shows the top 10 most important international rail freight transport relations within corridor area of the RFC Amber[5]. The main relation in the base year is between Koper and Budapest. This relation is important for liquid bulk transport with a volume of a bit more just under 1 million tonnes in the Reference scenario. In second place comes the reverse direction with a volume of around 0.6 million tonnes in the

[5] The analysis focusses on the international trains, i.e. those trains crossing at least one BCP. In this respect, it is noticed that in national train databases and in the TIS dataset, trains logged as national ones might operate along international itineraries. The use of the NEAC model made it possible to partially overcome the limitations of the current structure of the datasets. Nonetheless, the results presented in this report might be conservative in the estimation of the international flows along the RFCs.

Reference scenario. All other relations have volumes between 0.2 and 0.4 million tonnes in the Reference scenario.

Development of volume (in million tonnes) of all international rail freight transport by the top 10 relations within the catchment area of RFC Amber

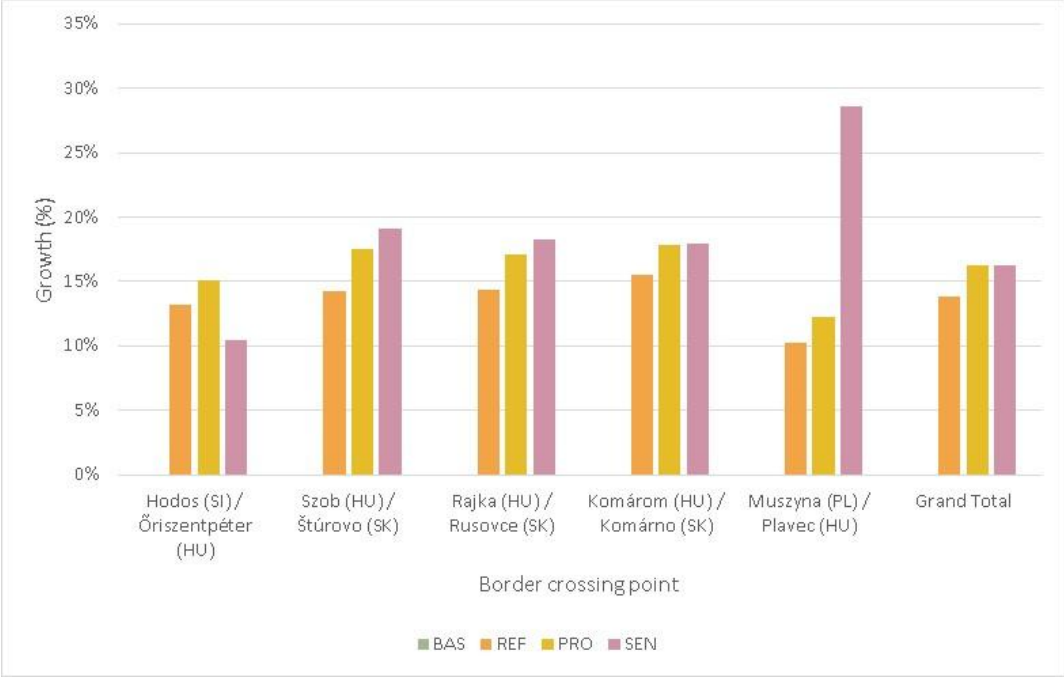


Source: NEAC estimations; Legend: BAS Base year scenario; REF Reference scenario, PRO Projects scenario; SEN: Sensitivity scenario

The different border crossing points in the RFC Amber each show different growth between the 2022 Base year and 2030 Reference, Projects and Sensitivity scenarios. Overall, the Reference shows growth in volume of 14% on the selected BCPs. This is in line with the general growth for rail transport between the 2022 Base year and 2030 Reference scenarios. The completion of different projects by 2030 leads to different growth patterns; on average, the growth in relation to the base is 16% more volume, which translates into 16% more trains on average on the BCPs. The Sensitivity scenario leads to 34% more volume on the selected BCPs, which is 18% more trains compared to 2022. Due to the extra train length, there is less growth in number of trains. Keep in mind that the number of trains on the different BCPs are related. One unique train often passes more than 1 BCP in this RFC.

The total amount of unique trains on some BCPs in 2022 in the graph below is estimated at 29.000 trains. In the Reference situation this would be approximately 33,000. In the Projects scenario, this is 34,000 trains, while in the Sensitivity scenario, this is 34,000 trains (due to extra volume per train, the same as the Projects scenario). Note that not all BCPs are included. A difference can be seen between the estimated 72,000 trains in 2022 and the 29,000 trains on the BCPs in 2022. This is due to international rail transport from China and Ukraine which is not accounted for.

Development of volume (in million tonnes) of international rail freight transport on important border crossing points of the RFC Amber



Source: NEAC estimations; Legend: REF Reference scenario, PRO Projects scenario; SEN: Sensitivity scenario

OCCURRED AND EXPECTED CHANGES DUE TO THE ESTABLISHMENT OF THE RFCS

The e-survey conducted to collect the opinion of the 11 RFCs RAGs and TAGs members on the occurred and expected impact of the establishment of the RFCs, involved 42 representatives of the RAGs and 30 members of the TAGs, who submitted valid questionnaires between September 2023 and January 2024. Whereas the overall number of responses makes the survey outcome meaningful for the analysis of the occurred and expected changes at the 11 RFCs network scale, an analysis specific to each individual RFC would not be statistically significant. The survey results are accordingly used in the 2024 11 RFCs Joint TMS Update for the 11 RFCs network. It is worth noticing that the survey responses reflect the views of the respondents at the time of submission of the questionnaire (Autumn 2023/January 2024). They furthermore represent a partial view of the market as the sample of the respondents is not representative of the market universe; and may contrast with the findings from the statistical review presented in the previous section above, as the opinions relate to the RFCs and international trains, whereas national statistics refer to the whole country network and national as well as international traffic. The main findings from the survey are summarised in the following bullet points for each of the three investigated areas.

Occurred and expected impact of RFCs, in the areas of governance, operational efficiency and capacity management

- The opinion of the 11 RFCs RAGs and TAGs members about the changes within the governance area is positive, especially in terms of cooperation with the market, including but not limited to RUs and terminal operators, as well as concerning facilitation of discussion among Member States about the issues affecting the competitiveness of international rail freight transport. The opinion about the progress made regarding cooperation between RFCs and Core Network Corridors (CNCs)/ERTMS

horizontal priority is less favourable. The market opinion is unfavourable about the progress made on harmonising international freight rail services' legislative, regulatory, procedural and operational aspects. The expectations of the market players concerning the future impact of the programmes and activities of the RFCs are relatively positive concerning all aspects. Respondents consider the cooperation between RFCs and an EU Network of Infrastructure Managers (ENIM) as assumed in the proposal for the new capacity regulation, to be the best governance solution for bringing issues forward.

- The stakeholders' opinion about the changes that occurred within the operational efficiency area is also generally positive, except for the progress made in the promotion of technical and operational harmonisation of the European railway transport system towards its interoperability. The respondents' expectations concerning the future impact of the programmes and activities of the RFCs are relatively positive concerning all the assessed issues related to operational efficiency. Cooperation between RFCs and an EU Network of Infrastructure Managers (ENIM) is also considered the best-fitting governance solution to bring operational efficiency issues forward.
- The respondents' opinions about the changes that occurred within the capacity management area are predominantly unfavourable. Notwithstanding the market's negative opinion of the progress made since the establishment of the RFCs in this area, the expectations on the future impact of the programmes and activities by the RFCs are rather positive with regard to all the investigated aspects related to capacity management. The best governance solution for capacity management improvements is deemed to be the cooperation between the RFCs and an European Network of Infrastructure Managers (ENIM).

Occurred and expected market developments

- The vast majority of the e-survey respondents operated or still operate rail services or manage/operate terminals serving trains across at least one border crossing point on any of the RFCs. Most of them also operated or served international rail freight transport before the establishment of the RFCs. The majority of the respondents declare they experienced an increase in their operations since 2013, and most of them also have a positive expectation about the future, expecting overall market growth.
- The majority of the RUs and terminal operators declare the market is stable or growing along the RFC Amber since 2013.
- The prevailing type of international trains operated on the RFCs Network consists of intermodal trains, followed by conventional block trains and single-wagon load trains. Most RUs and terminal operators experienced growth in intermodal train operations in the past years, whereas the trend for conventional block and single-wagon load trains is predominantly stable. Most respondents have a positive expectation for the future in terms of traffic growth for all market segments.
- Concerning traffic between logistics nodes, most operations relate to Port to Rail-Road Terminal (RRT) transport, followed by RRT to RRT services and Port to Port operations. Experienced variations by RUs were mostly positive for the Port to RRT or RRT to RRT segments and stable for the Port to Port one. Terminal operators have predominantly experienced growing trends in all market segments in the past years. The vast majority of RUs and terminal operators are expecting positive future trends for the three market segments.
- Regarding service distances, most operations cover distances between 300 km and 900 km, followed by services covering distances longer than 900 km and below 300 km. RUs experienced mostly

positive variations for services covering distances longer than 300 km and declared the market is stable for operations below 300 km. Terminal operators have predominantly experienced growing trends in all market segments in the past years. The vast majority of RUs and terminal operators are expecting positive future trends for the three market segments.

Market drivers

- RUs and terminal operators have very similar views about the effects of the main market drivers on the growth of international rail freight transport in the short term, i.e., up until 2030. Most identified drivers are expected to have positive effects as they are assumed to improve rail transport's competitiveness. At the same time, the geopolitical context and socio-economic outlook, as well as the shortfall of the labour force, are perceived as threats.
- The socio-economic outlook is ranked first by the market, followed by infrastructure development and interoperability, policy and economic incentives to promote shift to rail. Increased performance of rail freight services and harmonisation of procedures and national legislation to improve cross-border operations are the two most relevant market drivers, according to the respondents, if considering both first- and second-ranking options.
- Although indicated as having a potential negative impact on the market, labour shortages and geopolitical context are not ranked among the most critical market drivers. Finally, technological improvements towards better integration and increased efficiency of multimodal logistics chains, better-integrated RFCs and terminal capacity management do not seem to be considered priority issues by the RUs and terminal operators.

RECOMMENDATIONS ON FACILITATING AND STRENGTHENING THE RAIL FREIGHT MARKET ALONG THE 11 RFCS AND THE RFC AMBER

In line with the overall study approach aimed at conducting the 2024 RFC Amber TMS Update as part of a Joint TMS Update of the 11 RFCs, study recommendations are primarily formulated focussing on the short-term development of the 11 RFCs belonging to the European rail network for competitive freight. RFCs share indeed both infrastructure and market, and more importantly a same EU policy background and overall socio-economic and geopolitical challenges despite some differences between Eastern and Western as well as Northern and Southern European countries. The 2024 11 RFCs Joint TMS Update allows for an estimation of the current market with reference to the RFCs catchment areas based on a common approach and tool, and for an overall assessment of the impact of the development of the 11 RFCs network towards the development and completion of the TEN-T network at standard. In line with the methodology decided to be adopted for the 2024 11 RFCs TMS Update, no assessment of the current and future capacity was performed as part of the study and no detailed quantitative assessment of the current and future market operations by the operators along the individual RFCs and with reference to the expansion or new construction of individual projects and logistics nodes. The adopted approach albeit appropriate for an assessment of the market and modal share of the individual RFCs as part of the 11 RFCs network, does not allow capturing RFCs specific market elements, especially the ones related to operational aspects. Study recommendations have been formulated around two main areas: market developments and targets and institutional and operational developments.

MARKET DEVELOPMENTS AND TARGETS

The simulations made in the study demonstrate that major projects, and particularly the completion of the TEN-T network at standard, would significantly increase the competitiveness of rail freight transport. The post-COVID recovery and the recent geopolitical crises caused delays in the implementation and completion of the projects needed to complete an high quality and interoperable TEN-T network. Price increases and shortages of construction materials particularly affected the advancement of ongoing and planned projects. A high-quality and interoperable network might, furthermore, not be sufficient to achieve the ambitious targets set in the relevant European transport policies, in the absence of a significant change in the structure of the costs of road and rail transport. The following recommendations are proposed to support market development towards the achievement of the EU policy targets:

- Timely complete the development of a high-quality, interoperable network:
  - *Building missing links and removing infrastructure bottlenecks* increasing infrastructure capacity by adding new tracks and lines where needed, increasing their speed and improving their gradient, can solve congestion problems, save energy and reduce transport costs as well as improve travel times. Such developments are relevant at the network level, but produce effects also at the individual corridor scale;
  - *Achieving the requirements set in the TEN-T Regulation towards a Single European Railway Area*, i.e. 740 meter long trains, ERTMS, 22.5 tonnes axle load, intermodal loading gauge, UIC gauge, electrification, is fundamental to support the development of a Single European Railway Area;
  - *Support intermodal and combined transport*. The intermodal market is the most promising international rail freight market segment, requiring improvement of interconnectivity between main railway lines and terminals, increasing the capacity of the existing terminal infrastructure, investing in technologies to facilitate and speed up transport and transhipment operations, and tracking and making more reliable the transport of intermodal units along logistics chains and within logistics clusters.
  - *Stronger cooperation between all involved parties for better effectiveness in the availability and use of funds and the definition of investment implementation strategies focussed on those sections of the network with higher market potential*. For over a decade, the sector has benefited from a stronger TEN-T policy with a dedicated Connecting Europe Facility Fund. Among the different transport modes involved in the TEN-T network, rail and rail cross-border initiatives are treated as a priority. However, the available financial resources are limited overall compared to the financial needs that would be necessary to complete all projects. Investing in infrastructure might not be sufficient, e.g. to be operational, ERTMS also requires rolling stock to be equipped with onboard units.
- *Introduce market regulatory and policy measures to increase the competitiveness of rail freight transport*. Although not a specific subject of this study, regulatory and policy measures might be necessary to facilitate and foster the rail freight market in Europe towards the achievement of higher market shares and EU policy targets. Rail freight transport is generally more expensive and less flexible compared to road transport. Internalising external costs of road transport, and/or creating incentives to reduce the costs of rail transport would increase its competitiveness and support the achievement of the ambitious EU policy targets. In this respect, policymakers shall also consider the

potential effects on the modal share of measures improving the efficiency of road transport. As emphasised in the above-mentioned study by ERFA[6] regulatory measures facilitating market opening appear also to be relevant in increasing the competitiveness of rail transport (e.g. enforcement of antitrust regulations; unbundling of subsidised public service operations from open market business; and ending direct subsidies to or recapitalization of state-owned freight railway undertakings).

INSTITUTIONAL AND OPERATIONAL DEVELOPMENTS

Recommendations on institutional and operational developments are formulated as follows, according to the findings from the market consultation (2023 11 RFCs Joint TMS Update Survey), conducted as part of the 2024 11 RFCS Joint TMS Update:

- *Improve capacity management*. Capacity management is considered by the market and also by the analyses and studies at the basis of the proposal for the new capacity regulation, a key area for improvement. Progress was made in the management of Temporary Capacity Restrictions; however capacity planning remains an issue. Digital Capacity Management as an integral part of the European program "Timetable Redesign (TTR) for Smart Capacity Management" is at the core of the proposal for the new capacity regulation, and it is paramount to reaching Green Deal targets for the transport sector and the rail freight segment within it.
- *Monitor operational performance*. The revised TEN-T Regulation (EU) 1679/2024 identifies new operational requirements, related to punctuality and dwell times at borders. Furthermore, some infrastructure requirements also depend on operations, such as 740 meter long trains. Investing in infrastructure, albeit needed, is long-lasting and capital-intensive. The competitiveness of international rail freight transport also depends on the improvement of cross-border operations and coordinated planning and management of the rail network at the European scale. An RFCs common KPI framework is already in place, and RNE is also already monitoring infrastructure KPIs. Such activities might be continued in light of the new set of requirements foreseen in the revised TEN-T Regulation (EU) 1679/2024 and RFC governance structure, also defined in the Art. 67 of this regulation.
- *Balance network and corridor governance approach*. The analysis of the RFC catchment areas shows that international trains using at least one corridor BCP may actually use more than one RFC. A network approach is more fitting to the planning and management of the network capacity. Geographical specificities and logistics clusters and chains exist that still make the corridor concept useful, especially to support discussion and coordination among IMs and Member States and for a customer-oriented approach aimed at involving RUs and Terminal Operators. This consideration also seems to be in line with the opinions expressed by the 11 RFCs RAGs and TAGs members in the survey conducted as part of this study.

[6] https://erfarail.eu/news/the-european-rail-freight-market-competitive-analysis-and-recommendations

1 INTRODUCTION

1.1 LEGAL BASIS AND PURPOSE OF THE TRANSPORT MARKET STUDY

Regulation (EU) 913/2010 concerning a *European rail network for competitive freight* stipulates the implementation of Rail Freight Corridors (RFCs) and a package of measures to improve the competitiveness of rail freight services along these corridors. 11 RFCs have been established under the scope of this regulation since it entered into force and are currently operational. According to Article 9.3 of Regulation (EU) 913/2010, the Management Board of the RFC shall carry out and periodically update a Transport Market Study (TMS) related to the observed and expected changes in the traffic on the freight corridor as a consequence of the RFC being established. Over the past decade, RFCs elaborated first TMSs and, in most cases, TMS updates. However, these studies were carried out without a common approach or a shared methodological framework.

To support the RFCs in achieving compliance with the above requirement in a coordinated and harmonised manner, the Management Boards of the 11 RFCs decided to execute a Joint TMS Update under the coordination of RailNetEurope.

This report provides the results of the 2024 TMS Update for the Amber Rail Freight Corridor (RFC Amber).

1.2 COMMON METHODOLOGY FOR A JOINT TMS UPDATE

For the analysis of the current and future transport markets along the 11 RFCs, a European-wide transport model has been used – the NEAC Model – which combines socio-economic, trade and transport statistics with traffic flows for different transport modes. The geographic scope of the model covers the European Union and the non-EU countries crossed by the 11 RFCs and involved in their catchment areas. The model has been calibrated to the year 2022 (Model Base Year). Future scenarios have been elaborated for the 2030 time horizon. A short overview of the model is provided in Annex 1 of this report.

The scope of the current market analysis covers the alignment of the RFCs in operation at the time of the start of this study update (June 2023). The future market analysis concerns these lines and any possible expected lines that are currently foreseen to be operational in 2030.

Due to the adoption of a common, network-wide approach and use of an EU-wide network model, the analysis of the individual RFCs is presented within the framework of the 11 RFCs network and overall European policy and market trends. This approach is also appropriate considering that the 11 RFCs share many infrastructure components, i.e. corridor lines, logistics nodes and Border Crossing Points, as well as their catchment areas. Also, regulatory, policy and economic backgrounds and developments, as well as most available statistics on the sector, generally concern the country or EU territorial scale.

1.3 REPORT STRUCTURE

Further to this introductory chapter, the present report includes six additional sections:

- Chapter 2, describing the RFC alignment and infrastructure, the existing bottlenecks and the ongoing and planned projects to solve current gaps with reference to the TEN-T requirements and capacity constraints, as well as an overview of the operational performance of the RFC with particular reference to the international trains and the managed capacity;
- Chapter 3, providing background information to the TMS update, including a summary of the main trends related to rail freight transport in Europe and along the RFC;
- Chapter 4, describing the current transport market along the RFC;
- Chapter 5, illustrating the analysis of the future transport market along the RFC;
- Chapter 6, reporting on the outcome of a market survey conducted as part of this joint TMS update, i.e. 2023 11 RFCs Joint TMS Update Survey;
- Chapter 7, summarising key findings and providing recommendations on facilitating and strengthening the rail freight traffic along the RFC.

1.4 LIST OF ACRONYMS

AB	Allocation Body
BCP	Border Crossing Point
CID	Customer Information Document
CIP	Customer Information Platform
CNC	Core Network Corridor
CRD	Central Reference File Database
EC	European Commission
EU	European Union
GDP	Gross Domestic Product
IM	(Railway) Infrastructure Manager
IRG	Independent Regulators' Group
km	Kilometre
KPI	Key Performance Indicator
ETCS	European Train Control System
ERTMS	European Rail Traffic Management System
PaP	Pre-arranged Path
PCS	Path Coordination System
RAG	Railway Undertaking Advisory Group
RFC	Rail Freight Corridor
RFC AMBER	Rail Freight Corridor Amber
RFC ATL	Rail Freight Corridor Atlantic
RFC AWB	Rail Freight Corridor Alpine-Western Balkan
RFC BA	Rail Freight Corridor Baltic-Adriatic
RFC MED	Rail Freight Corridor Mediterranean
RFC NS-B	Rail Freight Corridor North Sea-Baltic
RFC NSM	Rail Freight Corridor North Sea-Mediterranean
RFC OEM	Rail Freight Corridor Orient/East-Med
RFC RALP	Rail Freight Corridor Rhine-Alpine
RFC RD	Rail Freight Corridor Rhine-Danube

RFC SCANMED	Rail Freight Corridor Scandinavian-Mediterranean
RFP	Rail Facilities Portal
RINF	Register of Infrastructure
RIS	Railway Infrastructure System
RNE	RailNetEurope
RU	Railway Undertaking
TAG	Terminal Advisory Group
TCR	Temporary Capacity Restriction
TIS	Train Information System
tkm	tonne-kilometre
TMS	Transport Market Study
UIRR	International Union for Road-Rail Combined Transport

A general glossary which is harmonised over all RFCs is also available under the following link: https://rne.eu/downloads/.

2 CORRIDOR PRESENTATION

2.1 CORRIDOR CHARACTERISTICS

The Rail Freight Corridor Amber crosses four Member States of the European Union, namely Poland, Slovakia, Hungary, and Slovenia. For the purposes of the Joint TMS Update, the description of the RFC Amber lines focusses, in particular, on the principal and diversionary lines currently in operation, excluding the connecting lines A and B, as well as the expected lines currently not in operation. The total length of the RFC Amber principal and diversionary lines is 3,357 km. Most of the corridor network is located in Hungary (1,275 km) and Poland (1,065 km) followed by Slovakia (623 km), and Slovenia (394 km).

Table 1 Corridor extent by Member State/Country (principal and diversionary lines)

Member State	Length in km
Poland	1,064.72
Slovakia	622.69
Hungary	1,275.21
Slovenia	394.35
Total	**3,356.97**

Source: Authors based on CIP

2.1.1 CORRIDOR LINES

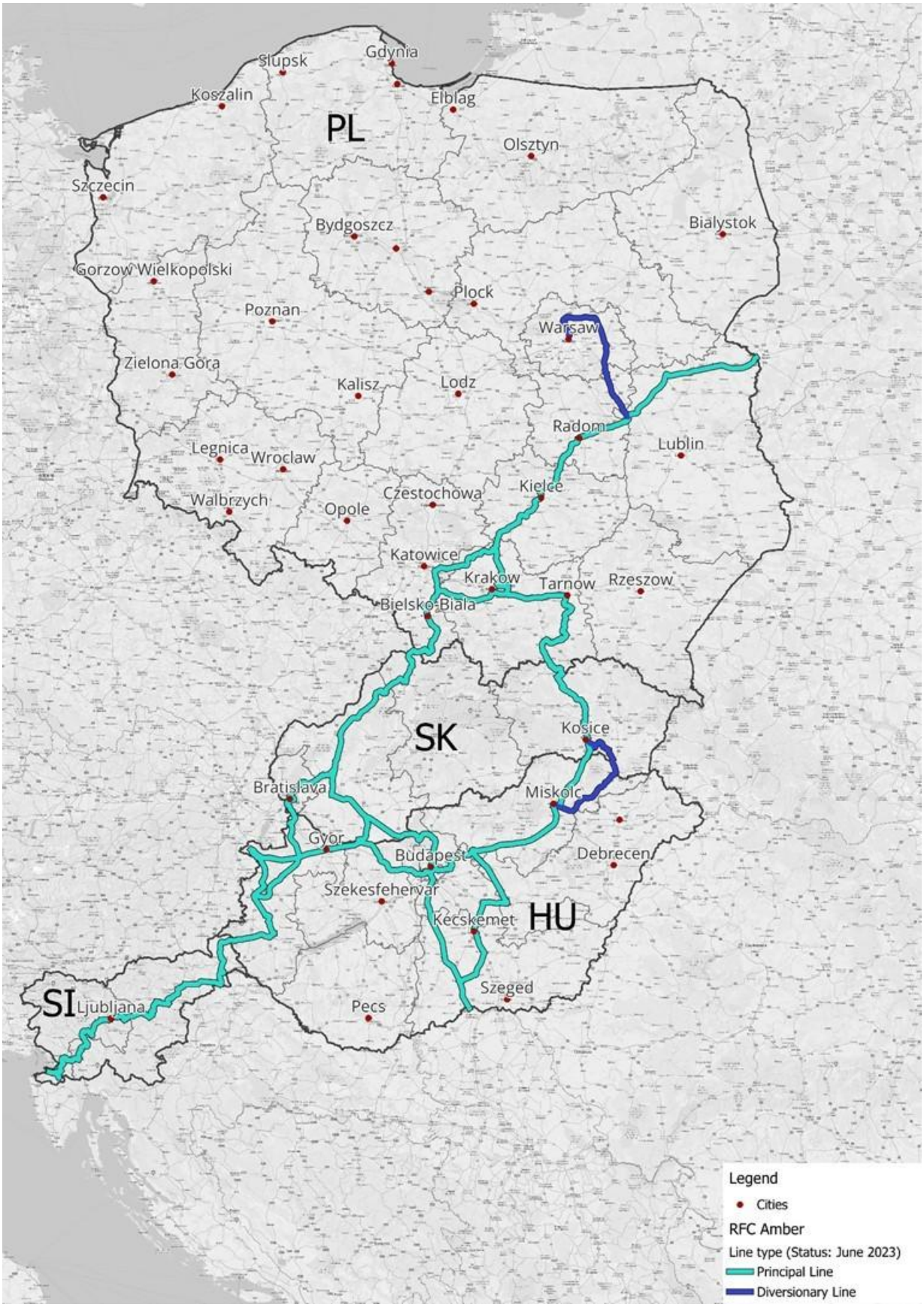
The following table summarises the length of the RFC Amber lines by type of RFC line, i.e. principal and diversionary. Details are provided for the whole RFC and overlapping sections.

Table 2 RFC Amber - Type of RFC lines and overlapping RFCs

Rail Freight Corridor	Principal Line	Diversionary Line	Total
RFC Amber	1,269.83	194.83	**1,464.66**
RFC MED	320.04	37.71	**357.75**
RFC RD	24.29	57.63	**81.92**
RFC NS-B	174.52	0.00	**174.52**
RFC BA	265.81	0.00	**265.81**
RFC OEM	261.55	0.00	**261.55**
RFC BA, RFC NS-B	4.00	0.00	**4.00**
RFC BA, RFC OEM	62.87	0.00	**62.87**
RFC BA, RFC MED	148.53	0.00	**148.53**
RFC MED, RFC OEM, RFC RD	173.03	0.00	**173.03**
RFC BA, RFC RD	73.97	0.00	**73.97**
RFC MED, RFC OEM	16.04	0.00	**16.04**
RFC OEM, RFC RD	129.27	0.00	**129.27**
RFC BA, RFC MED, RFC AWB	136.59	0.00	**136.59**
RFC BA, RFC OEM, RFC RD	6.46	0.00	**6.46**
Total	**3,066.80**	**290.17**	**3,356.97**

Source: Authors based on CIP

Figure 1 RFC Amber - Type of RFC lines



Source: Authors based on CIP

The RFC Amber at June 2023 consists of 3,067 km of principal lines and 290 km of diversionary lines.

The RFC Amber shares its network with other corridors such as RFC BA, RFC MED, RFC AWB, RFC NS-B, RFC OEM, RFC RD. The longest overlapping is with RFC MED.

2.1.2 CORRIDOR TERMINALS

A number of terminals are active along the RFC Amber. Table 3 provides an indicative, not exhaustive list of active terminals along the RFC Amber also indicating overlapping RFCs where applicable.

Table 3 List of terminals on the RFC Amber

Name	Country	Common to other RFCs according to CIP
Brzeski Terminal Kontenerowy	Poland	RFC NS-B
Euroterminal Sławków	Poland	RFC BA, RFC NS-B
PKP Cargo Centrum Logistyczne Małaszewicze	Poland	
EUROPORT Małaszewicze Duże	Poland	
Terminal przeladunkowy Wólka	Poland	
Transgaz S.A.	Poland	
Terminal Kontenerowy Warszawa – PKP Cargo Connect Sp. z o.o.	Poland	
Loconi Intermodal Terminal Kontenerowy Warszawa	Poland	
Polzug Terminal Kontenerowy Pruszków	Poland	
Terminal Kontenerowy Warszawa Główna Towarowa SPEDCONT Sp. z o.o.	Poland	
Terminal Kontenerowy Gliwice – PKP CARGO CONNECT Sp. z o.o.	Poland	
PCC Intermodal – Terminal PCC Gliwice	Poland	
Terminal Sosnowiec Poludniowy (Spedycja Polska Spedcont Sp. z o.o.)	Poland	
Izug Terminal Dąbrowa Górnicza	Poland	
Terminal kontenerowy Włosienica	Poland	
PCC INTERMODAL - Terminal Kolbuszowa	Poland	
Lubelski Terminal Kontenerowy	Poland	
Erontrans Terminal Kontenerowy w Radomsku	Poland	
Loconi Intermodal S.A. Terminal Kontenerowy Radomsko	Poland	
Erontrans Terminal Kontenerowy w Strykowie	Poland	
Terminal Kontenerowy Łódź Chojny	Poland	
Terminal Kontenerowy Łódź Chojny	Poland	
HUB Dunajská Streda	Slovakia	RFC BA, RFC OEM, RFC RD
Priemyselný park Štúrovo	Slovakia	RFC OEM
Rail Cargo Operator CSKD s.r.o	Slovakia	RFC BA, RFC RD
Rail Cargo Operator CSKD s.r.o	Slovakia	RFC BA, RFC OEM, RFC RD
Slovenská plavba a prístavy a.s.	Slovakia	RFC BA, RFC OEM, RFC RD
Terminál Košice	Slovakia	RFC RD
Žilina-Teplička TIP	Slovakia	RFC BA, RFC RD
Budapest Szabadkikötő (port)	Hungary	RFC MED, RFC OEM, RFC RD
Győr / ÁTI Depo	Hungary	RFC MED, RFC OEM, RFC RD
Győr-Gönyű Kikötő	Hungary	RFC MED, RFC OEM, RFC RD

Name	Country	Common to other RFCs according to CIP
METRANS Terminal Budapest	Hungary	RFC MED, RFC OEM, RFC RD
RailCargo Terminal - BILK Zrt.	Hungary	RFC MED, RFC OEM, RFC RD
Railport Győr	Hungary	RFC MED, RFC OEM, RFC RD
Terminal GYSEV Sopron	Hungary	RFC OEM, RFC RD
Törökbálint DEPO Intermodal Logistic Centre	Hungary	RFC MED, RFC OEM, RFC RD
Logistics Service Centre Sopron	Hungary	
Sopron Terminal	Hungary	
Mahart Container Center	Hungary	OEM
Celje tovorna kontejnerski	Slovenia	RFC BA, RFC MED, RFC AWB
Gorenje Velenje	Slovenia	RFC BA, RFC MED
Koper Luka KT	Slovenia	RFC BA, RFC MED
Ljubljana Moste KT	Slovenia	RFC BA, RFC MED, RFC AWB
Ljubljana Zalog ranžirna	Slovenia	RFC BA, RFC MED, RFC AWB
Revoz Novo mesto	Slovenia	RFC BA, RFC MED
Maribor	Slovenia	
Sežana	Slovenia	

Source: Authors based on CIP

2.1.3 CORRIDOR BORDER CROSSING POINTS

Border Crossing Points (BCPs) are of particular relevance for RFCs as their remit is dedicated to the promotion of international traffic across the borders of the European Union Member States. Trains crossing BCPs are accordingly one of the monitored KPIs by the RFCs. According to the current alignment of the RFC Amber, there are in total 8 BCPs identifiable along the corridor as detailed in the following table.

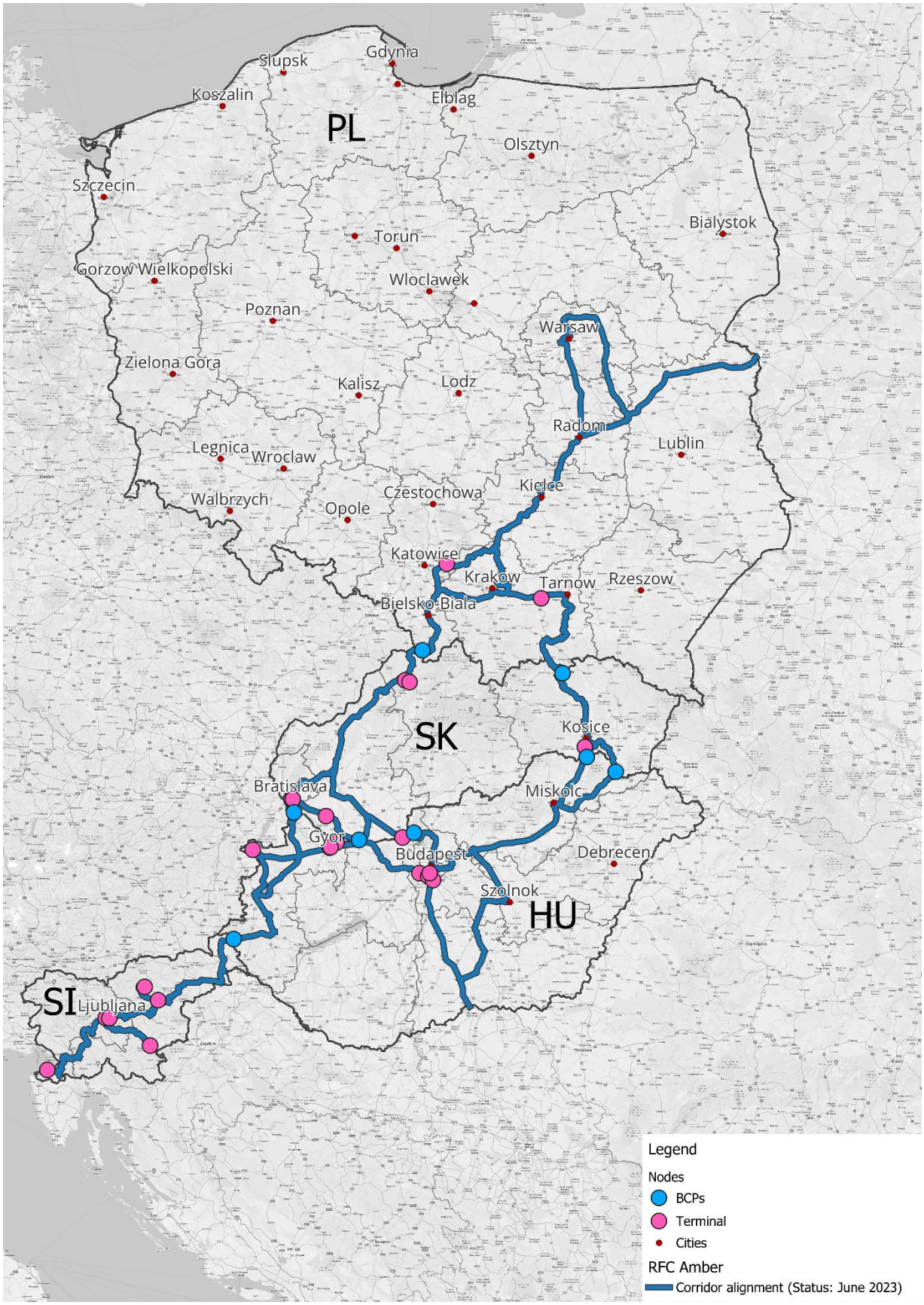
Table 4 RFC Amber BCPs

Bordering Member States		Border Crossing Point
PL	SK	Muszyna/Plaveč
PL	SK	Zwardoń/Skalite
SK	HU	Komárno/Komárom
SK	HU	Štúrovo/Szob
SK	HU	Rusovce/Rajka
SK	HU	Čaňa/Hidasnémeti
SK	HU	Slovenské Nové Mesto/Sátoraljaújhely
HU	SI	Őriszentpéter/Hodoš

Source: Authors based on CIP

The map in the figure overleaf illustrates the alignment of the RFC Amber, its terminals and cross-border nodes, also identifying the sections overlapping with other RFCs.

Figure 2 RFC Amber alignment, terminals and cross-border nodes



Source: Authors based on CIP

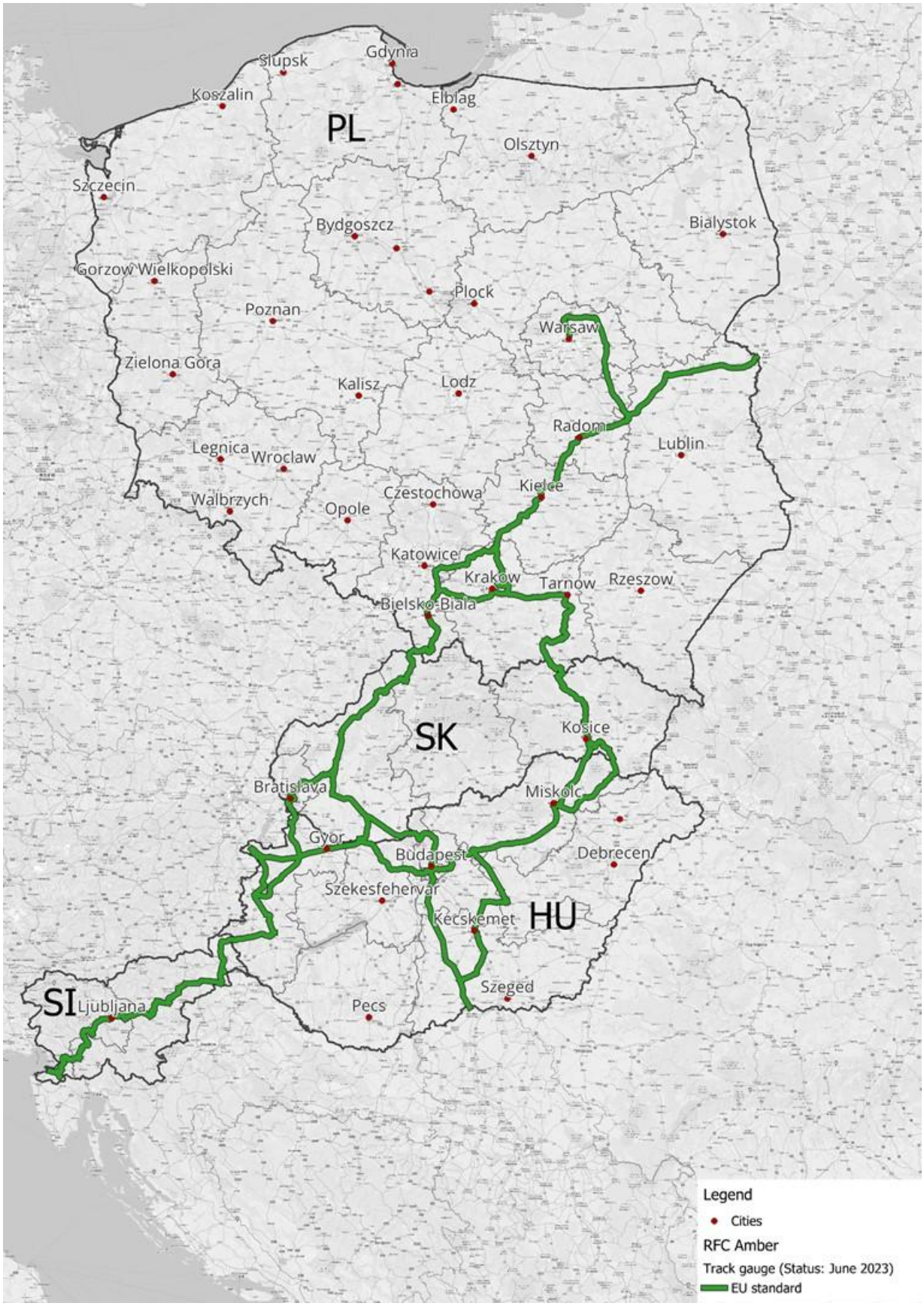
2.1.4 CORRIDOR INFRASTRUCTURE PARAMETERS

An analysis of the main characteristics of the corridor lines has been performed with reference to the rail infrastructure requirements set in Regulation (EU) 1315/2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU, i.e. EU track gauge (1435 mm), electrification, maximum line speed (100 km/h), axle load (22.5 t), train length (740 m) and ERTMS (Class A or Class A+B). Such an exercise has been conducted, focussing on the principal and diversionary lines of the RFC. Data have been primarily sourced from the Customer Information Platform (CIP). The information was extracted in August 2023, and it reflects the status of the infrastructure in June 2023. For some sections, data from the CIP database have been integrated with information from the Network Statements of the corridor concerned Infrastructure Managers.

On the basis of this analysis, compliance maps have been elaborated, which are provided overleaf for each parameter.

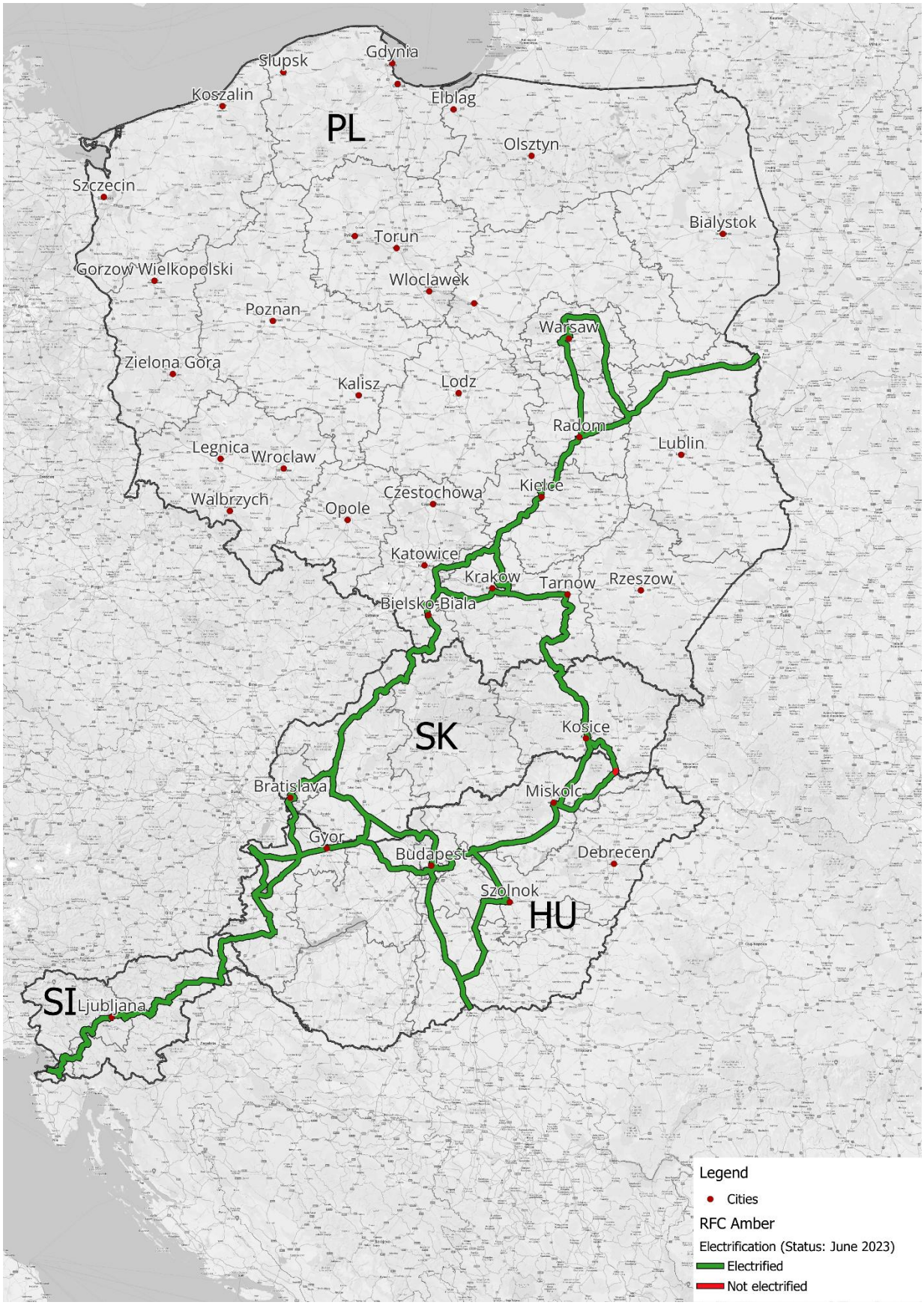
The RFC Amber is at standard concerning track gauge. It is also almost entirely electrified except for some lines and terminals' interconnecting lines in Hungary, Slovakia, and Slovenia. Speed limitations exist along the RFC Amber particularly affecting the network in Poland, Slovakia and Slovenia, including cross-border itineraries between Poland and Slovakia and Slovakia and Hungary. The same cross-border itineraries are also affected by axle load restrictions, which are also present along some terminals' interconnecting lines in Hungary, Slovakia, and Slovenia. The operation of 740 m long trains is not possible or possible subject to traffic conditions and permissions (operational compliance), except on some limited very sections, including in Hungary towards Slovakia and in Poland towards Ukraine. Finally, ERTMS is available in Slovenia and in some corridor sections in Hungary and Slovakia.

Figure 3 RFC Amber - Track gauge



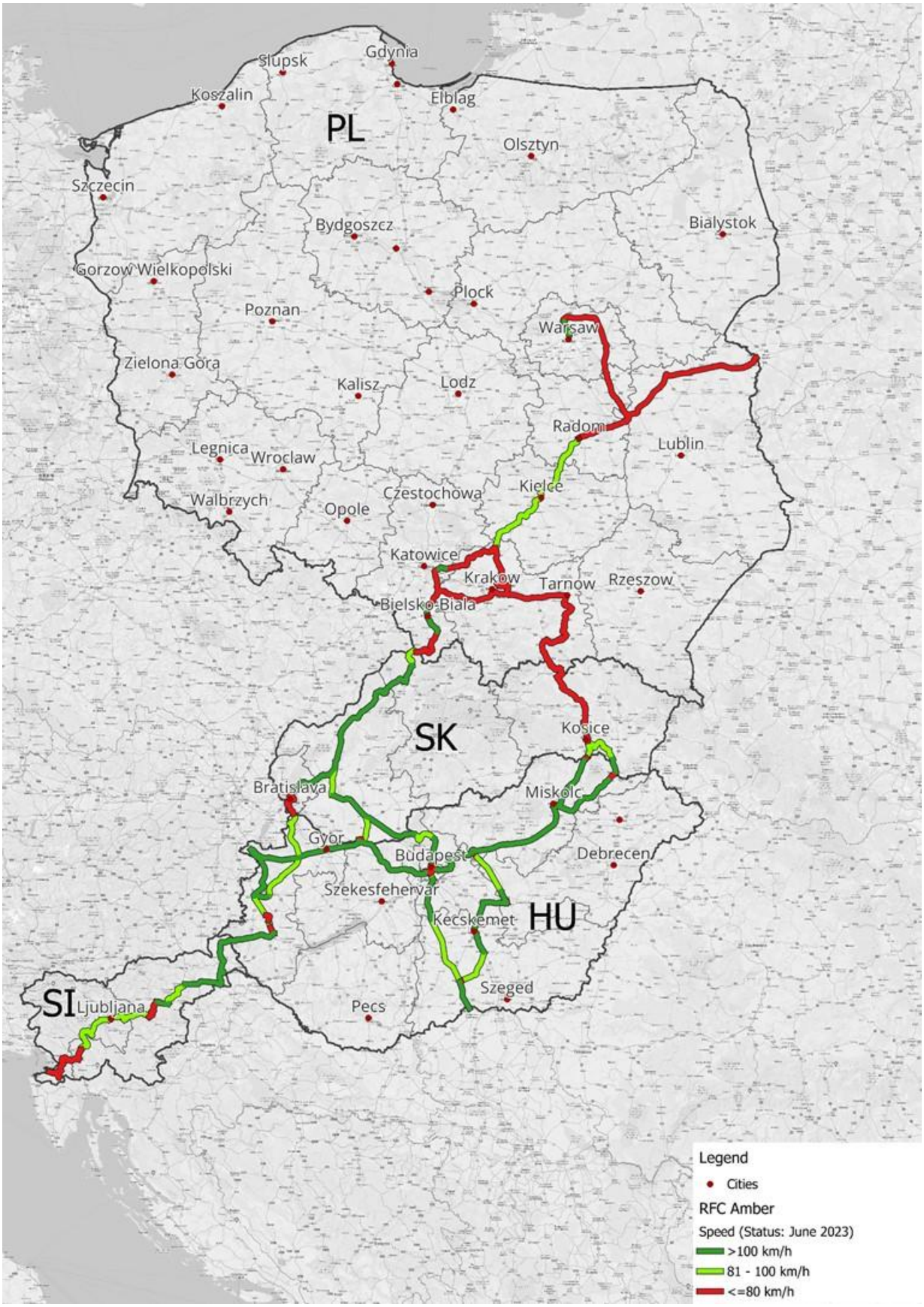
Source: Authors based on CIP

Figure 4 RFC Amber – Electrification



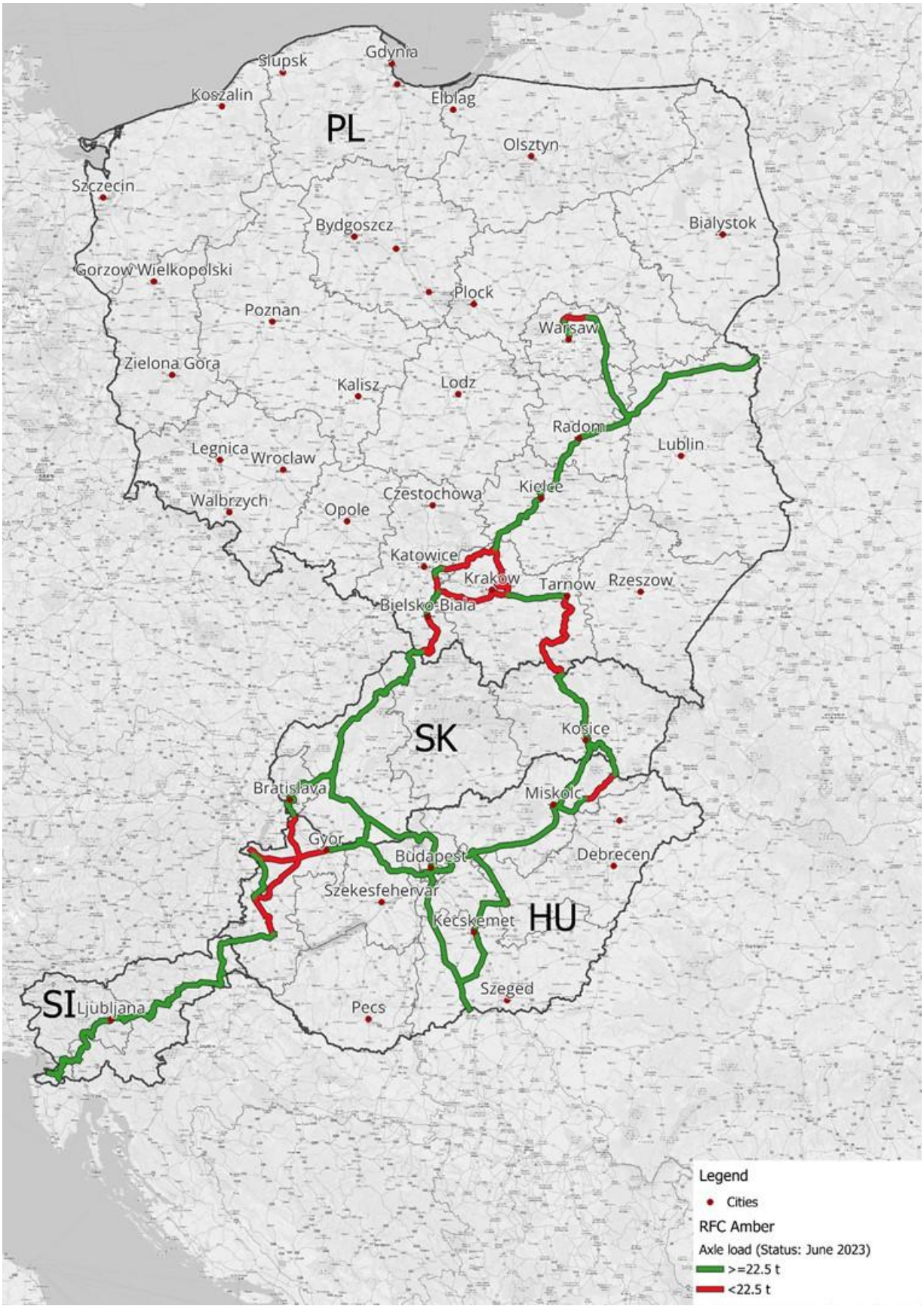
Source: Authors based on CIP

Figure 5 RFC Amber - Speed



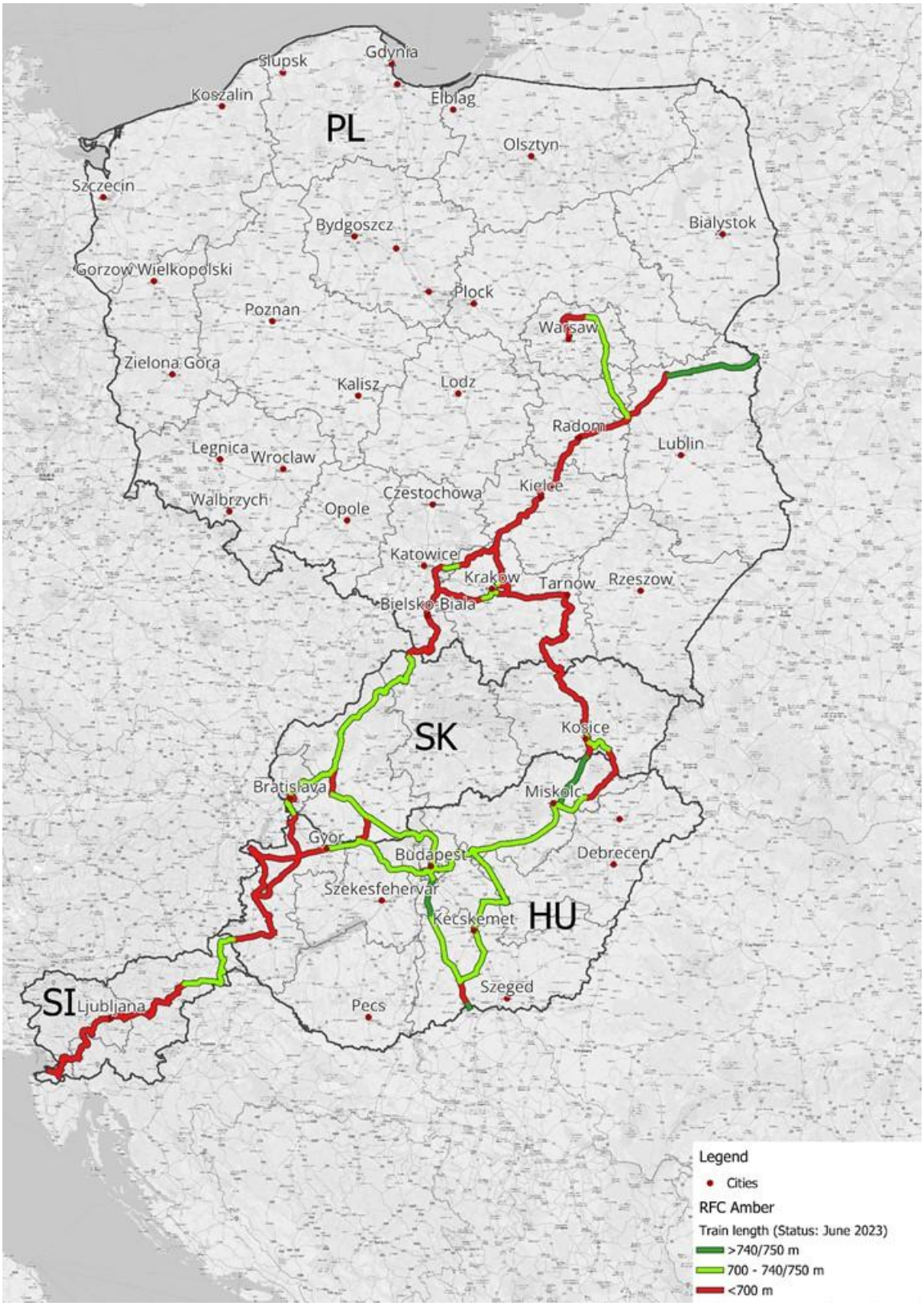
Source: Authors based on CIP

Figure 6 RFC Amber – Axle load



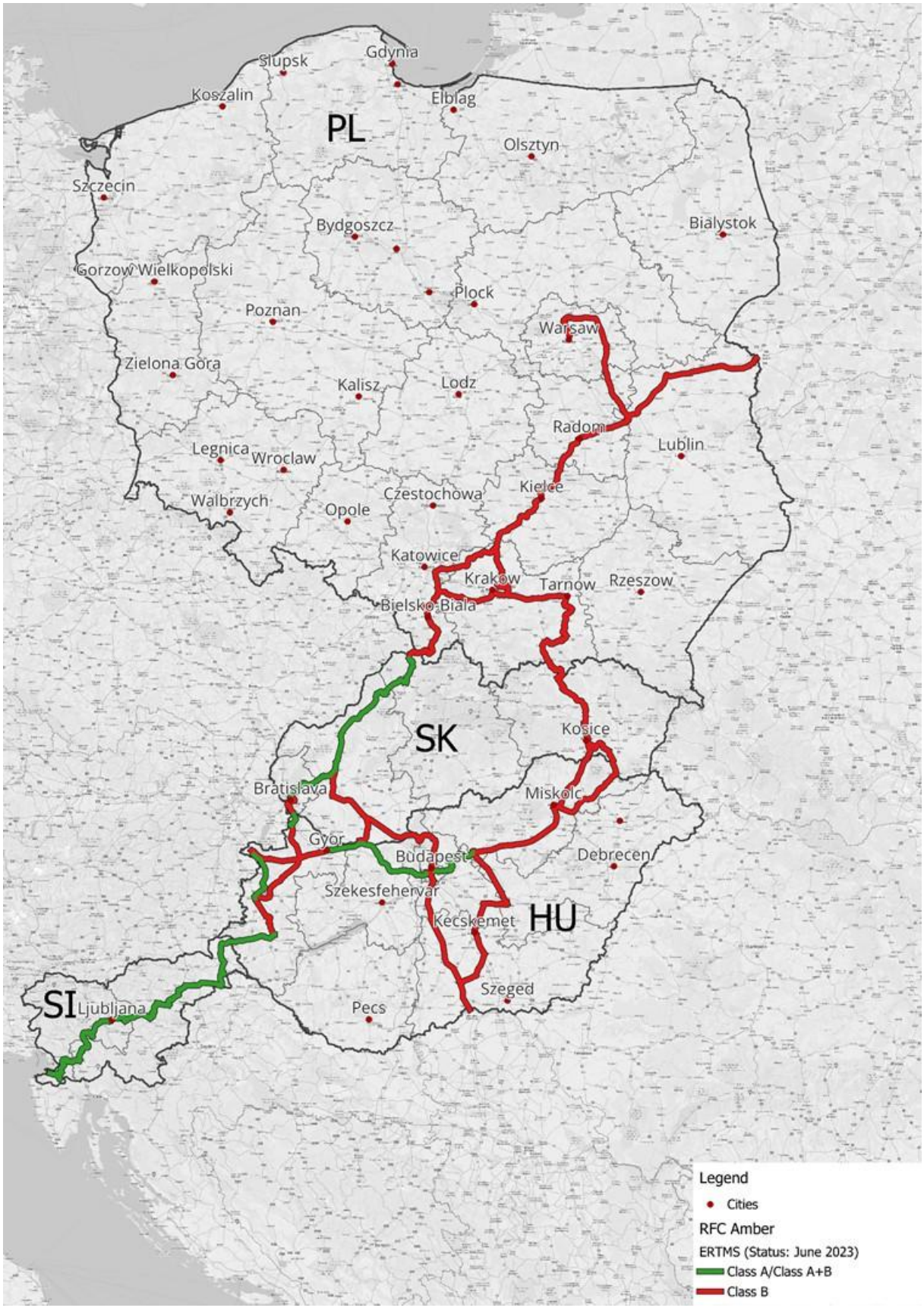
Source: Authors based on CIP

Figure 7 RFC Amber - Train length



*Source: Authors based on CIP; Note: * Sections displayed in light green, where 740 meter long trains are possible to be operated based on traffic conditions and upon request, i.e. "operational compliance", also include the network segments codified in CIP as "upon request". The operational compliance concept also applies to railway lines in Slovenia, though the map represents the infrastructure compliance*

Figure 8 RFC Amber - ERTMS



Source: Authors based on CIP

2.1.5 INFRASTRUCTURE BOTTLENECKS, ONGOING AND PLANNED PROJECTS

Infrastructure bottlenecks

The RFC Amber classifies the issues which hinder smooth and competitive rail freight transport into the following categories:

- ***Infrastructural bottlenecks***. Sections which do not meet the TEN-T requirements specified in Article 39 (2a) of the Regulation (EU) No 1315/2013 of the European Parliament and of the Council;
- ***Operational bottlenecks***. Capacity and traffic management issues during the train run;
- ***Administrative bottlenecks***. Effects of non-harmonised rules and procedures;
- ***Capacity bottlenecks***. Issues in relation with capacity planning and path allocation. This includes the lack of multi-annual planning works due to missing multi-annual financing environment;
- ***Other bottlenecks***.

The RFC Amber 2025 Implementation Plan focusses particularly on infrastructure bottlenecks. A comprehensive "Study on bottlenecks along Rail Freight Corridor Amber (RFC Amber)" was carried out between 2019 and 2021. The Bottleneck Study gives an in-depth understanding of the compliance of the corridor infrastructure with TEN-T minimum requirements (defined by Regulation 1315/2013 EU Art 39. (2a)), TSI line performance parameters, bottlenecks in terms of capacity and line standard, and of potential measures for infrastructure and operational improvements for efficient rail freight operations along the network of RFC Amber. The study is proposing appropriate measures for infrastructure and operational improvements with the aim to eliminate or reduce the negative effects of such bottlenecks and to allow more efficient rail freight operations along RFC Amber.

The plans for elimination of the identified bottlenecks are provided in the tables overleaf for each RFC Amber Member State and IM/AB.

It should be noted, that notwithstanding the presence of the identified bottlenecks, the RFC Amber lines are fully functional, operable and removing the mentioned bottlenecks would only improve their technical parameters to be compatible with the parameters specified in the Regulation (EU) No. 1315/2013, Article 39 (2a). The collected information below also includes the deadlines for the projects aiming to eliminate the identified bottlenecks and the estimated financial cost and source of funding belonging to their realisation.

Table 5 List of bottlenecks in Poland

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro (1€=4,50PLN May 2021)	Financial Sources
Poland	Muszyna (G.P.) - Muszyna	Muszyna (G.P.) - Muszyna	One track line, low axle load, low max train length, low speed	Project: "Work on the railway lines no. 96, 105 Tarnów - Leluchów/Krynica" The implementation of the comprehensive investment project depends on the availability of funds.	potentially 2030	300	ERDF 2021-2027 or Cohesion Fund 2021-2027
Poland	Muszyna - Nowy Sącz	Muszyna - Nowy Sącz	One track line, low axle load, low max train length, low speed				
Poland	Nowy Sącz - Tarnów	Nowy Sącz - Tarnów	Section with one track, low axle load, low max train length, low speed				
Poland	Podłęże - PodłężeR 201	Podłęże - Podłęże R 201	Low max train length	Project: Adaptation of the Krakow railway junction to the parameters of the TEN-T core network	potentially 2030	155,6	CEF 2021-2027
Poland	Podłęże - PodłężeR 101	Podłęże - Podłęże R 101	Low max train length				
Poland	Podłęże R 101 - Podłęże R 201	Podłęże R 101 - Podłęże R 201	**L**ow max train length				
Poland	Podłęże R 201 - Raciborowice	Podłęże R 201 - Raciborowice	Low axle load, low max train length, low speed				
Poland	Raciborowice - Tunel	Raciborowice - Tunel	Low max train length, low speed				

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro (1€=4,50PLN May 2021)	Financial Sources
Poland	Tunel - Radom	Tunel - Radom	Low max train length, low speed	Projects: "Works on railway line no. 8 on section SkarżyskoKamienna – Kielce – Kozłów" Project will improve the technical parameters. " Work on the railway line no. 8 on the Radom - Skarżysko Kamienna section" The implementation of the comprehensive investment project depends on the availability of funds.	1) potentially 2030 2) potentially after 2030	1) 555 2) -	1) Cohesion Fund 2021-2027 -
Poland	Radom - Dęblin	Radom - Dęblin	Low max train length, low speed	Project: "Work on lines 22, 25 and 26 on the Koluszki - Tomaszów Maz. - Radom – Łuków section" The implementation of the comprehensive investment project depends on the availability of funds.	potentially 2030		- -
Poland	Dęblin - Łuków	Dęblin - Łuków	Low max train length, low speed				
Poland	Podłęże R 101 - Kraków Prokocim Towarowy	Podłęże R 101 - Gaj	Low axle load, low max train length, low speed	Project: Adaptation of the Krakow railway junction to the parameters of the TEN-T core network	potentially 2030	155,6	CEF 2021-2027

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro (1€=4,50PLN May 2021)	Financial Sources
Poland	Kraków Prokocim Towarowy - Oświęcim (OwC)	Kraków Prokocim Towarowy - Oświęcim (OwC)	Low axle load, low max train length, low speed	1) Project: Adaptation of the Krakow railway junction to the parameters of the TEN-T core network Project: "Work on the railway line no. 94 on the Skawina – Oświęcim section" The implementation of the comprehensive investment project depends on the availability of funds.	1) potentially 2030 potentially 2030	1) 155,6 2) 311	1) CEF 2) Cohesion Fund 2021-2027
Poland	Oświęcim (OwC) – Oświęcim (OwC1)	Oświęcim (OwC) - Oświęcim (OwC1)	Low axle load, low max train length, low speed	Project: "Work on the railway line 93 on the Trzebinia – Oświęcim – Czechowice Dziedzice section" Project improve technical condition and modernisation station Oświęcim.	2023	183	OPIE
Poland	Oświęcim (OwC1) - Mysłowice Brzezinka	Oświęcim (OwC1) - Mysłowice Brzezinka	Low axle load, low max train length, low speed	: "Work on the railway line no. 138 on the Oświęcim – Mysłowice section" The implementation of the comprehensive investment project depends on the availability of funds.	potentially 2030	178	Cohesion Fund 2021-2027
Poland	Jaworzno Szczakowa - Tunel	Jaworzno Szczakowa - Tunel	Low axle load, low max train length, low speed	Project: "Work on the railway line no. 62 on the Tunel - Sosnowiec Główny section"	potentially 2030	112	Cohesion Found 2021-2027

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro (1€=4,50PLN May 2021)	Financial Sources
				The implementation of the comprehensive investment project depends on the availability of funds. Project will improve technical parameters.			
Poland	Radom - Warszawa Główna Tow.	Radom - Warszawa Główna Tow.	Section with one track, low max train length, low speed, low axle load	Projects: 1) Modernisation railway line no. 8, section Warszawa Okęcie – Radom (LOsT: A, B, F) Phase II Works on railway line no. 8, section Warka – Radom (Lots:C, D, E). Projects aim to improve parameters to TEN-T requirements	1) 2023 2) 2023	1) 202 171	1) OPIE 2) OPIE
Poland	Warszawa Główna Tow. - Warszawa Praga	Warszawa Główna Tow. - Warszawa Praga	Low axle load, low max trainlength	Project: “Increasing the capacity of the Warszawa Wschodnia - Nasielsk (Kątne/Świercze) section” The implementation of the comprehensive investment project depends on the availability of funds.	potentially 2030	578	Cohesion Fund 2021-2027
Poland	Zwardoń (G.P.) - Zwardoń	Zwardoń (G.P.) - Zwardoń	One track line, low axle load, low max train length, low speed	Project: “Work on the railway line no. 139 on the Czechowice Dziedzice – Bielsko Biała – Żywiec - Zwardoń (national border)”	potentially 2030	666,7	Cohesion Fund 2021-2027

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro (1€=4,50PLN May 2021)	Financial Sources
				The implementation of the comprehensive investment project depends on the availability of funds. Project will improve technical parameters.			
Poland	Zwardoń - Bielsko-Biała	Zwardoń - Bielsko- Biała	Section with one track, low axle load, low max train length, low speed, high gradient				
Poland	Bielsko-Biała - Czechowice-Dziedzice	Bielsko-Biała - Czechowice-Dziedzice	Low axle load, low max train length, low speed,				
Poland	Czechowice-Dziedzice - Oświęcim	Czechowice-Dziedzice - Oświęcim	Low axle load, low max train length, low speed,	Project: "Work on the railway line 93 on the Trzebinia – Oświęcim – Czechowice Dziedzice section" Project improves technical condition and includes modernization of Oświęcim station.	2023	183	OPIE
Poland	Oświęcim - Oświęcim (OwC1)	Oświęcim – Oświęcim (OwC1)	Low axle load, low max train length, low speed,				
Poland	Oświęcim – Oświęcim (OwC)	Oświęcim – Oświęcim (OwC)	Low axle load, low max train length, low speed,				

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro (1€=4,50PLN May 2021)	Financial Sources
Poland	Tłuszcz - Warszawa Praga	Krusze - Legionowo Piaski	Low axle load, low max train length, low speed	Project: "Increasing the capacity of the Warszawa Wschodnia - Nasielsk (Kątne/Świercze) section" The implementation of the comprehensive investment project depends on the availability of funds.	potentially 2030	578	Cohesion Fund 2021-2027

Source: RFC Amber 2025 Implementation Plan

Table 6 List of bottlenecks in Slovakia

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro	Financial Sources
Slovakia	Bratislava Vajnory - Dunajská Streda - Komárno border	Bratislava Nové Mesto - Komárno	One track line→lack of capacity (strong passenger transport, connection to intermodal terminal)	Electrification, building of 2. line track	According to the results of Feasibility study of junction Bratislava after 2030	assumption 600	OPII/ State budget
Slovakia	Košice - Plaveč border	Lipany -Plaveč border	Low speed, ERTMS not full deployment	Modernisation of track	after 2023	-	TBD
		Prešov - Kysak	Low speed, ERTMS not full deployment	Modernisation of track	after 2023	-	TBD
		Košice - Kysak	ERTMS not full deployment	ERTMS	after 2023	1,622	TBD
Slovakia		Košice - Michaľany	High gradient, no ERTMS	Modernisation of track/remote control	after 2023		TBD

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro	Financial Sources
	Košice – Slovenské Nové Mesto	Slovenské Nové Mesto – Satoraljaújhely (state border)	No electrification, train speed very low, no ERTMS	Modernisation/electrification of track	after 2023		TBD
Slovakia	Čadca - Skalité	Čadca - Skalité	Hing gradient, no ERTMS	Modernisation	after 2023		TBD
Slovakia	Node Bratislava	Low speed allowed among Bratislava´s stations	Geographical conditions	NODE Bratislava construction works	after 2023		EU funds/state budget

Source: RFC Amber 2025 Implementation Plan

Table 7 List of bottlenecks in Hungary (MÁV)

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
Hungary MÁV	(Border SLO) - Őriszentpéter - Zalaszentiván	(Border SLO) - Őriszentpéter - Zalaszentiván	Max. train length < 740m	-	-	-	-
Hungary MÁV	Győr - Ferencváros	Budaörs - Kelenföld	Max. axle load < 22.5t	Capacity increase on the section Budaörs–Kelenföld (4 tracks)	2026	Not known.	-
Hungary MÁV	Győr - Ferencváros	Kelenföld - Ferencváros	Max. speed < 100km/h Max. axle load < 22.5t	Capacity increase on the section Kelenföld–Ferencváros (3 tracks, partially 4)	2026		EU and Hungarian budget,

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
Hungary MÁV	Győr - Ferencváros	Győr - Kelenföld	ETCS baseline is not interoperable	On the Kelenföld - Hegyeshalom (oh) section, the upgrade of ETCS L1 is underway, in the framework of which Baseline will be upgraded to version 3.6.0, which will ensure interoperability.	2023	19,4	Hungarian budget
Hungary MÁV	Komárom - Border SK	Komárom - Border SK	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Ferencváros - Kelebia - (Border SRB)	Ferencváros - Soroksár	ETCS is not deployed	Reconstruction works of the Hungarian part of Budapest - Belgrade railway line	2024	Not known	Hungarian budget
Hungary MÁV	Ferencváros - Kelebia - (Border SRB)	Soroksár - Kunszentmiklós- Tass	Max. axle load < 22.5t ERTMS is not deployed	Reconstruction works of the Hungarian part of Budapest - Belgrade railway line	2024	Not known	Hungarian budget
Hungary MÁV	Ferencváros - Kelebia - (Border SRB)	Kunszentmiklós- Tass - Border SRB	Max. train length < 740m Max. axle load < 22.5t ERTMS is not deployed	Reconstruction works of the Hungarian part of Budapest - Belgrade railway line	2024	Not known	Hungarian budget
Hungary MÁV	Ferencváros - Kőbánya felső	Ferencváros - Kőbánya felső	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Kőbánya felső - Rákos elágazás	Kőbánya felső - Rákos elágazás	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	Capacity increase on the section Kőbánya felső–Rákos–Rákosliget	2027	Not known yet.	-
Hungary MÁV	Rákos elágazás - Rákospalota-Újpest	Rákos elágazás - Rákospalota-Újpest	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
Hungary MÁV	Rákospalota-Újpest – Border SK	Rákospalota-Újpest – Border SK	ERTMS is not deployed.	-	-	-	-
Hungary MÁV	Rákospalota-Újpest - Border SK	Rákospalota-Újpest - Border SK	Max. axle load < 22.5t ERTMS is not deployed	Development of the section Budapest-Nyugati–Vác	2025	Not known	Hungarian budget
Hungary MÁV	Rákospalota-Újpest – Border SK	Vác – Border SK	Max. axle load < 22.5t				
Hungary MÁV	Rákos - Rákos-elágazás	Rákos - Rákos-elágazás	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	Capacity increase on the section Kőbánya felső - Rákos - Rákosliget	2027		-
Hungary MÁV	Kőbánya felső -Rákos	Kőbánya felső -Rákos	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	Capacity increase on the section Kőbánya felső - Rákos - Rákosliget	2027		-
Hungary MÁV	Rákos - Felsőzsolca	Rákos - Hatvan	ETCS is not deployed	Reconstruction works of the Rákos - Hatvan railway line and the deployment of ETCS L2	2022	672.6	EU and Hungarian budget
Hungary MÁV	Rákos - Felsőzsolca	Hatvan - Füzesabony	Max. axle load < 22.5t ETCS is not deployed	Reconstruction of and ETCS deployment on the section Hatvan „A” elágazás – Füzesabony	2027	Not known yet.	-
Hungary MÁV	Rákos - Felsőzsolca	Füzesabony - Felsőzsolca	Max. axle load < 22.5t ETCS is not deployed				
Hungary MÁV	Rákos - Felsőzsolca	Rákos - Felsőzsolca	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	10.3	EU and Hungarian budget
Hungary MÁV	Felsőzsolca - Hidasnémeti - (Border SK)	Felsőzsolca - Border SK	Max. axle load < 22.5t ETCS is not deployed	-	-	-	-

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
Hungary MÁV	Felsőzsolca - Hidasnémeti - (Border SK)	Felsőzsolca - Border SK	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	3.4	EU and Hungarian budget
Hungary MÁV	Felsőzsolca - Sátoraljaújhely - (Border SK)	Felsőzsolca - Border SK	Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Felsőzsolca - Sátoraljaújhely - (Border SK)	Felsőzsolca - Mezőzombor	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	2.2	EU and Hungarian budget
Hungary MÁV	Felsőzsolca - Sátoraljaújhely - (Border SK)	Mezőzombor - Border SK	Max. train length < 740m GSM-R is not deployed	-	-	-	-
Hungary MÁV	Felsőzsolca - Sátoraljaújhely - (Border SK)	Sátoraljaújhely - Border SK	Max. speed < 100km/h Track is not electrified	-	-	-	-
Hungary MÁV	Hatvan A elágazás - Hatvan D elágazás	Hatvan A elágazás - Hatvan D elágazás	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Hatvan A elágazás - Hatvan D elágazás	Hatvan A elágazás - Hatvan D elágazás	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	0.2	EU and Hungarian budget
Hungary MÁV	Hatvan B elágazás - Hatvan C elágazás	Hatvan B elágazás - Hatvan C elágazás	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Hatvan B elágazás - Hatvan C elágazás	Hatvan B elágazás - Hatvan C elágazás	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	0.1	EU and Hungarian budget

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
Hungary MÁV	Hatvan - Újszász	Hatvan - Újszász	Max. axle load < 22.5t ERTMS is not deployed	-	-	-	-
Hungary MÁV	Újszász - Újszászi elágazás	Újszász - Újszászi elágazás	Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Újszász - Újszászi elágazás	Újszász - Újszászi elágazás	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	0.8	EU and Hungarian budget
Hungary MÁV	Újszászi elágazás - Paládicspuszta elágazás	Újszászi elágazás - Paládicspuszta elágazás	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Szolnok A elágazás - Szolnok-Rendező	Szolnok A elágazás - Szolnok-Rendező	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Szolnok B elágazás - Szolnok-Rendező	Szolnok B elágazás - Szolnok-Rendező	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Szolnok C elágazás - Szolnok-Rendező	Szolnok C elágazás - Szolnok-Rendező	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Szolnok D elágazás - Szolnok-Rendező	Szolnok D elágazás - Szolnok-Rendező	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Abony elágazás -	Abony elágazás -	Max. axle load < 22.5t	-	-	-	-

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
	Paládicspuszta elágazás	Paládicspuszta elágazás					
Hungary MÁV	Abony elágazás - Paládicspuszta elágazás	Abony elágazás - Paládicspuszta elágazás	ETCS is not deployed	Deployment of ETCS L2 on the Monor - Szajol railway line	2023	20.0	EU and Hungarian budget
Hungary MÁV	Nyársapát elágazás - Abony elágazás	Nyársapát elágazás - Abony elágazás	Max. speed < 100km/h Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Nyársapát elágazás - Kiskunfélegyháza	Nyársapát elágazás - Városföld	ETCS is not deployed	-	-	-	-
Hungary MÁV	Nyársapát elágazás - Kiskunfélegyháza	Nyársapát elágazás - Városföld	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	2.4	EU and Hungarian budget
Hungary MÁV	Nyársapát elágazás - Kiskunfélegyháza	Városföld - Kiskunfélegyháza	Max. axle load < 22.5t ETCS is not deployed	-	-	-	-
Hungary MÁV	Nyársapát elágazás - Kiskunfélegyháza	Városföld - Kiskunfélegyháza	GSM-R is not deployed	Deployment of GSM-R system, 2. stage	2023	0.8	EU and Hungarian budget
Hungary MÁV	Kiskunhalas - Kiskunfélegyháza	Kiskunhalas - Kiskunfélegyháza	Max. axle load < 22.5t ERTMS is not deployed	-	-	-	-

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euros	Financial Sources
Hungary MÁV	Balotaszállás elágazás - Harkakötöny elágazás	Balotaszállás elágazás - Harkakötöny elágazás	Max. train length < 740m Max. speed < 100km/h Max. axle load < 22.5t ERTMS is not deployed	-	-	-	-

Source: RFC Amber 2025 Implementation Plan

Table 8 List of bottlenecks in Hungary (GYSEV)

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Estimated Costs in mil. of Euro	Financial Sources
Hungary / GYSEV	Rajka s.b. - Hegyeshalom	Rajka s.b. - Hegyeshalom	Single track; Max. axle load < 22.5t; track conditions deteriorating;	Modernisation, upgrade of railway infrastructure	2027	110	CEF, Cohesion Found
Hungary / GYSEV	Hegyeshalom - Csorna	Hegyeshalom - Csorna	Max. axle load < 22.5t; Max. train length < 740m; track conditions deteriorating; no ETCS	Modernisation, upgrade of railway infrastructure	n/a	n/a	n/a
Hungary / GYSEV	Csorna - Porpác	Csorna - Porpác	Max. axle load < 22.5t; Max. train length < 740m; track conditions deteriorating; InterCity traffic every two hours per direction; no ETCS	Modernisation, upgrade of railway infrastructure	n/a		n/a
Hungary / GYSEV	Porpác - Szombathely	Porpác - Szombathely	Max. axle load < 22.5t; track conditions deteriorating; high density of InterCity and commuter trains; no ETCS	Modernisation, upgrade of railway infrastructure	n/a	n/a	n/a

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Estimated Costs in mil. of Euro	Financial Sources
Hungary / GYSEV	Szombathely	Szombathely	Outdated track and signalling infrastructure; Max. speed <100km/h; capacitiy problems for freight; no ETCS	Modernisation, upgrade of railway and signalling infrastructure	n/a	n/a	n/a
Hungary / GYSEV	Szombathely - Vasvár	Szombathely - Vasvár	Max. axle load < 22.5t; Max. train length < 740m; track conditions deteriorating; no ETCS	Modernisation, upgrade of railway infrastructure	n/a	n/a	n/a
Hungary / GYSEV	Vasvár - Pácsony	Vasvár - Pácsony	Max. speed < 100km/h; Max. axle load < 22.5t; 13‰ elevation; track conditions deteriorating; no ETCS	Modernisation, upgrade of railway infrastructure	n/a	n/a	n/a
Hungary / GYSEV	Pácsony - Egervár-Vasboldogasszony	Pácsony - Egervár-Vasboldogasszony	Max. axle load < 22.5t; Max. train length < 740m; track conditions deteriorating; no ETCS	Modernisation, upgrade of railway infrastructure	n/a	n/a	n/a
Hungary / GYSEV	Egervár-Vasboldogasszony - Zalaszentiván	Egervár-Vasboldogasszony - Zalaszentiván	Max. speed < 100km/h; Max. axle load < 22.5t; Max. train length < 740m; track conditions deteriorating; no ETCS Change of direction of trains at Zalaszentiván when going to Hodoš/Koper	Modernisation, upgrade of railway infrastructure New triangle track at Zalaszentiván	n/a	n/a	n/a
Hungary / GYSEV	Sopron-Rendező - Harka	Sopron-Rendező - Harka	Single track line; Max. axle load <22.5t; high density of domestic and international passenger trains at least hourly; no ETCS	Modernisation, upgrade of railway infrastructure Phase 0: Sopron - Harka 2nd track 2025 -2027	n/a	n/a	n/a

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Estimated Costs in mil. of Euro	Financial Sources
Hungary / GYSEV	Harka - Pinnye	Harka - Pinnye	Single track line; Max. axle load <22.5t; at least hourly regular interval commuter trains; every two hours Intercity trains; no ETCS	Modernisation, upgrade of railway infrastructure. Phase 2B: Sopron - Harka - Fertőboz new double track alignment	Beyond 2030	n/a	n/a
Hungary / GYSEV	Pinnye - Fertőszentmiklós	**P**innye - Fertőszentmiklós	Single track line; Max. axle load < 22.5t; at least hourly regular interval commuter trains; every two hours InterCity trains; no ETCS	Modernisation, upgrade of railway infrastructure. Phase 2A: (Fertőboz) - Pinnye - Csorna partially double track	Beyond 2030	n/a	n/a
Hungary / GYSEV	Fertőszentmiklós - Petőháza	Fertőszentmiklós - Petőháza	Single track line; Max. axle load <22.5t; at least hourly regular interval commuter trains; every two hours Intercity trains; no ETCS	Modernisation, upgrade of railway infrastructure. Phase 2A: (Fertőboz) - Pinnye - Csorna partially double track	Beyond 2030	n/a	n/a
Hungary/ GYSEV	Petőháza-Csorna	Petőháza-Csorna	Single track line; Max. axle load <22.5t; at least hourly regular interval commuter trains; every two hours Intercity trains; no ETCS	Modernisation, upgrade of railway infrastructure. Phase 2A: (Fertőboz) - Pinnye - Csorna partially double track	Beyond 2030	n/a	n/a
Hungary / GYSEV	Csorna - Győr	Csorna - Győr	Single track line; Max. axle load < 22.5t; high density of passenger trains; at least hourly regular interval commuter trains; every hours Intercity trains; no ETCS	Modernisation, upgrade of railway infrastructure, construction of 2nd track Phase 1: new second track	Beyond 2030	229	n/a

Source: RFC Amber 2025 Implementation Plan

Table 9 List of bottlenecks in Slovenia

Member State	Line Section	Bottleneck	Reasons	Suggestions How to Remove Bottlenecks			
				Project Name and Description	End Date	Costs in mil. of Euro	Financial Sources
Slovenia	Station Ljubljana (node)	Station Ljubljana(node)	Lack of capacity, longer station tracks, signalling	Modernisation, upgrade of railway infrastructure	2026	n/a	EU and Slovenian budget
Slovenia	section Ljubljana – Zidani Most	section Ljubljana – Zidani Most	Signalling, longer station tracks,	Modernisation, upgrade of railway infrastructure	2027	n/a	EU and Slovenian budget
Slovenia	section Divača – Koper	section Divača - Koper	An additional track on other route (shorter track) but not parallel, creation of new structure (line, tunnel, bridge, leapfrog)	Modernisation, upgrade of railway infrastructure	2025	n/a	EU and Slovenian budget
Slovenia	section Ljubljana – Divača	section Ljubljana – Divača	More energy for traction, signalling, longer station tracks	Modernisation, upgrade of railway infrastructure	2025	n/a	EU and Slovenian budget
Slovenia	Station Pragersko	Station Pragersko	Modernisation, upgrade of railway station Pragersko. Creation of siding, passing tracks, longer station tracks, catenary system.	Modernisation, upgrade of railway infrastructure	2023	n/a	EU and Slovenian budget

Source: RFC Amber 2025 Implementation Plan

Ongoing and planned investments

The RFC Amber recently elaborated their 2025 Implementation Plan, which includes a detailed list of investments foreseen for the development, modernisation, upgrade, and renewal of the railway infrastructure along the whole RFC Amber. Such investments will be particularly useful to solve infrastructure bottlenecks primarily related to the interoperability issues described in the previous section above, which on some sections of the corridor also affect the capacity of the lines.

The table overleaf includes the list of ongoing and planned investments on the RFC Amber.

Table 10 List of ongoing and planned projects

Status	Member state	IM	Line	Section		Category	Project name	Start		End		Maximum speed [km*h^{-1}]	Axle load [t] / Line category	Maximum train length [m]	Traction power	ETCS Level	Interm. Code
				From	To			Month	Year	Month	Year						
ongoing	Poland	PKP PLK S.A.	Czechowice-Dziedzice - Oświęcim	Czechowice-Dziedzice	Oświęcim	Diversionary	Works on the railway line 93 on the Trzebinia – Oświęcim – Czechowice Dziedzice section	10	2017	8	2023	80 - 120	22,5 / D3	740 m			
	Poland	PKP PLK S.A.	Oświęcim - Oświęcim (OwC1)	Oświęcim	Oświęcim (OwC1)	Diversionary											
	Poland	PKP PLK S.A.	Oświęcim - Oświęcim (OwC)	Oświęcim	Oświęcim (OwC)	Diversionary											
	Poland	PKP PLK S.A.	Oświęcim (OwC) - Oświęcim (OwC1)	Oświęcim (OwC)	Oświęcim (OwC1)	Principal											
ongoing	Poland	PKP PLK S.A.	Dęblin - Tłuszcz	Dęblin	Pilawa	Future diversionary	Works on the railway line no. 7 Warszawa Wschodnia Osobowa – Dorohusk on the Warszawa – Otwock – Dęblin – Lublin section	9	2016	5	n/a	160	22,5 / D3	740 m	3 kV AC	2	
planned	Poland	PKP PLK S.A.	Dęblin - Tłuszcz	Pilawa	Krusze	Future diversionary	Works on the railway lines no. 13, 513 on section Krusze / Tłuszcz – Pilawa	-	-	-	-	-	-	-	3 kV AC		
planned	Poland	PKP PLK S.A.	Tłuszcz - Warszawa Praga	Krusze	Legionowo Piaski	Future diversionary	Increasing the capacity of the section Warszawa Wschodnia - Nasielsk (Kątne/Świercze)	11	2027	10	2031	t.b.a.	t.b.a.	t.b.a.	t.b.a	t.b.a.	
planned	Poland	PKP PLK S.A.	Nowy Sącz - Tymbark	Nowy Sącz	Tymbark	Expected line	Construction of a new railway line Podłęże – Szczyrzyc – Tymbark/Mszana Dolna and modernisation of the existing railway line no. 104 Chabówka – Nowy Sącz – Stage II	10	2022	12	2023	100-160	22,5/D3.	750 m	3 kV AC		
planned	Poland	PKP PLK S.A.	Tymbark - Podłęże	Tymbark	Podłęże	Expected line	Construction of a new railway line Podłęże – Szczyrzyc – Tymbark/Mszana Dolna and modernisation of the existing railway line no. 104 Chabówka – Nowy Sącz – Stage III	2	2023	10	2028	160	22,5/D3	750 m	3 kV AC	2	
ongoing	Poland	PKP PLK S.A.	Tarnów - Podłęże	Tarnów	Podłęże	Principal	Construction of ERTMS/ETCS on TEN-T core network	1	2018	4Q4	2023	-	-	-	3 kV DC	2	
	Poland	PKP PLK S.A.	Łuków - Terespol	Łuków	Terespol	Principal		1	2018	12	2023	-	-	-	3 kV AC	2	

Status	Member state	IM	Line	Section		Category	Project name	Start		End		Maximum speed [km*h^{-1}]	Axle load [t] / Line category	Maximum train length [m]	Traction power	ETCS Level	Interm. Code
				From	To			Month	Year	Month	Year						
ongoing	Poland	PKP PLK S.A.	All lines and sections				Construction of GSM- R network infrastructure		2018	5	2023	n/a	n/a	n/a	n/a	n/a	n/a
partly completed	Slovakia	ŽSR	Púchov – Považská Teplá	Púchov	Považská Teplá	Principal	Reconstruction, upgrade of the line	9	2016	2	2022	160	22,5/D4	According TEN-T	25 kV AC	ETCS L1	
ongoing	Slovakia	ŽSR	Bratislva Nové Mesto – Komárno	Bratislva Nové Mesto	Dunajská Streda	Connecting	Local measures to increase the capacity										
ongoing	Slovakia	ŽSR	Bratislva Nové Mesto – Komárno	Bratislva Nové Mesto	Dunajská Streda	Connecting	Study for double line operation finished. Start of reconstruction – TBD					According TEN-T	According TEN-T	According TEN-T			
ongoing	Slovakia	ŽSR	Bratislva Nové Mesto – Komárno	Dunajská Streda	Komárno	Connecting	Local measures to increase the capacity										
ongoing	Slovakia	ŽSR	Node Žilina	Žilina zr.st	Varín	Principal	Modernisation of node Žilina		2020	12	2024	According TEN-T	According TEN-T	According TEN-T	25 kV AC	ETCS L1/ETCS L2	
planned	Slovakia	ŽSR	Node Bratislava	Bratislava	Bratislava	Principal	Study finished. Start of modernisation - TBD					According TEN-T	According TEN-T	According TEN-T			
planned	Slovakia	ŽSR	Bratislava – Nové Zámky	Trnovec nad Váhom	Tvrdošov ce	Principal	Tracks reconstructions	04	2023	12	2023						
planned	Slovakia	ŽSR	Košice – Čierna nad Tisou	Košice	Čierna nad Tisou	Diversionary	GSM-R Implementation	04	2023		2024						
ongoing	Hungary	MÁV	Budapest - Kelebia	Soroksár	Kelebia border	Principal	Modernization of Budapest - Belgrad railway line and ERTMS deployment		2022		2025	160	22,5	750 m	25 kV AC	ETCS L2	
planned	Hungary	MÁV	Budapest - Kelebia	Ferencváros	Soroksár	Principal	Modernization of Ferencváros - Soroksár railway line and ERTMS deployment		2022		2024	100/120	22,5	750 m	25 kV AC	ETCS L2	
planned	Hungary	MÁV	Budapest – Miskolc	Kelenföld	Kföldol	Principal	3rd track building		N.A.		N.A.	100	22,5	750 m	25 kV AC	ETCS L2	
planned	Hungary	MÁV	Budapest – Hegyeshalom	Kelenföld	Budaörs	Principal	3rd and 4th tracks building		N.A.		N.A.	120	22,5	750 m	25 kV AC	ETCS L2	
planned	Hungary	MÁV	Budapest – Hegyeshalom	Almásfüzítő	Komárom	Principal	Elimination of bottlenecks		N.A.		N.A.	160	22,5	750 m	25 kV AC	ETCS L2	
planned	Hungary	GYSEV	Rajka s.b. - Hegyeashalom	Rajka	Hegyeshalom	Principal	Upgrade of railway infrastructure	2025	n/a	n/a	2027	100/120	n/a	750 m	25 kV AC	L2	C21/340
planned	Hungary	GYSEV	Hegyeshalom - Szombathely	Hegyeshalom Csorna	Csorna Porpác	Principal	Upgrade of railway infrastructure	n/a	n/a	n/a	Beyond 2030	100/120	n/a	750 m	25 kV AC	L2	C21/340

Status	Member state	IM	Line	Section		Category	Project name	Start		End		Maximum speed [km*h^{-1}]	Axle load [t] / Line category	Maximum train length [m]	Traction power	ETCS Level	Interm. Code
				From	To			Month	Year	Month	Year						
planned	Hungary	GYSEV	Szombathely station	Szombathely	Szombathely	Principal	Upgrade of railway and signalling infrastructure	n/a	n/a	n/a	Beyond 2030	n/a	n/a	750 m	25 kV AC	L2	C21/340
planned	Hungary	GYSEV	Szombathely - Zalaszentivan	Szombathely	Vasvár	Principal	Upgrade of railway infrastructure	n/a	n/a	n/a	Beyond 2030	100/120	n/a	750 m	25 kV AC	L2	C21/340
				Vasvár	Pácsony							80					
				Pácsony	Egervár-Vasboldogasszony							100/120					
				Egervár-Vasboldogasszony	Zalaszentivan							80					
planned	Hungary	GYSEV	Hegyeshalom - Zalaszentivan	Hegyeshalom	Zalaszentiván	Principal	GSM-R implementation	n/a	n/a	n/a	Beyond 2030	n/a	n/a	n/a	n/a	n/a	n/a
planned	Hungary	GYSEV	Hegyeshalom - Zalaszentivan	Sopron	Győr	Principal	GSM-R implementation	n/a	2019	n/a	2023/ 2024	n/a	n/a	n/a	n/a	n/a	n/a
planned	Hungary	GYSEV	Sopron - Györ	Sopron Rendezö	Harka	Principal	Upgrade of railway infrastructure, construction of the second track	n/a	2023	n/a	2027	160	n/a	750 m	25 kV AC	L2	C21/340
planned	Hungary	GYSEV	Sopron - Györ	Harka	Pinnye	Principal	Upgrade of railway infrastructure, construction of the second track	n/a	n/a	n/a	Beyond 2030	160	n/a	750 m	25 kV AC	L2	C21/340
				Pinnye	Fertöszentmiklós												
				Fertöszentmiklós	Petőháza												
				Petőháza	Csorna												
				Csorna	Györ												
ongoing	Slovenia	SŽ-I	Ljubljana -	Zidani Most	Pragersko	Principal	Modernisation, upgrade of railway infrastructure Higher category (C3 to D4) and upgrading signalling safety devices		2016		2022	20	22.5 t / D4	740 m	3kV DC	ETCS_L1	
ongoing	Slovenia	SŽ-I	Ljubljana	Ljubljana	Ljubljana	Principal	Modernisation, upgrade of railway station Ljubljana Lack of capacity, longer station tracks, signalling		2021		2026	80	22,5 t / D4	740 m	3kV DC	ETCS_L1	
planned	Slovenia	SŽ-I	Ljubljana	Zidani Most	Ljubljana	Principal	Modernisation, upgrade of railway infrastructure, Signalling, longer station tracks,		2023		2027	120	22,5 t / D3	570 m	3kV DC	ETCS_L1	
ongoing	Slovenia	SŽ-I	Koper - Ljubljana	Divača	Koper	Principal	Construction of the second track Divača - Koper, an additional track on other route (shorter track) but not parallel, creation of new structure		2018		2025	120	22.5 t / D4	740 m	3kV DC	ETCS_L1	

Status	Member state	IM	Line	Section		Category	Project name	Start		End		Maximum speed [km*h^{-1}]	Axle load [t] / Line category	Maximum train length [m]	Traction power	ETCS Level	Interm. Code
				From	To			Month	Year	Month	Year						
							(line, tunnel, bridge, leapfrog)										
ongoing	Slovenia	SŽ-I	Koper - Ljubljana	Ljubljana	Divača	Principal	Modernisation, upgrade of railway infrastructure (more energy for traction, signalling, longer station tracks, required speed,..). to meet the required TEN-T standards regarding interoperability. Creation of Automatic Block Signalling		2018		2027	100	22,5 t / D4	740 m	3kV DC	ETCS_L1	
ongoing	Slovenia	SŽ-I	Pragersko	Pragersko	Pragersko	Principal	Modernisation, upgrade of railway station Pragersko, Lack of capacity, longer station tracks, signalling		2017		2023	80	22.5 t / D4	740 m	3kV DC	ETCS_L1	
ongoing	Slovenia	SŽ-I	Pragersko - Hodoš	Ormož	Hodoš	Principal	Creation of new structure (Automatic Block Signalling)		2022		2025	100	2,5 t / D4	740 m	3kV DC	ETCS_L1	

Source: RFC Amber 2025 Implementation Plan

Deployment Plan

The previous sections detail the proposed measures identified for the removal of bottlenecks to ensure interoperability, thus achieving higher speed allowances, improving environmental protection, increasing capacity, etc. In order to achieve the compatibility of technical parameters, interoperability systems within the frame of Directive (EU) 2016/797, some further measures should be put in place. The following Technical Specifications for Interoperability (TSI) are relevant for improving the interoperability of rail subsystems or part of subsystems:

- a/ Fixed installations TSIs INF TSI – infrastructure ENE TSI – energy;
- b/ Common TSIs:
  - CCS TSI – control command and signalling TSI – Safety in railway tunnels TSI – Persons with reduced mobility;
- c/ Functional TSIs:
  - OPE TSI – Operation and Traffic Management;
  - TAF TSI – Telematics applications for freight service TAP TSI – Telematics applications for passenger services;
- d/ Rolling Stock TSIsWAG TSI – Wagons NOI TSI – NoiseLOC & PAS TSI – Locomotives and Passenger Rolling Stock.

The development and elaboration of TSIs is the competence of the European Railway Agency (ERA), based on the mandate of the European Commission.

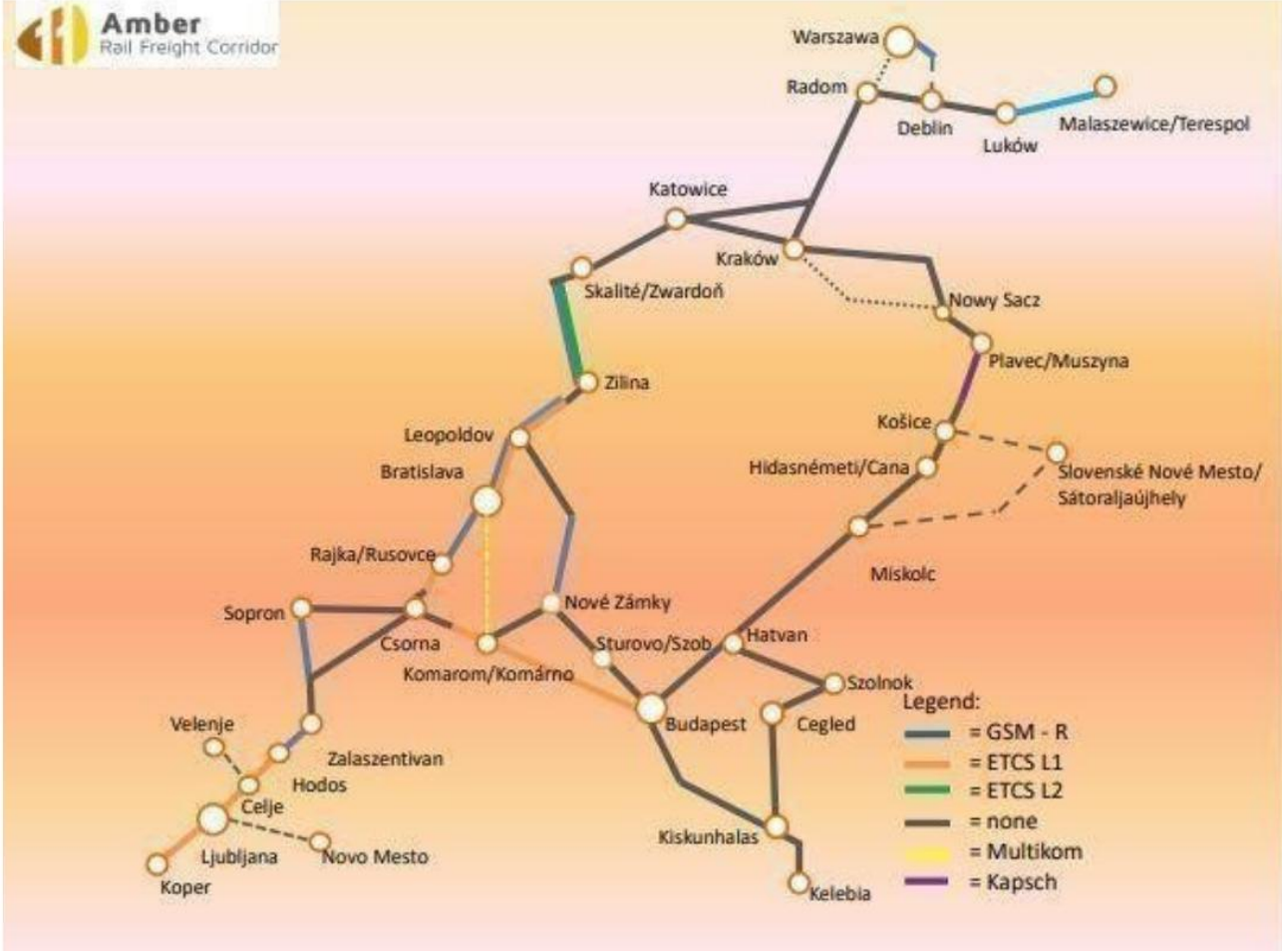
The implementation of the ongoing and planned projects will result in an improvement of interoperability along the RFC Amber as follows:

- Poland: The corridor's lines are electrified with direct current. Some sections have lower loading capacity and speed allowance than the directive prescribes. All five sections are equipped with the ETCS level no. 2. Most sections are currently under modernization, only some projects are planned to start at a later phase. Slovakia: The corridor's lines are electrified. Most parts are powered by direct current and certain sections with an alternating current of 25 kV / 50 Hz. Some parts have lower speed allowance than the directive prescribes. The axle load category C4 and the diesel traction are only relevant on the connecting line. Sections and stations are currently being upgraded.
- Hungary (MÁV): The corridor's lines are electrified with an alternating current AC 25 kV / 50 Hz. Some sections have a lower loading capacity and speed allowance than the directive prescribes. A number of infrastructure, signalling, telecommunication reconstructions projects are running on various sections to fulfil the requirements.
- Hungary (GYSEV): The corridor's lines are fully electrified with an alternating current of 25 kV / 50 Hz AC. Some sections have a lower loading capacity and speed allowance than the directive prescribes. Further update and modernization of the railway infrastructure is only at a planning phase.
- Slovenia: The principal route of the corridor is electrified with direct current. Some parts have lower speed allowance than the directive prescribes. The axle load category C4 and the diesel traction are only on the connecting line.

Regarding the implementation of the TAF TSIs, it is estimated that until the end of 2022 all Member States in RFC Amber will comply. However, a detailed analysis can be found about that in the TAF-TSI Master Plan: http://www.era.europa.eu/Document-Register/Documents/TAF-TSI-Master-Plan.pdf.

The current state of the control command and signalling system is shown on the map in the figure below.

Figure 9 RFC Amber alignment, terminals and cross-border nodes



Source: RFC Amber 2025 Implementation Plan

2.2 CORRIDOR OPERATIONAL PERFORMANCE

2.2.1 KEY PERFORMANCE INDICATORS

According to article 19 (2) of Regulation (EU) 913/2010 the Management Boards of the Rail Freight Corridors are requested to monitor the performance of rail freight services on the freight corridor and publish the results of this monitoring once a year.

The RFCs are free to choose their own Key Performance Indicators (KPIs) to fulfil this requirement. However, in order to facilitate data provision for the calculation of the KPIs and the processing of such data, a common approach and set of KPIs applicable to all RFCs was developed and adopted under coordination of RNE.

The KPI framework includes capacity management, operations and market development indicators. The most relevant indicators are described below for the years 2020, 2021 and 2022.

Table 11 provides the number of trains per BCP along the RFC Amber (i.e. the number of commercial freight trains crossing selected border points), whereas Table 12 includes the number of trains crossing a BCP along the RFC (i.e. the number of trains crossing a corridor BCP, provided that trains crossing more than one BCP are only counted once).

Table 11 Number of trains per BCP along the RFC Amber

Border		BCP	2020	2021	2022	2023
PL	SK	Muszyna/Plaveč	1,884	2,004	1,972	1,337
PL	SK	Zwardoń/Skalite	0	0	0	0
SK	HU	Komárno/Komárom	N/A	16,585	14,875	2,675
SK	HU	Štúrovo/Szob	N/A	3,677	3,542	7,871
SK	HU	Rusovce/Rajka	N/A	1,618	1,884	4,610
SK	HU	Čaňa/Hidasnémeti	N/A	N/A	N/A	N/A
SK	HU	Slovenské Nové Mesto/Sátoraljaújhely	N/A	N/A	N/A	N/A
HU	SI	Őriszentpéter/Hodoš	6,097	6,755	6,297	6,492

Source: RFC Amber KPIs

According to the available data, during the last four years the highest traffic was registered at Štúrovo/Szob, between Slovakia and Hungary, followed by Őriszentpéter/Hodoš, between Hungary and Slovenia and Rusovce/Rajka, between Slovakia and Hungary. The significant decrease of traffic was detected at Komárom/Komárno, between Slovakia and Hungary over past two years.

Train traffic data/trends at BCPs include all RFCs trains and may vary according to traffic management solutions and traffic conditions on the accessing/interconnected lines, as well as traffic capacity restrictions on these lines, due to temporary/permanent maintenance and/or construction works. Furthermore, the COVID Pandemic first and the Russian war of aggression against Ukraine later also affected traffic on the European network for competitive rail transport.

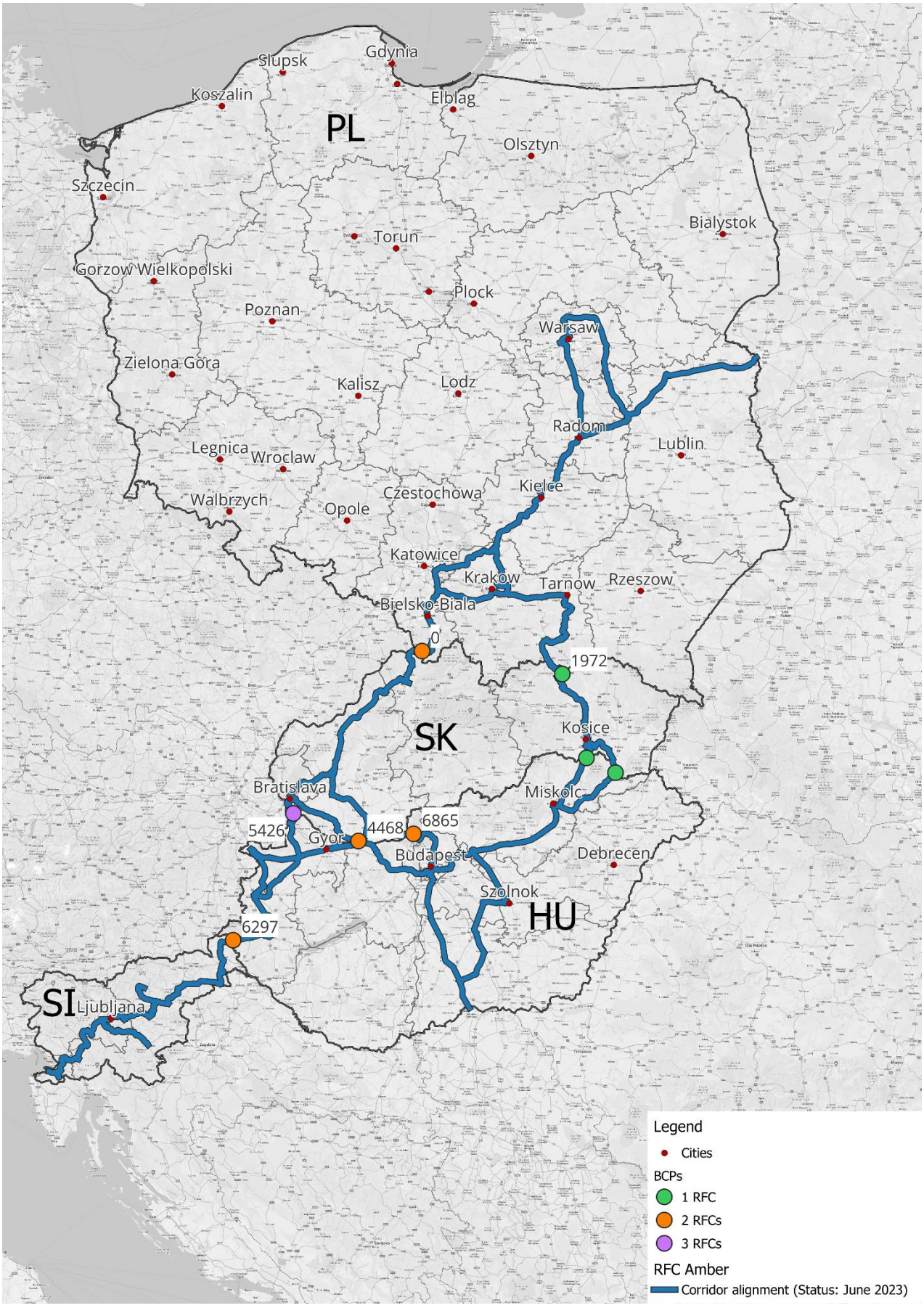
Table 12 Corridor trains crossing at least one RFC Amber BCP

	2022	2023
Number of trains crossing a border along RFC Amber	21,448	18,448

Source: RFC Amber KPIs

No data other than for 2022 are available concerning the number of corridor trains.

Figure 10 RFC Amber – Trains at BCPs along the RFC Amber in 2022



Source: CIP June 2023 and RFC Amber KPIs

Further to the number of trains at BCPs, the set of common indicators also includes capacity management related parameters, for which data are collected and provided for all RFCs. Figures for the RFC Amber are provided in Table 13 below.

Table 13 Capacity Management KPIs

Parameter	TT 2022	TT 2023	TT 2024	TT 2025
	2021	2022	2023	2024
Volume of offered capacity – PaPs (at X-11), mio (path) km	5.7	4.5	3.6	3.9
Volume of requested capacity – PaPs (at X-8), mio (path) km	1	0.8	0.6	0.9
Number of requests – PaPs (at X-8)	12	10	10	10
Number of conflicts – PaPs (at X-8)	0	3	5	2
Volume of pre-booked capacity– PaPs (at X-7.5), mio (path) km	1	0.6	0	0.9
Ratio of pre-booked capacity (to the volume of capacity offered at x-11)	17.8%	14.1%	13.3%	22.6%
Volume of offered capacity – Reserve Capacity (at X-2), mio (path) km	6	4.6	4.6	
Number of requests – Reserve Capacity (at X+12) (number of PCS dossiers)	2	0		
Volume of requested capacity – Reserve Capacity (at X+12), mio (path) km	0.13	0		

Source: RFC Amber KPIs

The commonly adopted KPI framework additionally includes indicators to measure the average planned speed of the offered Pre-allocated Paths (Figure 11) and punctuality of freight services along the RFCs (Table 14).

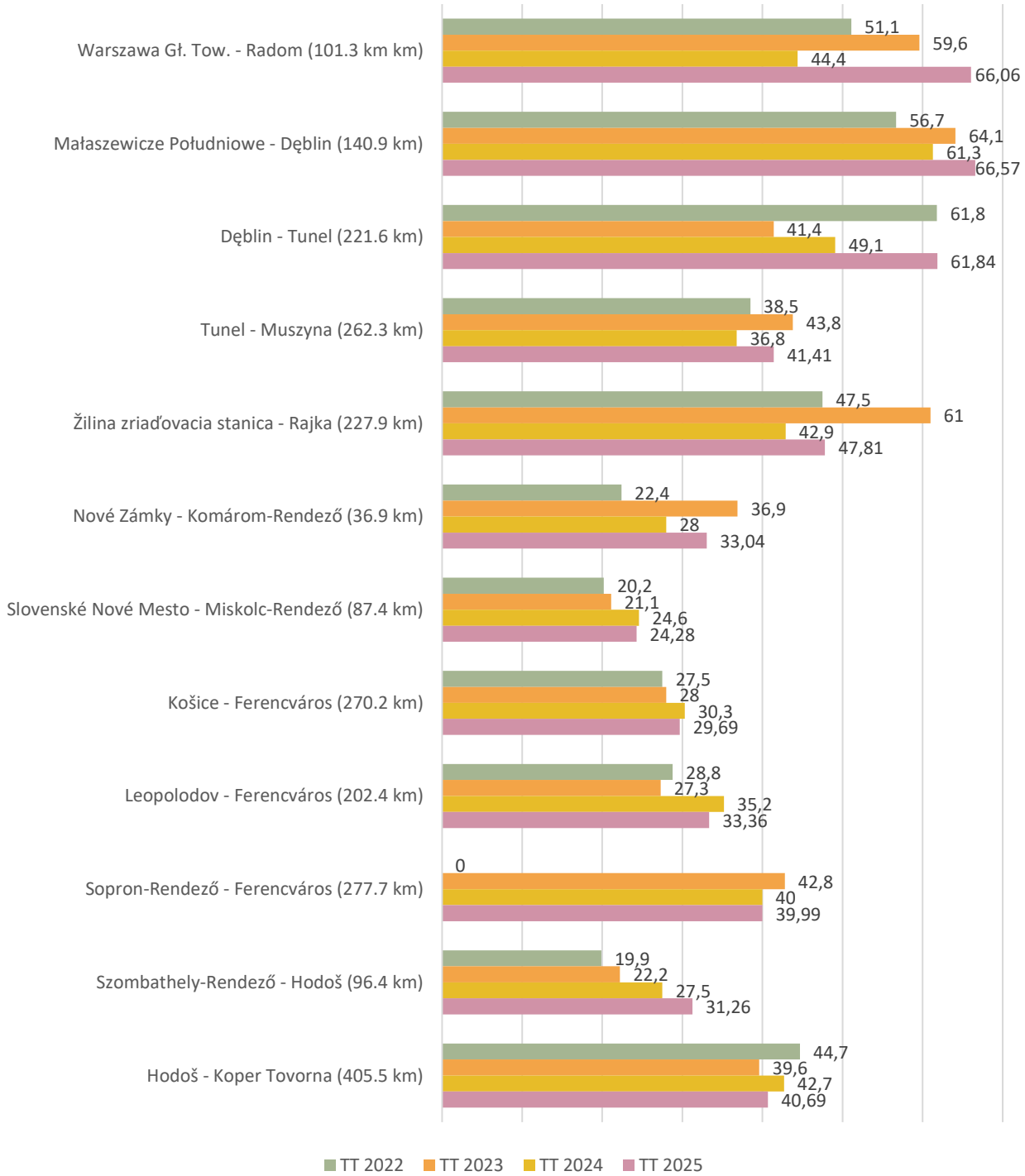
Table 14 Punctuality

				(delay ≤ 30 minutes)
	2020	2021	2022	2023
Punctuality at origin (RFC entry)	45.0%	38.0%	36.0%	37.0%
Punctuality at destination (RFC exit)	30.0%	20.0%	62.0%	26.0%
				(delay ≤ 15 minutes)
Punctuality at origin (RFC entry)		36.0%	35.0%	35.0%
Punctuality at destination (RFC exit)		18.0%	24.0%	25.0%

Source: RFC Amber KPIs

The indicators for the past four years show a slight decline in the parameters related to capacity management except for ratio of pre-booked capacity and number of conflicts. Also, improvements can be noticed for punctuality at destination. Average planned speed of PaPs shows improvements as well on most of the lines except for Sopron-Rendező – Ferencváros and Hodoš - Koper Tovorna, which may also be related to works along the corridor sections.

Figure 11 Average planned speed of PaPs, km/h



Source: RFC Amber KPIs

2.2.2 SPECIFIC PERFORMANCE OBJECTIVES AND TARGETS

Further to the monitoring activities associated with the common KPIs applicable to all RFCs, specific objectives have been also adopted by the RFC Amber, associated with quantified targets. The following paragraphs provide a description of the identified objectives and related targets. Similarly to other RFCs, RFC NS-B also undertakes Train Performance Management tasks (producing annual reports on the performance of the corridor) and the user satisfaction survey.

The Management Board of RFC Amber has adopted five specific corridor objectives – in the sense of Art. 9(1c) of the RFC Regulation) – in the fields of capacity management, operations, market development and customer offer:

- Objective 1: Average planned speed of PaPs (Capacity Management);
- Objective 2: Punctuality at destination (Operations);
- Objective 3: Dwell times in border sections (Operations);
- Objective 4: Number of trains per border (Market development);
- Objective 5: Provision of paths with improved parameters (Customer offer).

The Management Board decided to apply the objectives from 1 January 2024 on and set target values both for a short-term and a medium-term perspective, with monitoring done annually. The following table contains the objectives and the respective short- and medium term target values.

Table 15 Target values for the identified RFC Amber objectives

Objective	Target value 2024	Target value 2028
Average planned speed of PaPs	+12,5%	+25%
Punctuality at destination (<= 30 min)	+5%	+12%
Dwell times in border sections	-10%	-25%
Number of trains per border	+3%	+10%
Provision of paths with improved parameters	6 paths	10 paths

Source: RFC Amber 2025 Implementation Plan

The following paragraphs provide some methodological notes of relevance for the monitoring of the achievement of the proposed objectives.

Average planned speed of PaPs

For the monitoring of the objective the KPI Average planned speed of PaPs is used, which shows the average of the planned commercial speed of the PaPs in km/h for selected connections. The KPI is calculated by dividing the length of the PaP by the planned travel time. Therefore, the Average planned speed of PaPs also includes necessary stops on the route, as well as parts with restricted speed Often paths are adjusted from year-to-year to better fit the applicants needs, for instance considering necessary stops for train drivers or necessary waiting times at borders. Thus, increasing the average planned speed of a PaP is not only dependent on the potential train speed itself but also on the optimization of related operational processes and the production system of the railway undertaking.

The sections for monitoring are selected based on available historical data and optimal geographical coverage of corridor lines. Initially, four PaP sections have been selected:

- Tunel – Muszyna;
- Žilina-zriaďovacia stanica – Rajka;
- Szombathely-Rendező – Hodoš;
- Hodoš – Koper Tovorna.

As for the timetable 2024 the speeds of the PaPs are between 24,62 and 61,27 km/h. The average speed is about 40 km/h.

Punctuality

Punctuality of a train is measured on the basis of comparisons between the time planned in the timetable of a train identified by its train number and the actual running time at certain measuring points. A measuring point is a specific location on the route where the trains running data is captured. One can choose to measure the departure, arrival or run through time. The comparison should always be done with an internationally agreed timetable for the whole train run.

Dwell times in border sections

There are several ways to measure and calculate the dwell time on border sections. The most common one does not take into account whether a train is running in advance or is delayed. This is the real dwell, which measures the difference between the arrival and departure of the train and calculates the average dwell time for a specific border section. RNE uses the real clean dwell, which excludes the time that the train spent running in advance. Considering that many trains have unnecessary buffer times built into their timetables and other capacity allocation specialties, the real clean dwell often gives a much better picture of the real situation than it really is. With this in mind, RFC Amber decided to use the "classic" real dwell time to measure the dwell time on border sections.

This offers several advantages over the real clean dwell:

- Although not all PMs have data available on the „classic" real dwell time on border sections, most of them use this calculation method, which makes it possible to check the reliability of the data in RNE systems in some cases. Most of the IMs are developing the necessary reports according to this calculation method.
- This method was used to measure dwell times on border sections and to do thorough border crossing analysis before and was not criticized by the RUs. The real clean dwell is a new method, and since the values are a lot better than by using the old method, its introduction might not be well received by the stakeholders.
- The calculation method and the background of the calculated value is a lot more intuitive and understandable for every stakeholder, than the clean real dwell.

Number of trains per border

This indicator shows the number of commercial freight trains crossing selected border points. Loco runs and service trains are not considered. It shows real traffic data which is stemming from the IMs national systems. Figures can, however, illustrated per border sections (included more border crossing points) on a consolidated way. These border figures are calculated for calendar year (see Section 2.2.1).

Provision of paths with improved parameters

RFC Amber offered PaPs for "extra-long" trains on the section Czechowice Dziedzice – Žilina (border crossing Zwardoń – Skalité) for TT2021 and for TT2022 on section Czechowice Dziedzice – Bratislava. There were no PaPs for "extra-long" trains in the offer for TT2023. For TT 2024 it was offered again on section Czechowice Dziedzice – Bratislava. RFC Amber also offered PaP for trains with a length of 700 m in a section Bratislava ÚNS – Szombathely-Rendező.

In October 2021, a „TEN-T Demo-Train" was operated on the Sopron – Budapest section of the corridor within the CORCAP-project, forming the first 740 m long train on this route, which today is partially still limited to 650 m train length. As a result of the project, train paths with up to 700 m train length are now offered on a regular basis between the marshalling yards of Bratislava and Szomtbathely.

The aim is to increase number of PaPs with improved parameters to enable increasing the efficiency of rail freight traffic and strengthening the railway's competitive position.

2.2.3 RAILWAY UNDERTAKINGS OPERATING FREIGHT SERVICES ALONG THE 11 RFCS AND RFC AMBER

The Train Information System (TIS) tool coordinated by RNE includes a detailed database of train operations. An analysis of the TIS dataset for the year 2022 has been made as part of this study aimed at producing statistical information on train operations along the RFCs. However, train operations encoded in TIS do not correspond to individual trains by Origin and Destination as more Railway Undertakings can be involved in the operation of international trains. A train along an RFC can be operated by more Railway Undertakings from origin to destination. For the analysis presented in this section, Railway Undertakings belonging to the same group of companies have been aggregated into a single unit of analysis. This specified, according to the TIS database, 166 railway undertakings/groups of railway undertakings have been identified which were involved in the operation of international rail freight services along the RFCs in 2022. About half operated more than 1,000 trains, whereas one-fourth operated more than 5,000 trains.

Table 16 Railway Undertakings operating international rail freight trains in 2022

N. trains	N. of RUs
> 15,000	18
> 10,000 < 14,999	11
> 5,000 < 9,999	12
> 2,000 < 4,999	27
> 1,000 < 1,999	16
> 500 and 999	24
> 200 < 499	31
> 100 < 199	14
< 100	13
Total	**166**

Source: RNE – TIS

The number of Railway Undertakings operating trains along the RFCs in 2022 varied from a minimum of 27 on the RFC Atlantic to 134 on the RFC Rhine-Danube. Overall, the number of RUs operating along each RFC and the number of trains they operate align with the market size and shares of rail transport in the countries crossed by the RFCs as illustrated in Sections 3.1 and 3.2 below. Not surprisingly, more operations, particularly

by large Railway Undertakings/Groups of Railway Undertakings, are concentrated along the RFCs crossing Central and Eastern European countries.

Table 17 Railway Undertakings using RFCs in 2022 by class of number of operated trains

N. trains	RALP	NSM	SCANMED	ATL	BA	MED	OEM	NSB	RD	AWB	Amber
> 5,000	7	5	6	1	8	2	9	10	9	2	**4**
> 1,000 < 4,999	18	5	6	6	13	9	24	19	19	1	**6**
< 1,000	61	23	49	20	96	40	99	79	106	49	**66**
Total	**86**	**33**	**61**	**27**	**117**	**51**	**132**	**108**	**134**	**52**	**76**

Source: RNE - TIS

Referring to the entire 11 RFCs network, most RUs operate trains on more than one corridor: 55% of the RUs operate trains on 4 to 7 RFCs, whereas about 25% operate trains on up to 3 corridors and another 20% operate trains on 8 or more corridors. Only 4 RUs operate trains on all RFCs, and 12 operate trains on only one RFC.

Table 18 Railway Undertakings using RFCs in 2022 by number of corridors where they operate

N. of RFCs where RUs operate	N. of operating RUs by RFC											
	RALP	NSM	SCANMED	ATL	BA	MED	OEM	NSB	RD	AWB	AMBER	11 RFCs
1	1	1	1	2	1	1	2	0	3	0	0	**12**
2	6	0	0	1	2	1	3	7	3	1	0	**12**
3	3	2	2	4	6	2	12	7	11	1	4	**18**
4	5	2	3	1	13	4	17	8	17	3	11	**21**
5	9	5	6	2	21	4	23	18	24	4	14	**26**
6	19	4	11	4	28	10	30	25	30	8	17	**31**
7	10	1	11	0	13	4	13	12	13	6	8	**13**
8	14	4	9	3	14	8	14	13	14	11	8	**14**
9	10	7	9	3	10	8	9	9	10	9	6	**10**
10	5	3	5	3	5	5	5	5	5	5	4	**5**
11	4	4	4	4	4	4	4	4	4	4	4	**4**
Total	**86**	**33**	**61**	**27**	**117**	**51**	**132**	**108**	**134**	**52**	**76**	**166**

76 RUs operated trains on the RFC Amber in 2022. Most of them operated trains on more corridors and registered up to 1,000 operations. Still, 4 RUs operated more than 5,000 trains along the RFC Amber in 2022.

2.2.4 PASSENGERS TRAIN OPERATIONS ALONG THE RFC AMBER

As part of the study, a high-level recognition of the passengers' train operations was performed based on the information available from the Train Information System (TIS) tool coordinated by RNE. Given that the database is not fully complete, the analysis is limited to identifying the main Origins and Destinations (O/Ds) of international passenger traffic along the 11 RFCs network.

The following table lists the main train relations for the year 2022, i.e. the O/Ds with more than 500 registered international trains per direction. All other relations present a number of international trains lower than this threshold. It shall be noted that these O/D relations may be part of trips over longer O/D.

Table 19 Main international passengers' cross-border relations encoded in TIS using RFC Amber in 2022

Involved RFC	Origin		Destination	
RFC Amber	Košice	SK	Budapest	HU
RFC Amber	Warszawa	PL	Budapest	HU
RFC MED; RFC Amber	Budapest	HU	Ljubljana	SI
RFC OEM; RFC Amber	Budapest	HU	Praha	CZ
RFC OEM; RFC RD; RFC Amber	Hegyeshalom	HU	Bratislava	SK

Source: RNE – TIS and IMs individual data

Detailed historical data are not available to assess the impact of the establishment of the RFCs on passenger operations and vice versa. There seems to be no evidence of the negative effects of the establishment and operations of the RFCs on passenger traffic.

3 2024 TMS UPDATE BACKGROUND INFORMATION

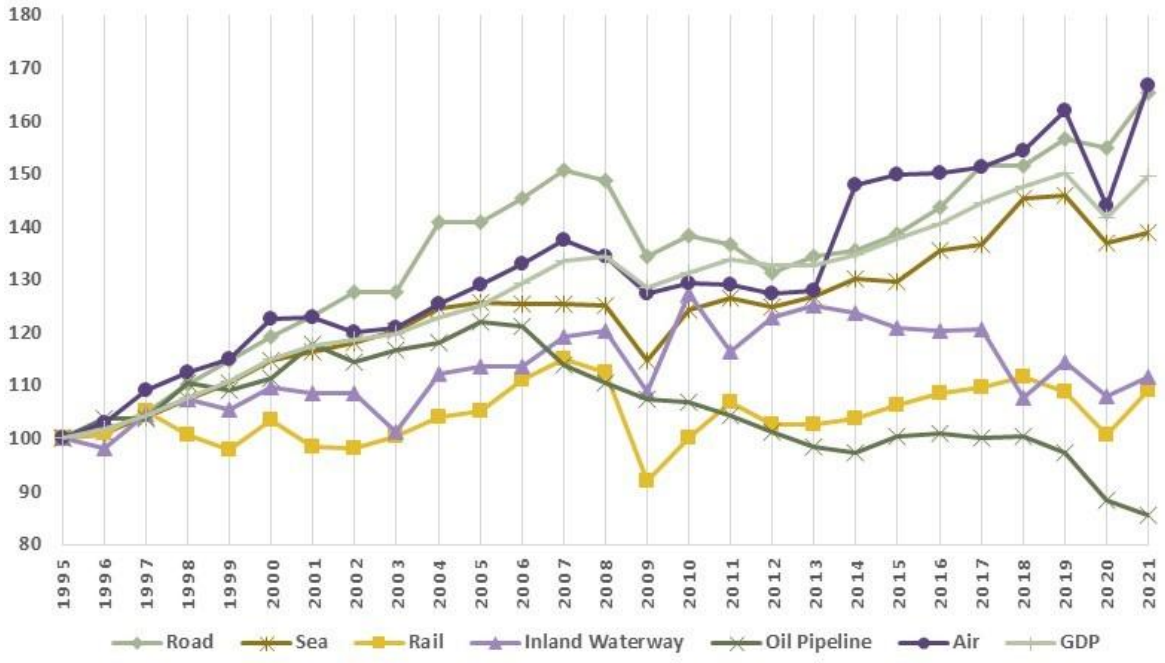
The first section of this chapter provides a statistical framework on the main socio-economic and transport developments on a European scale over the past decades. The second section reports on the main indicators monitored at the European level regarding the rail transport market and its liberalization process. The last section concerns the scenarios considered for elaborating future market estimates as part of the 2024 TMS Update, including the presentation of the main socio-economic assumptions and infrastructure developments.

Given that the rail freight market and international freight train operations across EU Member States and between the EU and its neighbouring countries are shared among the different corridors, and considering that most statistics are available at the country level, and some of them only at the EU level, the analysis in this chapter is presented for the entire 11 RFCs network, covering the entire EU and the relevant neighbouring countries for which data are collected and available from EU institutions. Whenever possible, data have been elaborated for the RFC concerned countries. Corridor countries have also been highlighted in the exhibits. Allowing for an understanding of the market trends along the RFCs within the wider EU context, such a solution is also more in line with the adopted approach of developing a market analysis using an EU-wide network model.

3.1 TRANSPORT MARKET TRENDS IN THE EU

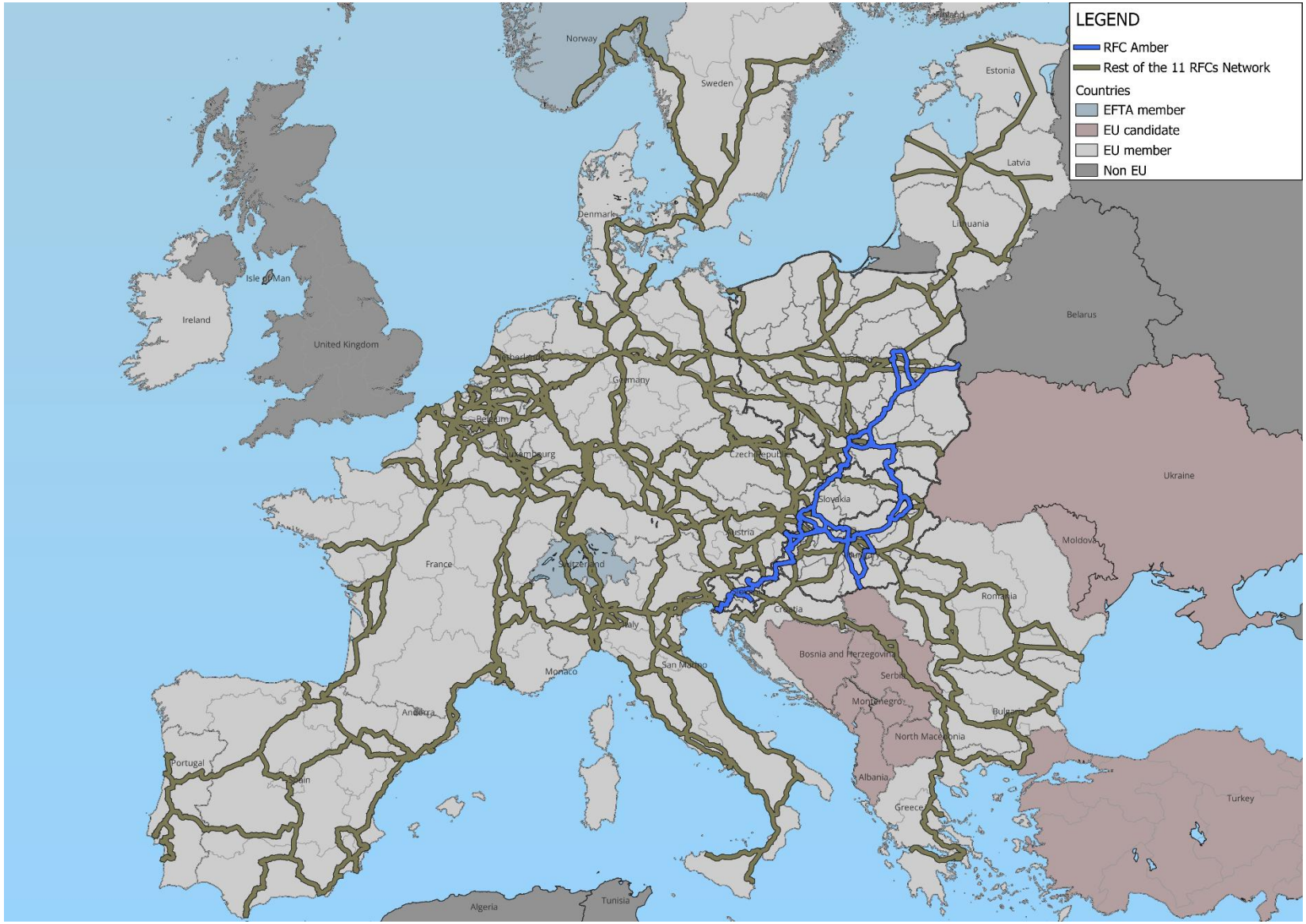
This section briefly reports the main transport statistics from the Statistical Pocketbook 2023, produced by the EC – DG MOVE and Eurostat. The analysis provides an overview of the development of the European rail freight sector since the middle of the 1990s when the rail freight market liberalization started, allowing monitoring trends before and after the 2008 credit crunch, which is considered the second major financial crisis after the 1930s Great Depression, and which was followed by additional adverse events during the past 10-15 years when the 11 RFCs were gradually established and entered into operation.

Figure 12 Transport trends in billion tkm EU27 (1995=100)



Source: EC – DG MOVE – Statistical Pocketbook 2023

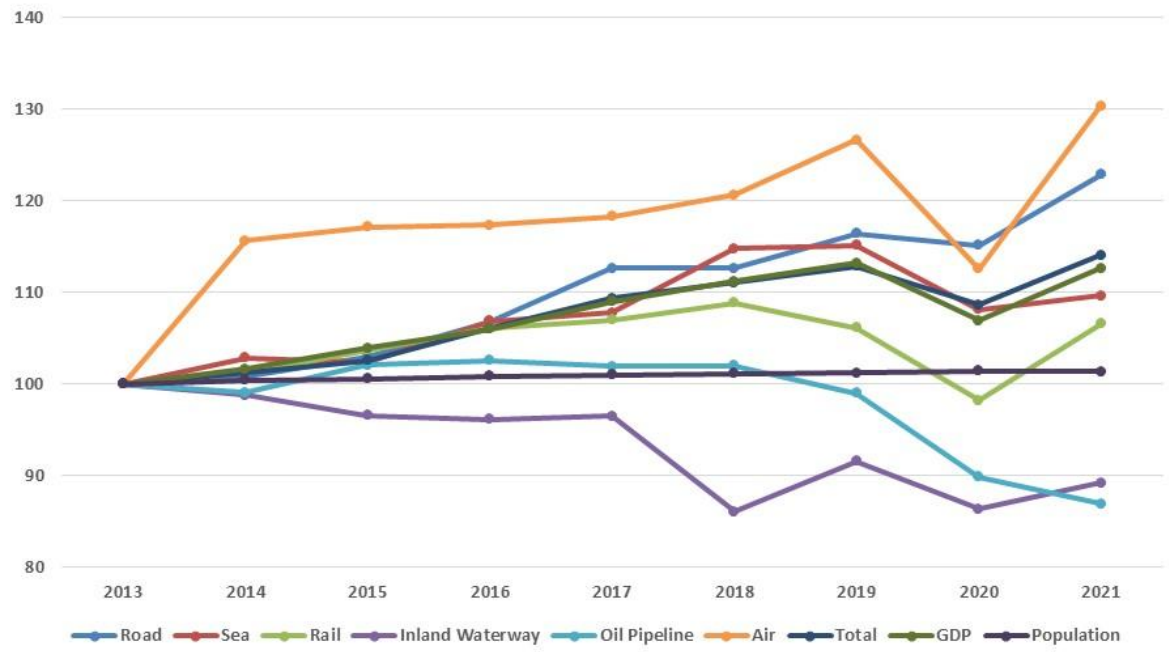
Figure 13 The RFC Amber within the 11 RFCs network



Source: Authors based on CIP

The period since the entry into force of the Regulation (EU) 913/2010 has indeed been marked by a number of socio-economic, health and geopolitical events which negatively impacted trade and transport flows at the global and European scale. As visible from the available statistics, the above-mentioned 2008 financial crisis basically altered the economic and transport developments experienced by Europe over the previous decades. Long-term series over the past 30 years show that the effects of this crisis are persisting, which were more recently further impacted by the 2020-2021 COVID-19 pandemic and by the current geopolitical crisis that started in 2022 with the Russian war of aggression against Ukraine and deteriorated with the Israel-Gaza conflict and Red Sea crisis. Notwithstanding the recurrent negative events and persisting economic uncertainties, most socio-economic and transport developments show overall positive trends, although the curves of the period after 2008 stand at lower growth rates. This is particularly true for the primary economic variable – Gross Domestic Product (GDP) – and freight traffic for all transport modes.

Figure 14 EU-27 performance by mode for freight transport 2013-2021 (billion tkm) (2013=100)



Source: EC – DG MOVE – Statistical Pocketbook 2023

Freight transport volumes in the EU have grown from about 2,400 billion tkm in 1995 to about 3,000 billion tkm in 2013 — when six of the first 9 RFCs in the Regulation 913/2010 were established — to over 3,400 billion tkm in 2021. Aviation is the only mode for which growth levels returned close to the previous pattern from 2014 until the COVID-19 pandemic, which negatively affected all transport modes' performance. Compared to 1995, all transport modes, except oil pipelines, showed higher levels of traffic volumes expressed in tkm in 2021. All transport modes except inland waterways and oil pipelines also show overall growing trends for the past decade – up until the COVID-19 pandemic – although they are lower for rail transport than for aviation, maritime and road transport.

About 425 million inhabitants lived in the EU27 in 1995, 441 million in 2013, and 447 million in 2021. Over 5,600 tkm of goods per inhabitant were transported in the EU27in 1995, growing to 6,800 tkm in 2013 and 7,700 tkm in 2021.

Table 20 EU-27 performance by mode for freight transport 2013-2019 and 2019-2021 (billion tkm)

	2013	2019	2021	CAGR '19-'13	CAGR '21-'13	Var. '21-'19
GDP	106.1	120.1	119.5	2.1%	1.5%	-0.5%
Population	441.3	446.4	447.2	0.2%	0.2%	0.2%
Air	1.8	2.3	2.4	4.0%	3.4%	2.9%
Inland Waterway	152.6	139.7	136.1	-1.5%	-1.4%	-2.6%
Rail	384.3	407.9	409.6	1.0%	0.8%	0.4%
Combined transport	40.7	83.5	100.2	12.7%	11.9%	19.9%
Oil Pipeline	102.1	101.0	88.7	-0.2%	-1.7%	-12.2%
Road	1,516.4	1,764.8	1,862.5	2.6%	2.6%	5.5%
Sea	851.0	979.5	932.7	2.4%	1.2%	-4.8%
Total	**3,008.1**	**3,395.3**	**3,431.9**	**2.0%**	**1.7%**	**1.1%**

Source: EC – DG MOVE – Statistical Pocketbook 2023

Looking at the differences between the 2013-2019 and 2019-2021 periods, the impact of the COVID-19 pandemic seems particularly damaging for oil pipelines and maritime transport. During lockdowns, growth/decline rates were higher for all transport modes, except for air and rail transport.

Notwithstanding the marginal increase of rail freight transport between 2013 and 2021, compared to other transport modes, particularly road (see Table 20), combined transport more than doubled from about 41 billion tkm to 100 billion tkm (Table 21).

Table 21 Combined transport traffic by UIRR companies

Year	tkm				Traffic% of consignments		
	billion	% of which:			Semi-trailers	Rolling motorway	Swap bodies and containers
		below 300 km	between 300 and 900 km	more than 900 km			
1990	18.7	1%	68%	31%	20%	18%	61%
2000	35.2	2%	71%	27%	9%	23%	68%
2010	42.4	5%	58%	37%	10%	15%	75%
2015	55.0	1%	50%	49%	13%	5%	82%
2020	90.3	1%	49%	50%	15%	5%	80%
2021	100.2	1%	48%	51%	14%	5%	80%
2022	88.8	1%	52%	46%	16%	4%	80%

Source: EC – DG MOVE – Statistical Pocketbook 2023

Trends for the RFC Amber concerned countries are similar to the EU ones, whereas rail grew at higher rates in the corridor countries than at the EU level, during the COVID-19 pandemic, and inland waterways remained stable over the same period.

Table 22 RFC Amber concerned countries performance by mode for freight transport 2013-2019 and 2019-2021 (billion tkm)

	2013	2019	2021	CAGR '19-'13	CAGR '21-'13	Var. '21-'19
Road	181.0	227.5	245.8	3.9%	3.9%	8.0%
Railways	72.9	78.6	78.9	1.3%	1.0%	0.3%
Inland waterways	3.0	3.1	2.8	0.7%	-1.1%	-12.0%
Oil pipelines	27.7	26.4	24.3	-0.8%	-1.6%	-8.1%
Total	**284.6**	**335.7**	**351.7**	**2.8%**	**2.7%**	**4.8%**

Source: EC – DG MOVE – Statistical Pocketbook 2023

The share of rail in total freight transport based on tkm varies significantly across the European Union. Data in Table 23 shows rail share is generally higher in Eastern and Central European countries and lower in

Western Europe. Austria and Switzerland are exceptions to this pattern, which is also due to the support these countries give to rail transport to reduce the impact of freight transport on the environment, with a focus on the alpine crossings.

Table 23 Share of rail in total freight transport in % (based on tkm)

	2008	2013	2015	2019	2022	Var. '19-'13	Var. '22-'13	Var. '22-'08
Lithuania	64.5	57.2	56.4	56.8	37.2	-0.4	-20	-27.3
Switzerland	35.3	36.0	37.2	34.1	33.4	-1.9	-2.6	-1.9
Slovakia	**40.0**	**38.6**	**36.3**	**30.7**	**30.1**	**-7.9**	**-8.5**	**-9.9**
Austria	33.3	31.9	32.3	30.6	30.0	-1.3	-1.9	-3.3
Slovenia	**26.7**	**30.5**	**30.9**	**31.4**	**28.8**	**0.9**	**-1.7**	**2.1**
Hungary	**24.9**	**30.3**	**29.1**	**26**	**26.3**	**-4.3**	**-4.0**	**1.4**
Latvia	47.9	43.1	42.3	37.4	26.0	-5.7	-17.1	-21.9
Czechia	**31.9**	**28.0**	**26.1**	**25.9**	**22.0**	**-2.1**	**-6.0**	**-9.9**
Romania	19.9	23.3	25.0	20.5	21.0	-2.8	-2.3	1.1
Poland	**30.5**	**24.2**	**23.3**	**21.5**	**20.8**	**-2.7**	**-3.4**	**-9.7**
Germany	14.6	13.9	14.1	13.7	14.9	-0.2	1.0	0.3
Bulgaria	10.3	7.5	8.7	8.5	11.2	1.0	3.7	0.9
Finland	13.1	12.7	10.9	11.8	10.8	-0.9	-1.9	-2.3
Sweden	10.3	9.6	8.6	9.4	10.5	-0.2	0.9	0.2
Belgium	8.2	6.8	6.9	7.2	7.3	0.4	0.5	-0.9
Luxembourg	9.8	7.2	7.0	6.8	6.1	-0.4	-1.1	-3.7
European Union - 27 countries (from 2020)	6.0	5.7	5.7	5.3	5.5	-0.4	-0.2	-0.5
Croatia	4.5	3.1	3.2	3.5	4.1	0.4	1.0	-0.4
France	4.2	3.6	4.1	3.5	3.7	-0.1	0.1	-0.5
Italy	2.6	2.4	2.6	2.3	2.7	-0.1	0.3	0.1
Estonia	10.4	7.6	4.5	3.3	2.4	-4.3	-5.2	-8.0
Norway	2.0	1.9	1.6	1.6	2.1	-0.3	0.2	0.1
Netherlands	2.0	1.7	1.8	1.8	1.9	0.1	0.2	-0.1
Denmark	1.4	1.8	1.9	1.7	1.6	-0.1	-0.2	0.2
Spain	0.8	0.8	0.9	0.8	0.8	0.0	0.0	0.0
Portugal	0.3	0.3	0.3	0.3	0.2	0.0	-0.1	-0.1
Ireland	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Greece	0.2	0.0	0.1	0.1	0.1	0.1	0.1	-0.1

Source: Eurostat [tran_hv_ms_frmod]

Compared to 2013, the share of rail in total freight transport based on tkm seems to have generally declined. The most significant drops can be seen in the Baltic States and Eastern Europe, whereas in the other countries, positive and negative variations are marginal. The rail share in so-to-say “isolated networks” like Portugal, Spain, and Ireland. Greece also shows a low modal share for rail transport.

The RFC Amber countries are among the ones registering a higher rail modal share in the EU. All four RFC Amber countries are indeed positioned within the ten first-ranking EU countries for rail modal share in 2022. However, Poland and Slovakia are also among the ones that are registering a high decline in rail modal share over time. A trend that is likely related to the change in the commodity basket trade.

Table 24 Goods transported by rail by group of goods - from 2008 onwards based on NST 2007 (Tonnes '000) in the EU 27

Main group of commodities	Transported goods in Tonnes ('000)				Variations in Tonnes ('000)			Share in total in %			
	2008	2013	2019	2022	2019-2008	2019-2013	2022-2019	2008	2013	2019	2022
Unidentifiable goods: goods which for any reason cannot be identified and therefore cannot be assigned to groups 01-16	187,740	248,671	316,077	345,593	128,337	67,406	29,516	12.5%	16.3%	20.2%	23.5%
Metal ores and other mining and quarrying products; peat; uranium and thorium	241,294	254,245	254,355	217,994	13,061	110	-36,361	16.0%	16.7%	16.2%	14.8%
Products of agriculture, hunting, and forestry; fish and other fishing products	70,094	79,243	88,030	94,987	17,936	8,787	6,957	4.7%	5.2%	5.6%	6.5%
Chemicals, chemical products, and man-made fibers; rubber and plastic products ; nuclear fuel	99,803	102,438	108,291	85,334	8,488	5,853	-22,957	6.6%	6.7%	6.9%	5.8%
Basic metals; fabricated metal products, except machinery and equipment	169,705	146,343	135,089	127,790	-34,616	-11,254	-7,299	11.3%	9.6%	8.6%	8.7%
Coke and refined petroleum products	206,442	179,497	154,412	141,855	-52,030	-25,085	-12,557	13.7%	11.8%	9.9%	9.7%
Coal and lignite; crude petroleum and natural gas	267,461	266,949	213,421	182,566	-54,040	-53,528	-30,855	17.8%	17.5%	13.6%	12.4%
Other goods	262,695	248,962	297,904	272,329	35,209	48,942	-25,575	17.5%	16.3%	19.0%	18.5%
Total transported goods	**1,505,234**	**1,526,348**	**1,567,579**	**1,468,448**	**62,345**	**41,231**	**-99,131**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Eurostat [rail_go_grpgood__custom_10416020]

Table 25 Goods transported by rail by group of goods - from 2008 onwards based on NST 2007 (tkm '000.000) in the EU 27

Main group of commodities	Transported goods in tkm ('000.000)				Variations in tkm ('000.000)			Share in total in %			
	2008	2013	2019	2022	2019-2008	2019-2013	2022-2019	2008	2013	2019	2022
Unidentifiable goods: goods which for any reason cannot be identified and therefore cannot be assigned to groups 01-16	72,621	81,257	101,632	113,203	29,011	20,375	11,571	19.0%	21.3%	25.0%	29.0%
Products of agriculture, hunting, and forestry; fish and other fishing products	19,100	21,513	23,723	25,601	4,623	2,210	1,878	5.0%	5.6%	5.8%	6.6%
Chemicals, chemical products, and man-made fibers; rubber and plastic products ; nuclear fuel	29,933	30,682	31,347	23,744	1,414	665	-7,603	7.8%	8.0%	7.7%	6.1%
Metal ores and other mining and quarrying products; peat; uranium and thorium	50,565	49,328	49,966	45,058	-599	638	-4,908	13.2%	12.9%	12.3%	11.6%
Coal and lignite; crude petroleum and natural gas	43,281	44,928	38,063	33,768	-5,218	-6,865	-4,295	11.3%	11.8%	9.4%	8.7%
Basic metals; fabricated metal products, except machinery and equipment	42,766	35,939	34,740	31,185	-8,026	-1,199	-3,555	11.2%	9.4%	8.6%	8.0%
Coke and refined petroleum products	51,691	47,259	41,087	38,087	-10,604	-6,172	-3,000	13.5%	12.4%	10.1%	9.8%
Other goods	73,243	70,606	85,507	79,055	12,264	14,901	-6,452	19.1%	18.5%	21.1%	20.3%
Total transported goods	**383,200**	**381,512**	**406,065**	**389,701**	**22,865**	**24,553**	**-16,364**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Eurostat [rail_go_grpgood__custom_10416020]

Table 26 Goods transported by rail by group of goods - from 2008 onwards based on NST 2007 (Tonnes '000) in the RFC Amber concerned countries

Main group of commodities	Transported goods in Tonnes ('000)				Variations in Tonnes ('000)			Share in total in %			
	2008	2013	2019	2022	2019-2008	2019-2013	2022-2019	2008	2013	2019	2022
Unidentifiable goods: goods which for any reason cannot be identified and therefore cannot be assigned to groups 01-16	9,631	14,860	25,280	31,148	15,649	10,420	5,868	2.9%	4.7%	7.3%	8.9%
Metal ores and other mining and quarrying products; peat; uranium and thorium	61,720	77,117	85,099	81,201	23,379	7,982	-3,898	18.7%	24.2%	24.5%	23.1%
Products of agriculture, hunting, and forestry; fish and other fishing products	8,262	13,166	12,408	16,881	4,146	-758	4,473	2.5%	4.1%	3.6%	4.8%
Chemicals, chemical products, and man-made fibers; rubber and plastic products ; nuclear fuel	15,029	15,135	16,356	14,583	1,327	1,221	-1,773	4.6%	4.7%	4.7%	4.2%
Basic metals; fabricated metal products, except machinery and equipment	23,482	17,691	16,334	16,664	-7,148	-1,357	330	7.1%	5.5%	4.7%	4.7%
Coke and refined petroleum products	34,163	32,566	35,394	38,503	1,231	2,828	3,109	10.4%	10.2%	10.2%	11.0%
Coal and lignite; crude petroleum and natural gas	109,417	105,981	102,891	95,507	-6,526	-3,090	-7,384	33.2%	33.2%	29.7%	27.2%
Other goods	67,669	42,329	52,995	56,342	-14,674	10,666	3,347	20.5%	13.3%	15.3%	16.1%
Total transported goods	329,373	318,845	346,757	350,829	17,384	27,912	4,072	100.0%	100.0%	100.0%	100.0%

Source: Eurostat [rail_go_grpgood__custom_10416020]

Table 27 Goods transported by rail by group of goods - from 2008 onwards based on NST 2007 (tkm '000.000) in the RFC Amber concerned countries

Main group of commodities	Transported goods in tkm ('000.000)				Variations in tkm ('000.000)			Share in total in %			
	2008	2013	2019	2022	2019-2008	2019-2013	2022-2019	2008	2013	2019	2022
Unidentifiable goods: goods which for any reason cannot be identified and therefore cannot be assigned to groups 01-16	2,571	3,707	8,147	9,885	5,576	4,440	1,738	3.7%	5.3%	10.6%	12.0%
Products of agriculture, hunting, and forestry; fish and other fishing products	17,183	17,939	19,585	19,119	2,402	1,646	-466	24.5%	25.6%	25.4%	23.2%
Chemicals, chemical products, and man-made fibers; rubber and plastic products ; nuclear fuel	2,005	3,573	3,114	4,174	1,109	-459	1,060	2.9%	5.1%	4.0%	5.1%
Metal ores and other mining and quarrying products; peat; uranium and thorium	4,137	4,070	4,263	4,113	126	193	-150	5.9%	5.8%	5.5%	5.0%
Coal and lignite; crude petroleum and natural gas	6,061	4,276	3,590	3,638	-2,471	-686	48	8.6%	6.1%	4.7%	4.4%
Basic metals; fabricated metal products, except machinery and equipment	9,012	9,323	10,965	12,396	1,953	1,642	1,431	12.8%	13.3%	14.2%	15.1%
Coke and refined petroleum products	17,240	18,261	16,607	17,736	-633	-1,654	1,129	24.5%	26.0%	21.6%	21.6%
Other goods	12,061	8,984	10,741	11,239	-1,320	1,757	498	17.2%	12.8%	13.9%	13.7%
Total transported goods	70,270	70,133	77,012	82,300	6,742	6,879	5,288	100.0%	100.0%	100.0%	100.0%

Source: Eurostat [rail_go_grpgood__custom_10416020]

The above-described trends, including market and market share reduction in Eastern European countries and growth of combined transport, are indeed associated with changes in the type and quantities of goods transported across Europe (see Table 24 and Table 25). Products such as *chemicals, chemical products, and man-made fibers; rubber and plastic products; nuclear fuel, and particularly metal ores and other mining and quarrying products; peat; uranium and thorium; coal and lignite; crude petroleum and natural gas; basic metals; fabricated metal products, except machinery and equipment; and coke and refined petroleum products;* are gradually declining, whereas unidentifiable goods, i.e. goods which for any reason cannot be identified and therefore cannot be assigned to groups 01-16 of the NST 2007 (Standard goods classification for transport statistics abbreviated as NST), are growing, which are usually transported as unitised cargo and moved across intermodal logistics chains. Such trends are also visible in the RFC Amber concerned countries (see Table 26 and Table 27).

3.2 RAIL MARKET MONITORING INDICATORS

In line with Article 56 (paragraph 2) of Directive 2012/34/EU, foreseeing that regulatory bodies have the power to monitor the competitive situation in the railway market, national regulatory bodies started collecting and producing statistics on the rail market, delivering IRG-Rail's Market Monitoring Reports on an annual basis[7]. The first report was released in 2013, the latest one in 2023.

Since 2007, the EC (DG MOVE) has also started collecting data on rail market developments in Member States via the Rail Market Monitoring (RMMS) Questionnaires. The recast of the first Railway package (Directive 2014/34/EU) finally created a legal base for RMMS reporting and data harmonisation. Accordingly, in July 2015, after thorough consultation with Member States and stakeholders, the Commission adopted an implementing Regulation (EU) 2015/1100 on the reporting obligations of the Member States in the framework of rail market monitoring. Since 2016, EU Member States and Norway have been providing input to the Commission's rail market monitoring in line with the format and content defined in the Regulation. The latest RMMS report was released in 2023[8].

This section combines data from the above two market monitoring reports by IRG-Rail and the EC, providing data for 2013 and 2021, where available, to comment on the trends after the entry into force of Regulation (EU) 913/2010 and subsequent establishment of the RFCs. It shall be noted that data are not consistently available for all Member States and EU neighbouring countries and for considered years.

The first relevant information analysed in the above-mentioned market monitoring reports relates to market opening and liberalisation in the EU Member States. Table 28 provides information on the year of introduction of the legislation on the liberalisation of the rail freight market and the year of operation of the first new entrant. Additionally, the number of freight railway undertakings (RUs) is indicated for 2013 and 2021. Whereas the liberalisation of the rail market started in the EU well before 2013, the number of RUs operating in the EU further increased in many Member States and particularly in Poland (35), Germany (21), Austria (18), Croatia (13) and the Netherlands (11).

Focusing on the RFC MED-concerned countries, over 100 active RUs were registered in 2021, nearly 15% of the total number of active RUs registered in the monitored countries RFC Amber.

[7] https://irg-rail.eu/irg/documents/market-monitoring?page=0
[8] https://transport.ec.europa.eu/transport-modes/rail/market/rail-market-monitoring-rmms_en

Table 28 Market liberalisation and number of active railway undertakings

Country	Legal liberalisation freight	First new freight entrant	Number of freight RUs		
			2013	2021	var. 2021-2013
AT - Austria	1998	2001	28	46	18
BE - Belgium	-	-	13	10	-3
BG - Bulgaria	2002	2005	10	15	5
HR - Croatia	2009	2014	1	14	13
CZ - Czechia	-	-	-	97	-
DK - Denmark	1997	1997	5	8	3
EE - Estonia	2003	1999	-	2	-
FI - Finland	2007	2012	1	3	2
FR - France	2003	2005	20	23	3
DE - Germany	1994	1995	226	247	21
EL - Greece	2007	-	2	2	0
HU - Hungary	**2006**	**2007**	**21**	**29**	**8**
IE - Ireland	-	-	-	1	-
IT - Italy	2001	2001	-	25	-
XK - Kosovo*	2011	2015	1	2	1
LV - Latvia	1998	2003	-	4	-
LT - Lithuania	-	-	-	2	-
LU - Luxembourg	2010	-	-	1	-
MK - North Macedonia	-	-	-	1	-
NL - Netherlands	1995	1998	19	30	11
NO - Norway	2007	2007	8	12	4
PL - Poland	**2003**	**2003**	**61**	**96**	**35**
PT - Portugal	2007	2008	-	2	-
RO - Romania	2001	2001	-	24	-
RS - Serbia	-	-	-	13	-
SK - Slovakia	**2006**	**2006**	**42**	**46**	**4**
SI - Slovenia	**2007**	**2009**	**3**	**7**	**4**
ES - Spain	2003	2007	8	10	2
SE - Sweden	1996	1997	13	11	-2
CH - Switzerland	1999	1999	-	25	-
UK - United Kingdom	1994	1996	11	10	-1

*Source: EC – DG MOVE and IRG-Rail; Notes: * This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence*

Since the start of the liberalisation process, the market share of the domestic incumbent railway undertakings gradually declined in most EU Member States (Table 29), whereas the market share of non-incumbents increased together with the operations of foreign incumbents. As a general pattern, the trend of the market share by domestic incumbents continued to decline in the period 2013-2021.

In the RFC Amber concerned countries, the market share of the domestic incumbent in 2021 was about 60% on average, 63% considering national and international incumbents.

Table 29 Market shares of freight railway undertakings (based on net tkm)

Country	Market share of domestic incumbent	Market share of foreign incumbent	Market share of non-incumbent	Market share of domestic incumbent		
	2021	2021	2021	2013	2021	var. 2021-2013
AT - Austria	63.4%	7.7%	28.9%	81%	63%	-18%
BE - Belgium	58.2%	24.4%	17.4%	81%	58%	-23%
BG - Bulgaria	45.3%	0.0%	54.7%	55%	45%	-10%
HR - Croatia	54.1%	2.7%	43.2%	100%	54%	-46%
CZ - Czechia	65.4%	7.6%	27.0%	-	65%	-
DK - Denmark	0.0%	0.0%	100.0%	77%	0%	-77%
EE - Estonia	0.0%	0.0%	100.0%	-	0%	-
FI - Finland	95.6%	0.0%	4.4%	100%	96%	-4%
FR - France	68.7%	18.8%	12.5%	64%	69%	5%
DE - Germany	42.4%	18.9%	38.8%	67%	42%	-25%
EL - Greece	0.0%	96.6%	3.4%	100%	0%	-100%
HU - Hungary	**45.1%**	**1.8%**	**53.1%**	**67%**	**45%**	**-22%**
IE - Ireland	100.0%	0.0%	0.0%	-	100%	-
IT - Italy	39.7%	26.6%	33.7%	-	40%	-
XK - Kosovo*	100.0%	0.0%	0.0%	100%	100%	0%
LV - Latvia	70.3%	0.0%	29.7%	77%	70%	-7%
LT - Lithuania	99.9%	0.0%	0.1%	-	100%	-
LU - Luxembourg	100.0%	0.0%	0.0%	-	100%	-
MK - North Macedonia	100.0%	0.0%	0.0%	-	100%	-
NL - Netherlands	0.0%	47.0%	53.0%	48%	0%	-48%
NO - Norway	44.9%	18.2%	36.9%	48%	45%	-3%
PL - Poland	**46.4%**	**8.1%**	**45.5%**	**66%**	**46%**	**-20%**
PT - Portugal	0.0%	0.0%	100.0%	86%	0%	86%
RO - Romania	19.9%	11.9%	68.2%	-	20%	-
RS - Serbia	77.7%	0.0%	22.3%	-	78%	-
SK - Slovakia	**70.9%**	**0.0%**	**29.1%**	**87%**	**71%**	**-16%**
SI - Slovenia	**77.8%**	**0.0%**	**22.2%**	**91%**	**78%**	**-13%**
ES - Spain	57.8%	24.0%	18.2%	77%	58%	-19%
SE - Sweden	48.1%	6.7%	45.2%	-	48%	-
CH - Switzerland	65.8%	0.0%	34.2%	-	66%	-
UK - United Kingdom	4.7%	34.5%	60.8%	45%	5%	-40%

*Source: EC – DG MOVE and IRG-Rail; Notes: * This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence*

Rail traffic expressed in million train-km, including passenger and freight services, remained stable or even increased in most EU Member States. However, some countries, such as France, Spain, and the United Kingdom, also experienced a decline (Table 30). The share of freight services is also stable overall, with either marginal increases or decreases in the production of million train-km. The most relevant variations in the period 2013-2021 were registered by Croatia (+11%) and Latvia (-26%). It is noticed that 12 countries register a share of freight services expressed in train-km of about or over 30%, including in three RFC Amber concerned countries: Austria, Bulgaria, Croatia, Finland, Kosovo, Latvia, Lithuania, North Macedonia, **Poland**, Serbia, **Slovakia**, and **Slovenia**. Rail freight services account for over 50% of the total train-km produced in Lithuania and **Slovenia**.

Table 30 Rail traffic in million train-km

Country	Total rail traffic			Share of freight services		
Year	2013	2021	var. 2013-2021	2013	2021	var. 2013-2021
AT - Austria	149	174	25	26.8%	29.1%	2.2%
BE - Belgium	97	98	1	13.4%	12.3%	-1.1%
BG - Bulgaria	28	31	3	25.0%	30.7%	5.7%
HR - Croatia	22	21	-1	22.7%	33.7%	11.0%
CZ - Czechia	-	173	-	-	21.8%	-
DK - Denmark	85	92	7	4.7%	3.3%	-1.4%
EE - Estonia	-	7	7	-	18.8%	-
FI - Finland	50	47	-3	28.0%	31.0%	3.0%
FR - France	492	425	-67	15.0%	14.0%	-1.1%
DE - Germany	1055	1,140	85	24.5%	23.7%	-0.9%
EL - Greece	12	9	-3	8.3%	12.8%	4.4%
HU - Hungary	**98**	**108**	**10**	**17.3%**	**17.7%**	**0.4%**
IE - Ireland	-	16	16	-	1.7%	-
IT - Italy	-	358	-	-	15.4%	-
XK - Kosovo*	-	-	-	-	31.2%	-
LV - Latvia	19	10	-9	68.4%	41.8%	-26.6%
LT - Lithuania	-	15	-	-	61.1%	-
LU – Luxembourg	-	8	-	-	5.4%	-
MK - North Macedonia	-	2	-	-	41.2%	-
NL - Netherlands	154	163	9	6.5%	6.2%	-0.3%
NO - Norway	46	46	0	17.4%	18.6%	1.2%
PL - Poland	**211**	**259**	**48**	**35.5%**	**31.6%**	**-4.0%**
PT - Portugal	-	35	-	-	15.7%	-
RO - Romania	-	83	-	-	26.7%	-
RS - Serbia	-	14	-	-	42.9%	-
SK - Slovakia	**46**	**50**	**4**	**30.4%**	**30.5%**	**0.1%**
SI - Slovenia	**20**	**22**	**2**	**50.0%**	**51.8%**	**1.8%**
ES - Spain	187	156	-31	13.4%	15.4%	2.0%
SE - Sweden	151	156	5	25.2%	23.1%	-2.1%
CH - Switzerland	-	233	-	-	11.7%	-
UK - United Kingdom	541	494	-47	7.2%	6.7%	-0.5%

*Source: EC – DG MOVE and IRG-Rail; Notes: * This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence*

The analysis of rail freight traffic operations based on tkm (Table 31) aligns with the one concerning train-km. The COVID-19 pandemic seems to have had different impacts on rail freight traffic measured in net tkm, with

either increases or decreases in transport volumes between 2019 and 2021. The impact has been apparently significant in the Baltic States, Denmark, Luxembourg, and Portugal, whereas Bulgaria and Greece experienced about 20% growth in the same period. Except Hungary, the RFC Amber concerned countries seem to have also registered positive variations during the pandemic period.

Table 31 Rail freight traffic in billion net tkm

Country	Freight traffic			Evolution of tkm	
Year	2013	2021	var. 2021-2013	2019-2021	2020-2021
AT - Austria	21	23	2	1%	9%
BE - Belgium	7	7	-0.1	-7%	2%
BG - Bulgaria	3	5	2	20%	3%
HR - Croatia	2	3	1	9%	-3%
CZ - Czechia	-	16	-	1%	7%
DK - Denmark	2	2	0.0	-22%	-19%
EE - Estonia	-	1	-	-56%	-46%
FI - Finland	9	11	2	5%	6%
FR - France	32	36	4	5%	14%
DE - Germany	113	139	26	8%	13%
EL - Greece	<1	1	-	19%	5%
HU - Hungary	**9**	**11**	**2**	**-2%**	**-5%**
IE - Ireland	-	0.1	-	-2%	-5%
IT - Italy	-	27	-	8%	16%
XK - Kosovo*	<1	0.0	-	-9%	60%
LV - Latvia	20	7	-13	-50%	-6%
LT - Lithuania	-	15	-	-10%	-8%
LU - Luxembourg	-	0.2	-	-10%	9%
MK - North Macedonia	-	0.4	-	8%	10%
NL - Netherlands	6	7	1	2%	8%
NO - Norway	4	5	1	5%	3%
PL - Poland	**51**	**56**	**5**	**0%**	**7%**
PT - Portugal	-	2	-	-15%	-1%
RO - Romania	-	14	-	-2%	-14%
RS - Serbia	-	3	-	8%	13%
SK - Slovakia	**9**	**9**	**0.3**	**4%**	**13%**
SI - Slovenia	**4**	**5**	**1**	**-2%**	**6%**
ES - Spain	9	10	1	-2%	9%
SE - Sweden	21	23	2	3%	6%
CH - Switzerland	-	12	-	3%	9%
UK - United Kingdom	22	17	-5.3	-1%	10%

*Source: EC – DG MOVE and IRG-Rail; Notes: * This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence*

The share of international freight services in total freight services generally increased over the period 2010-2020, except in Estonia, Luxembourg, Latvia, Romania, Sweden and Slovakia (Table 32). Except for Slovakia, the RFC Amber-concerned countries show stable/marginally positive growth.

Table 32 International freight services

Member state	2010	2020	var. 2020-2010
AT - Austria	14%	17%	3%
BE - Belgium	4%	5%	1%
BG - Bulgaria	1%	2%	1%
CZ - Czechia	-	11%	-
DE - Germany	53%	62%	9%
DK - Denmark	2%	2%	0%
EE - Estonia	6%	1%	-4%
EL - Greece	-	1%	-
ES - Spain	1%	2%	0%
FI - Finland	3%	3%	1%
FR - France	8%	13%	5%
HR - Croatia	-	2%	-
HU - Hungary	**7%**	**10%**	**3%**
IT - Italy	10%	10%	0%
LT - Lithuania	10%	12%	2%
LU - Luxembourg	1%	0%	-1%
LV - Latvia	17%	7%	-9%
NL - Netherlands	5%	10%	5%
NO - Norway	1%	1%	0%
PL - Poland	**21%**	**23%**	**2%**
PT - Portugal	0%	1%	0%
RO - Romania	2%	0%	-2%
SE - Sweden	9%	8%	-1%
SI - Slovenia	**4%**	**5%**	**1%**
SK - Slovakia	**10%**	**8%**	**-2%**

Source: EC – DG MOVE and IRG-Rail

The network usage intensity of freight trains remained overall stable, with either marginal positive, negative or null variations between 2013 and 2021, except for Austria (Table 33). More significant variations during the same period occurred for total traffic, meaning that passenger services increased equally and, in most cases, more than freight services. The parameter is calculated on the total network of the countries, and the data for the electrified sections of the network generally show higher usage intensity than the one related to the entire network.

Table 33 Network usage intensity (trains per day per route km)

Country	Network usage intensity for freight services			Network usage intensity for total services			Network usage intensity for total services on electrified routes (electrified train-km only)
Year	2013	2021	var. 2021-2013	2013	2021	var. 2021-2013	2021
AT - Austria	19	25	6	72	84	12	103
BE - Belgium	10	9	-1	74	75	1	81
BG - Bulgaria	5	6	1	19	21	2	25
HR - Croatia	5	7	2	22	22	0	35
CZ - Czechia	-	11	-	0	50	-	-
DK - Denmark	4	3	-1	88	103	15	-
EE - Estonia	-	3	-	0	13	-	24
FI - Finland	7	7	0	24	22	-2	34
FR - France	7	6	-1	45	42	-3	59
DE - Germany	18	19	1	74	79	5	112
EL - Greece	1	1	0	15	10	-5	25
HU - Hungary	**7**	**7**	**0**	**37**	**39**	**2**	**70**
IE - Ireland	-	0	-	0	26	-	-
IT - Italy	-	8	-	0	53	-	71
XK - Kosovo*	1	0	-1	3	1	-2	-
LV - Latvia	8	5	-3	24	13	-11	39
LT - Lithuania	-	13	-	0	22	-	24
LU - Luxembourg	-	4	-	0	79	-	80
MK - North Macedonia	-	3	-	0	6	-	-
NL - Netherlands	9	9	0	138	145	7	-
NO - Norway	6	6	0	33	32	-1	-
PL - Poland	**10**	**12**	**2**	**29**	**37**	**8**	**48**
PT - Portugal	-	6	-	0	37	-	45
RO - Romania	-	6	-	0	21	-	32
RS - Serbia	-	5	-	0	12	-	18
SK - Slovakia	**11**	**12**	**1**	**35**	**38**	**3**	**-**
SI - Slovenia	**22**	**25**	**3**	**45**	**49**	**4**	**-**
ES - Spain	5	4	-1	34	27	-7	36
SE - Sweden	9	9	0	37	39	2	51
CH - Switzerland	-	14	-	0	120	-	-
UK - United Kingdom	-	6	-	0	83	-	126

*Source: EC – DG MOVE and IRG-Rail; Notes: * This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence*

3.3 2030 FUTURE MARKET SCENARIOS

As part of the 2024 TMS Update, future market estimates were elaborated for different scenarios at the short term (2030) time horizon. A scenario represents a narrative or framework that outlines a set of assumptions regarding future developments affecting the rail freight corridors. These assumptions can cover a wide range of factors, including economic growth, technological advances, policy changes, environmental conditions, or infrastructure developments. The main purpose of using scenarios is to assess how different conditions or decisions may affect rail freight transport, which in turn impacts infrastructure requirements and rail system performance.

In general, a scenario consists of different components, each of which serves to detail the assumptions and parameters that define the future. These components include:

- *Economic conditions*: Assumptions about future economic conditions, such as GDP growth rates, trade volumes and industrial production. These conditions have an impact on freight demand by influencing production and consumption patterns.
- *Infrastructure developments*: Details of expected changes in transport infrastructure, such as expansion of rail networks, missing links in road and rail infrastructure, development of new ports or logistics hubs, and improvements in rail and intermodal facilities. Infrastructure developments are important in determining the capacity and efficiency of freight transport systems.
- *Policies and regulations*: Specific changes in policies and regulations that affect freight transport, such as environmental regulations, transport policies, tariffs, and trade agreements. These factors can change transport costs, modal choices, and operational practices.
- *Technological innovations*: Assumptions regarding the adoption and impact of new technologies within the freight transport sector. This includes advances in vehicle technologies, automation, digitalisation of supply chains and energy-efficient practices. Technological innovations can improve efficiency, lower costs, and reduce environmental impacts.
- *Environmental conditions and sustainability goals*: Assumptions regarding environmental conditions and sustainability goals, including climate change impacts and emission reduction targets. These components are becoming increasingly important in planning resilient and sustainable freight transport systems.
- *Social and demographic trends*: Reflections on social and demographic changes that may affect freight transport demand, such as urbanisation patterns, population growth and shifts in consumer behaviour.

By integrating these components, scenarios provide a comprehensive and multifaceted framework for exploring the future of transport. They enable examining the possible effects of various assumptions and support decision making regarding infrastructure investments, policy interventions, or strategic planning. Scenarios serve as an important tool in the management of transport systems and facilitate the development of strategies that are robust and flexible to future uncertainties.

For the purposes of the 2024 Joint TMS Update, future scenarios have been built only considering socio-economic and infrastructure developments. This solution reflects the decision to develop only short-term forecasts up to 2030 and adopt a pragmatic and as far as possible, concrete approach, thus omitting the simulation of the possible effects associated with policy developments such as:

- The proposed weights and dimensions directive and electrification of Heavy Goods Vehicles;
- The internalization of external costs of road transport (road pricing);

- Incentives to rail/combined transport operations;
- Technological/operational improvements of intermodal transport solutions and logistics chains;
- Market sensitivity to climate and energy transition.

In line with this approach, the following scenarios have been defined, all of them at the 2030 time horizon:

- *Reference or background scenario*: It describes the economic developments (in terms of GDP changes), that have the most important impact on the future of rail transport. The base for this is the EU Reference Scenario 2020-2050 and the World Economic Outlook 2023. The economic projections are described in more detail in Section 3.3.1.
- *Projects scenario*: It provides an overview of the impact resulting from the expected developments in the rail transport system. These concern projects related to , ERTMS deployment, missing links, upgrades, and improvements of the rail network belonging to the 11 RFCs, expected to be implemented by 2030, according to the project completion dates defined in the available project lists by December 2023. In Section 3.3.2 an overview of the projects that are being considered is given, which is a subset of the most relevant projects that are ongoing or planned to be implemented and completed by 2030 on the 11 RFCs network.
- *Sensitivity scenario: an 11 RFCs network at TEN-T standard*: It provides an overview of what would happen if – in addition to the investments included in the Projects scenario - ERTMS is fully introduced, 740 meter long trains are allowed to operate anywhere on the whole network, 22.5 t axle load is achieved on the entire network, intermodal loading gauge is also possible along the RFCs and if the rail gauge in Spain and Portugal meets the European track gauge standards (the Rail Baltica initiative, providing interconnectivity of the three Baltic States to Europe is already considered in the *Projects scenario*). This scenario can be regarded as a hypothetical exercise as the projects needed to achieve these standards are not fully defined. Additionally, the TEN-T legislation allows Member States to apply for derogation to achieve compliance without achieving the TEN-T requirements in those cases where the cost of the investment may not be supported by sufficient economic benefits. Section 3.3.3 further describes the assumptions underlying this scenario.

All the above scenarios were analysed using the NEAC model (see Annex 1 to this report) to assess the impact of economic developments, infrastructural improvements, and further general changes for the sensitivity analysis.

3.3.1 ECONOMIC PROJECTIONS TOWARDS 2030

To create the projections for international rail transport, the EU Reference Scenario 2020-2050 (EC, 2021) and the World Economic Outlook (IMF, 2023) were considered. The EU Reference Scenario is used for projections in Europe, while the World Economic Outlook provides input for the rest of the world. This section focuses first on the EU Reference Scenario 2020-2050 and then on the World Economic Outlook.

EU Reference Scenario 2020-2050

This scenario has been used as a common ground because it covers the EU and makes it a consistent background framework for each of the individual 11 RFCs and their combined network.

The EU Reference Scenario 2020-2050 projects the impact of macro-economic developments, fuel prices, technology trends, and policies on the evolution of EU transport. It provides a model-based simulation of a possible future outlook until 2050, given the insights and policy context, based on certain framework conditions, assumptions, and historical trends, notably in the light of the most recent statistical data.

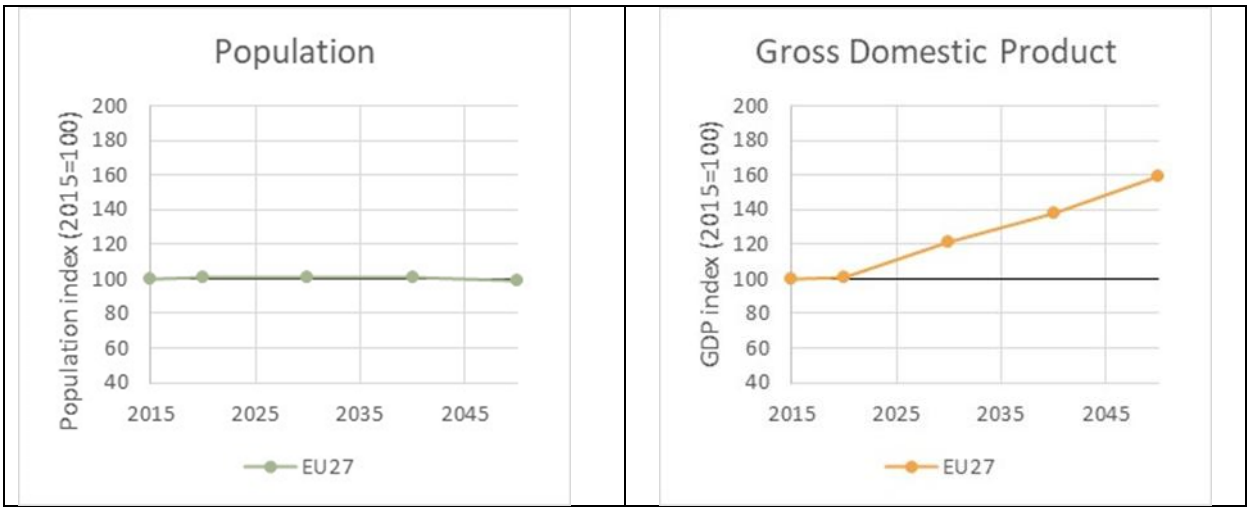
For a complete list of included transport and energy policies, we refer to the report on the EU Reference Scenario published by the European Commission[9]. The central model behind the EU Reference Scenario is the PRIMES model, an energy system model that produces projections for energy, transport and CO_2 emissions.

Figure 15 show the indexed trends for population, GDP, and road and rail freight transport according to the EU Reference Scenario (*The impacts of the COVID-19 pandemic are considered in the EU Reference Scenario. However, the pandemic effects seem to be negligible for the long-term trends*).

The growth of the EU27 population is expected to stagnate between 2030 and 2050. After 2040, it even goes into negatives. GDP levels, however, are projected to keep increasing until 2050.

Figure 16 shows the indexed trends for transport by road and rail, based on performance (tkm), relating to both international and domestic transport. The impact of the COVID-19 pandemic is visible in the transport levels for 2020. However, as of 2025 the transport forecasts seem to be following the pre-COVID trend. Hence, the pandemic effects seem to be negligible for the longer term. The growth rates for rail freight are, in general, higher than those for road transport, although this can differ per country. For freight transport by rail, the largest increases are projected between 2025 and 2040. The growth of transport is not evenly distributed across Europe. Some areas or countries show a moderate growth rate.

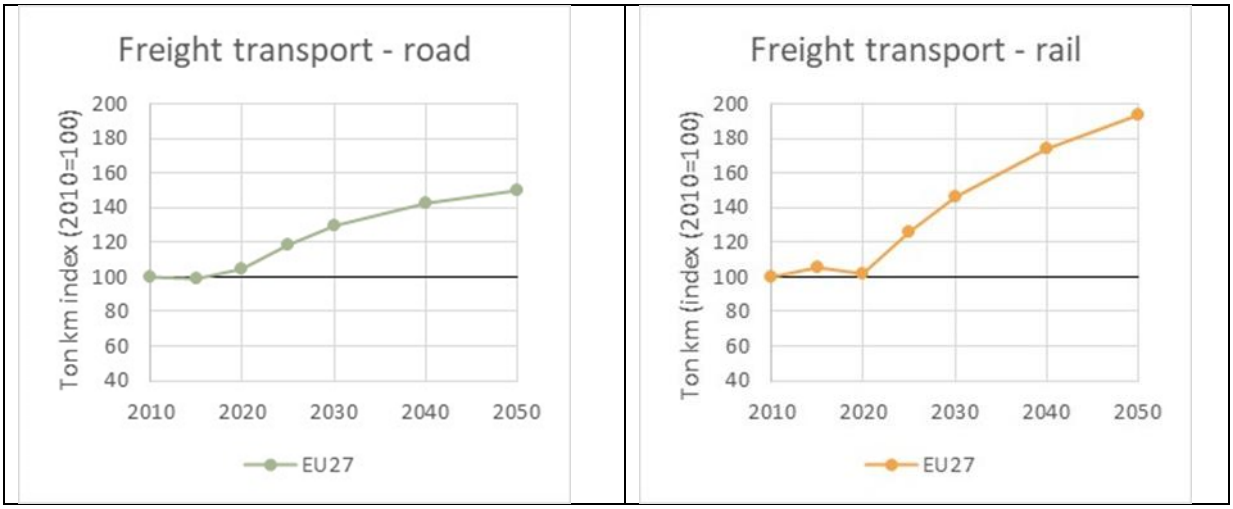
Figure 15 Forecasts population and GDP development in the EU27 between 2015 and 2045



Source: EC (2021)

[9] European Commission, Directorate-General for Climate Action, Directorate-General for Energy, Directorate-General for Mobility and Transport, De Vita, A., Capros, P., Paroussos, L., et al., EU Reference Scenario 2020 : energy, transport and GHG emissions : trends to 2050, Publications Office, 2021, https://data.europa.eu/doi/10.2833/35750

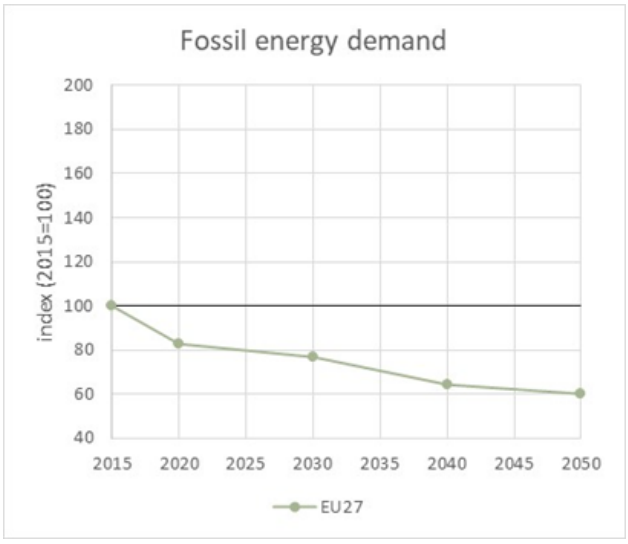
Figure 16 Forecasts on freight transport by road and rail (tkm, index 2010=100) for the EU27



Source: EC (2021)

Figure 17 shows the energy demand for fossil fuels (solid, petroleum products and natural gas) according to the EU Reference Scenario. The scenario predicts for the EU a decrease of 40% in 2050. This has an impact on the development of transport of dry and liquid bulk in the EU. Growth might be less or even negative.

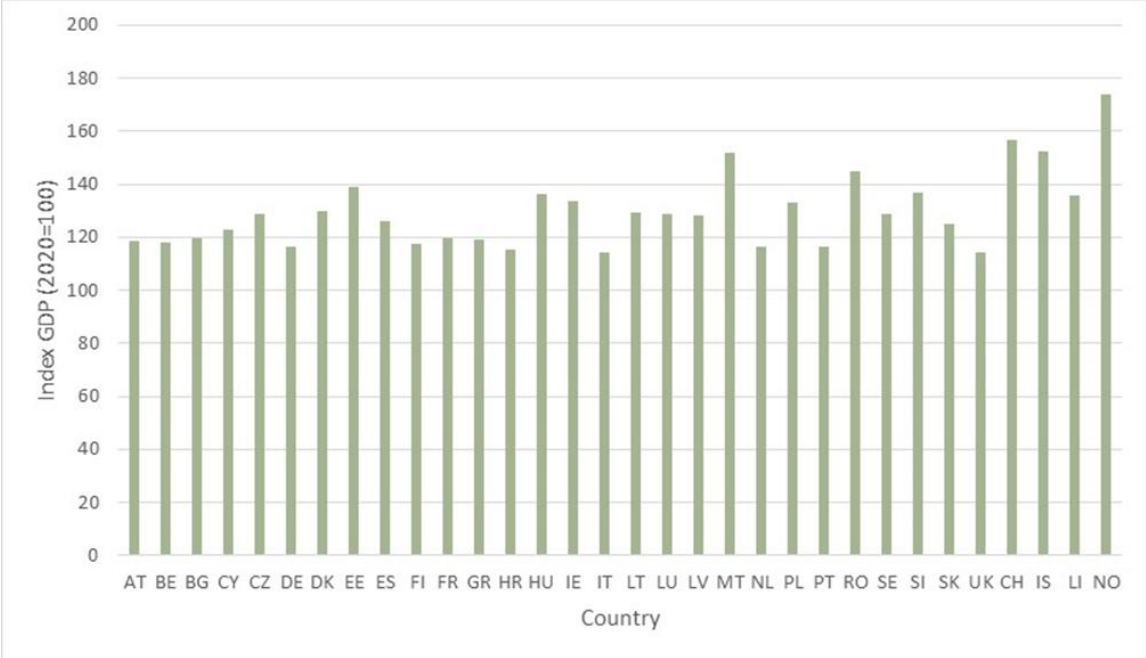
Figure 17 Forecasts on fossil energy demand for the EU27



Source: EC (2021)

The GDP figures from the EU Reference Scenario are used to make projections for 2030 for international rail transport in Europe. Figure 18 shows the economic development in GDP as an index (2020=100) by country, as provided by the EU Reference Scenario. The index ranges from 114 (Italy and the United Kingdom) to 174 (Norway). On average, the weighted growth index for the EU27 is about 117.

Figure 18 Development of GDP (Index 2020=100) for European countries according to the EU Reference Scenario



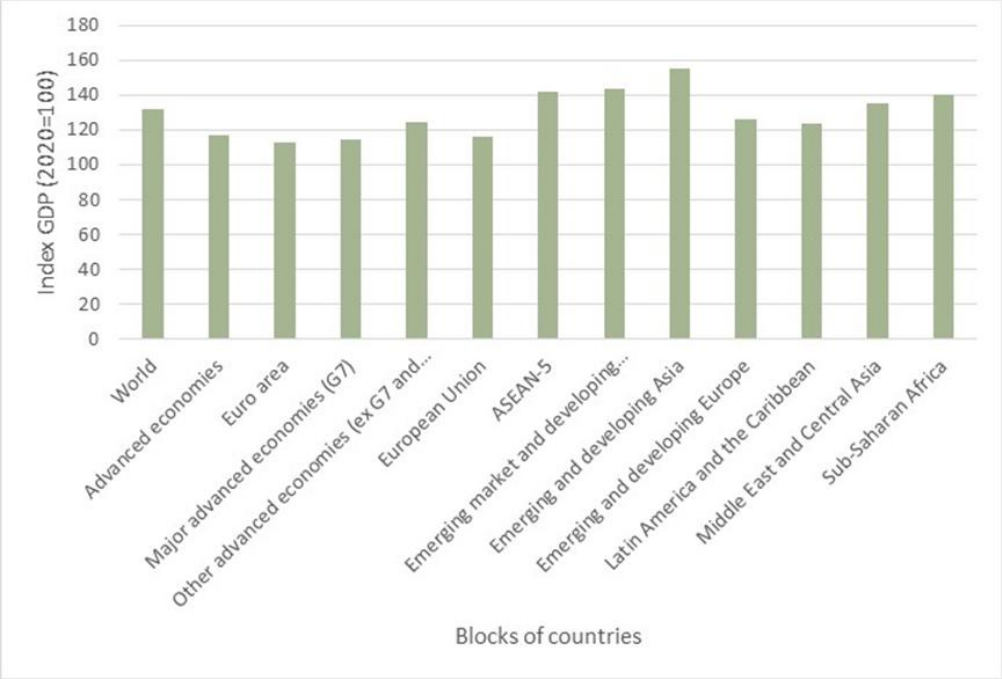
Source: EC (2021)

World Economic Outlook

Concerning the World Economic Outlook[10], the outlook for the GDP in constant prices for the period 2023-2028 was used in this study. Some historical figures are provided as well. Based on the 5-year period 2023-2028, an extrapolation was made for the remaining years until 2030. Figure 19 shows the GDP developments for blocks of countries. Worldwide, the GDP development between 2020 and 2030 is estimated at 32%. For the period 2022-2030, this is approximately 24%. The different blocks of countries show different growth patterns. Growth in the Euro area is, according to the IMF, the lowest at about 13% between 2020 and 2030, while the growth in the emerging and developing countries in Asia is the highest at about 54% between 2020 and 2030.

[10] IMF (2023). *World Economic Outlook. Navigating Global Divergences. October 2023*. Washington DC: International Monetary Fund.

Figure 19 Development of GDP between 2020 and 2030 in IMF economic blocks of countries



Source: IMF (2023), additional calculations Panteia

Road projects

Different road projects across Europe which are planned to be ready by 2030 are included in the Reference Scenario. This includes projects such as the Antwerp Western ring road, the Rotterdam Blankenburgtunnel or the A281 missing link in Bremen. These projects have an impact on road freight transport demand, which will increase.

3.3.2 RAIL PROJECTS FINISHED BY 2030

The Projects scenario is used to assess the impact of the different rail projects expected to be completed by 2030 along the 11 RFCs network. Time, distance and costs are important bases for calculating the changes in transport demand until 2030. These variables are also important for determining where shifts between modes will occur. The NEAC model was used to assess the impact of the Projects scenario (see Annex 1 to this report).

Currently, a number of projects are ongoing and/or are planned for the improvement of the railway infrastructure belonging to the 11 RFCs network. Such projects were first identified in the 11 RFCs Implementation Plans, which were further confirmed by the 11 RFCs. Furthermore, the list of the investments planned for the development of the 9 TEN-T Core Network Corridors was consulted to complement the information available from the RFCs. The ongoing and planned investments differ in size. Some are big projects such as Rail Baltica or the Fehmarnbelt. Other projects are much smaller such as the upgrading or modernisation of railway lines. A selection of projects was considered for forecasting purposes according to the following criteria:

- The projects need to be implemented before or in 2030;
- Projects should be able to 'translate' into a time gain or cost reduction.

Table 34 below shows the projects that are considered in the Projects scenario. The selected projects reflect the purpose of the study and nature of the model, limited to the freight market analysis and thus modal share estimation, excluding network capacity simulation and assessment, and looking at the 2030 time-horizon. It is worth noticing that given the uncertainties related to the completion by 2030 of the European standard gauge network in the Iberian peninsula, as well as the full deployment of ERTMS and the possibility of operating 740 meter trains and the achievement of the 22.5 t axle load and P400 loading gauge standards, a Sensitivity scenario has been developed as part of this study for the simulation of the completion of the 11 RFCs network in line with the TEN-T standards (see 3.3.3). This network-wide solution was deemed more appropriate than implementing individual projects within the Projects scenario 2030 as the presence of gaps in the completion of the 11 RFCs network at TEN-T standard makes the impact of those investments negligible, especially for the European track gauge, axle load, P400 loading gauge, ERTMS and 740 meter long trains standards.

Table 34 Rail projects considered in the Projects scenario 2030

Project	End date	RFC
Follobanen	03/2023	SCANMED
Rehabilitation and upgrade of Corridor Section Aveiro - Vilar Formoso	12/2024	ATL
ABS Hoyerswerda–Horka–Border DE/PL	12/2024	NS-B
Rehabilitation of the railway line Border – Curtici, Section Gurasda – Simeria	12/2025	OEM
Upgrade Stadlau-Marchegg (Marchegger Ast)	12/2025	BA, OEM
Graz-Klagenfurt; Koralm line	12/2025	BA
Second Track Divaça-Koper	10/2025	BA, MED, AMBER
Future Development of Railway Infrastructure: increase of capacity: Biasca, Chiasso, Arth-Goldau, Brig-Iselle, Basle PB, Basle-Luzern, Rothrist, noise protection Gotthard and Lötschberg axes	12/2025	RALP
EuroCap-Rail: modernization of the Brussels-Luxembourg axis	12/2026	NSM
ABS/NBS Karlsruhe - Basel Phase 2, No 1	12/2026	RALP, RD
Construction of double-track railway from Sandbukta to Såstad.	08/2026	SCANMED
Modernisation of Vidin - Medkovets railway section	12/2026	OEM
ABS Angermünde - Border DE/PL	12/2026	NS-B
ABS Berlin – Frankfurt (Oder) – Border (DE/PL)	12/2027	NS-B
Works on main passenger lines (E 30 and E 65) in Śląsk area, phase I: line E 65, section Będzin – Katowice – Tychy – Czechowice Dziedzice – Zebrzydowice, lots A, A1	06/2027	BA
Works on railway line E 75, section Białystok – Suwałki – Trakiszki (state border), Stage I, sub-section Białystok - Ełk, phase II	12/2027	NS-B
Rehabilitation of the railway line Cluj – Episcopia - Border	12/2027	OEM, RD
Upgrading of Alexandroupoli-Ormenio/BG border railway line	12/2027	OEM
Rehabilitation of the railway line Brasov - Simeria	12/2027	OEM
Upgrading Gallarate-Rho line 0294	11/2028	RALP
Upgrade of Brno - Breclav line as a High-speed Rail line	12/2029	OEM
Modernisation of the railway line Bucharest - Giurgiu	12/2029	OEM
Upgrade of the railway access line to the Fehmarn Belt Fixed Link - Section Ringsted - Rødby	06/2029	SCANMED
Southern access line to Brenner; Lotto/lot 1: Fortezza/Franzenfeste - Ponte Gardena/Waidbruck 0292A	12/2029	SCANMED

Project	End date	RFC
ABS/NBS Hamburg - Lübeck - Puttgarden (Hinterland connection to Fehmarn Belt Fixed Link)	12/2029	SCANMED
Rail Baltica	12/2030	NS-B
New Rail Line Dresden - Praha (Section Heidenau - State Border DE/CZ)	12/2030	NS-B, OEM
ABS/NBS München - Rosenheim - Kiefersfelden - Grenze D/A (--> Kufstein)	12/2030	SCANMED, RD
Upgraded line (ABS) (Amsterdam) - DE/NL border - Emmerich - Oberhausen (1. + 2. Phase)	12/2030	RALP, NS-B
Y Basque High-speed Rail (freight and passenger traffic): all sections + access to cities Bilbao and Vitoria + implementation of UIC between Astigarraga-border + ERTMS + electrification + systems	12/2030	ATL
ABS Kehl–Appenweier (POS-Süd)	12/2030	RD
ABS München-Mühldorf-Freilassing	12/2030	RD
ABS Nürnberg – Passau	12/2030	RD
ABS Hof - Marktredwitz - Regensburg - Obertraubling (Ostkorridor Süd)	12/2030	RD
Semmering base tunnel	12/2030	BA
Modernisation/ Rehabilitation and Electrification of Craiova-Calafat railway section (107 km)	12/2030	OEM
Upgrade Nordbahn Wien Süßenbrunn - Bernhardsthal	12/2030	BA, OEM
Modernization of the Radomir - Gyueshevo railway section	12/2030	OEM
ABS Nürnberg – Marktredwitz – Reichenbach/BGr DE/CZ (–Prag)	12/2030	RD
ABS Nürnberg - Schwandorf/München - Regensburg - Furth im Wald - Grenze D/CZ	12/2030	RD
Modernization of the line Plzeň - Česká Kubice, section Stod (excl.) - State border D	12/2030	RD
Rehabilitation of the railway line Caransebes – Craiova	12/2030	OEM
Kanin – Hradec Kralove – Chocen, second track increase speed	12/2030	OEM

3.3.3 SENSITIVITY ANALYSIS: AN 11 RFCS NETWORK IN LINE WITH TEN-T STANDARDS

The Sensitivity scenario helps to understand the impact of completing the 11 RFCs network according to TEN-T standards[11]. This scenario concerns the availability of European standard rail gauge in Spain and Portugal, the introduction of ERTMS on the entire rail network, and the introduction of 740-meter trains along the 11 RFCs. This scenario can be regarded as a hypothetical exercise as the projects needed to achieve these standards are by no means all ready to be implemented in 2030. Additionally, the TEN-T legislation allows Member States to apply for derogation to achieve compliance without achieving the TEN-T requirements in those cases where the cost of the investment may not be supported by sufficient economic benefits. Despite being theoretical, this scenario provides insights into what would happen with rail transport demand if the TEN-T standards would be achieved in full scale along the 11 RFCs network. The scenario has been implemented as follows:

- ***ERTMS***. The European Rail Traffic Management System (ERTMS) is important to enhance the interoperability of rail transport through a single European signalling system. ERTMS is designed to replace the multitude of incompatible safety systems currently in use across European railways,

[11] According to Article 39 of Regulation (EU) 1315/2013 on Union guidelines for the development of the trans-European transport network

thereby facilitating cross-border rail traffic and improving the competitiveness of the rail sector. It is expected that the implementation of ERTMS will lead to safety enhancements, operational efficiency, and environmental benefits. Despite the investments and the challenges faced during its deployment, the long-term benefits of ERTMS can be substantial. To simulate the improvements in safety and efficiency, the **speed on the entire network is increased by 3%**.

- ***Introduction of 740-meter trains***. The introduction of longer freight trains (740 meters) will further enhance the efficiency and capacity of rail freight transport. The 740 meter adjustments represent a significant increase over the standard length of freight trains, which traditionally varies by country often ranging around 400 to 600 meters. The transition to 740-meter trains is part of broader efforts to make rail freight a more competitive and sustainable alternative to road transport. The impact of deploying such long trains within the rail freight sector is multifaceted, encompassing operational, economic, and environmental perspectives. However, realizing these benefits fully necessitates significant investments in infrastructure and operational adjustments. The strategic move towards longer trains reflects a commitment to enhancing the competitiveness of rail freight and its role in a sustainable transport system, despite the challenges involved. From a study carried out for the Ministries of Transport in The Netherlands, Belgium, and Germany[12], it was found that, on average, **the average train volume will increase by 15%,** leading to a reduction in rail freight transport costs of approximately 5%. It is assumed that the 15% increase will take place **between *all* origins and destinations in Europe**. The increase will not always be possible, but as this scenario is hypothetical, we neglect these details for reasons of efficiency.
- ***European standard gauge.*** The Projects scenario already includes the development of the Rail Baltica Project, which among others integrate the rail system of the Baltic Member States into the EU one, with reference to the European standard track gauge. The Sensitivity scenario complement the Projects scenario in simulating the impact of the transition to European gauge of all the RFC lines crossing Spain and Portugal, thus assuming the whole 11 RFCs network would be in line with the TEN-T standards in terms of track gauge. Whereas the effects of such a scenario on the international traffic between the two Iberian countries might be marginal, international traffic between these two countries and other EU countries across the Pyrenees would be smoother and more efficient. Whereas the implementation of the EU track gauge network in the Iberian peninsula (and similarly in the Baltic States) may be challenging under the socio-economic point of view, as costs may exceed possible benefits especially upon accurate consideration of investments, resources and time needed to change not just the rail infrastructure, but also the rolling stock, and the terminals equipment and facilities along the whole logistics chain, the availability of an EU track gauge network reduces in principle logistical complexities, times and costs associated with gauge changeovers between different gauge systems. Taking into consideration the difficulties in assessing the impact of the migration of the Iberian network belonging to the RFCs to the EU standard track gauge, to the purposes of this study the transition has been simulated by a reduction of the waiting time by **4 hours**. We acknowledge that this approach is simple and that not all details or costs associated with the transition are considered. Nevertheless, some positive effects on demand are expected.
- ***22.5 t axle load and P400 intermodal loading gauge***. The above-quantified effects are assumed to generally capture also the benefits potentially attributable to the TEN-T axle load requirement and P400 intermodal gauge as conditions for an 11 RFCs network in line with TEN-T standards, specifying that both elements are crucial for the competitiveness of rail freight transport in Europe, although

[12] TML, Panteia, ViaCon (2023). Cost-benefit analysis 3RX. Leuven: TML.

their direct effects on transport costs and travel times are difficult to be quantified on the entire network.

The simulated measures provide insights into the potential impact that rail freight transport may have on transport demand. A shift from road and inland shipping to rail transport is expected.

4 ANALYSIS OF THE CURRENT RFC AMBER TRANSPORT MARKET

This chapter provides an overview of the analysis of the current freight transport market (2022) along the RFC NS-B. The analysis of both the current and future market has been done using an EU-wide NEAC model, combining transport and economic statistics from Eurostat with train traffic data available from the RNE TIS database. The analysis focusses on the international trains, i.e. those trains crossing at least one BCP. In this respect, it is noticed that in national train databases and in the TIS dataset, trains logged as national ones might actually operate along international itineraries. The use of the NEAC model made it possible to partially overcome the limitations of the current structure of the datasets. Nonetheless, the results presented in this report might be conservative in the estimation of the international flows along the RFCs.

For a correct assessment and understanding of the current RFC NS-B market, a top-down approach has been adopted. Before exploring the specifics of the RFC NS-B, an overview of the European international (rail) freight market is given. This is appropriate as on one hand the RFC NS-B is used by trains with origins and destinations outside the RFC concerned countries; on the other hand, the RFC NS-B overlaps with other RFCs. The analysis of the current market is presented as follows:

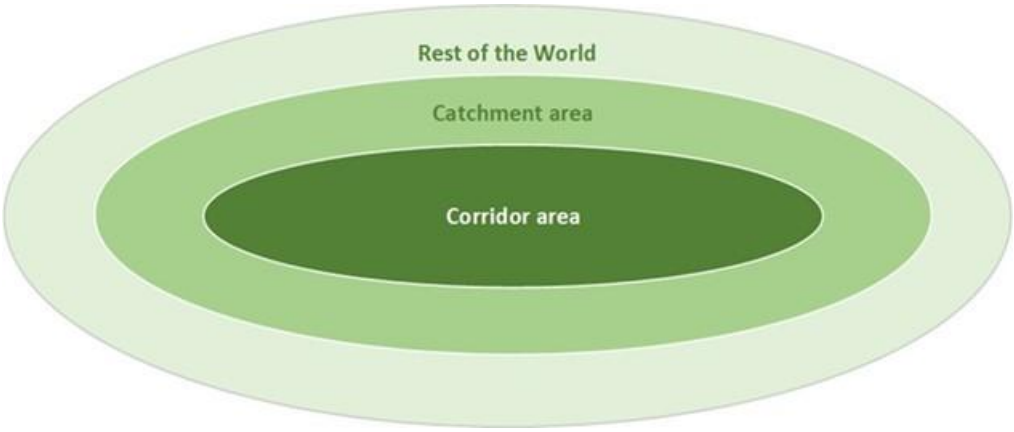
- Section 4.1 presents the **definition of the catchment area and corridor area**. It shows the importance of both definitions and lays a basis for the rest of the chapter.
- Section 0 presents **international rail freight transport in the 11 RFCs network**:
  - Section 4.2.1 gives an overview of the **11 RFCs network corridor and catchment areas**;
  - Section 4.2.2 provides a general overview of **all international freight transport for the combined 11 RFCs network catchment area**. This includes total volumes by mode and cargo type. Furthermore, we present the volumes by main origin and destination countries, as well as the main relations for all freight transport. Finally, a volume-distance distribution by mode is presented;
  - Section 4.2.3 describes the **international rail freight transport in the 11 RFCs network catchment area**. This provides a general overview of the origins and destinations of rail freight in Europe;
  - Section 4.2.4 presents the **international rail freight transport in the 11 RFCs network catchment area**.
- Section 4.3 provides the **international (rail) freight transport along the RFC Amber**:
  - Section 4.3.1 gives an overview of the **RFC Amber corridor and catchment areas**;
  - Section 4.3.2 provides a general overview of **all international freight transport in the RFC Amber catchment area**. This includes total volumes by mode and cargo type. Furthermore, the volumes by main origin and destination countries are described, as well as the main relations for all freight transport. Finally, a volume-distance distribution by mode is presented.
  - Section 4.3.3 illustrates the **international rail freight transport in the catchment area of the RFC Amber**. This provides a general overview of the origins and destinations of rail freight for the RFC Amber.
  - Section 4.3.4 describes the **international rail freight transport along the RFC Amber**.

4.1 DEFINITION OF CATCHMENT AREA AND CORRIDOR AREA

The presentation of results for a rail freight corridor necessitates a brief definition of the corridor area and of the corridor catchment area. The definition of both can be approached from two perspectives: the supply perspective, focusing on the railway network within a corridor, and the demand perspective, centred on the volume of goods transported via an RFC. The **corridor area** refers to the geographic area traversed by the rail freight lines. The **catchment area** encompasses regions that utilise the RFC for international goods transportation by rail, often extending beyond the boundaries of the corridor area. The corridor area is (by definition) part of the catchment area.

The differentiation between these two types of areas is important, as numerous origins and destinations within an RFC area may currently not receive or use rail services. However, they may be served by rail transport in the future. Furthermore, understanding the current origins and destinations served by an RFC is essential. This is where the catchment area comes in. It comprises all NUTS2[13] regions that are being served by a specific RFC. The chart below shows the differences between the corridor area and the catchment area, as well as the rest of the world. As can be seen, the corridor area has the smallest coverage of all areas.

Figure 20 Schematic concept of the geographic coverage of the market analysis



The **corridor area** of an RFC is defined as NUTS 2 zones which are being crossed by the railway freight lines of this RFC. Regarding the **catchment area**, a more precise definition is applied. To qualify, rail transport between an origin and destination must cross *at least* one border crossing point (BCP) associated with the respective RFC.

[13] A NUTS2 zone refers to a level within the Nomenclature of Territorial Units for Statistics (NUTS), a hierarchical system developed by the European Union to divide the economic territory of the EU into territorial units for the purpose of collecting, developing, and harmonising statistical information. NUTS 2 forms basic regions for the application of regional policies, often used for regional development and structural funding. These zones are generally composed of regions with a population between 800,000 and 3 million people, although there can be exceptions. The precise structure and the number of NUTS 2 zones can vary between countries, depending on national administrative structures and the size and population of the country.

4.2 INTERNATIONAL FREIGHT TRANSPORT IN THE 11 RFCS NETWORK

The rail freight market for the individual RFCs can only be appropriately understood within the rail freight market across the whole European rail network. Each RFC has connections or overlaps with other RFCs. Also, trains using an RFC often have an origin or destination outside of a corridor area. Furthermore, by looking at the entire network, the 'double counting' risk is mitigated. Therefore, a good knowledge of the European rail freight market forms the basis for the analysis of the individual RFCs' markets.

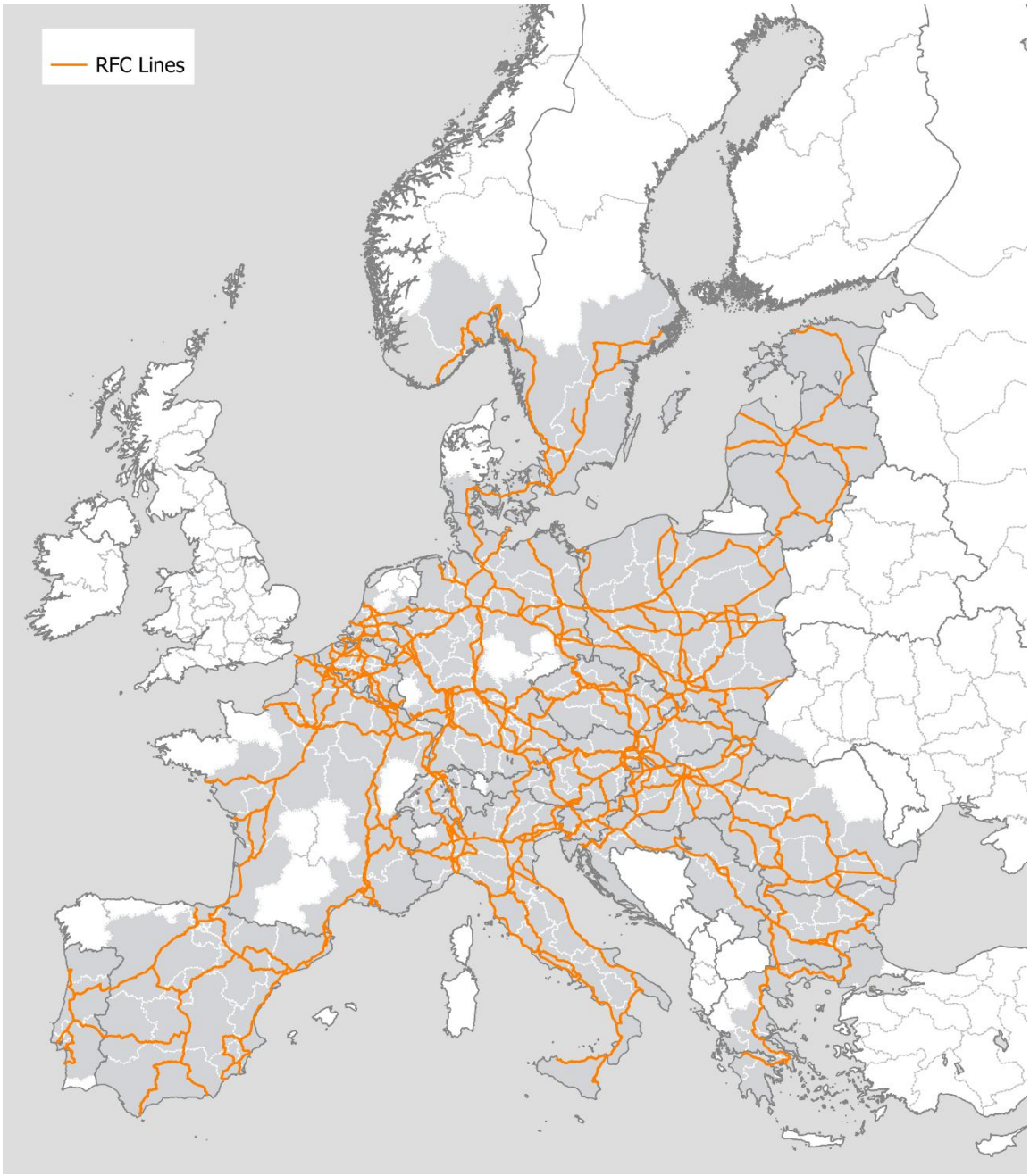
This section starts with a description of the corridor and catchment areas of the 11 RFCs network. It then first focusses on all international freight transport of the catchment area of the 11 RFCs network. After that, it presents the results at an aggregate level, before describing the volumes for origin and destination countries and the top 10 relations for the land transport modes, i.e. road, rail, and IWW (inland shipping).

4.2.1 CORRIDOR AND CATCHMENT AREAS OF THE JOINT RFCS

Figure 21 provides an overview of the *corridor areas* of the 11 RFCs network. It covers a vast part of Europe, but excludes countries such as UK, Ireland, Finland, Northern Scandinavia, and parts of the Balkan. Those countries or parts of countries that have no railway lines that belong to an RFC. The 11 RFCs network *catchment area*[14] covers a much wider area. Besides the excluded countries, it also includes countries such as Ukraine, Moldova, Kazakhstan, and China. For rail transport the catchment area seems vast, but the number of rail relations is limited when compared to road transport. This is due to the character of road transport which can reach any location in Europe, while rail transport only serves areas with a rail connection

[14] Not shown here, it will be shown later when presenting the international rail freight transport results.

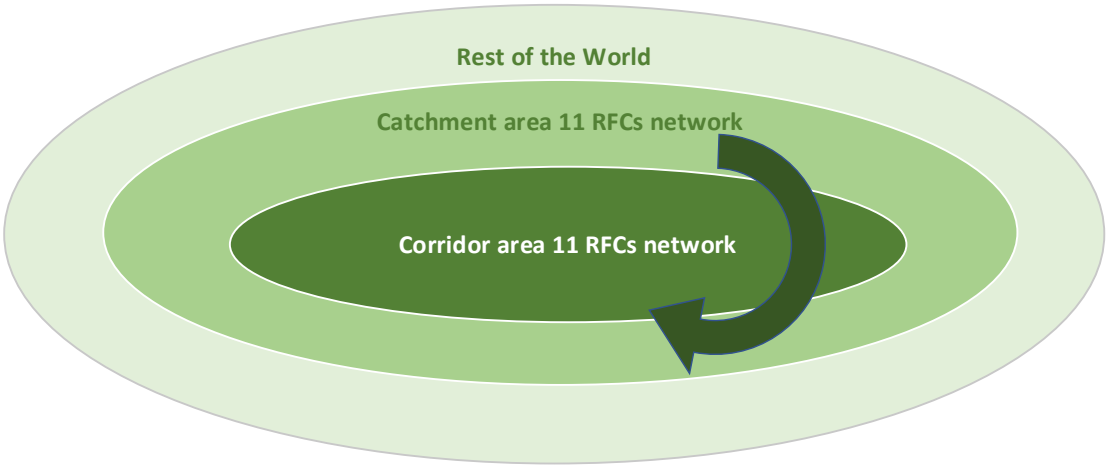
Figure 21 Corridor area and rail network of the joint RFCs



The next figure shows which results for the international freight transport for the 11 RFCs network are presented in this section. It includes *all* international freight transport within the 11 RFCs network corridor and catchment area. The latter includes all international freight transport to and from locations such as China, Ukraine, Moldova, Kazakhstan, the UK, or Northern Scandinavia as these countries and regions are part of the 11 RFCs network catchment area. However, it excludes international freight transport from Africa, the US, or South America, as these are not part of the catchment areas of the 11 RFCs network. The analysis

focusses on land modes that compete within the catchment area, i.e. road, rail, and IWW[15]. For the RFC specific part, also sea transport receives attention.

Figure 22 Schematic concept of the geographic coverage of the results presented in this section.



4.2.2 ALL INTERNATIONAL FREIGHT TRANSPORT FOR THE COMBINED 11 RFCS NETWORK AREA[16]

The total volume of international freight transport over land in the 11 RFCs network catchment area is 1,439 million tonnes. The volume of international rail freight transport is 265 million tonnes (about 442,000 international trains[17]), which is 18% of the total amount of transport to, from, and within the catchment area of the 11 RFCs network. The share and volume of IWW is 17% (240 million tonnes), and the share of road transport is 65% (934 million tonnes).

Concerning the cargo types[18], the category *Other* (general cargo, including intermodal transport and container) dominates the international freight transport for the 11 RFCs network, by 845 million tonnes of volume. This is about 59% of all international freight transport. This cargo type is mostly transported by road (about 69%). *Dry bulk* is the second largest cargo type at 32% (465 million tonnes). *Liquid bulk* has as share of 9% (128 million tonnes) in the total volume of international freight transport over all land modes.

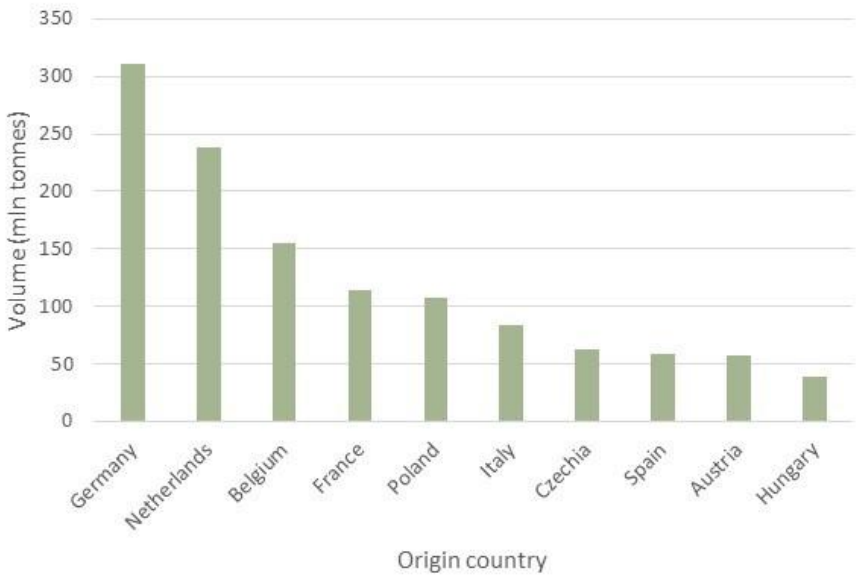
[15] Maritime transport is left out, as it makes the interpretation of the results challenging. As we only consider the rail catchment area, several other maritime relations are not considered, which might easily lead to misinterpretations. Therefore, we only consider land modes at European level, also because these are the main sources for modal shift to or from rail.
[16] This chapter is a copy of section 4.2.2 of the RFCs joint transport market study.
[17] Using an average of 600 tonnes per train
[18] We distinguish dry bulk, liquid bulk, and other (general cargo and container). Dry bulk comprises commodities such as sand, ores and coal. Liquid bulk comprises mainly oil(products) and liquid chemicals. General cargo concerns a broad range of products such as cars, machinery, and electronics. Containers concern intermodal transport. The content is often unknown.

Figure 23 Estimated volume (million tonnes)[19] and share of international freight transport over land by mode and cargo type within the combined 11 RFCs network catchment area in 2022

Source: NEAC estimations

Figure 24 and Figure 25 show the top 10 origin and destination countries of all international freight transport within the 11 RFCs network catchment area. The top 3 origin and destination countries for international freight transport over land in the 11 RFCs network catchment area are Germany, the Netherlands and Belgium. This concerns transport by road, rail, and IWW (inland shipping). A volume of 311 million tonnes of international freight transport has its origin in Germany, while 352 million tonnes have Germany as a destination in 2022. Due to the ports in the Rhine-Scheldt delta (such as Port of Rotterdam, Port of Amsterdam, North Sea Ports (Ghent-Terneuzen) and Port of Antwerp-Bruges), both the Netherlands and Belgium are important origin and destination countries as well for international freight transport. The top 10 countries for origin cover 85% of all international freight transport for the catchment area of the 11 RFCs network, while the top 10 destination countries cover 84% of all international freight transport.

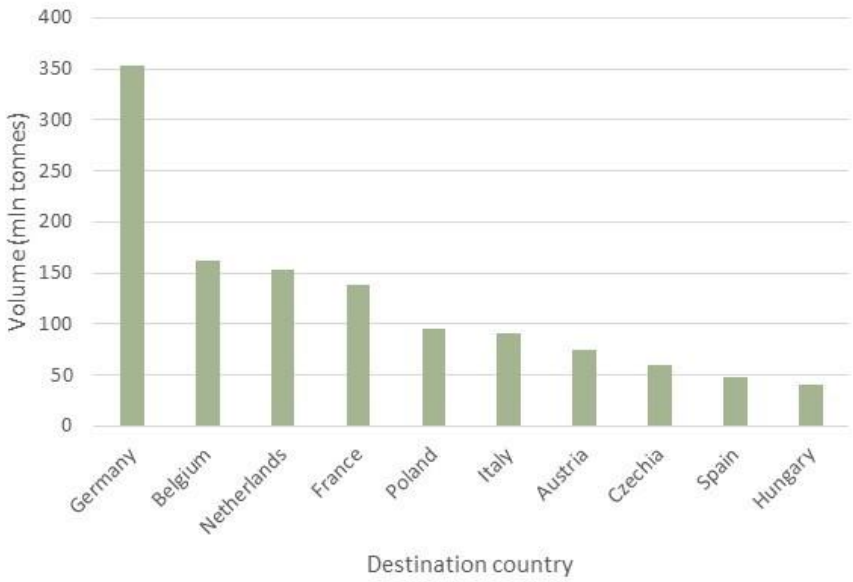
Figure 24 Estimated volume (million tonnes) of *all* international freight transport over land by *origin* in 2022 for the top 10 origin countries in the 11 RFCs network catchment area.



Source: NEAC estimations

[19] The volumes for 2022 are based on a combination of observed values from Eurostat, RNE (TIS) and estimated values from NEAC at a detailed NUTS2 level. Therefore, the results are called estimation. Detailed observed values are not available.

Figure 25 Estimated volume (million tonnes) of *all* international freight transport over land by *destination* in 2022 for the top 10 destination countries



Source: NEAC estimations

The following shows the international freight volumes transported between the 15 most important origin countries and the 15 most important destination countries within the catchment area of the 11 RFCs network. The total freight volume for these countries is 1,266 million tonnes, which is 85% of all international freight transport in the 11 RFCs network catchment area. The most important freight transport relation is between the Netherlands and Germany at 123 million tonnes of freight transport by all land modes. Other big relations concern Netherlands-Belgium (79 million tonnes), Germany-Netherlands (67 million tonnes), Belgium-Netherlands (58 million tonnes), and Belgium-Germany (42 million tonnes). Together the freight transport relations between these 3 countries show once more the importance of the ports in the Rhine-Scheldt delta for their hinterlands. Some 27% of all international freight transport in the 11 RFCs network catchment area concerns the relationship between these 3 countries.

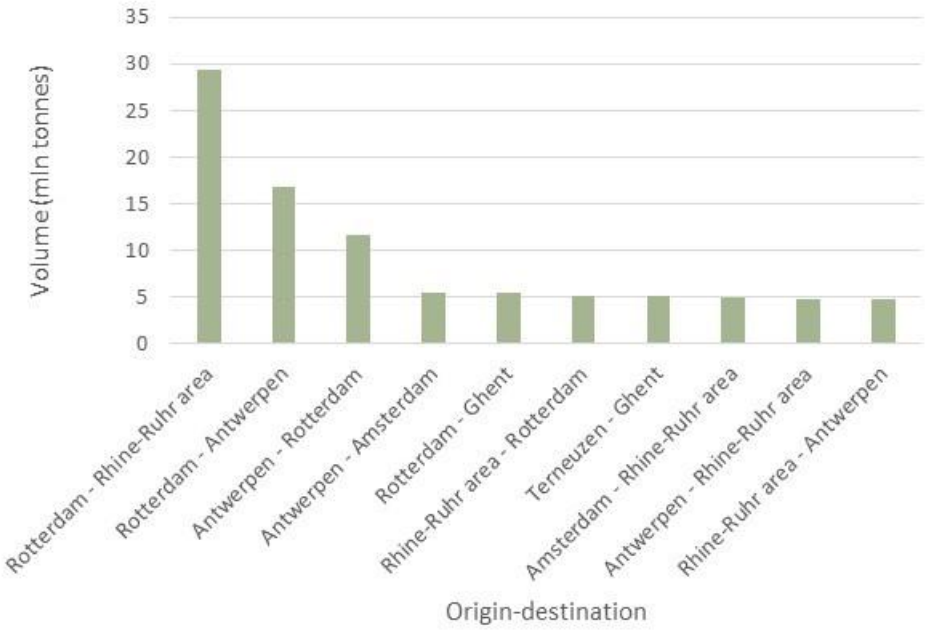
Table 35 Freight volume (million tonnes) between the 15 most important origin and destination countries in the catchment area of the 11 RFCs network

From/To	AT	BE	CH	CZ	DE	ES	FR	HU	IT	NL	PL	PT	RO	SI	SK	Total
AT		1	2	3	25	0	1	4	9	1	2	0	1	5	2	**56**
BE	1		1	2	42	2	35	1	3	58	5	0	0	0	0	**150**
CH	1	0		0	7	1	4	0	4	1	0	0		0	0	**18**
CZ	5	1	0		23	0	2	3	3	2	12		0	1	8	**61**
DE	33	38	17	18		8	31	7	28	67	36	1	2	2	5	**292**
ES	0	2	1	1	8		26	0	4	2	2	12	0	0		**58**
FR	1	30	7	1	25	20		0	11	10	3	1	0	0	0	**110**
HU	6	1	0	2	7	0	1		5	1	3	0	3	2	4	**34**
IT	8	2	7	2	25	4	12	3		3	5	0	1	4	1	**79**
NL	2	79	3	2	123	2	13	1	4		5	0	0	0	0	**235**
PL	3	3	1	17	41	1	4	3	5	4			3	1	6	**93**
PT	0		0		1	9	1	0	0	0	0			0		**12**
RO	1	0		0	2	0	1	3	2	1	2			0	1	**13**
SI	8	0	0	1	2	0	0	3	5	0	1	0	0		1	**21**
SK	4	0	0	9	6	0	0	7	2	0	5		1	1		**35**
Total	**73**	**158**	**39**	**58**	**336**	**48**	**133**	**35**	**86**	**150**	**81**	**14**	**11**	**15**	**29**	**1,266**

Source: NEAC estimations

The main origins and destinations for all land modes in international freight transport are depicted in Figure 26 below. As can be seen, these concern relations between the Netherlands, Belgium, and Germany mainly (with ports such as Rotterdam, Amsterdam, Ghent (North Sea Ports) and Antwerp (Port of Antwerp-Bruges), and inland locations such as the Rhein-Ruhr area).

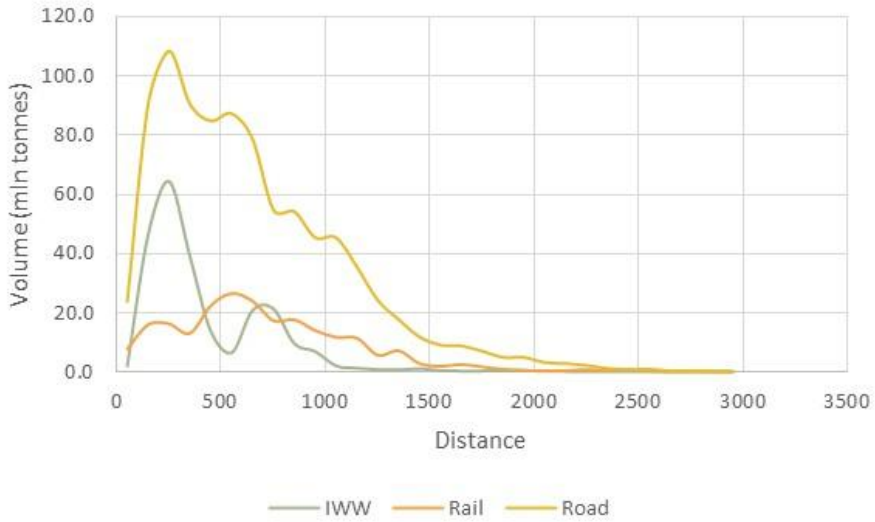
Figure 26 Estimated volume (million tonnes) for the 10 relations (at NUTS2 level) of all international freight transport over land in 2022 within the combined 11 RFCs network catchment area



Source: NEAC estimations

The 'trip' length distribution for international freight transport in Europe in the combined 11 RFCs network area is shown in the figure below. This graph shows the volume (in million tonnes) by distance (in km). The peak for road (107 million tonnes) and inland shipping (64 million tonnes) is in both cases around 250 km. For international rail transport this is around 550 and 750 km at 27 million tonnes.

Figure 27 Volume distribution (million tonnes) by distance (km) *within* the combined 11 RFCs network catchment area in 2022



Source: NEAC estimations

4.2.3 INTERNATIONAL RAIL FREIGHT TRANSPORT IN THE COMBINED 11 RFCS NETWORK CATCHMENT AREA

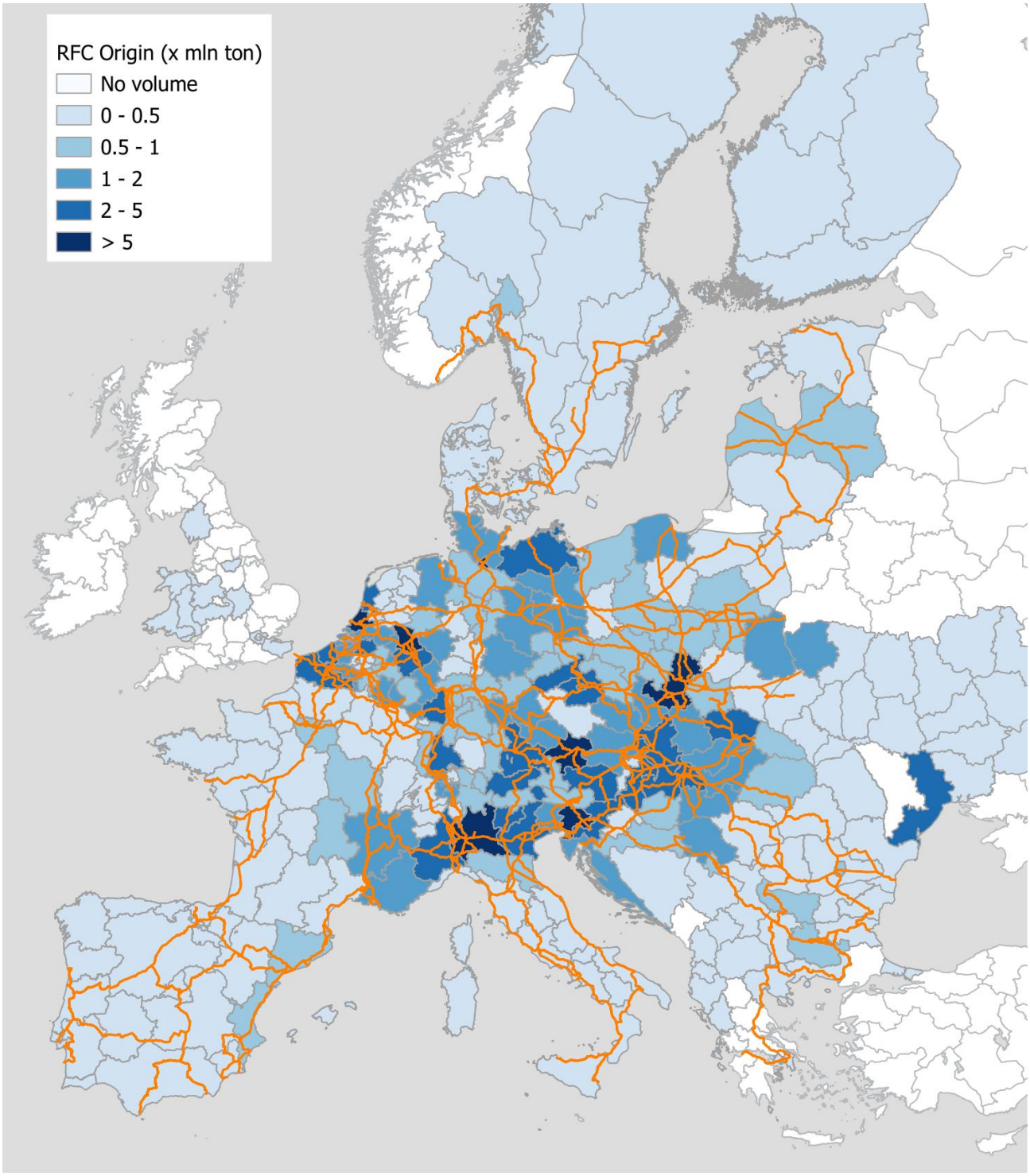
Figure 21 provides an overview of the *corridor area* of the 11 RFCs network. The corridor area of the 11 RFCs network covers a vast part of Europe, but excludes countries and regions such as the UK, Ireland, Finland, Northern Scandinavia, and parts of the Balkan. The 11 RFCs network catchment area covers a much wider area. It includes the previously mentioned countries, as well as countries east of Europe such as Ukraine, Moldova, Kazakhstan, and China.

The rail freight transport catchment area for the 11 RFCs network is shown in Figure 28 and Figure 29. Figure 28 provides an overview of the volumes by origin, while Figure 29 shows the volumes by destinations. As can be seen, international rail freight transport is clearly generated or destinated outside the corridor area of the 11 RFCs network area (in countries such as Ukraine, Finland and UK). The 11 RFCs network catchment area for international rail freight transport is thus wider than the corridor area of the 11 RFCs network area. Note that some areas are white coloured. These do not generate or receive international rail freight transport.

Important NUTS2 origins20 for rail freight transport are Rotterdam, Hamburg, the Rhein-Ruhr area, Linz, Ostrava, Katowice, Koper, and Milan. On the destination side, we see similar locations such as Rotterdam, Hamburg, Rhein-Ruhr area, Saarland, Ostrava, Katowice, Linz, Turin, Milan, and Budapest. Typically, land-locked regions in countries such as Austria, Czechia, Hungary, Poland and Slovakia rely upon rail transport for larger quantities of transport volumes. This is expressed in the maps presented below.

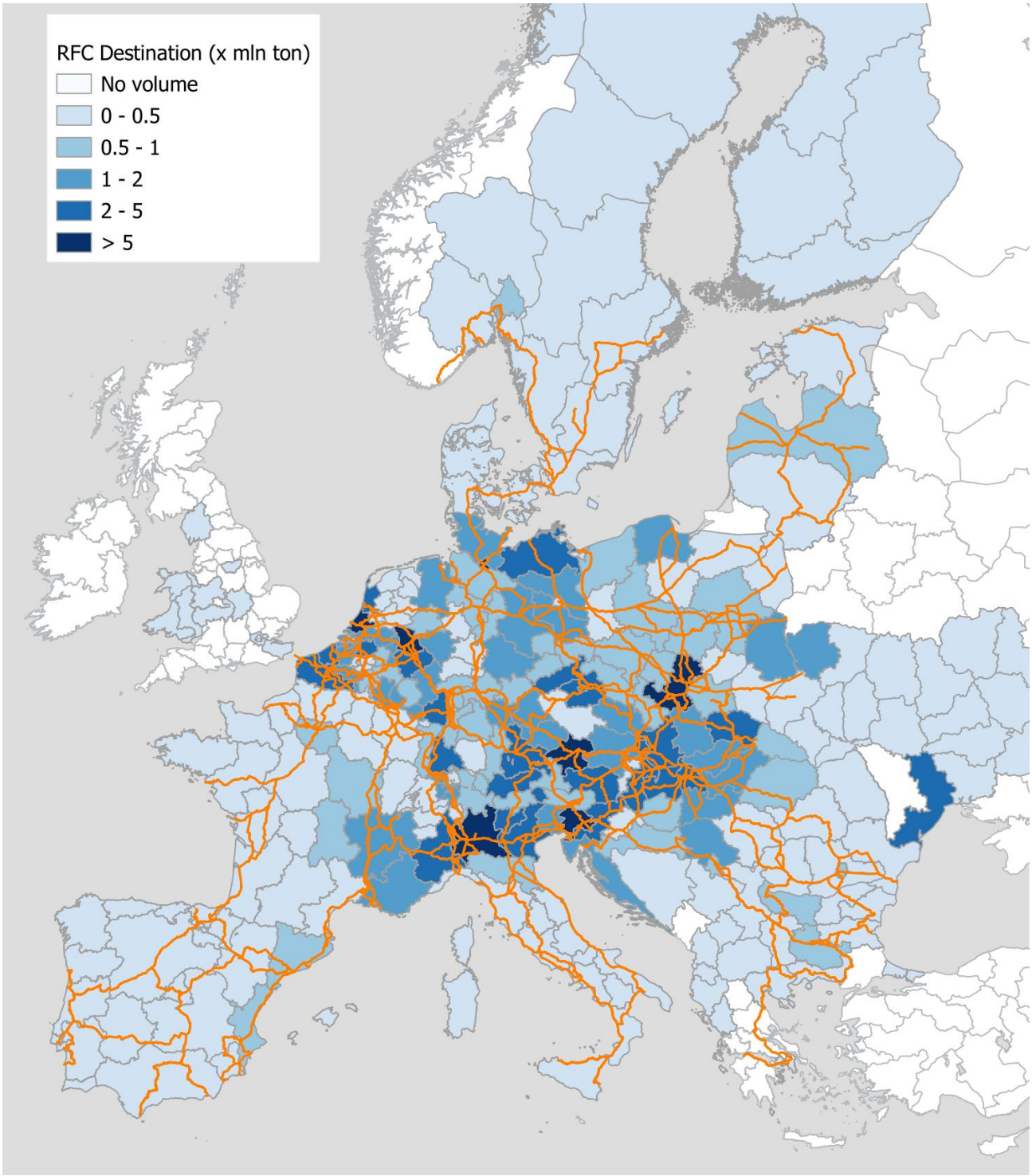
[20] We present the NUTS2 regions by mentioning the main cities in these regions, to make it easier to understand the results.

Figure 28 Origins of international rail freight transport (in million tonnes) for the combined 11 RFCs network catchment area



Source: NEAC estimations

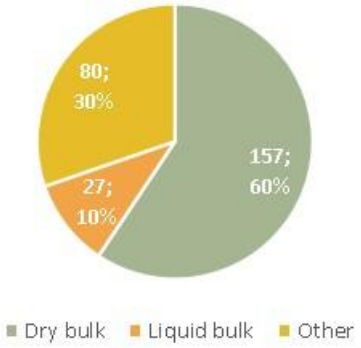
Figure 29 Destinations of international rail freight transport (in million tonnes) for the combined 11 RFCs network catchment area



Source: NEAC estimations

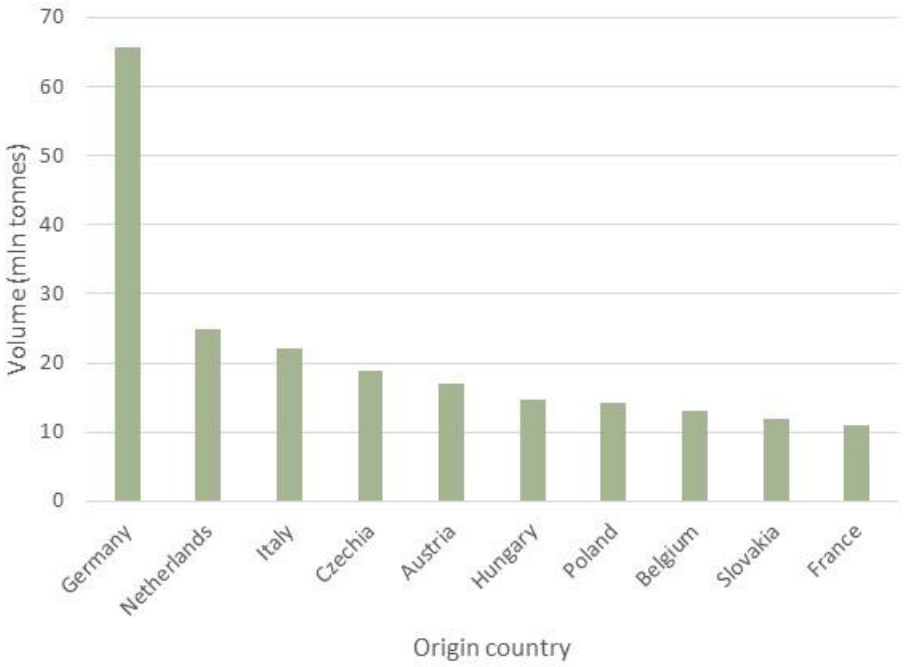
The next figure shows the volumes of international rail freight transport by cargo type in the 11 RFCs network catchment area. Dry bulk is the most important cargo type for international rail freight transport. It has a share of 59%, which is equivalent to 157 million tonnes. The cargo type *Other* (general cargo, including intermodal transport and container) has a share of 30% (80 million tonnes), and liquid bulk of 10% (27 million tonnes) in the total volumes of international rail freight transport.

Figure 30 Estimated volume and share of international rail freight transport (million tonnes) by cargo type in 2022, in the 11 RFCs network catchment area



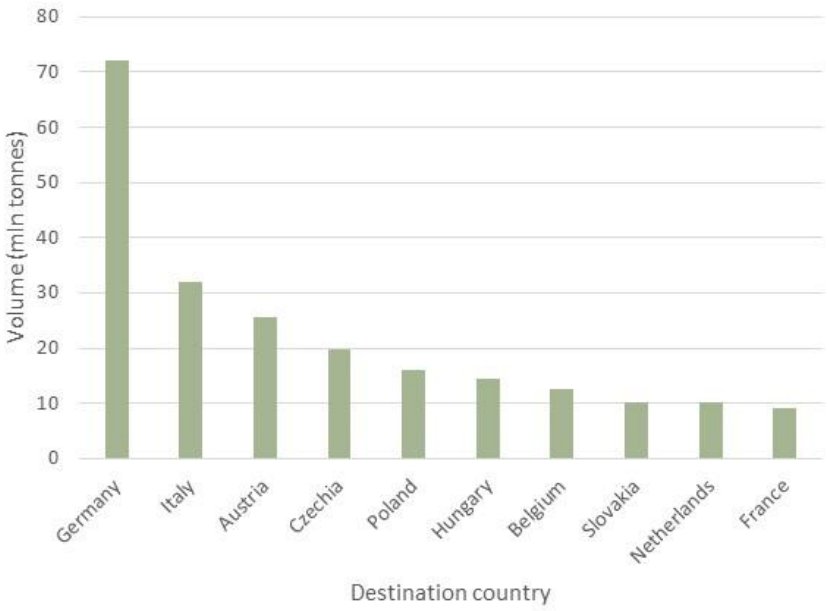
The most important origin and destination countries for rail transport are provided in the graphs below. Concerning both origin and destination, Germany is the country with the highest international rail freight transport volumes. As an origin country it ships 66 million tonnes, while as a destination it receives 72 million tonnes of international rail freight transport. Other important origin countries are The Netherlands and Italy (25 and 22 million tonnes). Concerning destination, Italy and Austria are number 2 and 3 with respectively 32 and 26 million tonnes of international rail freight transport.

Figure 31 Estimated volume of international rail freight transport (million tonnes) by *origin* country in 2022 in the 11 RFCs network catchment area



Source: NEAC estimations

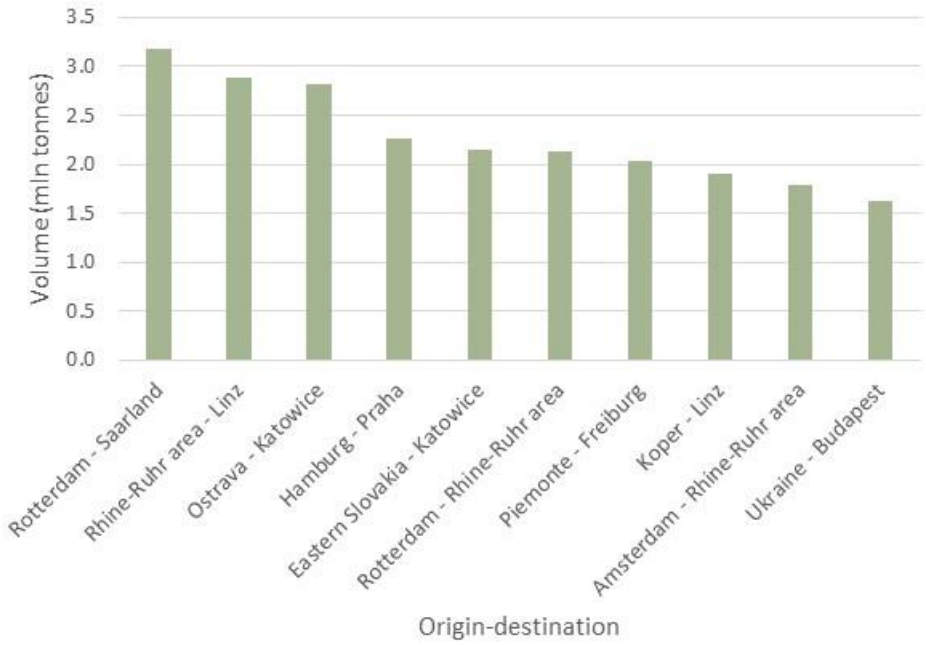
Figure 32 Estimated volume of international rail freight transport (million tonnes) by *destination* country in 2022 in the 11 RFCs network catchment area



Source: NEAC estimations

The figure below shows the 2022 top 10 international rail freight transport relations in the 11 RFCs network catchment area. The relation between Rotterdam and Saarland is the most important one, with a volume of 3.2 million tonnes. This concerns the transport of dry bulk (coal). Second comes the relation between the Rhein-Ruhr area and Linz, at 2.9 million tonnes. This concerns mostly liquid bulk transport. In third place we see the relation between Ostrava and Katowice, which is mostly dry bulk. The relation between Hamburg and Prague (Praha) comes in fourth place. This rail transport relation is mostly about the transport of general cargo. There is not a single relation that dominates the international rail freight transport market.

Figure 33 Estimated volume of international rail freight transport (million tonnes) on the top 10 most important relations in 2022 in the 11 RFCs network catchment area



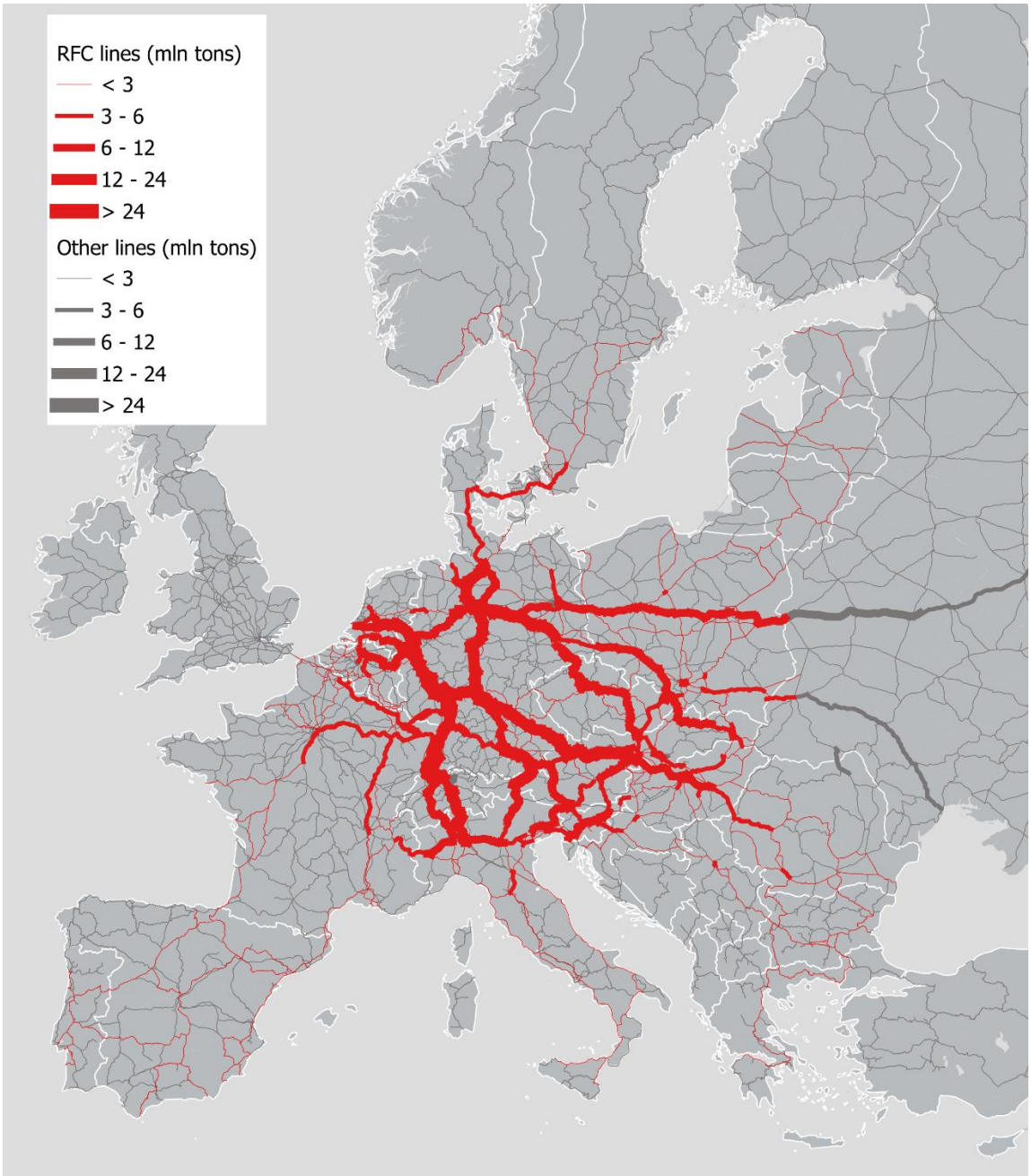
Source: NEAC estimations

4.2.4 INTERNATIONAL RAIL FREIGHT TRANSPORT FLOWS IN THE COMBINED 11 RFCS NETWORK

The figure below shows the estimated international rail freight flows (in tonnes) for the combined 11 RFCs network. This provides a general overview of the main rail lines in Europe. As can be seen, Germany comprises the most used rail tracks for international rail freight transport. Important relations between Germany and its neighbouring countries are also clearly depicted. Furthermore, a large amount of rail transport can be seen between Poland and Czechia. At the different border crossing points the volumes are consistent with the number of trains observed. Also important to note is transport to/from Ukraine and China.

Another thing to notice is the relatively small amount of international rail freight transport in Spain, Portugal, the Balkans, Mid and South Italy, South of France, Greece, Sweden, Norway and the Baltic States. The international rail freight volumes in those areas are limited compared to the larger volumes in the centre of Europe.

Figure 34 Estimated Volume of international rail freight transport (million tonnes) in 2022



Source: NEAC estimations

4.3 INTERNATIONAL FREIGHT TRANSPORT IN THE RFC AMBER

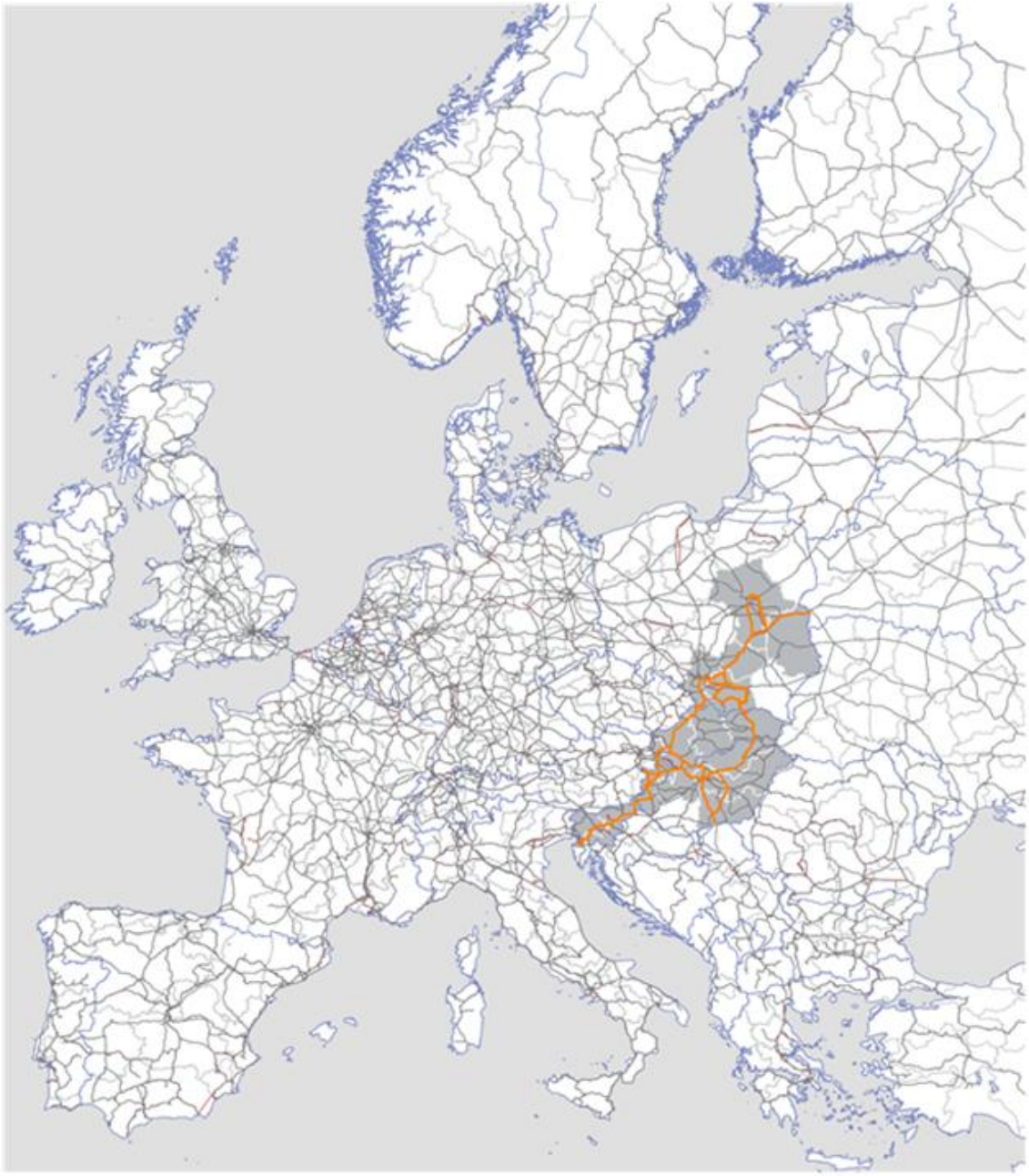
After the presentation of the European international freight transport market, this section provides further details on international freight transport for the RFC Amber. The structure of this section is as follows:

1. Presentation of the catchment and corridor areas of the RFC Amber;
2. Description of the results for all international freight transport for the RFC Amber corridor area;
3. Results of the international rail freight transport in the RFC Amber catchment area;
4. Flows of rail freight on the RFC Amber.

4.3.1 CORRIDOR AND CATCHMENT AREA OF RFC AMBER

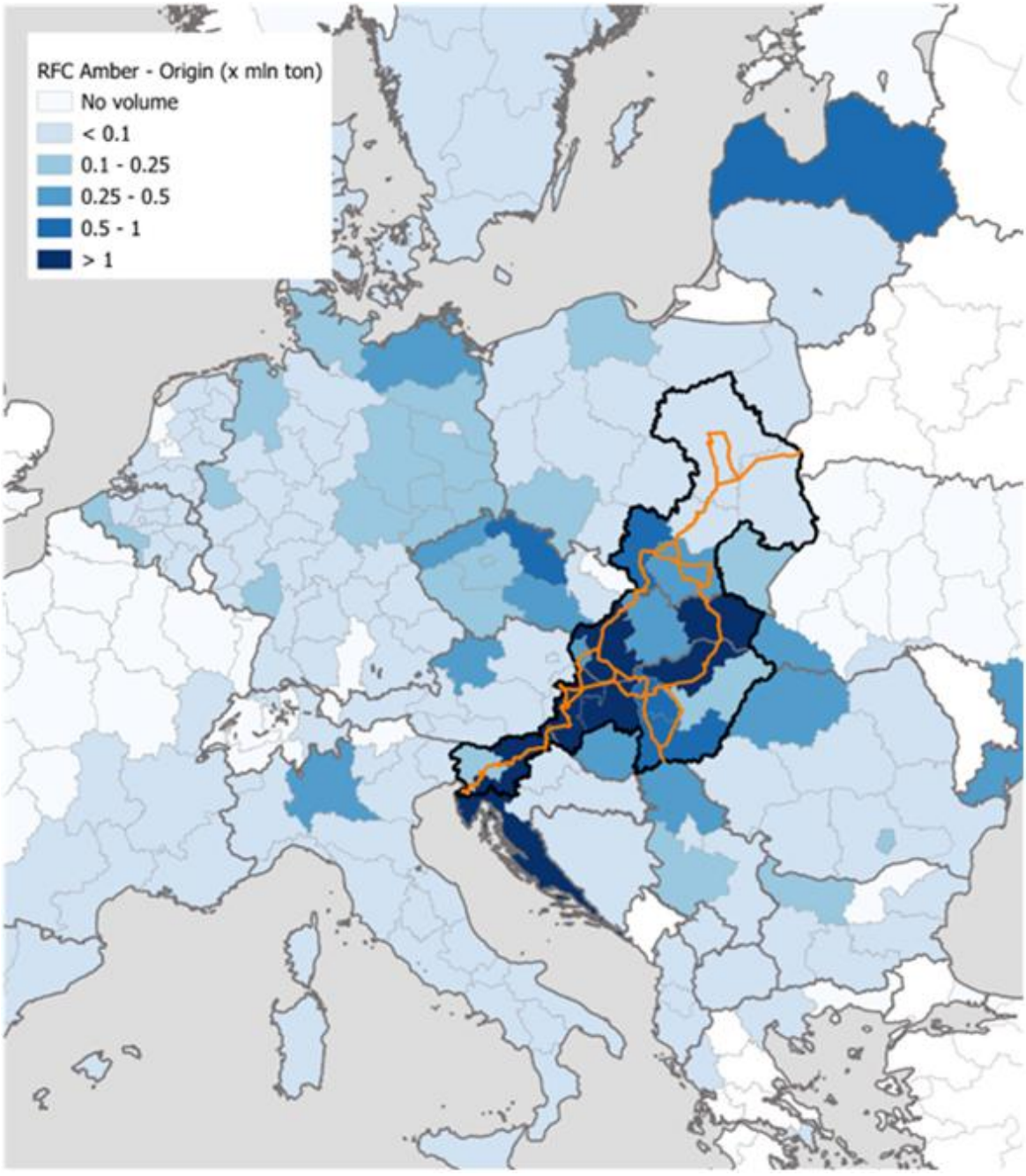
In section 4.1, a definition of corridor and catchment areas is given. This section details the corridor area for the RFC Amber. Figure 35 provides an overview of the RFC Amber network within its corridor area, in relation to the rest of the European rail network. The RFC Amber network and corridor area serves as a basis for the estimation of the international rail freight volumes transported between the different origins and destinations. It is worth noticing that international rail transport within the RFC Amber is also dependent upon rail transport to and from locations outside the corridor area of the RFC Amber, as further elaborated in later sections.

Figure 35 Corridor area and rail network of the RFC Amber



The catchment area for international rail freight transport of the RFC Amber exceeds the corridor area. It captures large parts of Germany, Poland, France, and Italy, to name a few countries. A large proportion of the rail freight transport uses the RFC Amber, and its border crossing points, to ship freight by rail from different origins to different destinations (see overview in the next figures). The picture below shows the origins of the RFC Amber, with important origins such as Bratislava and Budapest. Some origins are port areas such as Koper, which use the RFC Amber to ship goods to the hinterland. Also, outside the corridor area different zones can be seen that contribute to the RFC Amber. Note that outside the corridor it often concerns small amounts of volume.

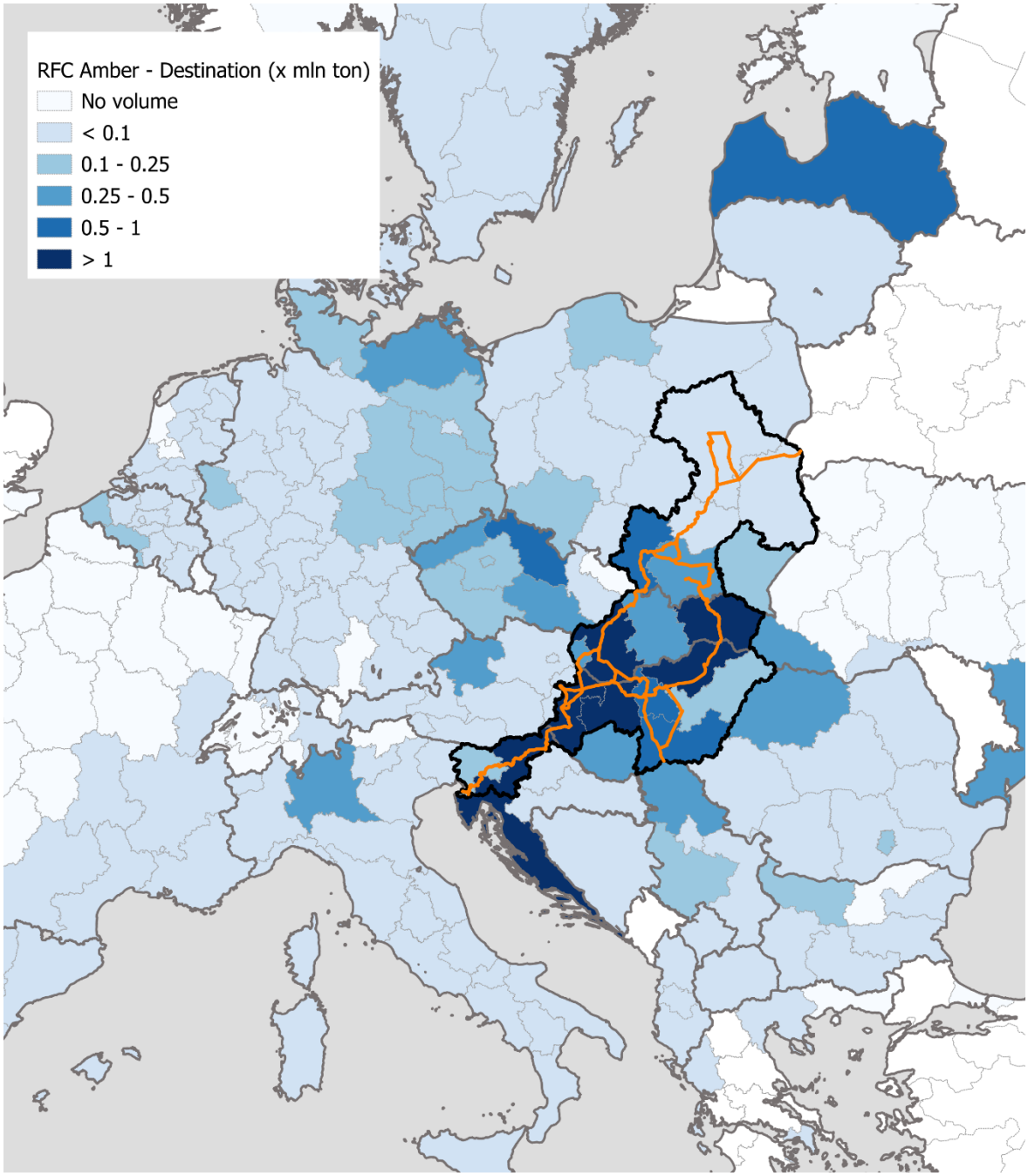
Figure 36 Origins of international rail freight volume (in million tonnes) that use the RFC Amber rail network and the delineation of the potential RFC Amber catchment area



Legend: Orange = rail tracks of RFC Amber. Blue = Volume by origin. Black = Delineation of corridor area. Source: NEAC estimations

The next figure presents the destinations within the RFC Amber catchment area. The figure highlights similar zones as the origins that exhibit the high freight volumes dispatched from these destinations. It is evident from the figure that numerous zones benefiting from RFC Amber's services fall outside the corridor area, such as areas Germany, Italy, and Austria.

Figure 37 Destinations of international rail freight volume (in million tonnes) that use the RFC Amber rail network and the delineation of the potential RFC Amber catchment area



Legend: Orange = rail tracks of RFC Amber. Blue = Volume by origin. Black = Delineation of corridor area. Source: NEAC estimations

4.3.2 ALL INTERNATIONAL FREIGHT TRANSPORT FOR THE RFC AMBER

The total volume of international freight transport in the *catchment* area of the RFC Amber is estimated at 139 million tonnes in 2022, transported by road, rail, inland shipping and sea shipping. The international rail freight transport volume in this area is estimated at 43 million tonnes (about 72,000 trains). This is 31% of the total amount of freight transport for the RFC Amber. The share of road transport 27%. Sea shipping has a share of 41%. Inland shipping is not relevant for the RFC Amber.

Concerning the cargo types, Other (General cargo, including intermodal transport and container) is the most important one at 68 million tonnes (49%). Dry bulk is second in the international freight transport within the catchment area of the RFC Amber, with a volume of 52 million tonnes (37%). Liquid bulk has a share of 14% in the total volume of international freight transport over all modes in the corridor area of the RFC Amber.

Figure 38 Estimated volume (million tonnes) and share of *all* international freight transport over land by mode and cargo type in the *catchment* area of RFC Amber

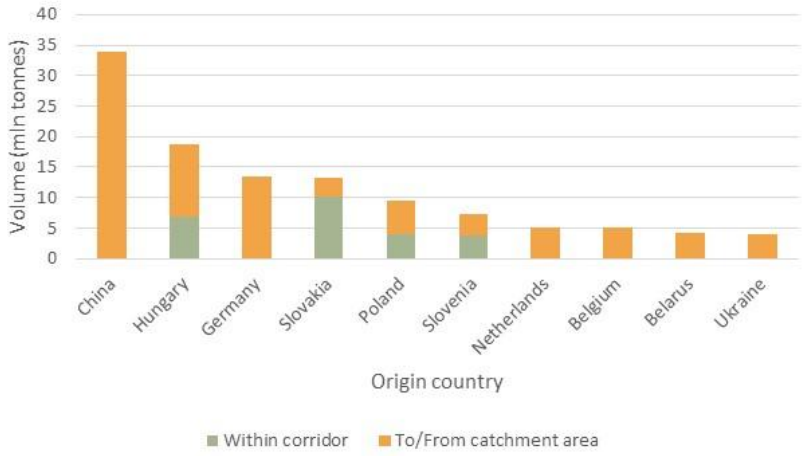
Source: NEAC estimations

Figure 39 and Figure 40 show the origin and destination countries for all international freight transport within the catchment area (which includes the corridor area) of the RFC Amber. The green colour shows the origin and destination within the corridor area of the RFC Amber. The orange colour shows the international freight transport to and from the rest of the catchment area. As can be seen, only the RFC Amber countries (HU, SK, PL, SI) have green-coloured bars beside the orange ones, as these are the corridor countries.

The main countries with origin locations for international freight transport in the RFC Amber are China, Hungary and Germany. This concerns all transport by road, rail, inland shipping, and sea shipping. A volume of 34 million tonnes of international freight transport has its origin in China, which mainly concerns sea transport. Hungary comes in second place with 19 million tonnes originating from locations in this country. In this case, 7 million tonnes (36%) go to other countries within the RFC. Germany is the third most important origin country with 14 million tonnes, As with China, a large part of this freight transport concerns sea shipping. RFC Amber countries thus play a less important role as origin for all freight transport than is the case with other RFCs.

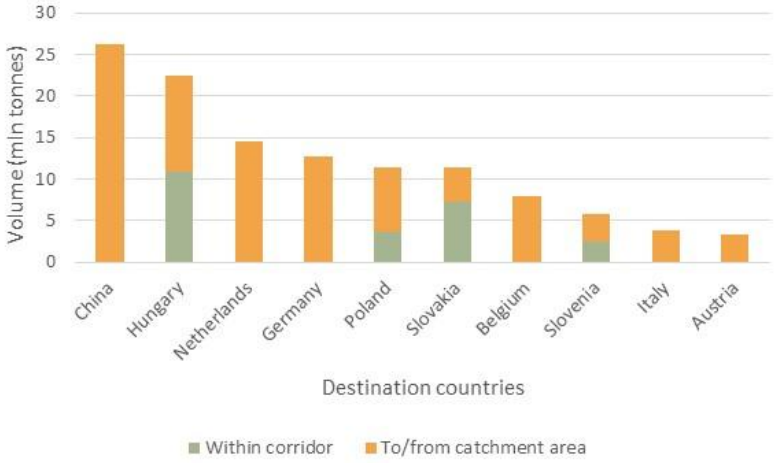
The main countries with destination locations are China, Hungary and Germany. China receives 26 million tonnes. Hungary is second, with a volume of 23 million tonnes, of which 11 million tonnes (49%) have their origin in other RFC Amber countries. The Netherlands receives 15 million tonnes. As already mentioned before, international freight transport in the RFC Amber is very international, in the sense that the countries in the RFC Amber produce and attract relatively lower volumes of goods.

Figure 39 Estimated volume (million tonnes) of *all* international freight transport over land by *origin* in 2022 within the catchment and corridor area of RFC Amber



Source: NEAC estimations

Figure 40 Estimated volume (million tonnes) of *all* international freight transport over land by *destination* in 2022 within the catchment and corridor area of RFC Amber



Source: NEAC estimations

The following table shows all international freight volume between the countries *within the corridor area* of RFC Amber for the *land* modes. The total amount of international freight volume is 24.6 million tonnes within the corridor area. The most important freight transport relation is between locations in Slovakia and Hungary at 7.0 million tonnes of freight transport by all land modes. Other relations play a less dominant role.

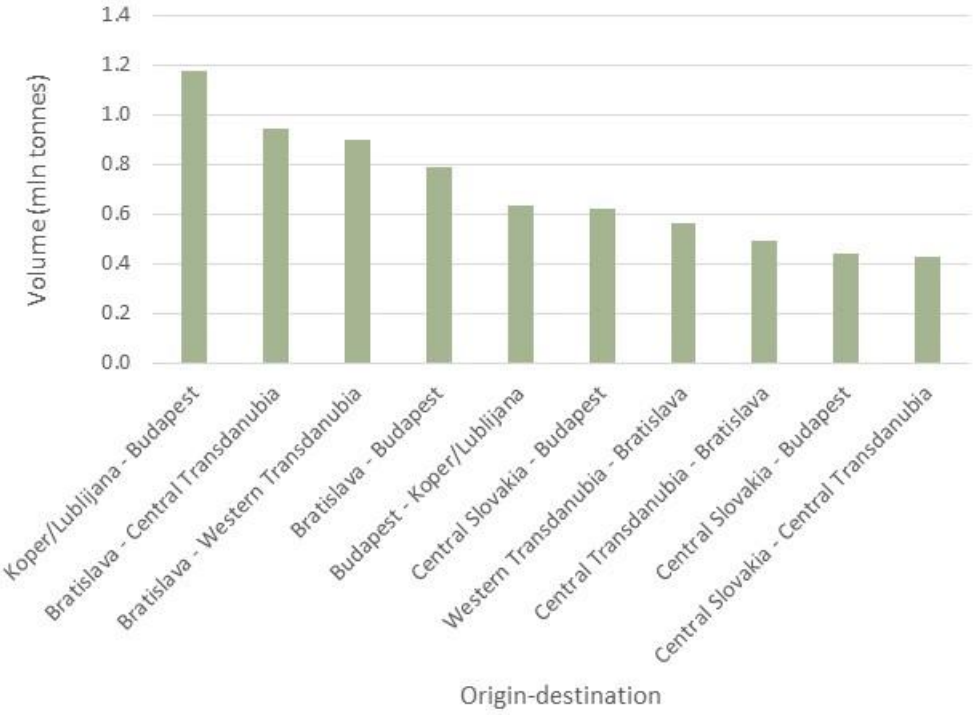
Table 36 Total freight volume (million tonnes) between the countries for land modes within the corridor area of the RFC Amber

From/To	HU	PL	SI	SK	Total
HU		1.1	1.5	4.2	6.8
PL	1.3		0.2	2.4	3.9
SI	2.6	0.3		0.8	3.7
SK	7.0	2.3	0.9		10.2
Total	**11.0**	**3.7**	**2.6**	**7.3**	**24.6**

Source: NEAC estimations

The chart below depicts the main origins and destinations for all *land* modes. The most important relation is Koper/Ljubljana - Budapest, at 1.2 million tonnes. Bratislava-Central Transdanubia comes in second place, at 0.9 million tonnes, followed by Bratislava – Western Transdanubia (at 0.9 million tonnes). Note that most origins and destinations of the RFC Amber can be found in Slovakia and Hungary. It shows the importance of Bratislava and Budapest for the RFC Amber specifically.

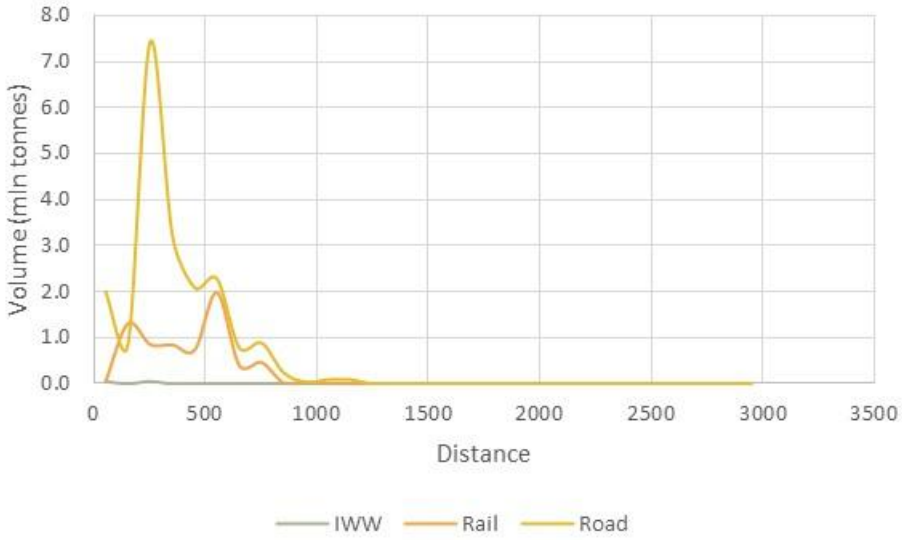
Figure 41 Estimated volume (million tonnes) for the 10 relations (at NUTS2 level) of *all* international freight transport over land in 2022 within the corridor area of RFC Amber



Source: NEAC estimations

The 'volume' distance distribution for international freight transport *within the corridor area* of RFC Amber is shown in the figure below (in million tonnes) by distance (in km). For international rail freight transport, the peak is around 550 km at 2.0 million tonnes. For road freight transport the peak lies at 250 km with a volume of 7.4 million tonnes. Inland shipping does not play an important role. As can be seen, after 1,000 km the volume of rail and road transport is small. Transport in the RFC Amber is thus concentrated in a relatively small area, which is in line with the conclusion that Hungary and Slovakia dominate the RFC Amber.

Figure 42 Volume distribution (million tonnes) by distance (km) within corridor area of RFC Amber in 2022

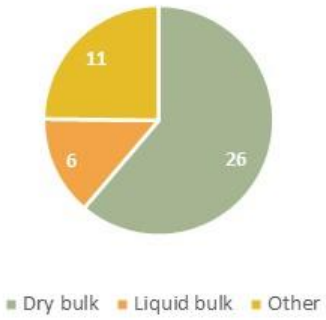


Source: NEAC estimations

4.3.3 INTERNATIONAL RAIL FREIGHT TRANSPORT IN THE RFC AMBER CATCHMENT AREA

Looking at the volumes of international rail freight transport by cargo type within the catchment (and corridor) area of the RFC Amber, *Dry bulk* is the most important cargo type. It has a share of 61%, with 26 million tonnes of rail freight. The category *Other* has a share of 25% and liquid bulk of 14% in the total volumes of international rail freight transport in the RFC Amber.

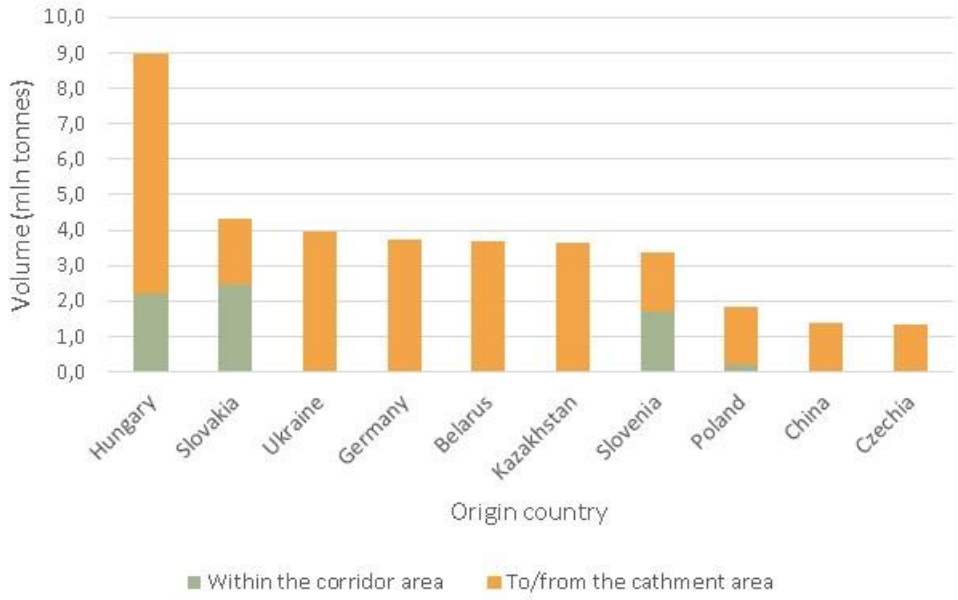
Figure 43 Estimated Volume of international rail freight transport (million tonnes) by cargo type in 2022 within the catchment (and corridor) area of the RFC Amber



Source: NEAC estimations

The origin and destination countries for international rail freight transport in the catchment and corridor area are provided in the graphs below. Concerning origin, Hungary is the country with the highest international rail freight transport volume. As an origin country, it ships 10 million tonnes. This country is an important origin for countries *outside* of the RFC Amber, 67% of the rail freight is transported to locations in outside of the RFC Amber countries, using the RFC Amber network. In second place comes Poland at 6 million tonnes. Third comes Slovakia at 5 million tonnes of international rail freight transport volume. Note that the share of rail freight transport *within* the corridor area of the RFC Amber is 18% (which relates to the green bars in the graph). Also note that the flows from non-RFC Amber countries such as Ukraine and Germany. There is a substantial amount of rail transport coming from outside of Europe.

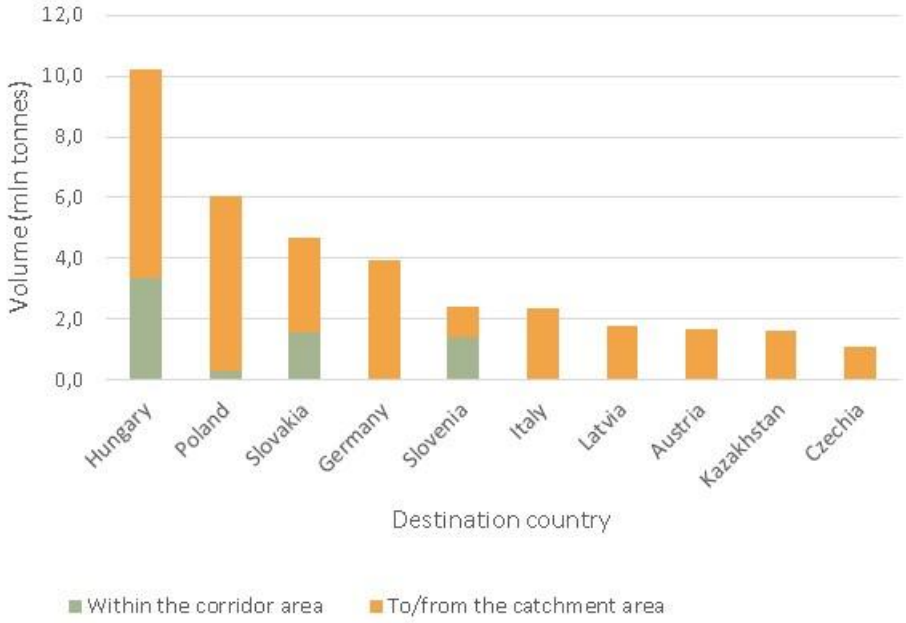
Figure 44 Estimated volume of international rail freight transport (million tonnes) by *origin* country in 2022 in the catchment and corridor area of the RFC Amber



Source: NEAC estimations

The most important destination country is Hungary. It receives some 9 million tonnes of rail transport. Other important destination countries are Slovakia (4 million tonnes), and Ukraine (4 million tonnes). The volume stemming from other countries in the RFC Amber is 18%. It shows that the RFC Amber is a rail freight corridor with an important international position as 82% of the relations outside the RFC Amber uses the rail network of the RFC Amber.

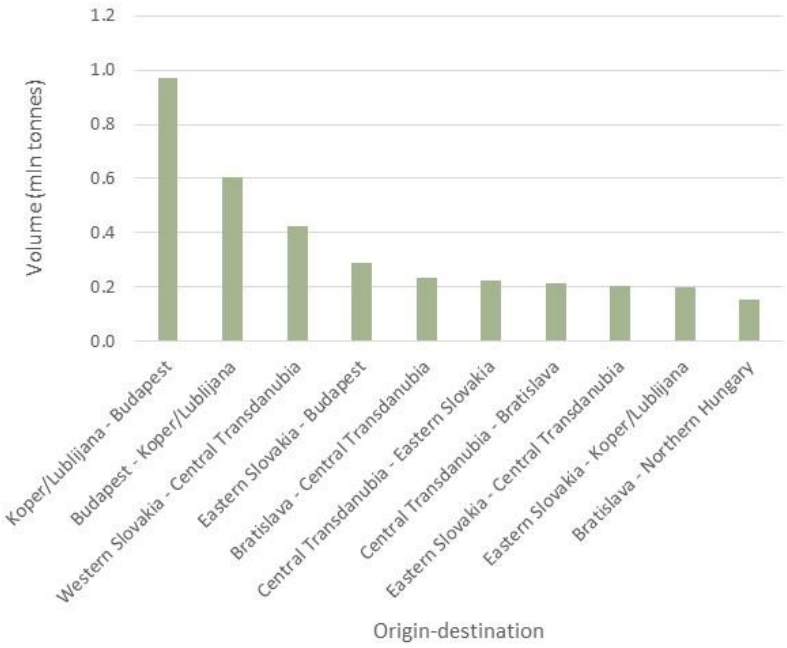
Figure 45 Estimated volume of international rail freight transport (million tonnes) by *destination* country in 2022 in the catchment and corridor area of the RFC Amber



Source: NEAC estimations

The figure below shows the top 10 most important international rail freight transport relations *within* the corridor area of the RFC Amber. The relation between Koper/Ljubljana and Budapest is the most important one, at 1.0 million tonnes. This concerns mostly liquid bulk. The reverse direction comes in second place, which is a mix general cargo, dry bulk and liquid bulk (0.6 million tonnes). Western Slovakia – Central Transdanubia comes in third place at 0.4 million tonnes of international rail freight transport (dry bulk, containers and general cargo). Note the importance of Koper for its hinterland in Hungary. Furthermore, there are several relations with smaller volumes (< 0.2 million tonnes) in the RFC Amber.

Figure 46 Estimated volume of international rail freight transport (million tonnes) on the top 10 most important relations in 2022 in the corridor area of the RFC Amber

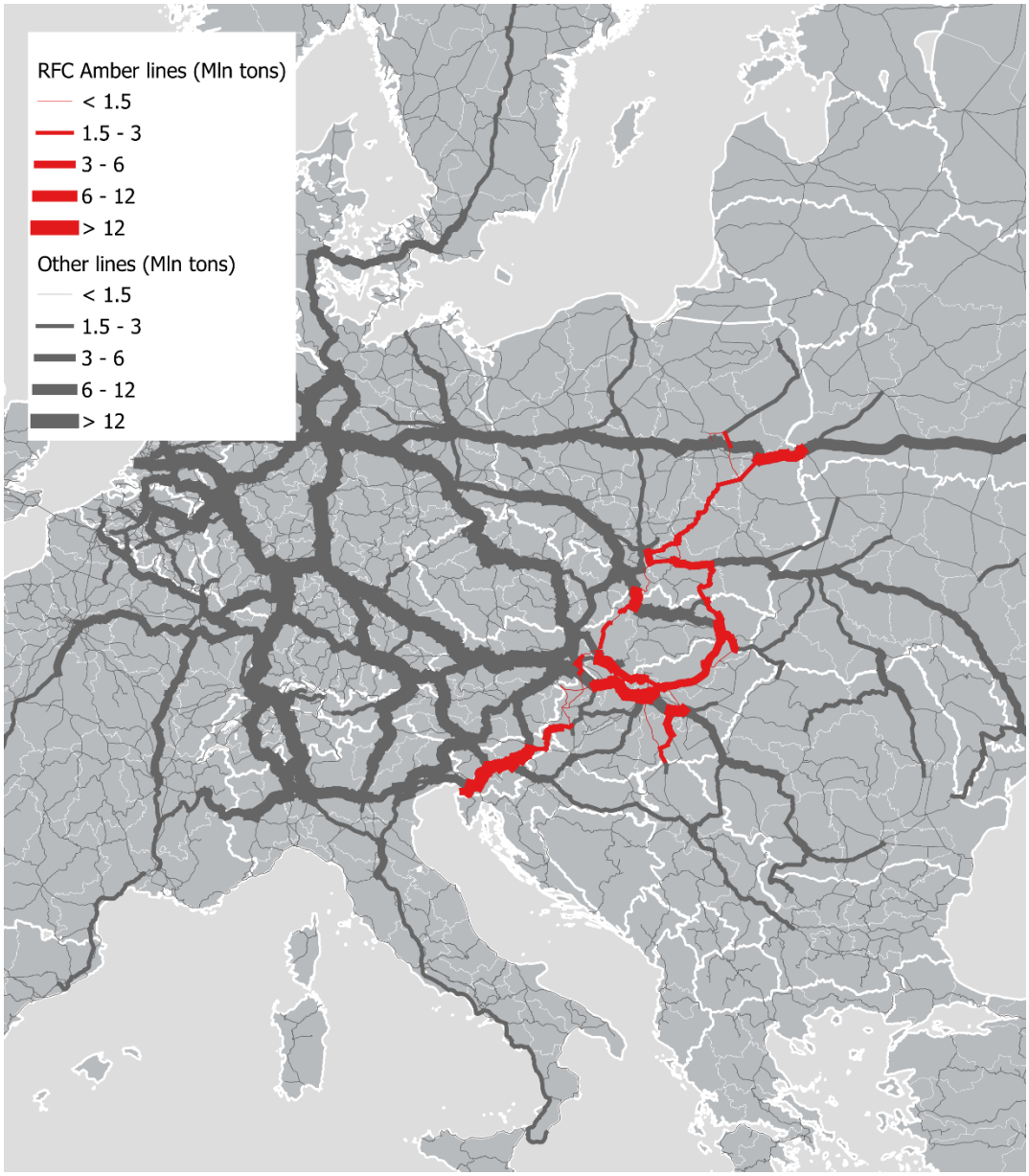


Source: NEAC estimations

4.3.4 INTERNATIONAL RAIL FREIGHT TRANSPORT FLOWS IN THE RFC AMBER

The figure below shows the estimated international rail freight flows (in tonnes) for the RFC Amber. This provides a general overview of the use of the main rail lines in the corridor area. The volumes on the RFC Amber cannot be understood if we present them isolated. The rail volumes on the different tracks of the RFC Amber often have an origin or destination elsewhere in Europe. Looking at the map, we see different volumes at different locations. In the northern part of RFC Amber, we see flows that stem from or go to Belarus that seem more east-west oriented. More south we see substantial volumes in Hungary and Slovakia, both east-west and north-south. In the south we see volumes from Western Slovenia to Hungary.

Figure 47 Estimated Volume of international rail freight transport (million tonnes) by cargo type in 2022



Source: NEAC estimations

5 ANALYSIS OF THE FUTURE RFC AMBER TRANSPORT MARKET

The future market analysis has been performed for the three scenarios described in Section 3.3 above, i.e. EU Reference scenario, Projects scenario 2030 and Sensitivity scenario. The results for three scenarios have been produced for 2030. The future of freight transport is presented in steps to help understand the importance of international freight transport in general and rail freight transport specifically. Results for the 11 RFCs network catchment and corridor area are presented, then for the RFC Amber corridor and catchment area:

- Section 5.1 presents the **future freight transport in the 11 RFCs network area**:
  - Section 5.1.1 provides a general overview of the **future of all international freight transport for the 11 RFCs network catchment area**. This includes total volumes by mode and cargo type. Furthermore, the volumes by main origin and destination countries are illustrated, as well as the main relations for all freight transport. Finally, a volume-distance distribution by mode is given;
  - Section 5.1.2 presents the **future of international rail freight transport for the 11 RFCs network catchment area**, with the volume by cargo type, the flows on the rail network, the rail volumes by origin and destination countries and the top 10 relations for international rail freight transport.
- Section 5.2 provides **the future of the international freight transport in the RFC Amber.**
  - Section 5.2.1 provides a general overview of **the future of all international freight transport for the RFC Amber**. This includes total volumes by mode and cargo type. Furthermore, we present the volumes by main origin and destination countries, as well as the main relations for all freight transport. Finally, a volume-distance distribution by mode is presented;
  - Section 5.2.2 describes the **future of international rail freight transport on the RFC Amber** is presented. This provides a general overview of the origins and destinations of rail freight for the RFC Amber. We present the volume by cargo type, the flows on the rail network, the rail volumes by origin and destination countries and the top 10 relations for international rail freight transport;
  - Section 5.2.3 presents the **developments of the most important BCPs** on the RFC Amber.

5.1 FUTURE TRANSPORT MARKET IN THE COMBINED 11 RFCS NETWORK AREA

This section describes the results of the future market analysis in the 11 RFCs network area. As explained in the previous chapter on the current market analysis, the market analysis of the individual RFCs is more appropriately assessed in the framework of the 11 RFCs network, as the RFCs do not function in isolation.

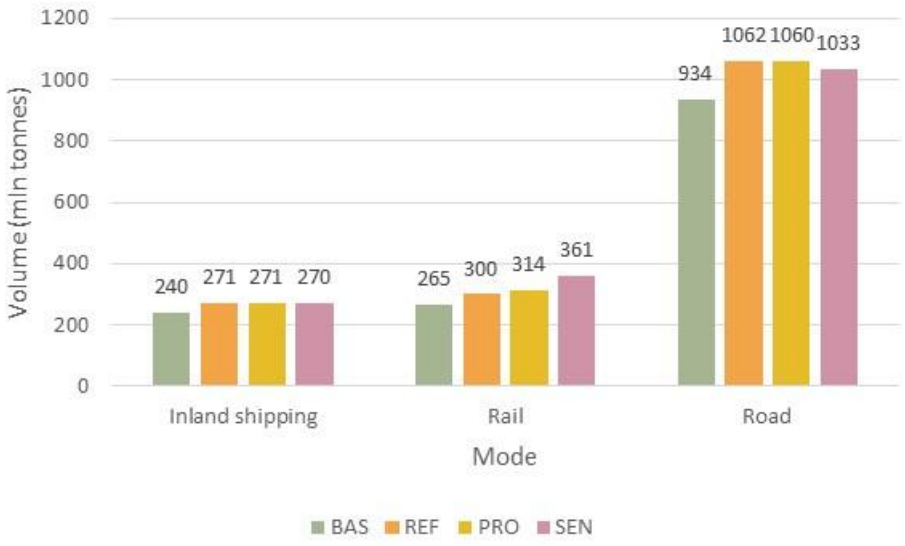
5.1.1 FUTURE OF INTERNATIONAL ALL FREIGHT TRANSPORT FOR THE COMBINED 11 RFCS NETWORK

Due to the economic developments, all modes grow in the Reference scenario between 2022 and 2030. Inland shipping and rail grow by 13%, road by 14%. In absolute terms, international road freight transport grows most, by 126 million tonnes (from 934 to 1,062 million tonnes). Inland shipping grows by 31 million tonnes (from 240 to 271 million tonnes) and rail transport by 35 million tonnes (from 265 to 300 million tonnes). Figure 48 shows the overall developments by mode and scenario within the 11 RFCs network catchment area.

The implementation of different rail projects across Europe (Projects scenario) leads to an extra growth of 5% for rail transport compared to the Reference scenario, which is 14 million tonnes. Large projects across Europe such as Rail Baltica, Fehmarn Belt, the Koralm railway line and tunnel, the Semmering tunnel, the second track Koper-Divača or Rijeka-Zagreb-Koprivncica, account for this growth. The volume for IWW (inland shipping) remains the same and road transport decreases a bit. Although not shown in the graph, a small shift in sea transport also causes extra growth.

The third scenario (Sensitivity) shows a hypothetical development for rail transport, assuming the completion of infrastructure with reference to the TEN-T requirements and the loading gauge. Compared to the base year situation, a growth of 36% is calculated for rail (+23% compared to the Reference scenario). The introduction of longer trains (740 meter) has an important effect on this result. This scenario can be regarded as a maximum potential for rail transport. Compared to the Reference, both inland shipping and road transport decrease, inland shipping by 1 million tonnes and road transport by 29 million tonnes. Keep in mind that the increase of rail transport (61 million tonnes) is not fully covered by a shift from inland shipping and road. This is due to the use of road transport for the first and last mile and a shift to shortsea transport.

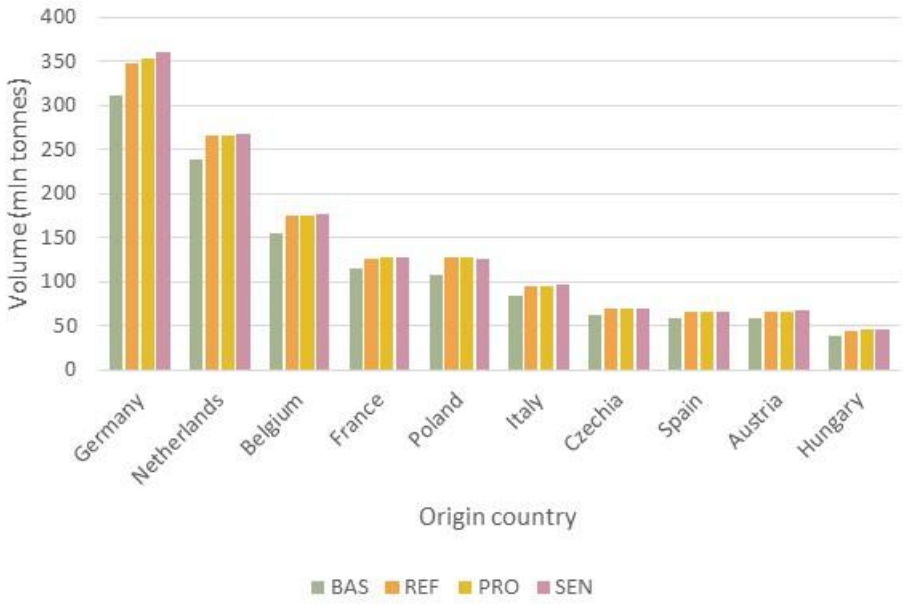
Figure 48 Development of volume (in million tonnes) by mode and scenario for the 11 RFCs network catchment area



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

The next two figures show the development of the volume of international freight transport for all modes for the top 10 countries and per scenario. The most prominent growth stems from the Reference scenario for both origins and destinations. The Projects scenario and the Sensitivity scenario show only small differences compared to the Reference scenario; the largest differences can be seen in Germany. The top 10 origin countries remain the same as presented earlier for 2022. Germany, the Netherlands, and Belgium constitute the 3 largest origin countries for international freight transport. The total amount of volume for Germany increases by 12% between the 2022 Base year and 2030 Reference scenario, from 311 to 348 million tonnes. Similar growth can be found in the Netherlands (+12% from 238 to 265 million tonnes) and Belgium (+13% from 155 to 175 million tonnes). The largest growth between the 2022 Base year and the 2030 Reference scenario can be found in Poland (+20% from 107 to 128 million tonnes) and in Hungary (+18%, from 38 to 45 million tonnes).

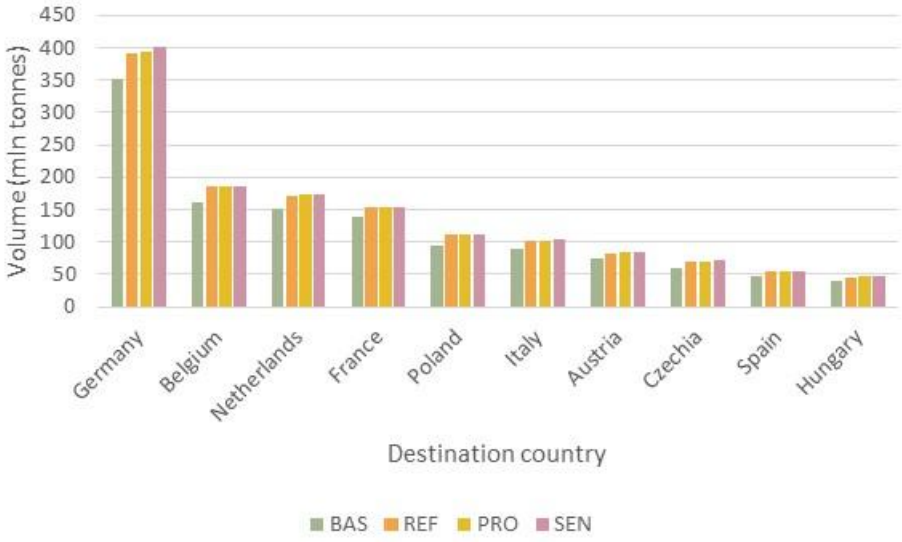
Figure 49 Development of volume (in million tonnes) of all international freight transport by the top 10 origin countries within the 11 RFCs network catchment area



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

Similar growth rates can be found for the destination countries. Also, the top three countries for international freight transport consists of Germany (+11% from 352 to 392 million tonnes), Belgium (+14% from 163 to 185 million tonnes), and The Netherlands (+13% from 152 to 172 million tonnes). As with the origin countries, the ranking of the destination countries does not change in 2030 compared to 2022.

Figure 50 Development of volume (in million tonnes) of all international freight transport by the top 10 destination countries within the 11 RFCs network catchment area



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

5.1.2 FUTURE OF INTERNATIONAL RAIL FREIGHT TRANSPORT FOR THE JOINT RFCS

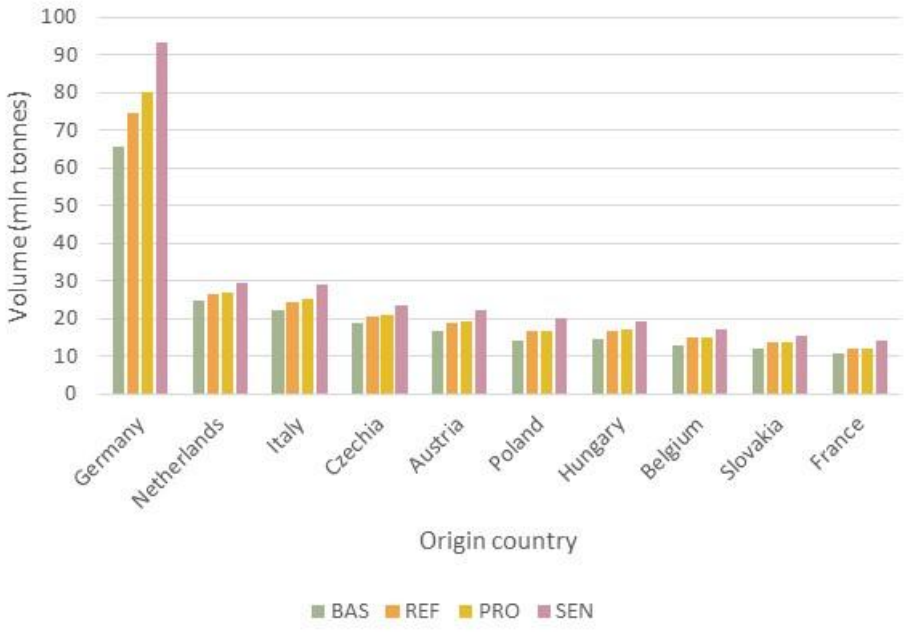
The next two graphs show the development of the volume in international rail freight transport for origins and destinations in the top 10 countries within the catchment area of the 11 RFCs network. The changes are more prominent for international rail freight transport than for *all* international rail freight transport as shown in the previous section.

In the *Reference scenario*, growth from 2022 on for international rail freight transport is the highest in Germany for both origin (+14% from 65 to 75 million tonnes) and destination (+11% from 72 to 80 million tonnes). In the top 10 origin countries, the overall growth varies per country from 7% (The Netherlands from 25 to 27 million tonnes) to 19% (Poland from 14 to 17 million tonnes). For the destination countries, similar growth patterns are forecasted.

The *Projects scenario* has a limited impact on international rail freight transport volume, except for Germany. On average, the growth in international rail volume for the top 10 countries is 4%, compared to the Reference scenario. The lowest extra growth for the Projects scenario compared to the Reference scenario is reported for Poland at 0%, the highest for Germany at 6% (from 75 to 80 million tonnes). For the destination top 10 countries the growth is 3%. The smallest growth is found in Czechia (+1% from 22 to 23 million tonnes), the largest growth can be found in Slovakia (+15%, from 12 to 14 million tonnes).

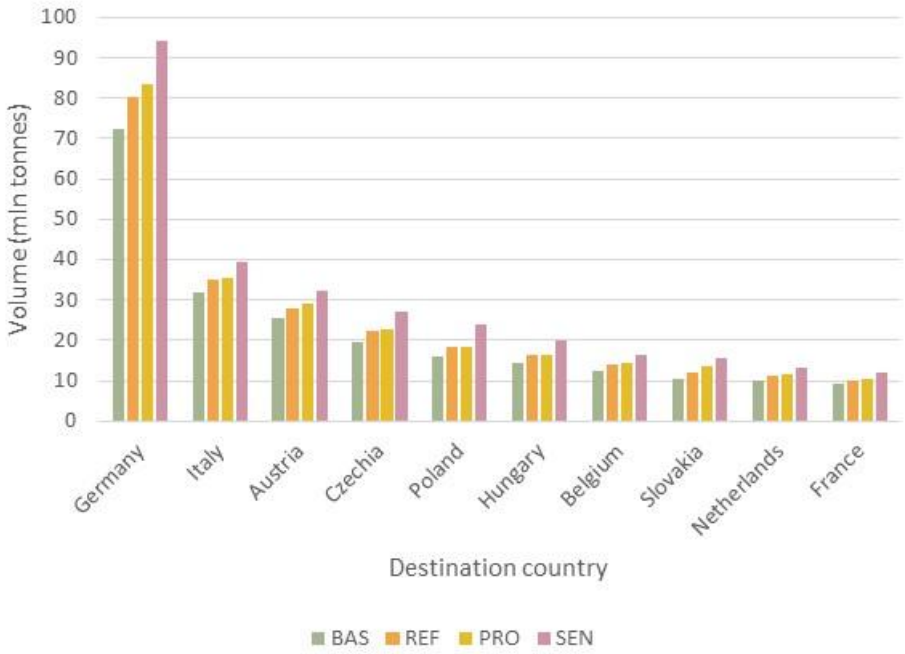
The potential extra volume in the top 10 origin countries, as shown by the *Sensitivity scenario*, is overall 18% (from 239 to 283 million tonnes), compared to the Reference scenario. The lowest growth compared to the Reference scenario can be seen for the Netherlands (+10% from 27 to 29 million tonnes), the highest growth for Germany (+25% from 75 to 93 million tonnes). For the destination countries the growth is 19% (from 247 to 293 million tonnes) compared to the Reference scenario. Italy has the lowest growth at +12% (from 35 to 39 million tonnes) and Poland shows the largest growth at +33% (from 18 to 24 million tonnes).

Figure 51 Development of volume (in million tonnes) of all international rail freight transport by the top 10 origin countries within the 11 RFCs network area



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

Figure 52 Development of volume (in million tonnes) of all international rail freight transport by the top 10 destination countries within the 11 RFCs network catchment area



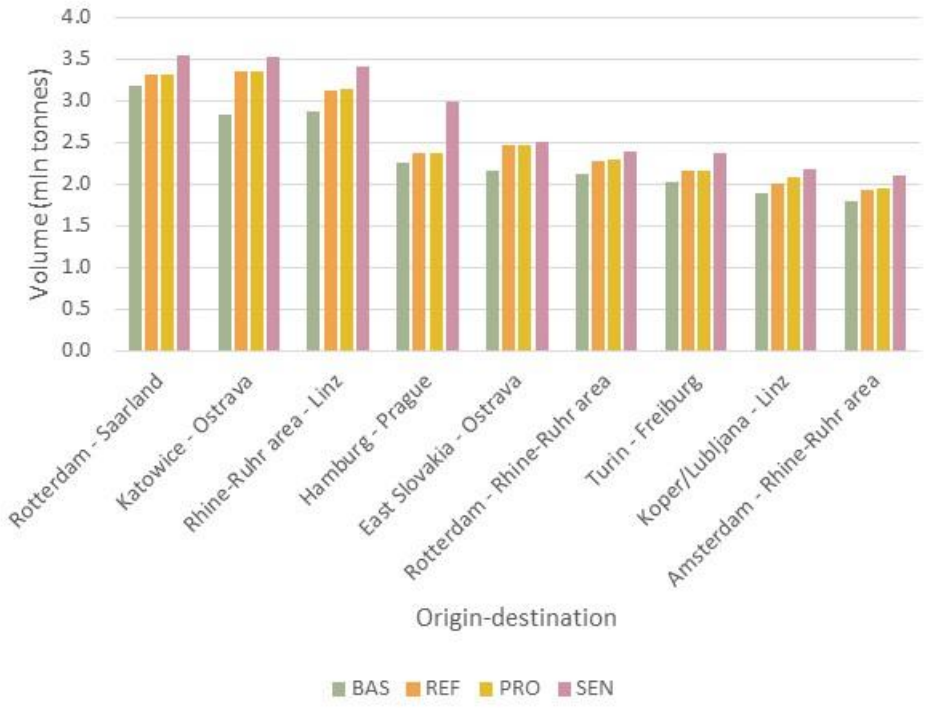
Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

Looking at the top 10 relations *within the corridor area* of the 11 RFCs network, the main one is between Rotterdam (NL) and Saarland (DE). The second most important relation is between Katowice (PL) and Ostrava (CZ). Both relations concern the transport of coal which is important for the steel production in Saarland and Ostrava. Another important relation concerns transport from the Rhein-Ruhr area to Linz. In this case, the type of cargo is more varied, but the transport of liquid bulk (oil products and chemicals) is important in this relation. Between Hamburg and Prague, the cargo comprises mainly general cargo.

Interesting to see is the impact of the Projects scenario between Katowice and Ostrava. It shows that new projects have a significant impact on international rail freight transport also on this relation. The same can be seen on the relation Eastern Slovakia – Ostrava.

The Sensitivity scenario shows, compared to the Reference scenario most growth between Hamburg and Prague (+25% from 2.3 to 3.0 million tonnes compared to the Reference). The general measures such as extra train length, function as a multiplier and add extra growth.

Figure 53 Development of volume (in million tonnes) of all international rail freight transport by the top 10 relations within the 11 RFCs network corridorarea



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

5.2 FUTURE OF THE INTERNATIONAL FREIGHT TRANSPORT FOR RFC AMBER

5.2.1 FUTURE OF ALL INTERNATIONAL FREIGHT TRANSPORT FOR RFC AMBER

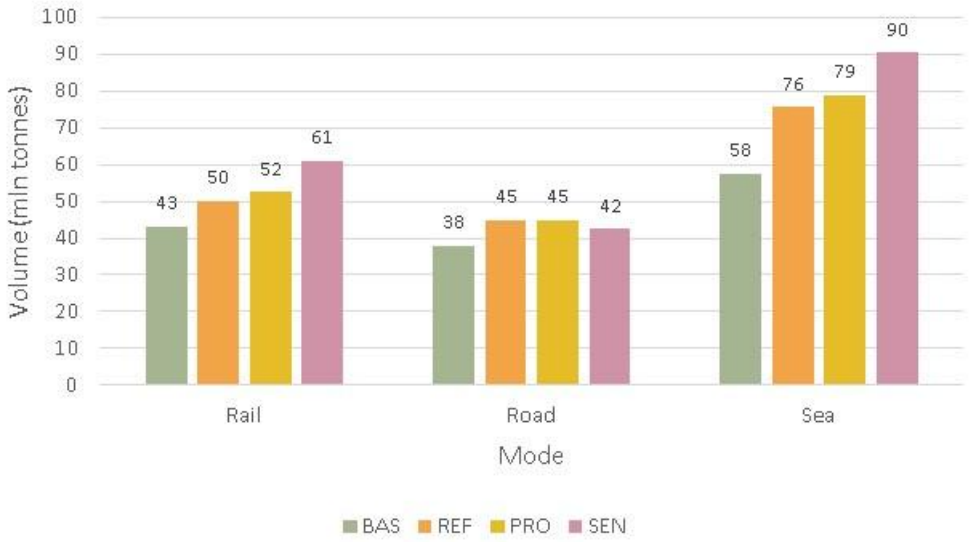
This section shows the results of the future market analysis for the RFC Amber. Figure 53 shows the overall developments by mode and scenario in the catchment and corridor area of RFC Amber.

Between the 2022 Base year and 2030 Reference scenarios, all modes grow due to economic developments, in general by 23%. Rail transport grows by 16% (7 million tonnes) from 43 to 50 million tonnes. Road by 19%, and sea shipping by 31%. Inland shipping does not play an important role in RFC Amber. In absolute terms, international freight transport by sea shipping grows most by 18 million tonnes. Road increases in volume from 38 to 35 million tonnes. Rail transport grows by 7 million tonnes from 43 to 50 million tonnes.

The implementation of different rail projects across Europe, leads to a small growth of rail transport in the RFC Amber (+2 million tonnes). There is some modal shift between road and rail. In the RFC Amber large and smaller projects across the rail network account for this shift. Also, infrastructure projects outside the RFC Amber contribute leading to mode shift or rerouting.

The third scenario shows a hypothetical development for rail transport. Compared to the base year situation, a growth of 42% in volume (16 million tonnes) is estimated. The introduction of longer trains (740 meters) has an important impact on this result. This scenario can be regarded as a maximum potential for rail transport in 2030. The growth has different causes, such as rerouting, mode shift, or splitting freight transport from one mode into transport by two modes (for example, splitting road transport into road and rail transport). In the third scenario, rail transport in the RFC Amber grows by 42% compared to the base situation. This is a substantial achievement compared to the 23% forecasted for the Reference scenario.

Figure 54 Development of volume (in million tonnes) by mode and scenario for the catchment area of RFC Amber

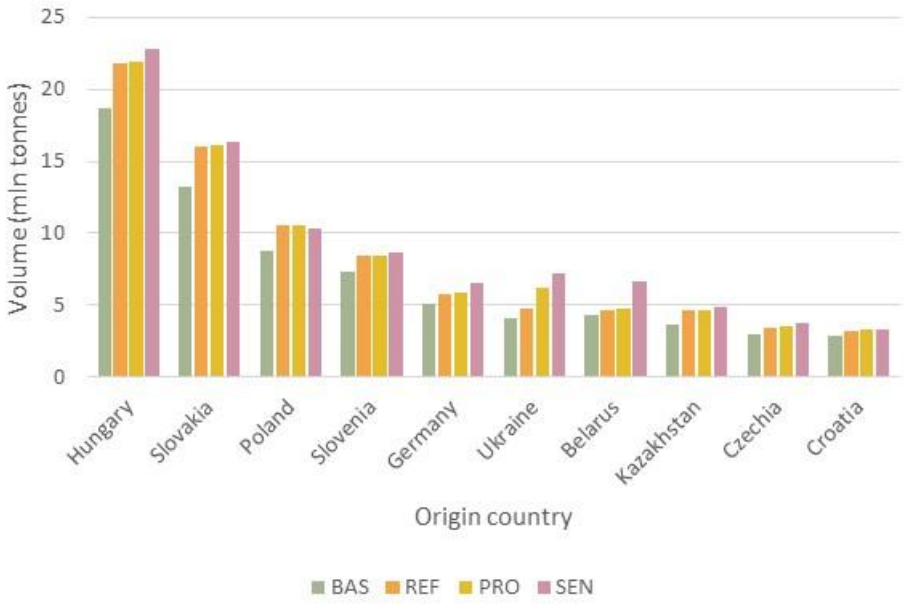


Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

The next two figures show the development of the volume of international in freight transport by *land modes* for the origin and destination countries in the catchment area and the corridor area of the RFC Amber for their respective scenarios. In general, the most prominent growth stems from the economic development (REF). The Projects (PRO) scenario and the Sensitivity (SEN) scenario show small differences. Concerning the Projects scenario variations are primarily due to mode shifts, where the total volume does not really change. The Sensitivity scenario for all land modes shows a bit more volume compared to the Reference and Projects scenarios. The totals are almost equal between the different scenarios. The reason is mainly due to a shift between the land modes.

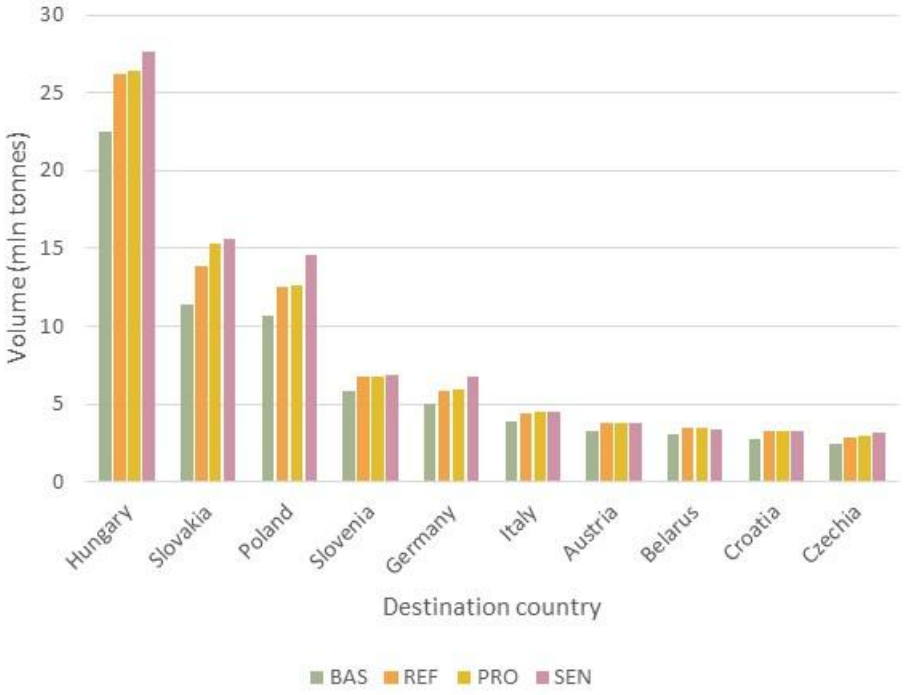
Concerning the top 10 origins, these are the same as for the base year. The overall growth for the top-10 origins in the Reference scenario is 17% and varies from 9% (Belarus) to 21% (Poland). Hungary, Slovakia, and Poland are the top 3 origin countries in the RFC Amber. Concerning the Projects scenario, in general the average growth rate slightly increases compared to the Reference scenario (+3%). Concerning the Sensitivity scenario, a slightly higher volume is registered (+10% compared to the Reference). Within the corridor area, the growth per country varies in the Sensitivity scenario from 17% (Slovenia) to 23% (Slovakia).

Figure 55 Development of volume (in million tonnes) of all international freight transport by origin countries in the catchment area of the RFC Amber



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

Figure 56 Development of volume (in million tonnes) of all international freight transport by the destination countries in the RFC Amber catchment area



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

The picture for the destination countries is like the one for the origin countries. Hungary dominates the chart. The overall growth in the top 10 countries is approximately 17% for the Reference and 20% for the Projects scenarios. The growth within the corridor area between the 2022 Base year and the Reference scenario varies

from 16% (Slovenia) to 21% (Slovakia). The overall growth for the Sensitivity scenario is some 26% and ranges from 18% (Slovenia) to 37% (Poland and Slovakia).

5.2.2 FUTURE OF INTERNATIONAL RAIL FREIGHT TRANSPORT FOR RFC AMBER

As concerns the RFC Amber, we see a growth from 43 million tonnes to 50 million tonnes in the Reference situation. Expressed in trains,[21] this would mean a growth from about 72,000 international trains to about 83,000 trains. The Projects scenario adds another 2 million tonnes to the total volume leading to a total number of trains of 87,000. The Sensitivity scenario will finally lead to a volume of 61 million tonnes, which is about 88,000 trains. The number of trains compared to the project scenario is almost equal because the volume is transported by longer trains.

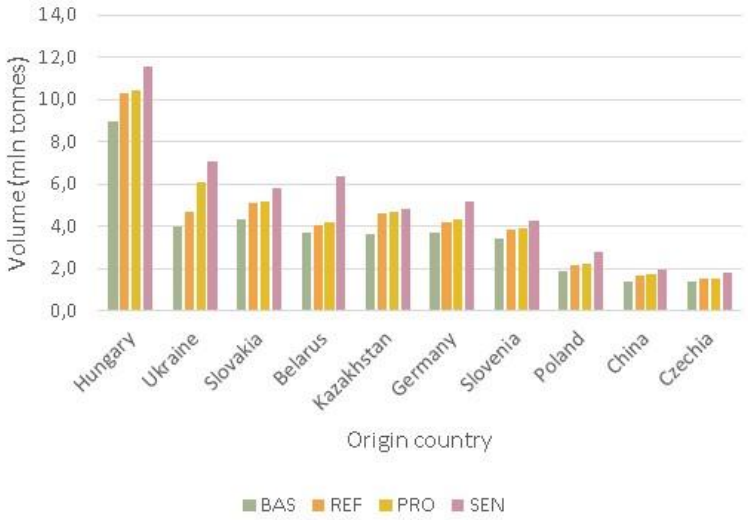
The next two graphs show the development of volume in international *rail* freight transport for origin and destination countries for the RFC Amber. Concerning origin countries, international rail freight transport is highest in Hungary (almost 12 million tonnes in the Reference scenario). Ukraine and Slovakia come in second and third place (at 7 and 6 million tonnes respectively).

The Projects scenario shows the impact on the volume of international rail freight transport. Overall, the growth in international rail volume for the top-10 countries is about 6% compared to the Reference scenario. The potential extra volume as shown by the TEN-T standards interoperability scenario is overall 26% higher on the total volume compared to the Reference scenario. In the Sensitivity scenario we see a relatively high growth in the RFC Amber countries Slovakia (34%) and Poland (50%). The Sensitivity scenario shows more growth of international rail freight transport. This is mainly due to the increase of train length up to 740 m and the transition to the standard gauge in Spain and Portugal.

For destinations, a similar picture can be noticed. In this case, Hungary has a number 1 position in the RFC Amber concerning international rail freight transport. Poland and Slovakia are ranked number 2 and 3 for international rail freight transport. The impact of the Projects is about 6% extra compared to the Reference, whereas the Sensitivity scenario shows higher effects (about 26% extra compared to the Reference.. Compared to the 2022 Base year situation, the growth in the Sensitivity scenario varies from 31% (Hungary) to 69% (Poland) in the RFC Amber countries.

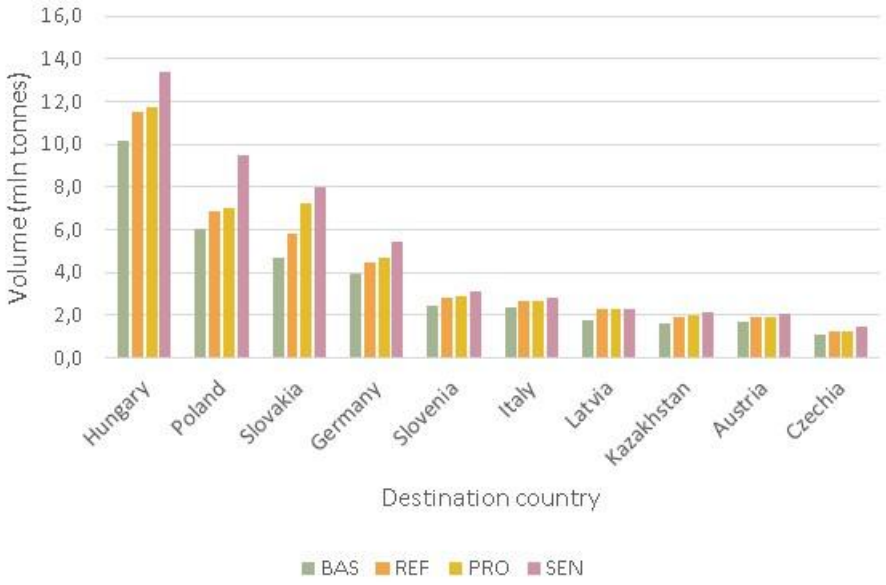
[21] Using an average volume of 600 tonnes per train and 690 tonnes per 740m trains.

Figure 57 Development of volume (in million tonnes) of all international rail freight transport by the origin countries in the RFC Amber catchment area



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

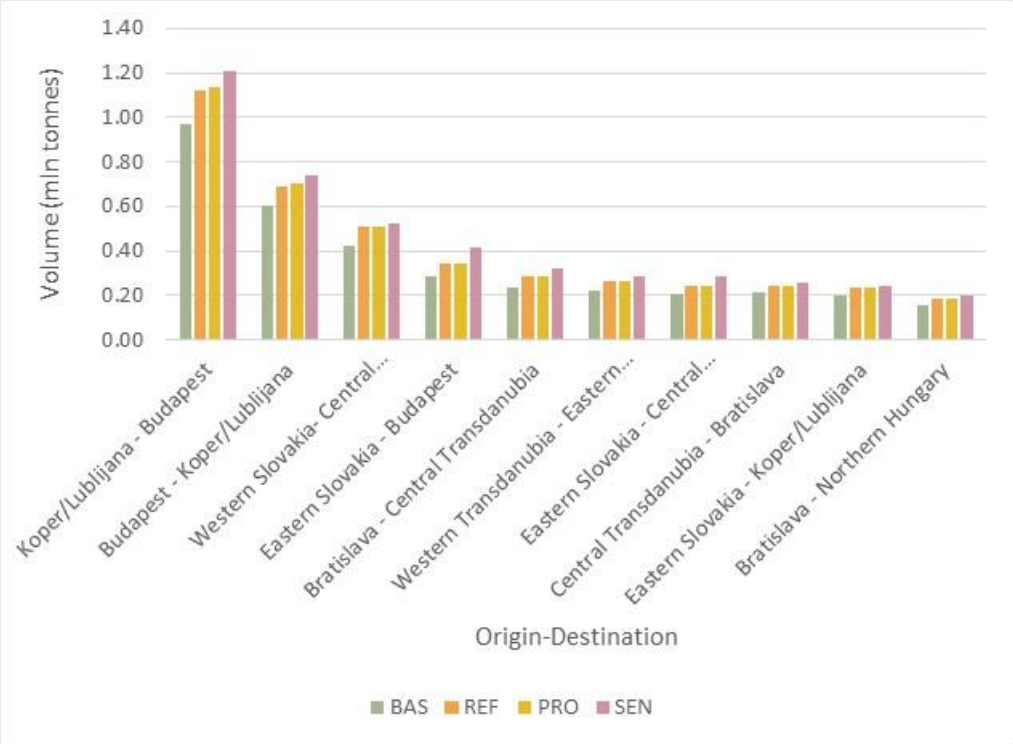
Figure 58 Development of volume (in million tonnes) of all international rail freight transport by destination countries in the RFC Amber



Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

Looking at the top 10 relations within the RFC Amber, the main relation is between Koper/Ljubljana and Budapest at 1 million tonnes in 2022. This relation is important for liquid bulk. In second place comes the reverse direction, also with a mix of cargo types. Another important relation concerns Western Slovakia – Central Transdanubia. The other relations show volumes between 0.5 and 1.0 million tonnes of volume. As can be seen each relation shows growth mainly in the Sensitivity scenario.

Figure 59 Development of volume (in million tonnes) of all international rail freight transport by the top 10 relations within the corridor area of RFC Amber



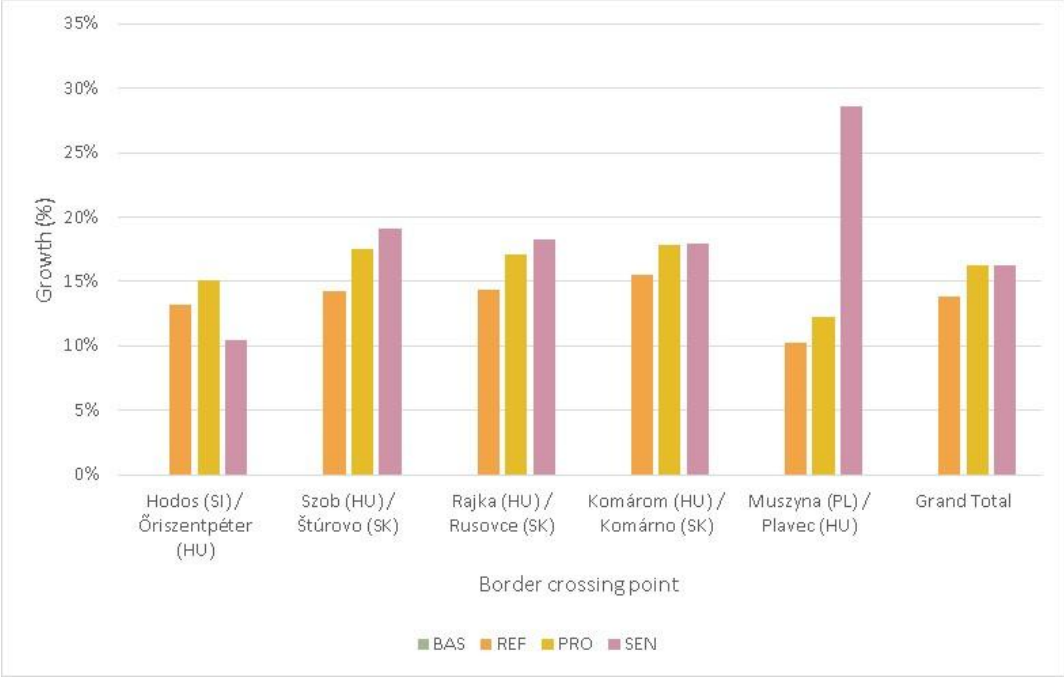
Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

5.2.3 DEVELOPMENT OF THE MOST IMPORTANT BCPS IN THE RFC AMBER

The different border crossing points in the RFC Amber each show different growth between the 2022 Base year and 2030 Reference, Projects and Sensitivity scenarios. Overall, the Reference shows growth in volume of 14% on the selected BCPs. This is in line with the general growth for rail transport between the 2022 Base year and 2030 Reference scenarios. The completion of different projects by 2030 leads to different growth patterns; on average, the growth in relation to the base is 16% more volume, which translates into 16% more trains on average on the BCPs. The Sensitivity scenario leads to 34% more volume on the BCPs, which is 18% more trains compared to 2022. Due to the extra train length, there is less growth in number of trains. Keep in mind that the number of trains on the different BCPs are related. One unique train often passes more than 1 BCP in this RFC.

The total number of trains on the BCPs is 29.000. Earlier a number of 72.000 trains was mentioned. The reason for this difference lies in the fact that international rail freight transport from Ukraine and China is not accounted for. Therefore, the real number of international freight trains using the RFC Amber is higher than one would expect by looking at the reported BCP numbers.

Figure 60 Development of volume (in million tonnes) of international rail freight transport on important border crossing points of the RFC Amber

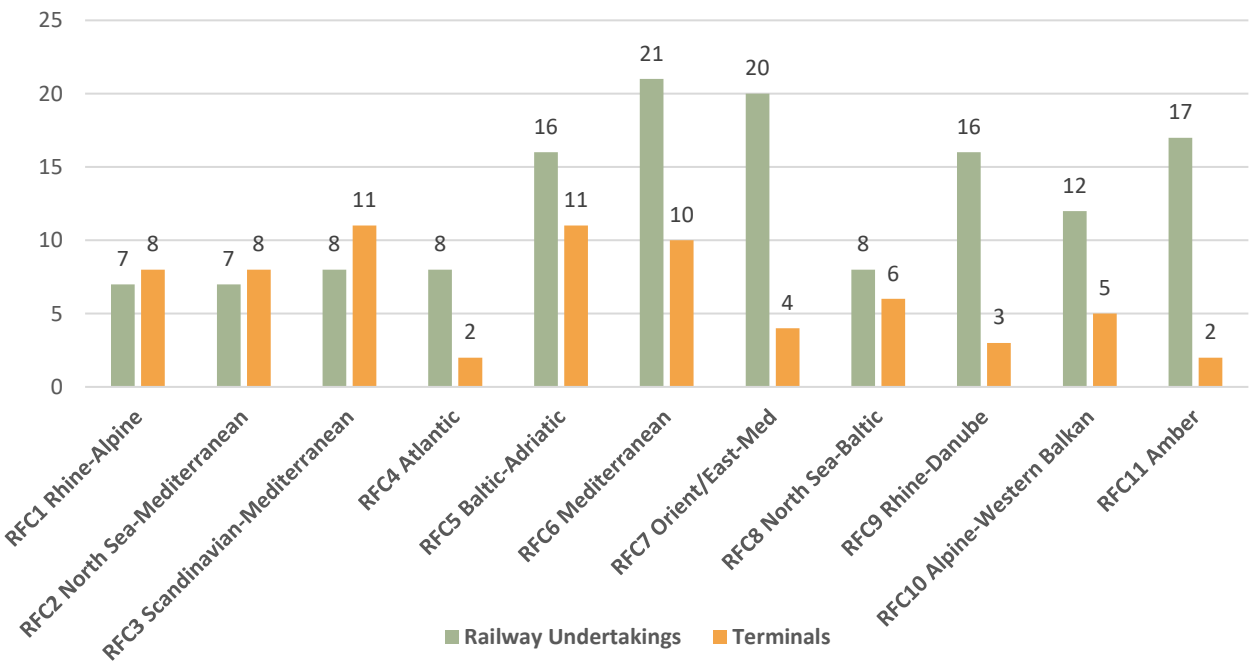


Source: NEAC estimation; Legend: BAS=Base year, REF=Reference, PRO=Projects, SEN=Sensitivity

6 OCCURRED AND EXPECTED CHANGES ASSOCIATED WITH THE ESTABLISHMENT OF THE RAIL FREIGHT CORRIDORS: 2023 11 RFCS JOINT TMS SURVEY

No relevant time series data are available supporting a consistent appraisal of the occurred and expected changes associated with the establishment of the 11 RFCs. It is worth adding that the current 11 RFCs started operating in different years, 5 in 2013, 3 in 2015 and 3 after 2018, and their alignment was adjusted over time to market needs. To assess the occurred and expected changes associated with their establishment, an e-survey (2023 11 RFCs Joint TMS Update Survey) has been conducted, submitting a questionnaire to the members of the Railway Undertaking Advisory Groups (RAGs) and the Terminal Advisory Groups (TAGs) of the 11 RFCs. Questionnaires were collected via the EUSurvey platform of the European Commission (DG DIGIT) between September 2023 and January 2024. Forty-two members of the RAGs and thirty members of the TAGs participated in the survey, for a total of seventy-two respondents, operating services/terminals along the alignment of all 11 RFCs (Figure 61).

Figure 61 RFCs usage by respondents operating or serving trains at terminals crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 3.R and 3.T

The survey was conducted to collect the opinion of the 11 RFCs market players on three main areas:

1. Occurred and expected changes due to the establishment of the RFCs;
2. Occurred and expected market developments along the RFCs; and
3. Market drivers.

This chapter summarises the main outcome of the survey with reference to these three areas. The full set of responses is provided in Annex 2 of this report.

Whereas the total number of responses for all RFCs makes the outcome of the survey meaningful from the 11 RFCs network perspective, a presentation of the results by individual RFC would lose significance due to

the limited number of answers. As a result, the outcome of the survey is presented in this report for all RFCs together /for the RFC Network as a whole.

Especially regarding the opinion of the 11 RFCs RAGs and TAGs members on the occurred and expected market developments, it is worth noticing that it reflects their views at the time of submission of the questionnaire (Autumn 2023/January 2024). Additionally survey responses represent a partial view of the market as the sample of the respondents is not representative of the market universe. Furthermore, differences may exist between RFCs as they were established and entered into operation in different years. Finally, the survey outcome may partially diverge from the findings from the statistical review presented in the previous section above, as the opinions relate to the RFCs and international trains, whereas national statistics refer to the whole country network and national as well as international traffic.

6.1 CHANGES OCCURRED SINCE THE ESTABLISHMENT OF THE RFCS AND EXPECTED CHANGES CONCERNING THE FACILITATION OF INTERNATIONAL RAIL FREIGHT TRANSPORT

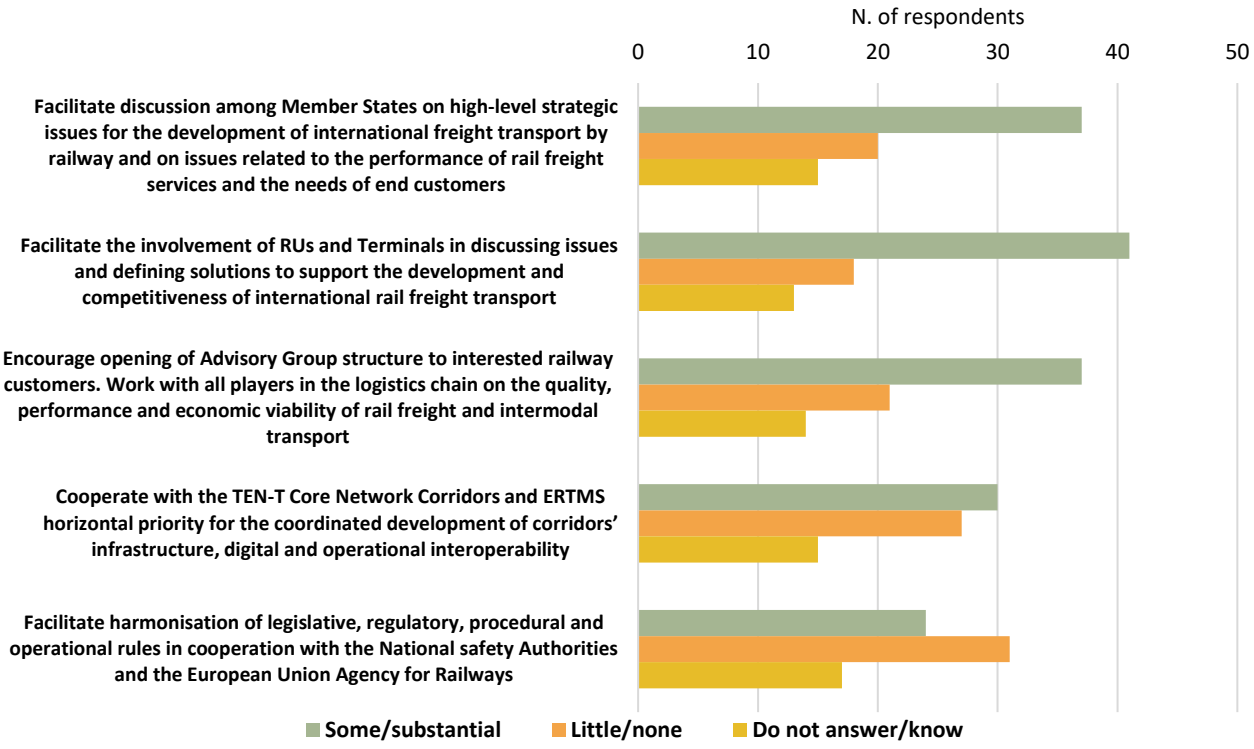
Occurred and expected changes have been investigated as part of the survey around three main areas of activity of the Rail Freight Corridors, which are of relevance for the facilitation of international rail freight transport, and namely: governance, operational efficiency and capacity management. For each area, questions have been made to assess:

- Changes occurred since the establishment of the RFCs;
- Expected changes assuming continuation of the activities by the RFCs; and
- The best fitting governance to address the issues identified for each of the three investigated areas, also considering the proposed termination of the RFCs activities in the Proposal for a Regulation of the European Parliament and of the Council on the use of railway infrastructure capacity in the single European railway area, amending Directive 2012/34/EU and repealing Regulation (EU) No 913/2010[22]

[22] https://ec.europa.eu/transparency/documents-register/detail?ref=SEC(2023)443&lang=en

6.1.1 GOVERNANCE ISSUES

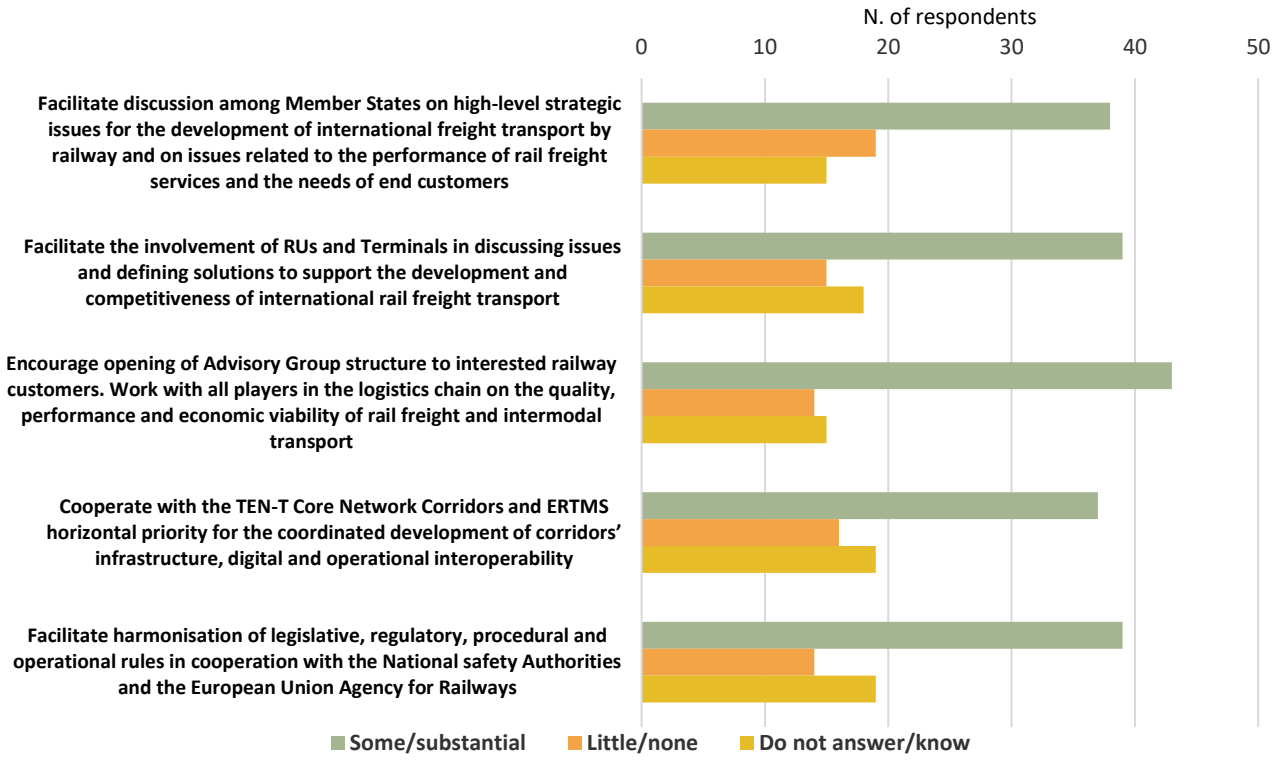
Figure 62 Progress made to date since the establishment of the RFCs - Governance Issues



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 1.RT

The respondents' opinion about the changes within the governance area is positive, especially in terms of cooperation with the market, including but not limited to RUs and terminal operators, as well as concerning facilitation of discussion among Member States about the issues affecting the competitiveness of international rail freight transport (Figure 62). The opinion about the progress made regarding cooperation between RFCs and Core Network Corridors (CNCs)/ERTMS horizontal priority is less favourable. The market opinion is negative about the progress made on harmonising international freight rail services' legislative, regulatory, procedural and operational aspects.

Figure 63 Expected changes based on current programmes/initiatives - Governance Issues

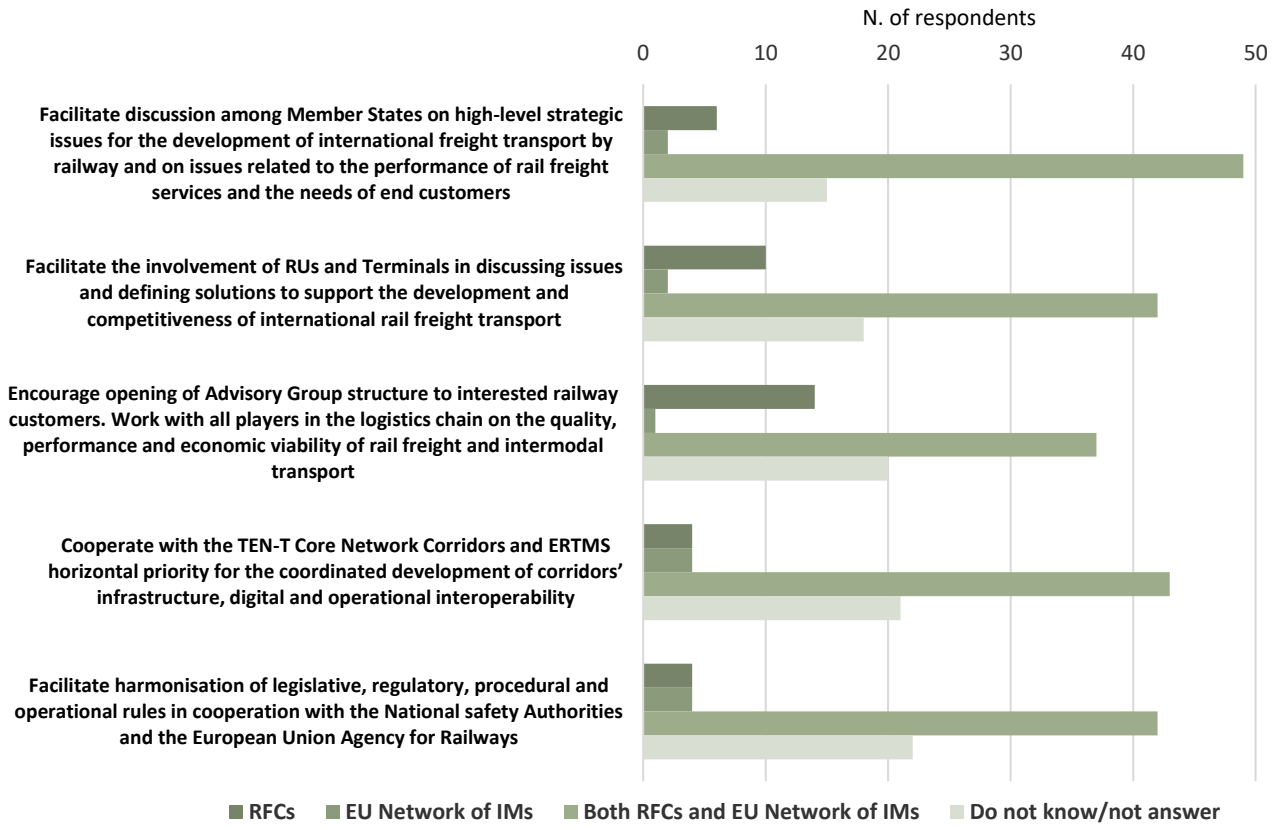


Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 1.RT

The expectations of the market players concerning the future impact of the programmes and activities of the RFCs are relatively positive concerning all issues (Figure 63).

Respondents consider the cooperation between RFCs and an European Network of Infrastructure Managers (ENIM) to be the best governance solution for bringing issues forward (Figure 64)

Figure 64 Best fitting governance to bring the issue forward - Governance Issues

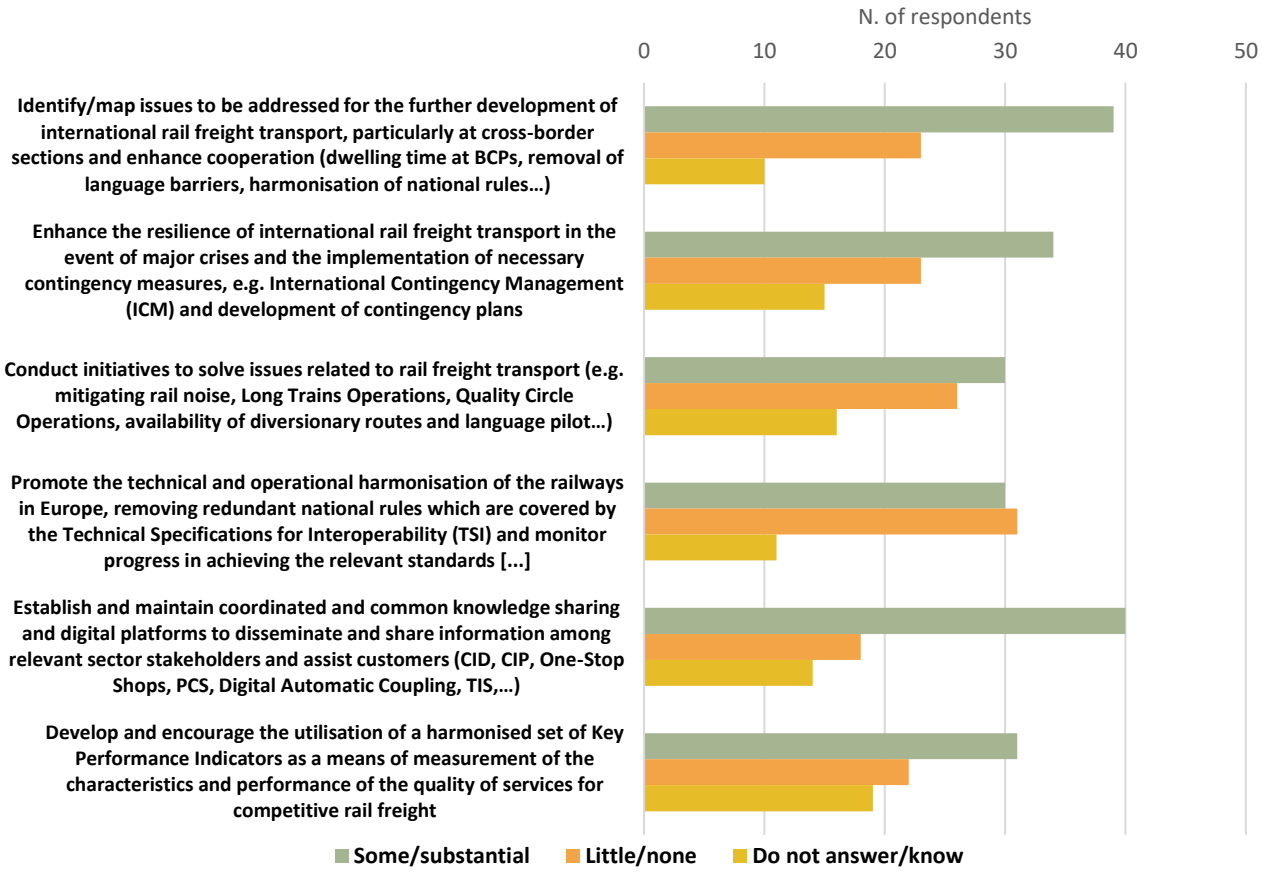


Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 1.RT

6.1.2 OPERATIONAL EFFICIENCY ISSUES

The market opinion about the changes that occurred within the operational efficiency area is also generally positive, except for the progress made in the promotion of technical and operational harmonisation of the European railway transport system towards its interoperability (Figure 65).

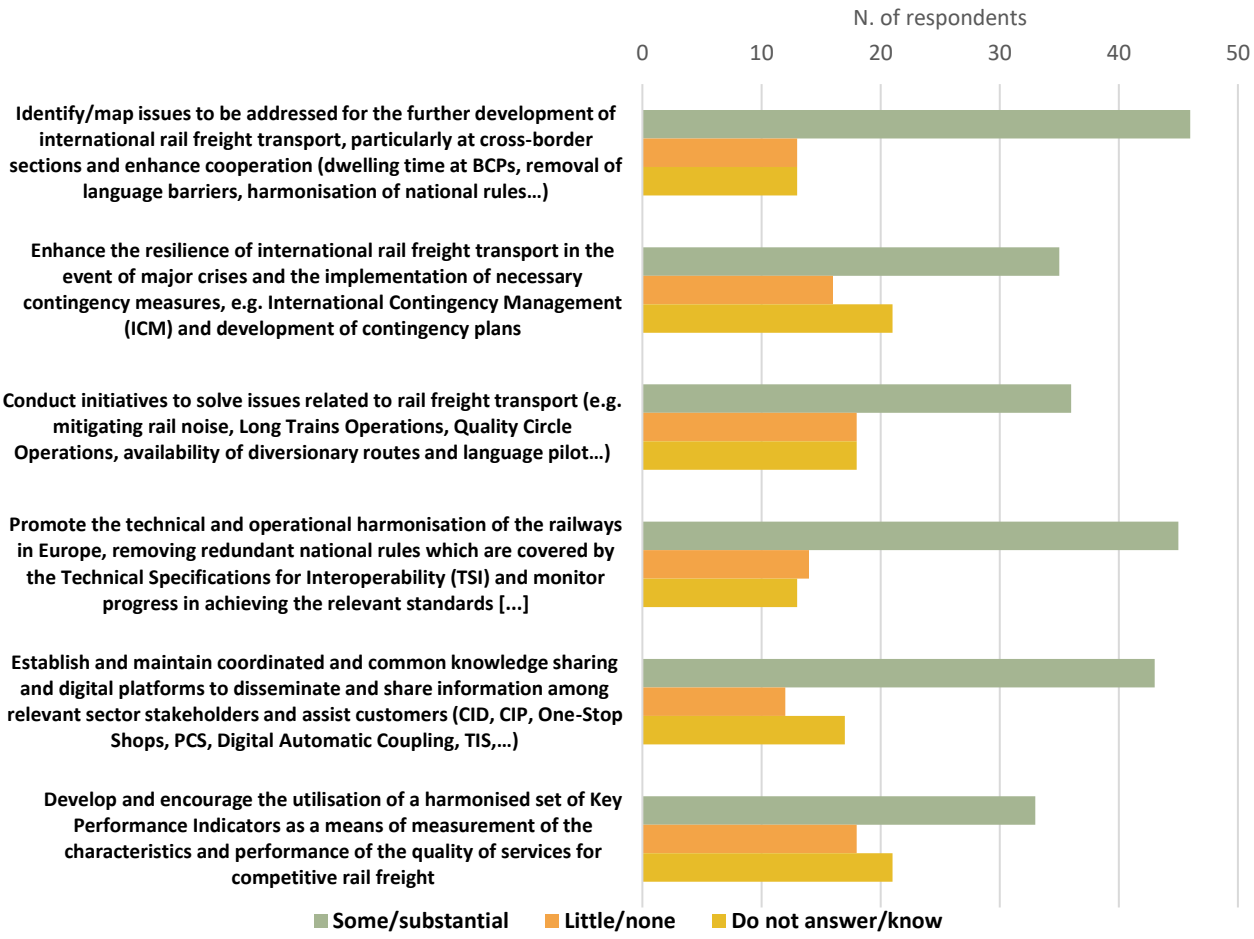
Figure 65 Progress made to date since the establishment of the RFCs - Operational Efficiency Issues



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 2.RT

The respondents' expectations concerning the future impact of the programmes and activities of the RFCs are relatively positive concerning all issues (Figure 66).

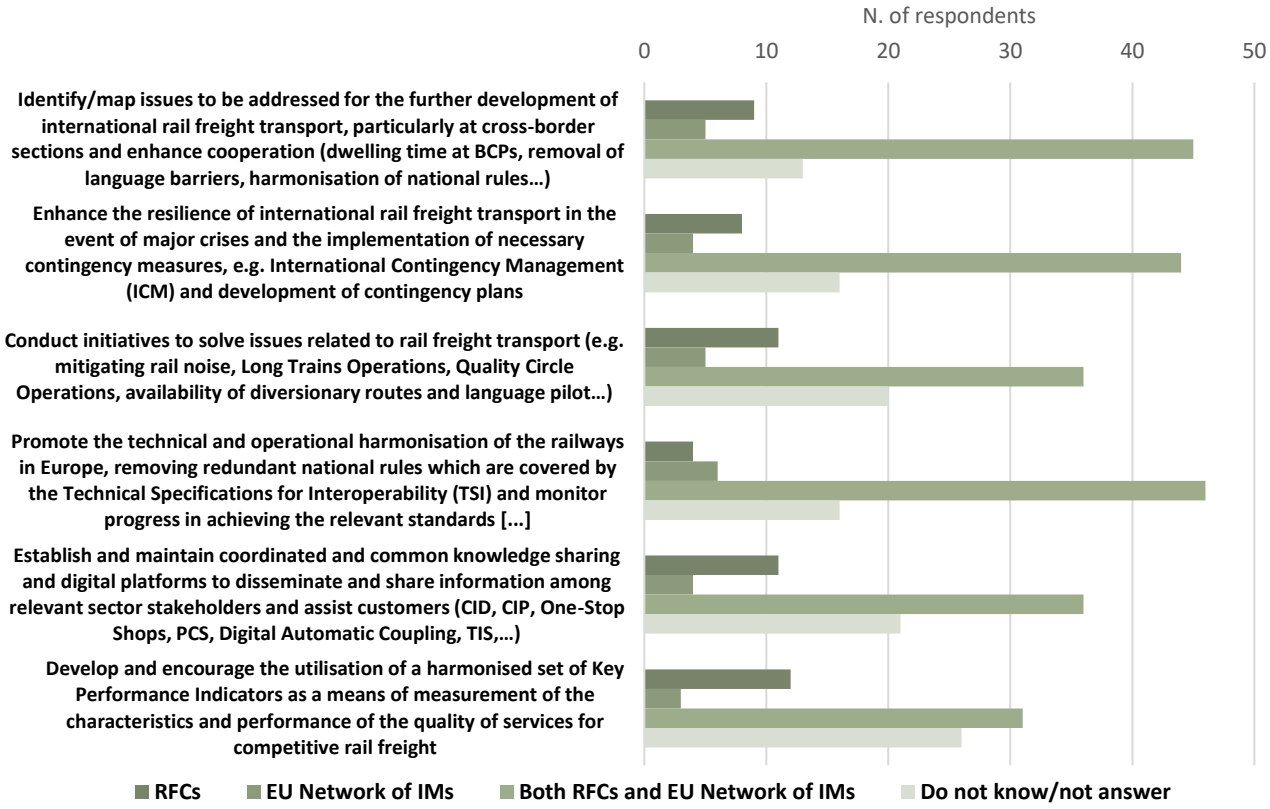
Figure 66 Expected changes based on current programmes/initiatives by RFCs - Operational Efficiency Issues



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 2.RT

Cooperation between RFCs and an European Network of Infrastructure Managers (ENIM) is also considered the best-fitting governance solution to bring operational efficiency issues forward (Figure 67).

Figure 67 Best fitting governance to bring the issue forward - Operational Efficiency Issues

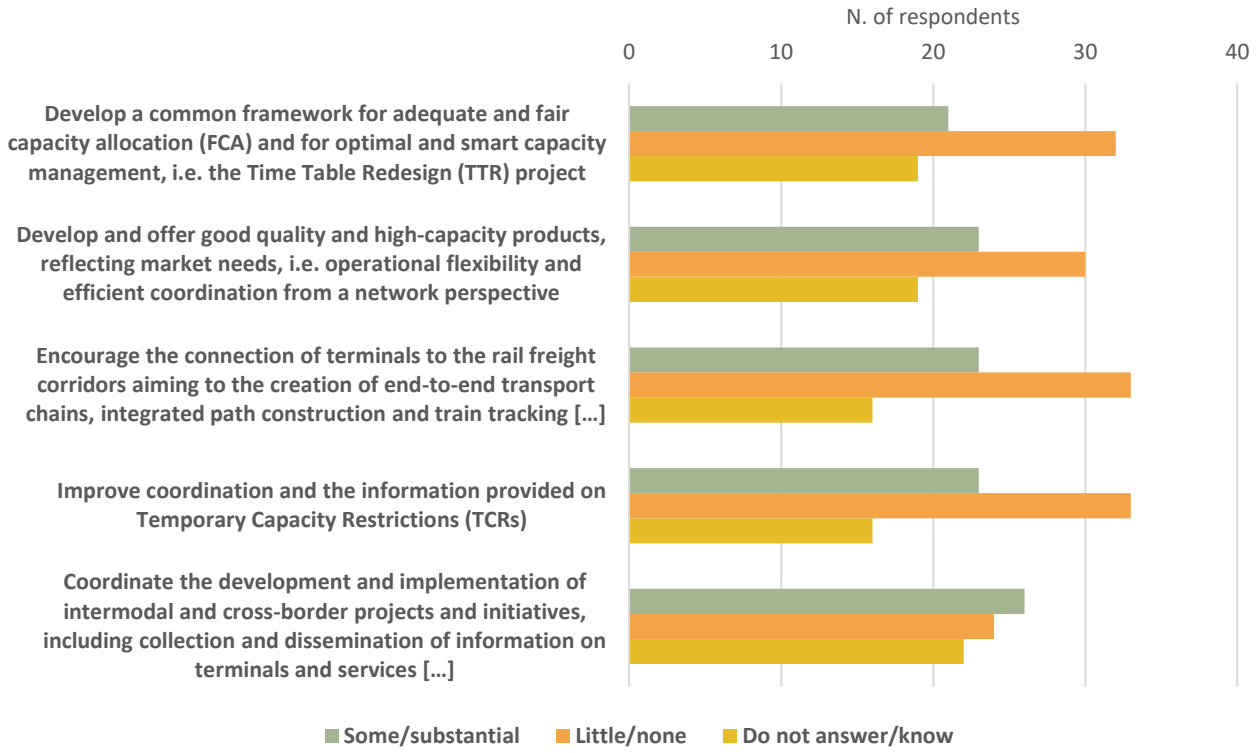


Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 2.RT

6.1.3 CAPACITY PLANNING ISSUES

The respondents' opinions about the changes that occurred within the capacity management area are predominantly negative, except for the coordination of the development and implementation of cross-border projects and initiatives (Figure 68).

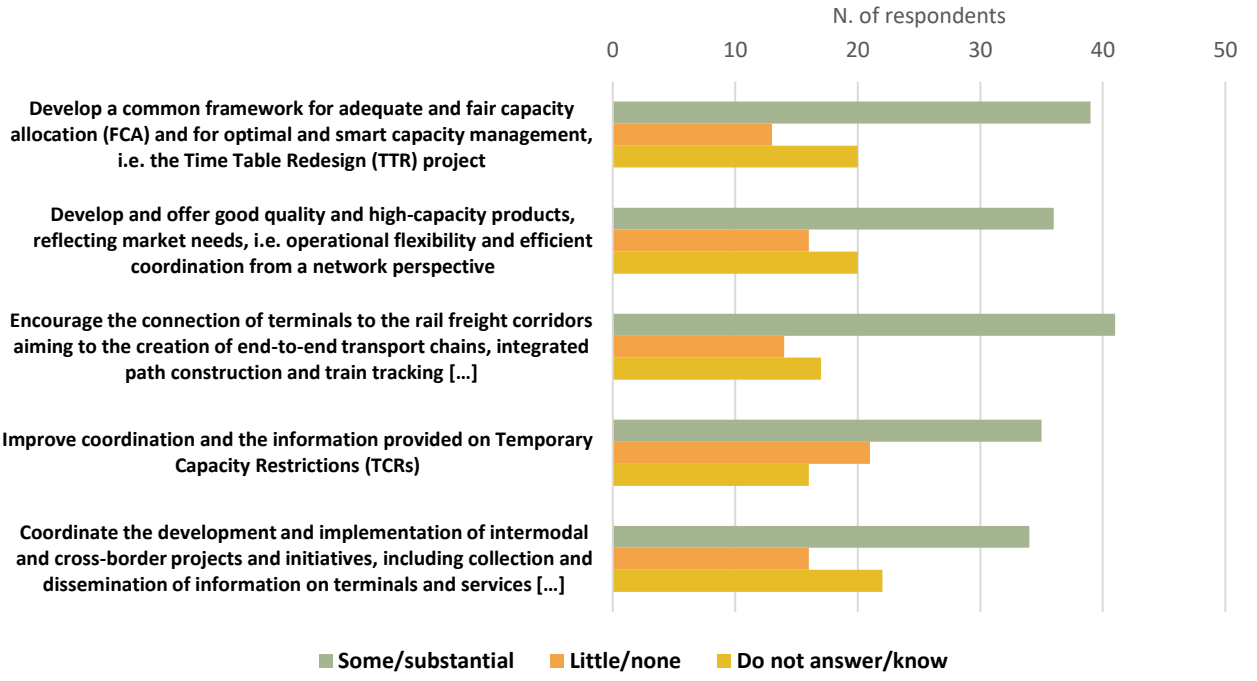
Figure 68 Progress made to date since the establishment of the RFCs - Capacity Planning Issues



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 3.RT

Notwithstanding the market's opinion that little or no progress made since the establishment of the RFCs, the expectations on the future impact of the programmes and activities by the RFCs are rather positive with regard to all issues (Figure 69).

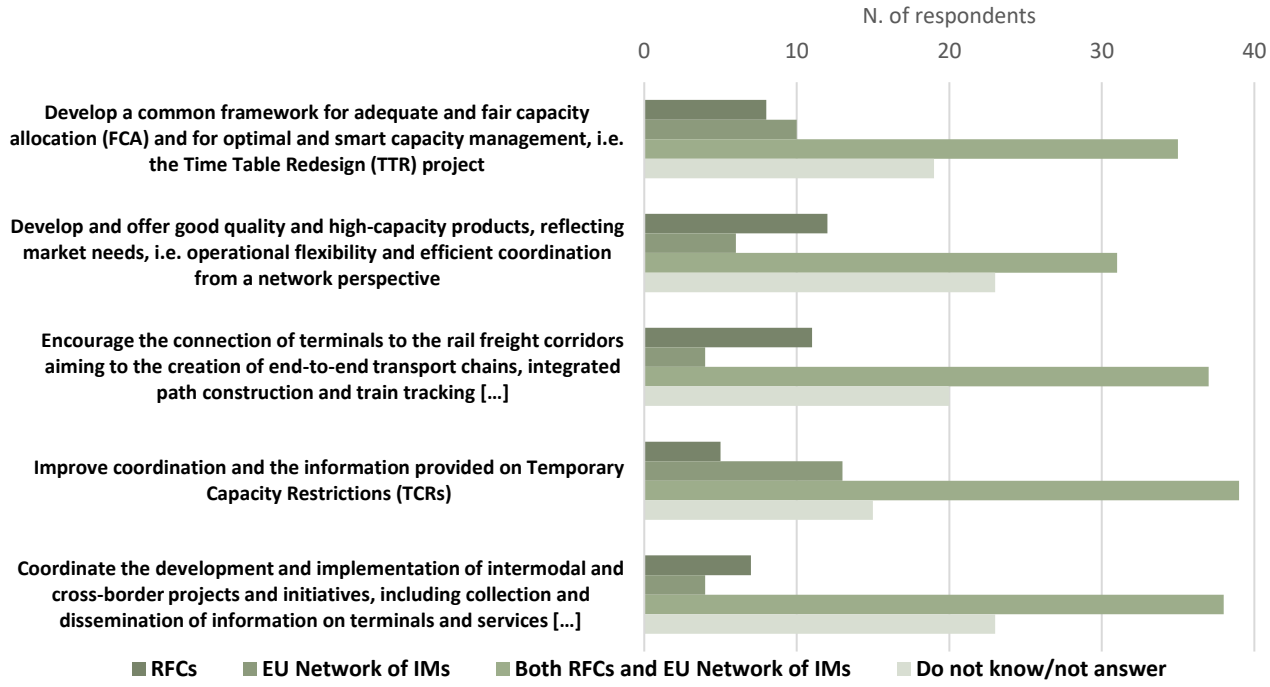
Figure 69 Expected changes based on current programmes/initiatives - Capacity Planning Issues



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 3.RT

Also, for the improvement of capacity management-related issues, the best governance solution is deemed to be the cooperation between RFCs and an European Network of Infrastructure Managers (ENIM) (Figure 70).

Figure 70 Best fitting governance to bring the issue forward - Capacity Planning Issues

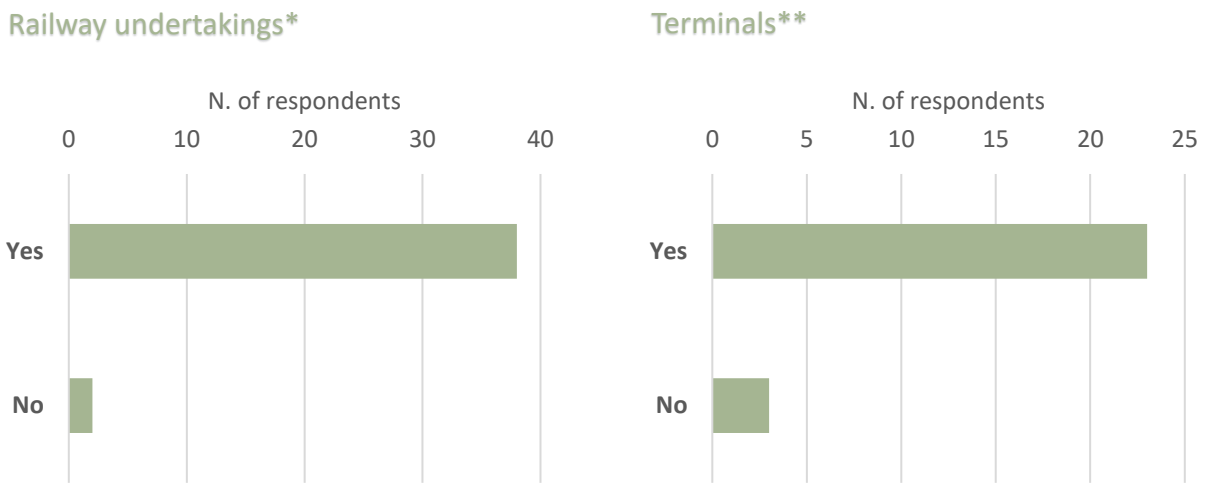


Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question B) 3.RT

6.2 EXPERIENCED AND EXPECTED MARKET DEVELOPMENTS

Experienced and expected variations in the market have also been investigated as part of the 2023 11 RFCs Joint TMS Survey, which is further described in this section.

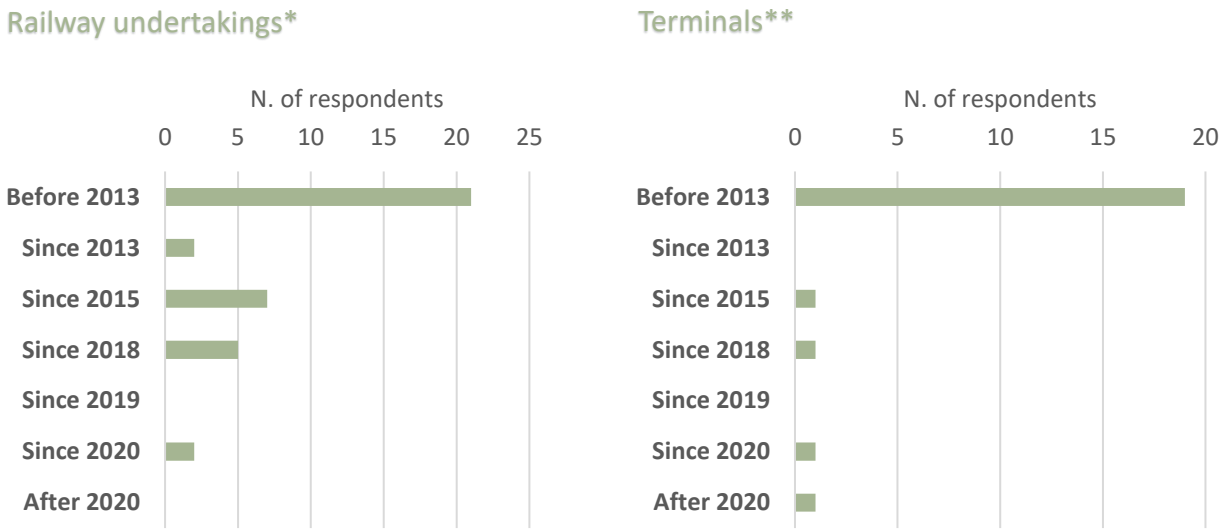
Figure 71 Respondent has operated/operates rail services or manages/operates terminals serving trains across at least one border crossing point(s) on any RFC



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 1.R and 1.T,
**40 out of 42 respondents, **26 out of 30 respondents*

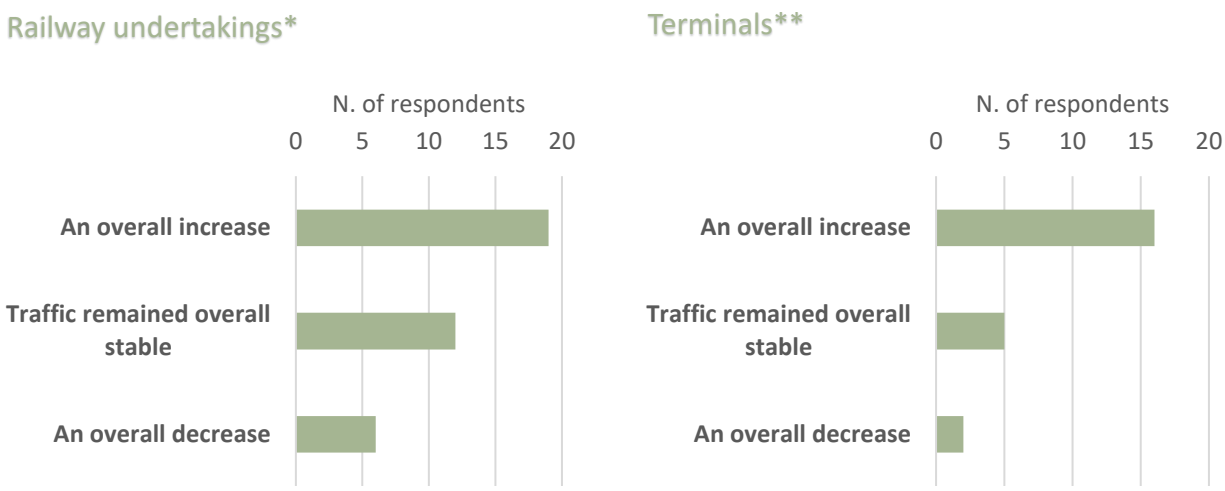
The vast majority of the respondents who participated in the survey operated or still operates rail services or manage/operate terminals serving trains across at least one border crossing point(s) on any RFC. Most of them also operated or served international rail freight transport before the establishment of the RFCs.

Figure 72 Respondent has operated/operates rail services or manages/operates terminals serving trains across at least one border crossing point(s) on any RFC



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 1.1R and 1.1T,
**37 out of 42 respondents, ** 23 out of 30 respondents*

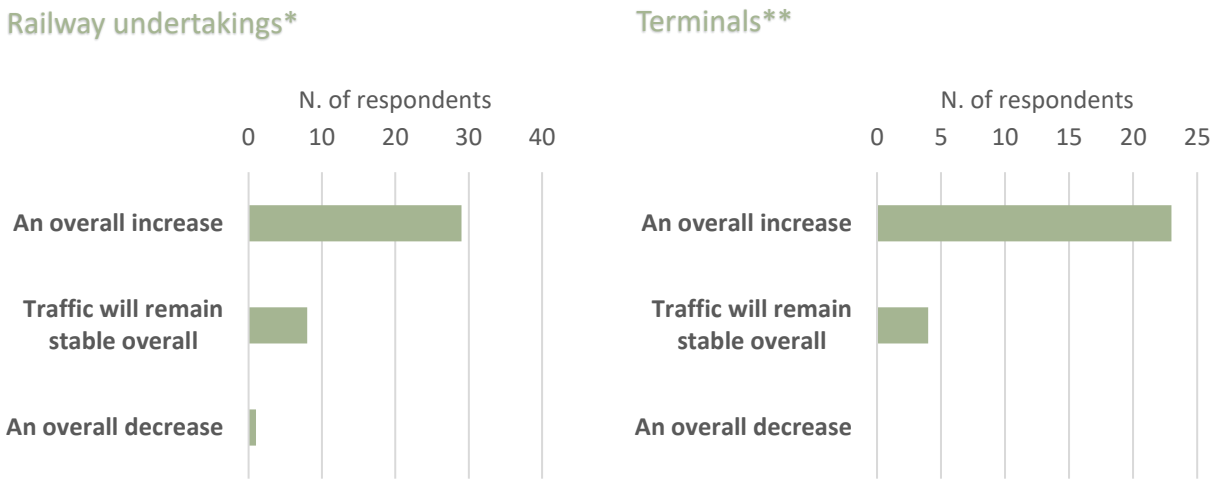
Figure 73 Variation in the operation of trains and in serving trains crossing at least one border crossing point(s) on any RFC since 2013



*Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 1.2R and 1.2T, *37 out of 42 respondents, ** 23 out of 30 respondents*

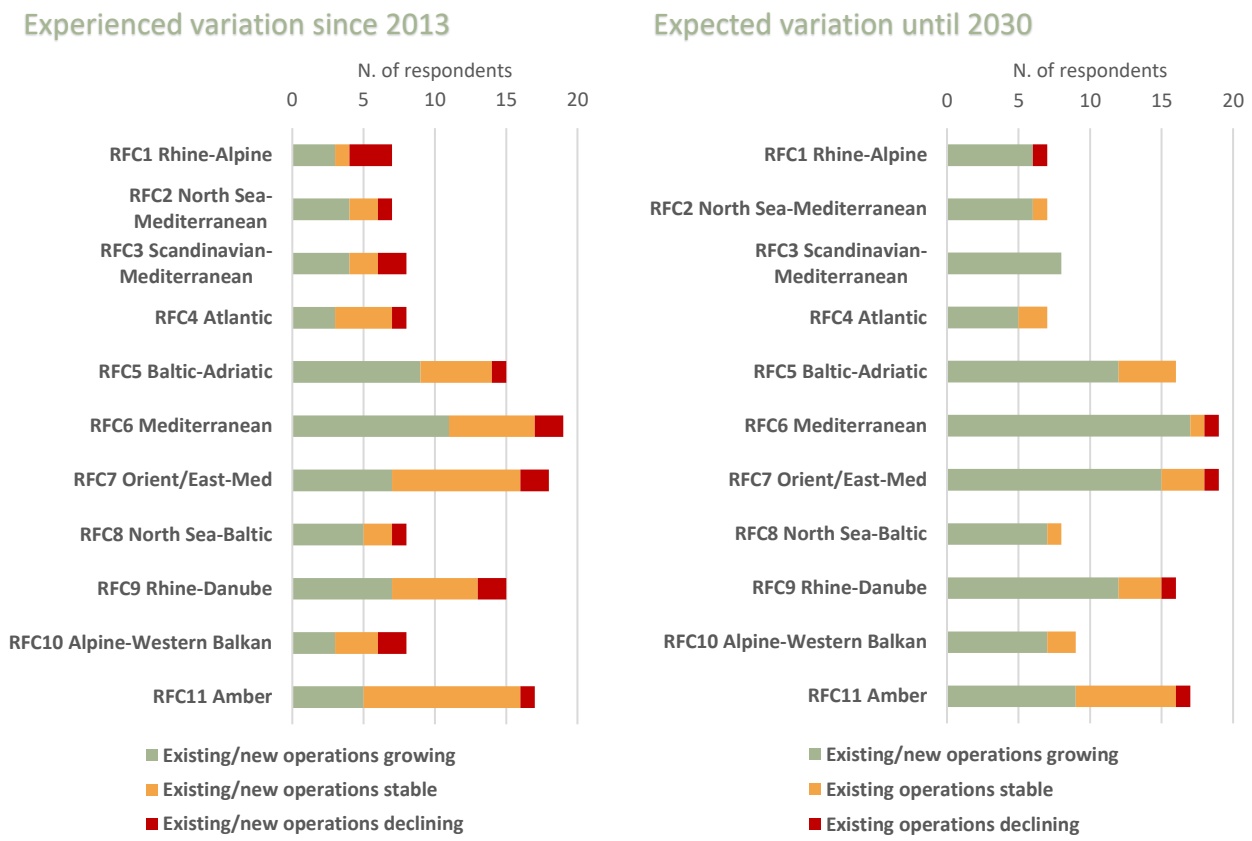
The majority of the respondents declare they experienced an increase in their operations since 2013 (Figure 73), and most of them also have a positive expectation about the future, expecting overall market growth (Figure 74).

Figure 74 Variation in the operation of trains and in serving trains crossing at least one border crossing point(s) on any RFC in the short term until 2030



*Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 2.R and 2.T, *38 out of 42 respondents, ** 23 out of 30 respondents*

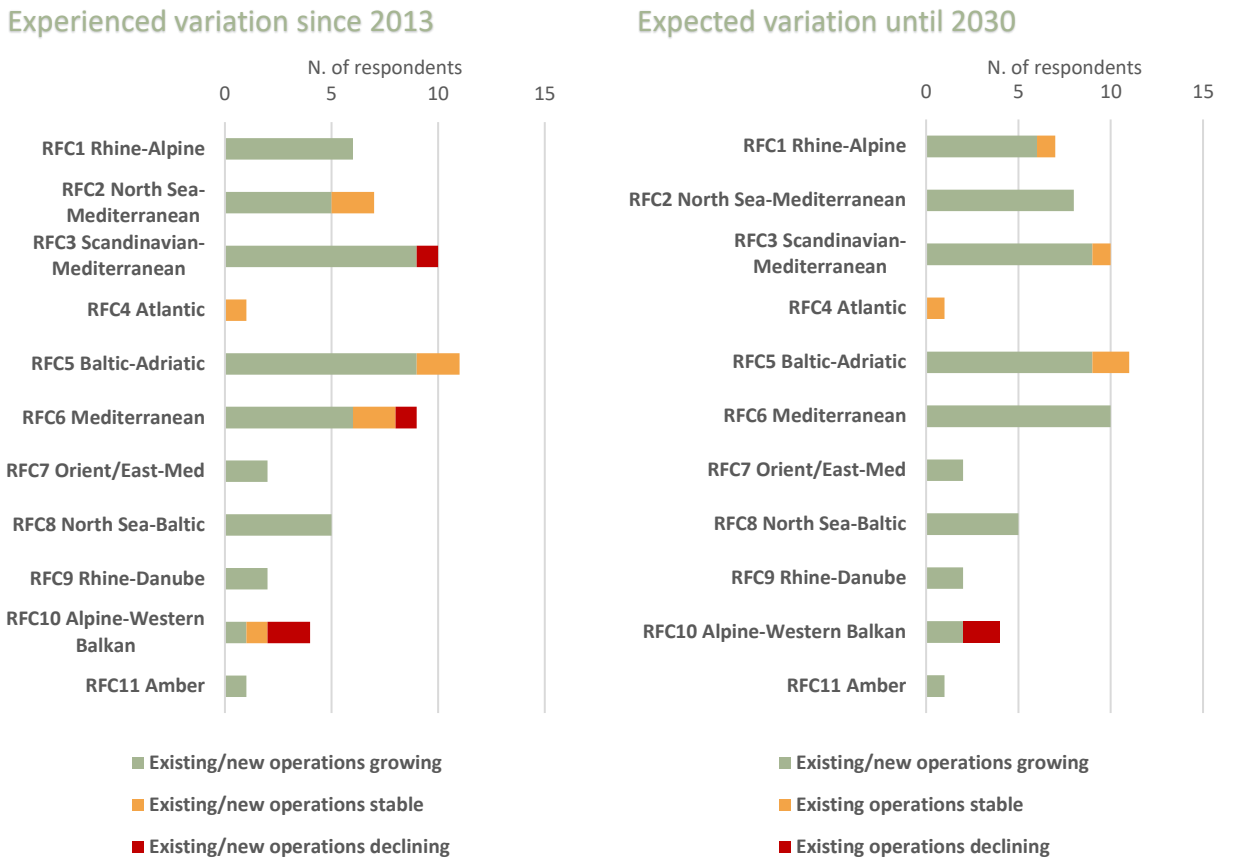
Figure 75 Experienced and expected traffic trends according to the trains operated by RUs, crossing at least one border crossing point(s) on any RFC



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 3.R

The variation in traffic experienced by RUs since 2013 differs from RFC (Figure 75). The majority of the respondents declare they experienced market growth along the NSM, SCAN-MED, BA, MED, NSB, and RD RFCs, whereas a prevailing stable trend is registered for the ATL, OEM, AWB, and RFC Ambers. For RALP, the number of growing and declining registered trends are similar. The expectation for the future (2030) is generally positive for all RFCs.

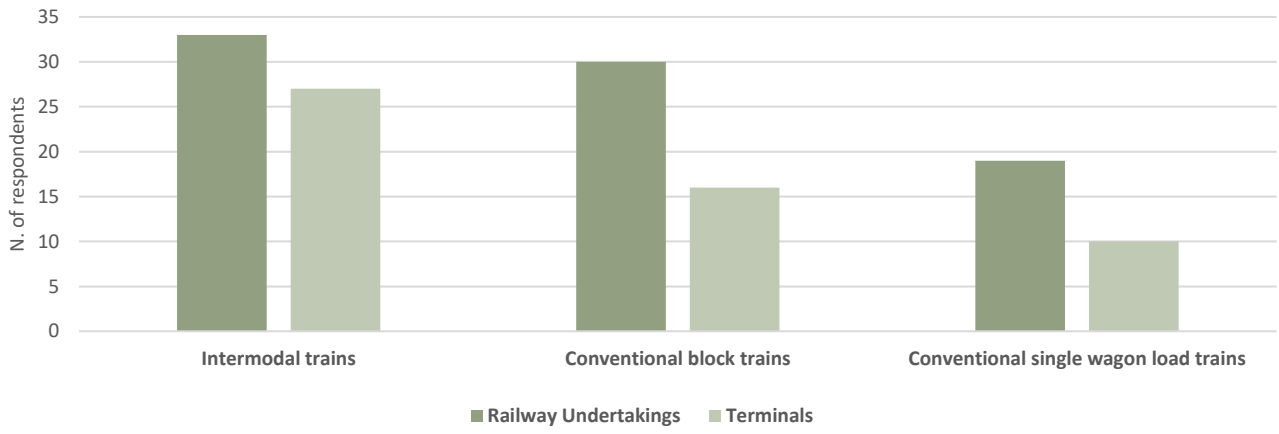
Figure 76 Experienced and expected traffic trends on corridors according to the trains served at terminals, crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 3.T

The variation in traffic experienced by terminal operators since 2013 and the expected growth are generally positive, except for the ATL and AWB RFCs (Figure 76). The prevailing response is pessimistic about the experienced variation, whereas the number of growing and declining registered trends is similar regarding future expectations.

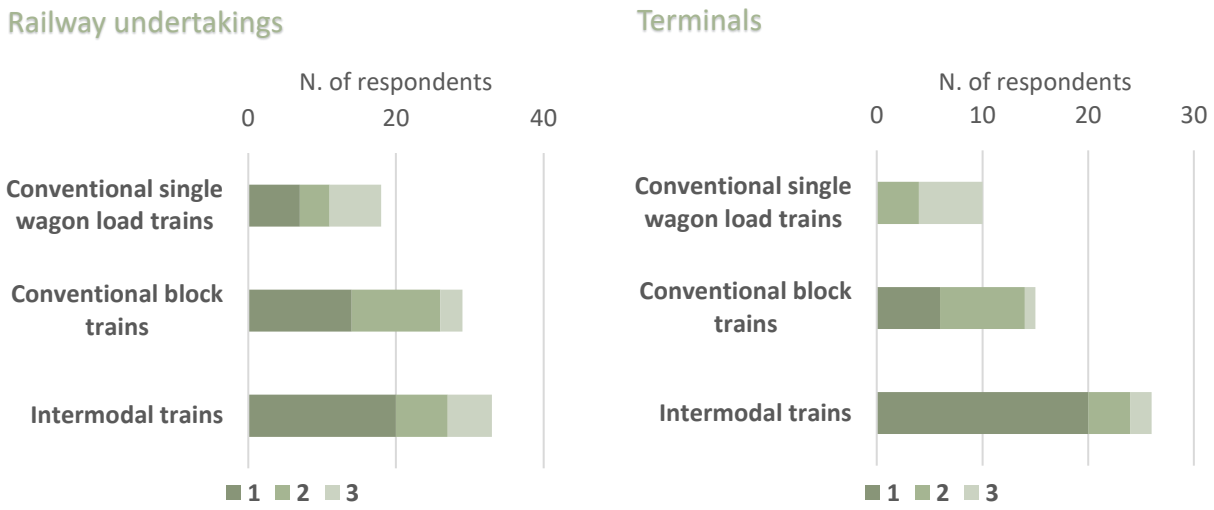
Figure 77 Type of trains operated by railway undertakings or served at terminals crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 4.R and 4.T

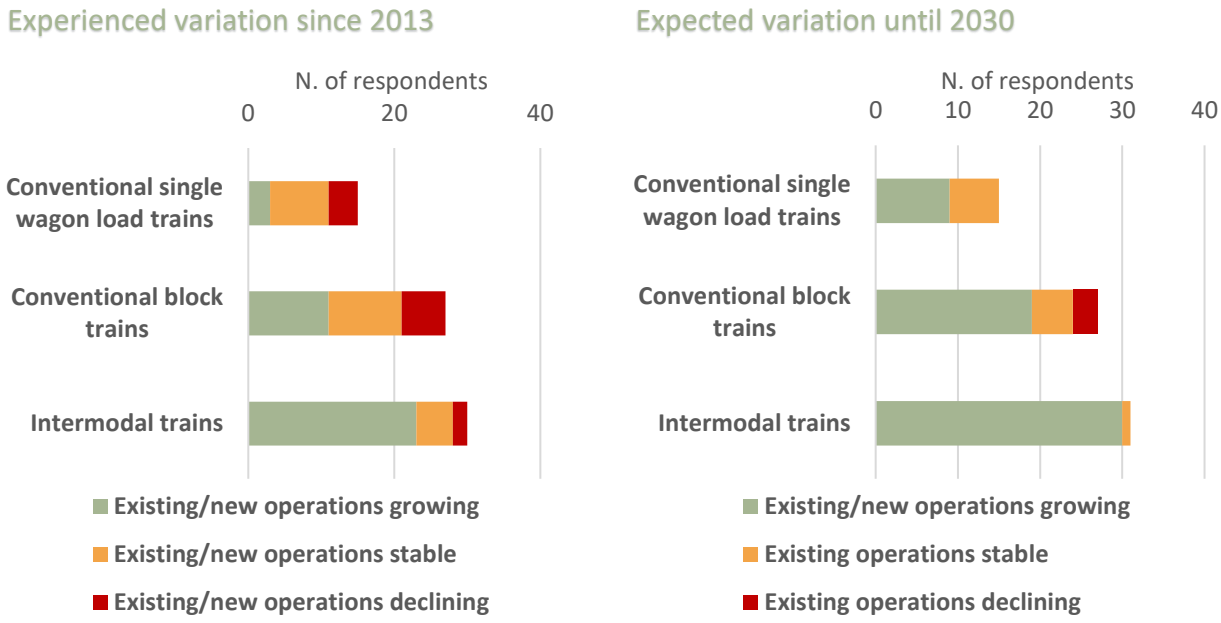
The prevailing type of international trains operated on the 11 RFCs network consists of intermodal trains, followed by conventional block trains and single wagonload trains (Figure 77 and Figure 78).

Figure 78 Ranking of type of trains operated by railway undertakings or served at terminals crossing at least one border crossing point(s) on any RFC



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 4.R and 4.T; Note: 1= first, 2=second, 3= third

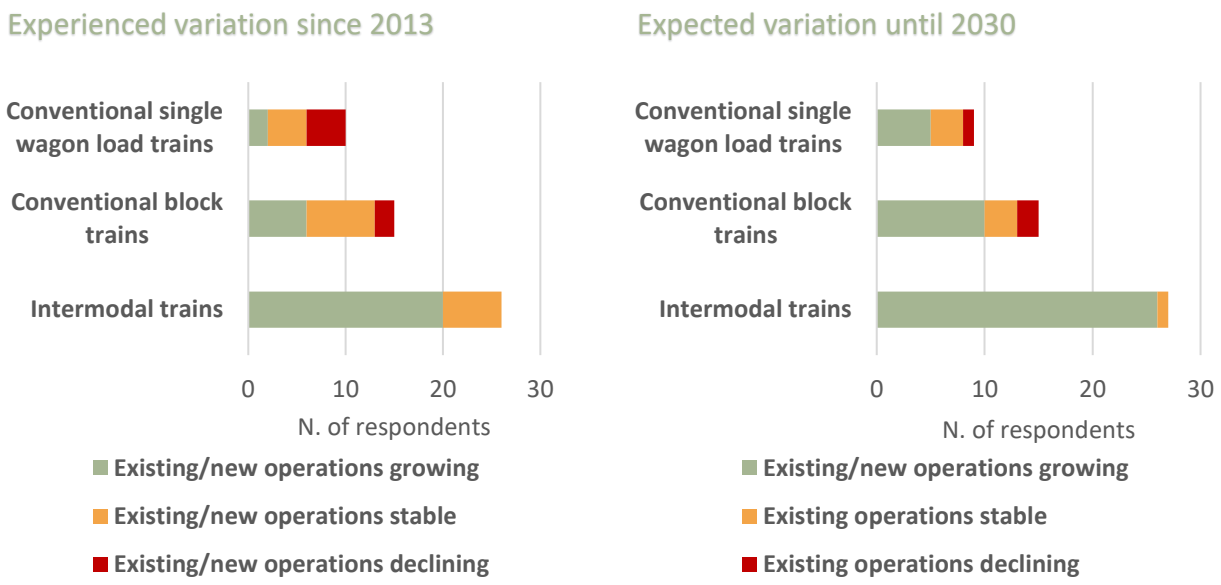
Figure 79 Experienced and expected traffic trend on the type of trains operated by RUs crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 4.R

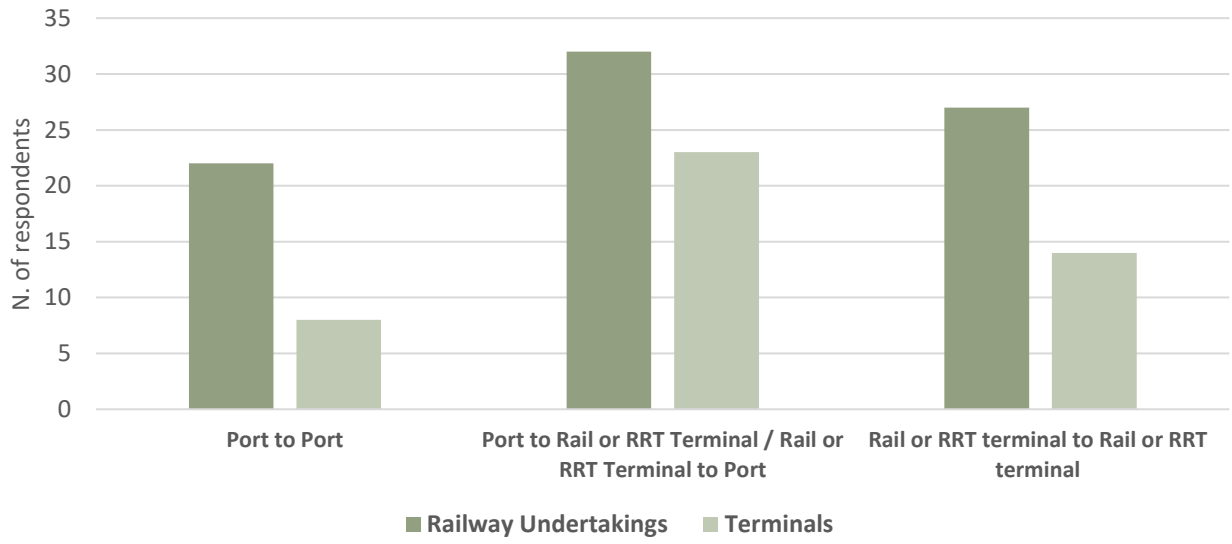
Most RUs and terminal operators experienced growth in intermodal train operations in the past years (Figure 79 and Figure 80), whereas the trend for conventional block and single wagonload trains is predominantly stable. Most respondents have a positive expectation for the future in terms of traffic growth for all market segments.

Figure 80 Experienced and expected traffic trend on the type of trains served at terminals crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 4.T

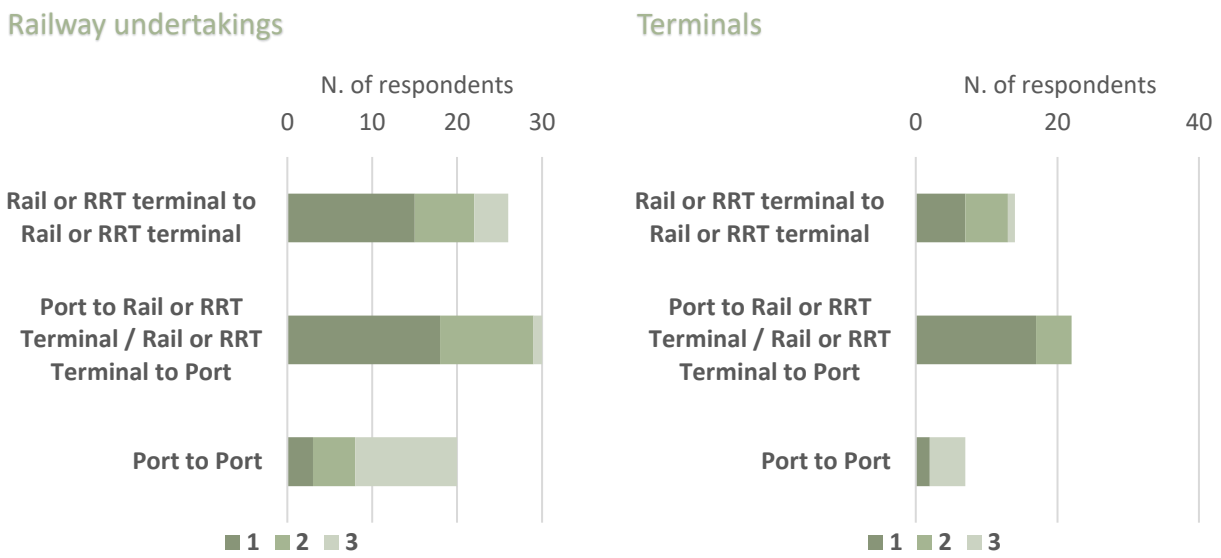
Figure 81 The type of O/Ds of the trains operated by railway undertakings or served at terminals crossing at least one border crossing point(s) on any RFC



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 5.R and 5.T

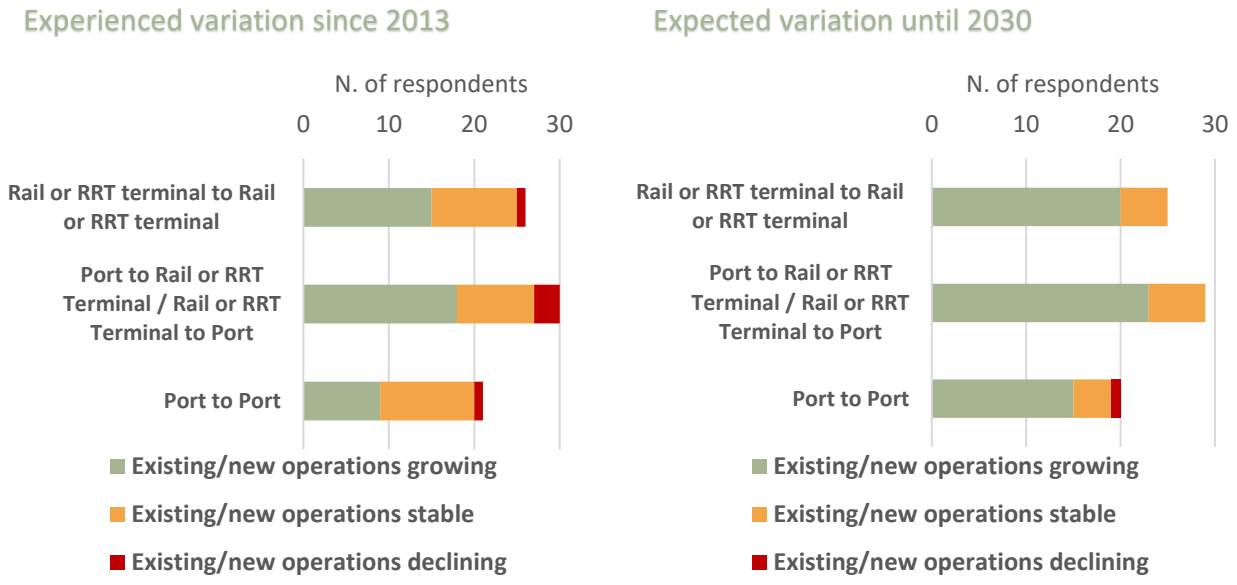
Most operations relate to Port to Rail-Road Terminal (RRT) transport, followed by RRT to RRT services and Port to Port operations (Figure 81 and Figure 82).

Figure 82 Ranking of the types of O/Ds of the trains operated by RUs or served at terminals crossing at least one border crossing point(s) on any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 5.R and 5.T; Note: 1= first, 2=second, 3= third

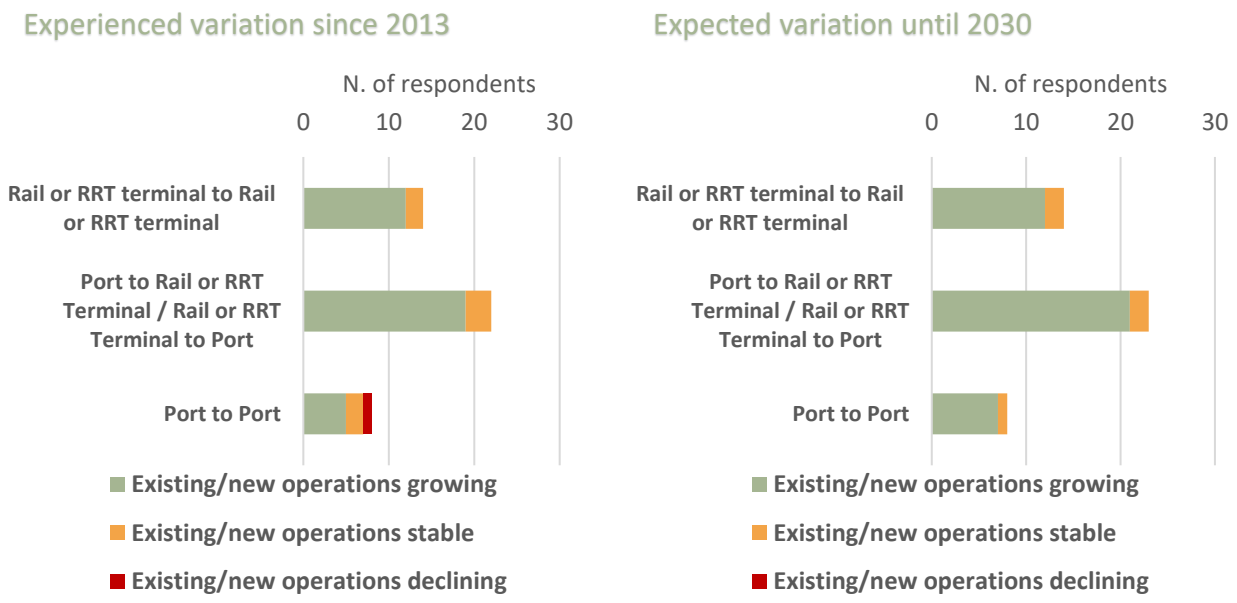
Figure 83 Experienced and expected traffic trend on the type of O/Ds of the trains operated by RUs crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 5.R

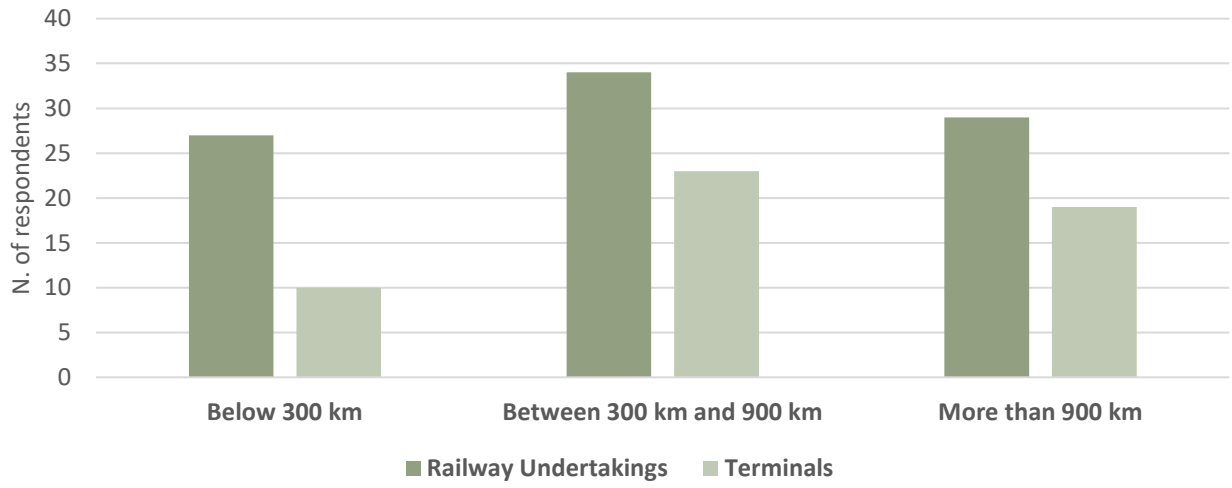
Experienced variations by RUs were mostly positive for the Port to RRT or RRT to RRT segments and stable for the Port to Port one (Figure 83). Terminal operators have predominantly experienced growing trends in all market segments in the past years (Figure 84). The vast majority of RUs and terminal operators are expecting positive future trends for the three market segments (Figure 83 and Figure 84).

Figure 84 Experienced and expected traffic trend on the type of O/Ds of the trains served at terminals crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 5.T

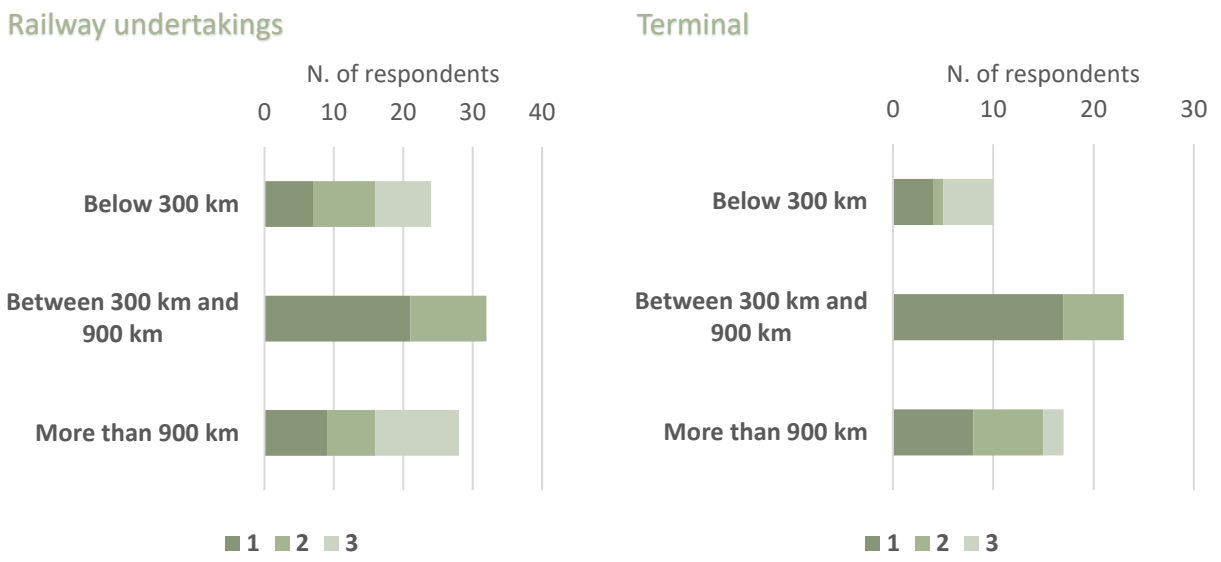
Figure 85 Type of distances of the trains operated by railway undertakings or served at terminals crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 6.R and 6.T

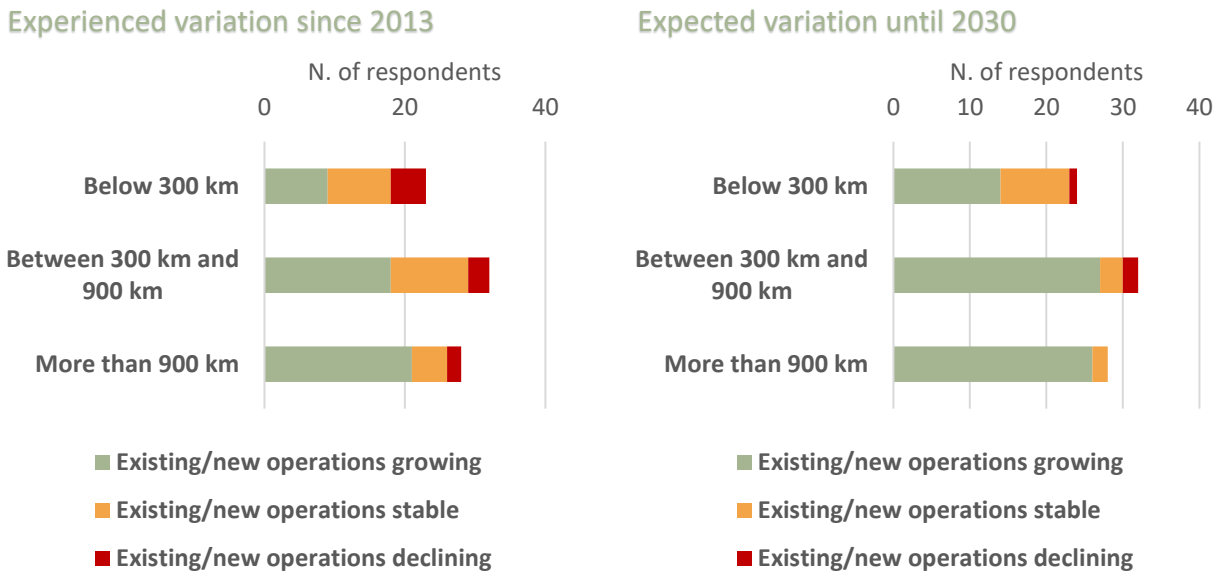
Most international train operations cover distances between 300 km and 900 km, followed by services covering distances longer than 900 km and below 300 km (Figure 85 and Figure 86).

Figure 86 Ranking of types of distances of the trains operated by railway undertakings or served at terminals crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 6.R and 6.T; Note: 1= first, 2=second, 3= third

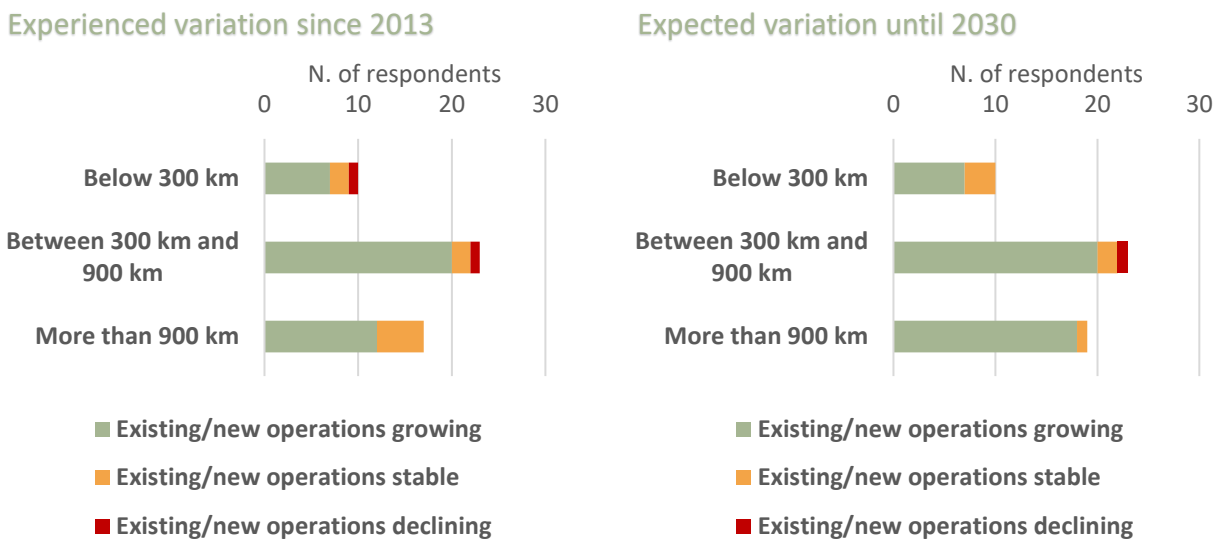
Figure 87 Experienced and expected traffic trend on type of distances of the trains operated by RUs crossing at least one border crossing point(s) in any RFCs



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 6.R

RUs experienced mostly positive variations for services covering distances longer than 300 km and declared the market is stable for operations below 300 km (Figure 87). Terminal operators have predominantly experienced growing trends in all market segments in the past years (Figure 88). The vast majority of RUs and terminal operators are expecting positive future trends for the three market segments.

Figure 88 Experienced and expected traffic trend on type of distances of the trains or served at terminals crossing at least one border crossing point(s) in any RFCs

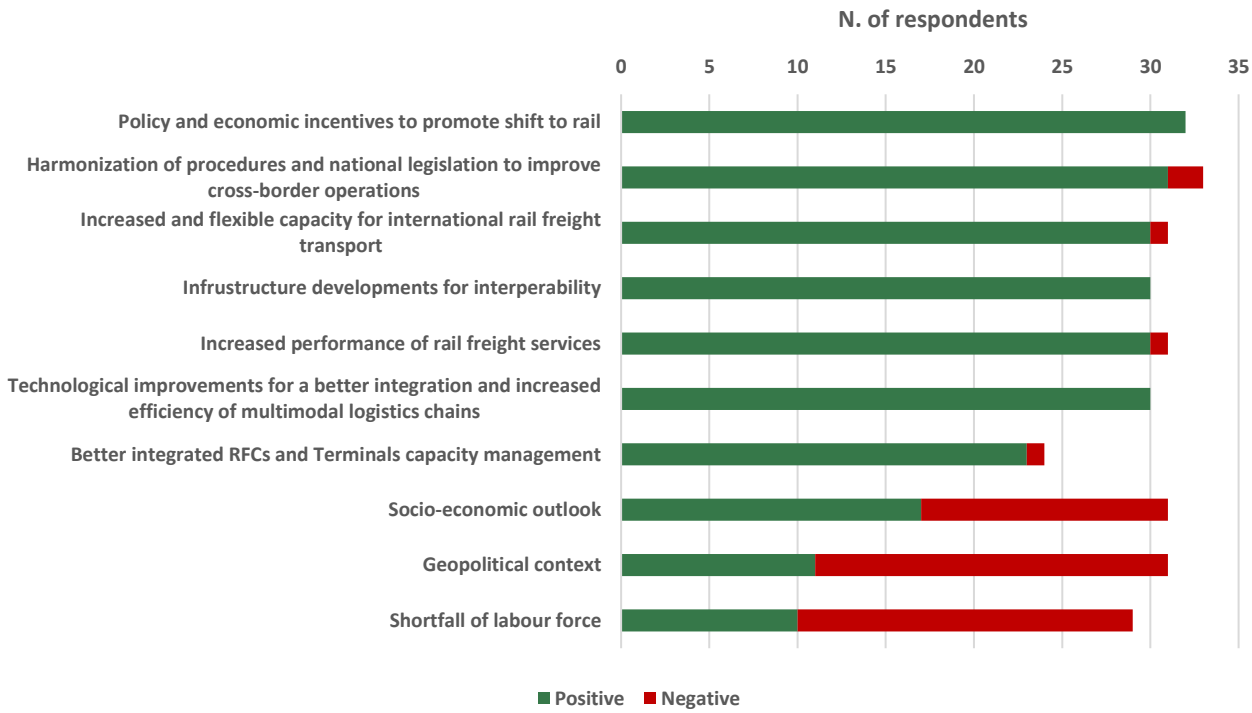


Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Questions C) 6.T

6.3 MARKET DRIVERS

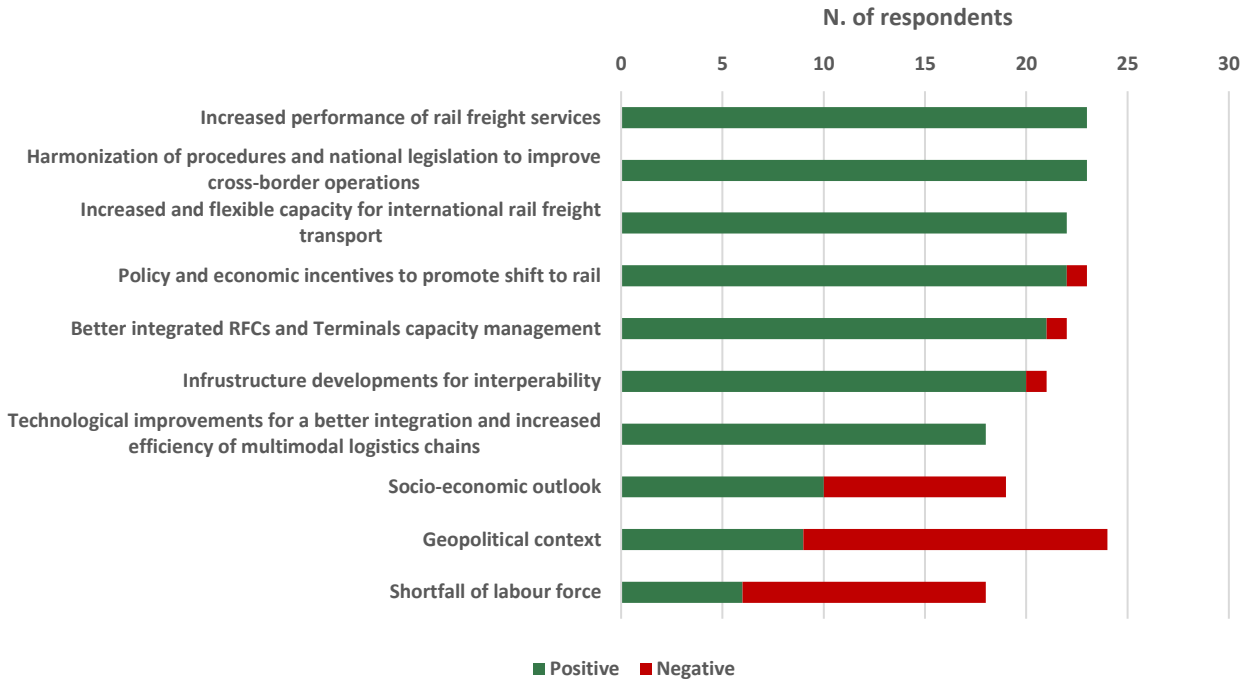
RUs and terminal operators have very similar views about the effects of the main market drivers on the growth of international rail freight transport in the short term, i.e., up until 2030 (Figure 89 and Figure 90). Most identified drivers are expected to have positive effects as they are assumed to improve rail transport's competitiveness. At the same time, the geopolitical context, the socio-economic outlook as well as the shortfall of the labour force are perceived as threats.

Figure 89 Potential effect of market drivers on the evolution of international rail freight transport operated by RUs until 2030



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 7.RT

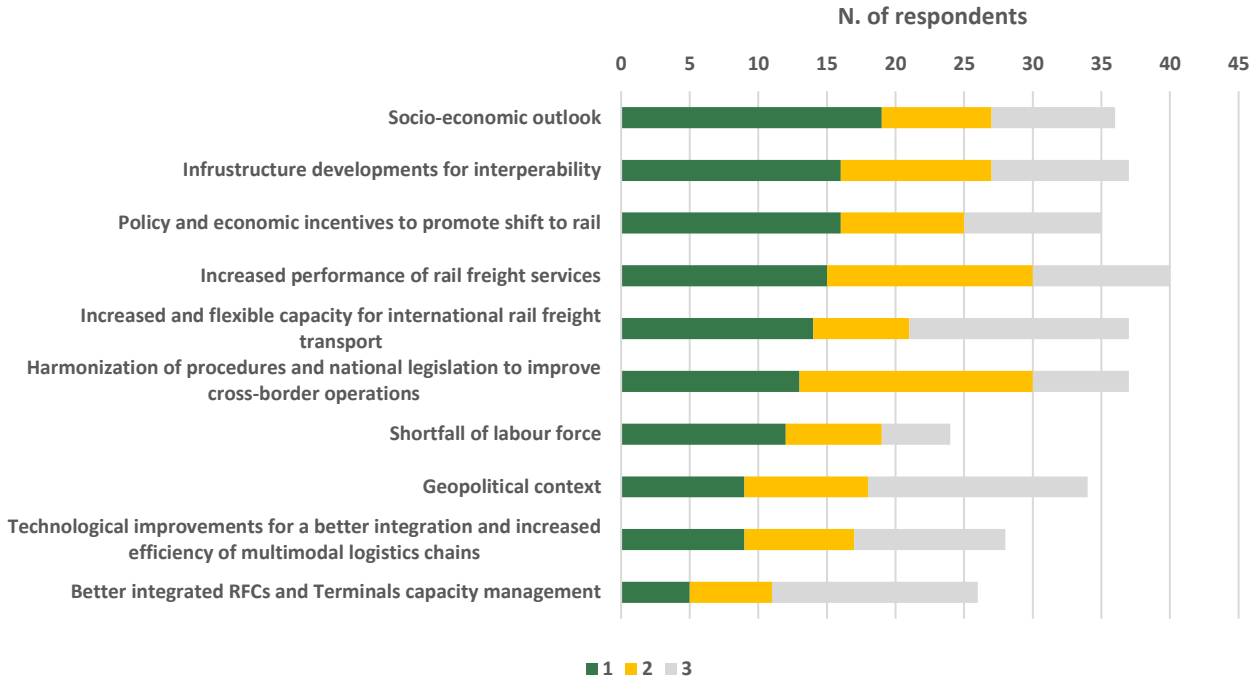
Figure 90 Potential effect of market drivers on the evolution of international rail freight transport served at terminals until 2030



Source: 2023 11 RFCs Joint TMS Update Survey; Notes: Question C) 7.RT

Market players rank as most relevant market driver the socio-economic outlook (Figure 91). This is followed by "infrastructure developments for interoperability", "policy and economic incentives to promote shift to rail". "increased performance of rail freight services" and "harmonisation of procedures and national legislation to improve cross-border operations" are the two most relevant market drivers, according to the respondents, if considering both first- and second-ranking options.

Figure 91 Ranking of the most relevant short-term market drivers for RUs and Terminals



Source: 2023 11 *RFCs* Joint TMS Update Survey; Notes: Question C) 7.RT

Although indicated as having a potential negative impact on the market, labour shortages and geopolitical context are not among the most critical market drivers. Finally, “technological improvements towards better integration and increased efficiency of multimodal logistics chains” and “better-integrated RFCs and terminal capacity management” do not seem to be considered priority issues by the RUs and terminal operators

7 KEY FINDINGS AND RECOMMENDATIONS ON FACILITATING AND STRENGTHENING RAIL FREIGHT MARKET ALONG THE 11 RFCS NETWORK AND THE RFC AMBER

The European Commission introduced the European Green Deal at the end of 2019, representing Europe's long-term comprehensive strategy to make the European continent carbon-neutral by 2050. To implement the European Green Deal and support the achievement of its ambitious goals, the European Commission updated between 2020 and 2021 all main economic sector policies, including for transport and mobility. About one year after the adoption of the European Green Deal, the European Commission published its Smart and Sustainable Mobility Strategy, replacing the 2011 White Paper. To support the achievement of the ambitious target of the European Green Deal, of reducing transport emissions by 90% by 2050 (compared to 1990 levels), the Sustainable and Smart Mobility Strategy sets specific milestones for the rail sector, i.e., doubling passenger high-speed rail traffic by 2030 and tripling it by 2050, while increasing rail freight by 50% by 2030 and doubling it by 2050 (compared to 2015 levels).

To make the above vision and targets a reality, the strategy identifies a total of 82 initiatives in 10 key areas for action, including one dedicated to the greening of freight transport, proposing measures to make freight transport more efficient and more sustainable, by improving rail infrastructure management, offering stronger incentives for low-emission lorries, and better information on freight transport greenhouse gas emissions. The Greening Freight Transport flagship action of the Smart and Sustainable Mobility Strategy involves three main measures:

- A new regulation on the use of railway infrastructure capacity in the single European railway area, amending Directive 2012/34/EU and repealing Regulation (EU) No 913/2010[23] aimed at optimising the use of the railway infrastructure, improving cross-border coordination, increasing punctuality and reliability, and ultimately attracting more freight to rail. Current rules on capacity management are decided annually, nationally and manually. This does not favour cross-border traffic (around 50% of rail freight crosses borders); the fractured approach leads to delays at borders. This, in turn, hinders the functioning of the Single Market. Delays due to congestion caused by uncoordinated maintenance works are also common. The proposal for a regulation on the use of railway infrastructure capacity in the single European railway area builds on the industry-led Timetable Redesign Project. The aim is to better respond to the different needs of the rail sector: stable timetables and early booking of tickets for passenger services, and flexible train runs adapted to just-in-time supply chains for freight shippers.
- A new directive amending Council Directive 96/53/EC laying down for certain road vehicles circulating within the Community the maximum authorised dimensions in national and international traffic and the maximum authorised weights in international traffic[24]. More than 50% of freight is carried by road in the EU (2020 figures), and this transport is a major contributor to greenhouse gas emissions. The current Weights and Dimensions Directive sets the maximum weight length, width and height for heavy-duty vehicles. The proposed directive revises these rules to allow additional weight for vehicles using zero-emission technologies, as they tend to increase a vehicle's weight. This is expected to incentivise the take-up of cleaner vehicles and technologies. The uptake of more

[23] https://transport.ec.europa.eu/document/download/9393e22e-72ee-440d-a983-e2ee116e11ba_en?filename=COM_2023_443_0.pdf
[24] https://transport.ec.europa.eu/document/download/6d96dca5-11f2-4499-81cd-b3d44b67a73d_en?filename=COM_2023_445_0.pdf

aerodynamic cabins and other energy-saving devices will also be encouraged increasing the efficiency of zero-emission powertrains (further to improving driver comfort and safety). The proposal also provides clarity on the use in cross-border traffic, in certain conditions, of heavier and longer vehicles than allowed today in some Member States. This includes clarifying that Member states who allow European Modular Systems (EMS) in their territories will also be able to use them in international operations among the neighbouring Member States, without a need for a bilateral agreement and without a restriction of crossing only one border. As a results, the same amount of cargo can be carried in fewer trips. Finally, to encourage intermodal transport, whereby goods are moved using two or more transport modes but with a standardised cargo unit (like a container trailer or other), lorries, trailers and semitrailers will be allowed to carry extra weight. Extra height will also facilitate the transport of high-cube containers by standard vehicles.

- A new regulation on the accounting of greenhouse gas emissions of transport services[25], defining a new methodology for companies to calculate their greenhouse gas emissions if they choose to publish this information, or if they are asked to share it for contractual reasons. The method is based on the recently adopted ISO/CEN standard for the quantification and reporting of greenhouse gas emissions arising from the operation of transport chains of passengers and freight. Reliable data on door-to-door emissions will enable operators to benchmark their services and allow consumers to make informed choices on transport and delivery options.

The Greening Freight Transport package is part of a broader effort to make mobility and transport more sustainable. It follows on from the key components of the "Fit for 55" package, such as its targets for recharging and refuelling stations, and for the deployment of sustainable fuels in aviation and maritime transport. To complement these proposals, the European Commission is also revising the Combined Transport Directive, as part of which it will consider a range of regulatory, operational and economic measures to make intermodal transport more competitive.

Finally, the Greening Freight Transport package also complements the revised Trans-European Transport Network (TEN-T) policy through incentives and requirements for infrastructure development, and by better integrating the different modes within a multimodal transport system. Digital technologies are also helping to increase efficiency, including the European Rail Traffic Management System and Digital Automatic Coupling for rail, the Electronic freight transport information Regulation and the European Maritime Single Window environment.

With reference to the 50% rail target growth set in the EU policies for the period 2015-2030, Table 37 provides the transport volume figures in million tkm for the EU27 in 2015 and 2022. Data show that the gap to be filled between 2023 and 2030 is significant, especially for the international segment.

Table 37 Freight volume (million tkm) in 2015 and 2022

	2015	2022	Var. % '15-22
International rail freight transport	155,289	149,032	-4%
National rail freight transport	181,811	199,830	10%
Total rail freight transport	337,100	348,862	3%

Source: Eurostat [rail_go_typepas]; Notes: (1) Data for Belgium are excluded from the total as they are not available for 2015 and 2022. (2) Data are limited to main undertakings

[25] https://transport.ec.europa.eu/document/download/6fd194f0-1618-45c8-822e-1b13e808eb23_en?filename=COM_2023_441.pdf

7.1 SUMMARY OF KEY FINDINGS OF THE STUDY

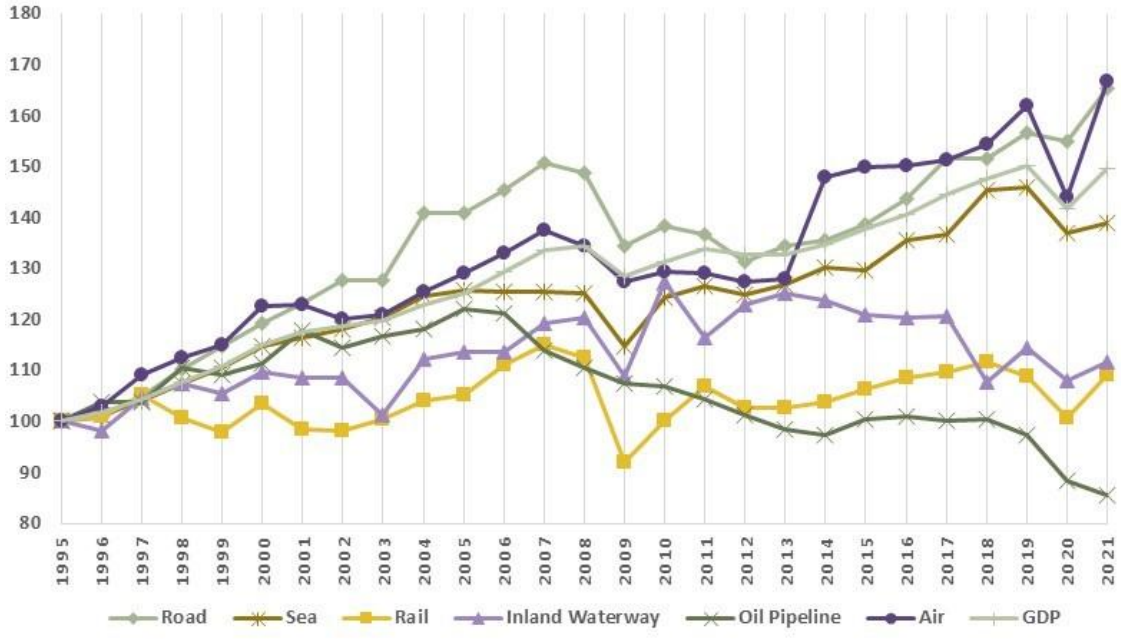
7.1.1 THE RAIL FREIGHT MARKET IN EUROPE AND ON THE RFC AMBER

Overall market trends and sector developments

An analysis of the available statistics was performed as part of the study based on the data available from the European Commission DG MOVE/Eurostat (Statistical Pocketbook 2023 and RMMS Rail Market Monitoring Report) and from the Independent Regulators Group (IRG)-Rail (Rail Market Monitoring Reports). The analysis provides an overview of the development of the European rail freight sector since mid of the 1990s when the rail freight market liberalization started, allowing monitoring trends before and after the 2008 credit crunch, which is considered the second major financial crisis after the 1930s Great Depression, and which was followed by additional adverse events during the past 10-15 years when the 11 RFCs were gradually established and entered into operation. Key findings from the statistical analysis are as follows:

- The period since the entry into force of the Regulation 913/2010 has indeed been marked by a number of socio-economic, health and geopolitical events which negatively impacted trade and transport flows at the global and European scale. The statistical review shows that the 2008 financial crisis basically altered the economic and transport developments experienced by Europe over the previous decades. EU27 long-term series over the past 30 years show that the effects of this crisis are persisting: albeit positive, the trend of GDP and most transport modes of the following period stands indeed at lower growth rates. Overall, the European rail freight market grew modestly over the last decade, contrasting with the strong development experienced between 2001 and 2008. The EU economy and transport markets were more recently further impacted by the 2020-2021 COVID-19 pandemic and by the current geopolitical crisis that started in 2022 with the Russian war of aggression against Ukraine and deteriorated with the Israel-Gaza conflict and Red Sea crisis.

Transport trends in billion tkm EU27 (1995=100)



Source: European Commission – DG MOVE – Statistical Pocketbook 2023

Rail freight transport between 2013 and 2021 marginally grew in the EU27 from about 385 billion tkm to 410 billion tkm, i.e. 7%, which is only half the rate of growth of total transport volumes and GDP. However, over the same period combined transport more than doubled from about 41 billion

tkm to 100 billion tkm. Trends for the RFC Amber concerned countries are similar to the EU ones. In the RFC Amber concerned countries rail freight transport grew indeed from about 73 to 79 billion tkm, i.e. 8%.

- The Amber RFC countries are among the ones registering a higher rail modal share in the EU. All Amber RFC countries are indeed positioned within the ten first-ranking EU countries for rail modal share in 2022. However, Poland and Slovakia are also among the ones that have registered a high decline in rail modal share over time. A trend that is likely related to the change in the commodity basket trade. At both EU 27 and RFC Amber concerned country levels, there is an underlying stagnation or decline of dry and liquid bulk commodities (originating even from before the mid of the 1990s), associated with a growth of intermodal transport, a market segment that is apparently growing with the gradual opening of the rail freight market and greening of logistics chains.
- The COVID-19 pandemic seems to have had different impacts at the EU27 scale on rail freight traffic measured in net tkm, with either increases or decreases in transport volumes between 2019 and 2021. Except Hungary, the RFC Amber concerned countries seem to have registered positive variations during the pandemic period. Baltic States, in particular, also experienced a significant drop in traffic since the start of the Russian war of aggression against Ukraine in 2022. In fact, EU sanctions implemented with Belarus and Russia following the start of the Russian war of aggression against Ukraine impacted negatively on rail freight traffic in the Baltic States, whereas train traffic between Ukraine/Moldova and the EU has increased, particularly through Poland and Romania.
- Since the start of the rail freight liberalisation process late 1990's and 2000's, the market share of the domestic incumbent railway undertakings gradually declined in most EU Member States, whereas the market share of non-incumbents increased together with the operations of foreign incumbents. As a general pattern, common to the EU27 and RFC Amber concerned countries, the trend of the market share by domestic incumbents continued to decline in the period 2013-2021. In the RFC Amber concerned countries, the market share of the domestic incumbent in 2021 was about 60% on average, 63% considering national and international incumbents.

Analysis of the current and future freight transport market along the 11 RFCs network

As part of the 2024 Joint TMS Update, an analysis of the current and future market has been done using an EU-wide NEAC model, combining transport and economic statistics at the EU scale with train traffic data available from the RNE TIS database.

Within the 11 RFCs network catchment area, rail freight transport in 2022 accounts for 18% of the total international freight transport volume, which is approximately 265 million tonnes. This relates to approximately 442,000 trains[26].

For the analysis of the future short-term market trends, at the 2030 time horizon, three scenarios have been simulated. The first one only simulates economic growth (Reference scenario); another one simulates the effects of the completion of major transport investments currently ongoing or expected to be finished by 2030 (Projects scenario). The third one simulates the impact of a fully interoperable rail network, regardless the possibility to implement the required projects (Sensitivity scenario). The three scenarios show an increase in international freight transport in general. Within the 11 RFCs network areas, due to economic growth (EU Reference), the increase in general is about 13%. This is in line with the GDP growth for the EU27, which is 17%. IWW shows a growth of 13%, road has a growth of 14% and rail transport of 13% in the 11 RFCs network

[26] An average volume per train of 600 tonnes is assumed.

catchment area. In the absence of further developments, the rail freight market is expected to grow at a slower pace compared to GDP and to the overall transport sector, therefore losing market share. This is due to the changing trends in the basket of transported commodities and differentiated geographic demand growth distribution. For all land freight transport, the Projects scenario and the Sensitivity scenario have a limited impact on the overall growth of international freight transport.

Focusing on international **rail freight** transport in the 11 RFCs network catchment area, the Reference scenario expects a growth of 13%, which is approximately 35 million tonnes extra compared to the 2022 Base year. Both the Projects scenario and the Sensitivity scenario show the impact of the different rail projects and rail measures. In the Projects scenario, rail transport grows an extra 5% compared to the Reference scenario (300 million tonnes to 314 million tonnes). In total it is estimated that this is approximately 14 million tonnes of extra international rail freight transport.

The hypothetical Sensitivity scenario shows that compared to the Reference scenario, there is a potential of 61 million tonnes extra rail freight transport due to longer trains, intermodal loading gauge, ERTMS, and European standard track gauge along the RFCs network. The total expected rail freight transport volumes in this scenario reaches 361 million tonnes, corresponding to a 20% growth compared to the Reference scenario.

Considering both economic and infrastructure developments, the Sensitivity scenario can be regarded as the potential maximum growth for rail transport across the 11 RFCs network. Compared to the 2022 Base year, transport volumes would increase from 265 to 361 million tonnes i.e. by 36%, out of which around 1/3 is due to economic development and 2/3 to infrastructure investments.

As a result of the analysis performed, it is possible to conclude that the major planned projects along the 11 RFCs network assumed to be completed by 2030 (see Section 3.3.2), and the modernisation of railway lines and cross-border sections in the Eastern European corridor countries, are fundamental to removing infrastructure bottlenecks and reducing travel times and transport costs. Such initiatives are expected to increase competitivity of rail transport on the 11 RFCs network, and thus on each RFC, including the RFC Amber. Further to these projects, completing an interoperable network in line with the TEN-T requirements is key to increase the rail market share.

With reference to the 50% rail growth set in the EU policies for the period 2015-2030, the combined observed growth for the period 2015-2022 (-4%, see Table 37) and expected for the time frame 2023-2030 (+36%) still lags below the target. Therefore, the development of a high-quality 11 RFCs network in line with TEN-T standards does not seem to be sufficient to achieve the ambitious targets set in the relevant European transport policies; an outcome that would hardly change even assuming that additional mega cross-border projects would be completed like the Brenner and Turin-Lyon tunnel.

Such targets remain challenging to meet in the absence of a significant change in the structure of the costs of road and rail transport. Internalising external costs of road transport, and or incentives to reduce the costs of rail transport might be needed. The potentially negative impacts on rail market share of measures such as improving the efficiency of road transport shall also be considered, as also reported in a recent study by the Community of European Railway and Infrastructure Companies (CER) – *Study on Weights and Dimensions: Impacts of the Proposed Amendments to the Weights and Dimensions Directive on Combined Transport and Rail Freight Transport*[27]. Market opening appears also to be relevant in increasing the competitiveness of rail

[27] https://www.cer.be/cer-reports/study-on-weights-and-dimensions

transport. A recent study by the European Rail Freight Association (ERFA) – *The European Rail Freight Market; Competitive Analysis and Recommendations*[28] – considers how non-incumbent operators, focussing on the fast-growing intermodal and logistics train segments, are likely to experience further growth in market share in the 2020s. According to the study, competition amongst railway undertakings has made rail more attractive compared with road, which can be partially explained by the business model of non-incumbents, more focused (i.e., intermodal and logistics, block trains, and international traffic), lean and agile, and cost competitive, able to offer better service levels consistently.

Analysis of the current and future freight transport market along the RFC Amber

International freight transport across *all modes* in the catchment area of the RFC Amber amounts to 139 million tonnes. Overall, most transport concerns cargo type *Other* (49%), followed by dry bulk (37%). The cargo type *Other* is mostly transported by road (65%), while rail has a large share in the international transport of dry bulk (51%).

On relations within the catchment area of RFC Amber, rail freight transport has a share of 31% in the total amount of international freight transport. This is a volume of approximately 43 million tonnes. This relates to approximately 72,000 trains within the catchment area of RFC Amber.

The most important rail transport origins and destinations can be found in locations such as Budapest, Transdanubia, and Bratislava. The port of Koper serves as a gateway to the hinterlands in the RFC Amber. Most rail transport relations are between inland locations and not between port and hinterland. However, the most important relation is between Koper/Ljubljana and Budapest (v.v.).

For the analysis of the future short-term market trends, at the 2030 time horizon, three scenarios have been simulated. The first one only simulates economic growth (EU Reference); another one simulates the effects of the completion of major transport investments currently ongoing or expected to be finished by 2030 (Projects); and an additional one simulates the impact of a fully interoperable rail network, regardless the possibility to implement the required projects (Sensitivity).

The three future scenarios (Reference, Projects and Sensitivity) show an increase in international freight transport in the RFC Amber in line with what expected at the European level. Mainly due to autonomous economic growth, the increase in general is about 13%, in the RFC Amber substantially more at 23%. This is in line with the GDP growth for the EU27 which is 17%. In the RFC Amber, rail transport shows a growth of 16 %, road of 19%, and sea shipping 31%. In the absence of further developments, the rail freight market is expected to grow at the same pace compared to GDP and to the overall transport sector. This means it would gradually lose market share. For all land freight transport, the Projects scenario and the Sensitivity scenario have an impact on the overall growth of international freight transport, especially in the RFC Amber.

In the RFC Amber, for the Reference scenario, a growth of international rail transport is expected at 16%, which is approximately 7 million tonnes extra compared to the 2022 situation. Using an average volume of 600 tonnes per train, this would be (rounded) 11,000 extra international freight trains in the RFC Amber, which gives 83,000 trains in total in the Reference scenario.

The Projects scenario shows the impact of the different rail projects and rail measures. Rail transport grows an extra 5% compared to the Reference scenario. In total it is estimated that this is approximately 2 million tonnes of extra international rail freight transport. Taking an average volume of 600 tonnes per train, this

[28] https://erfarail.eu/news/the-european-rail-freight-market-competitive-analysis-and-recommendations

gives (rounded) 4,000 extra trains in the RFC Amber. Together with the Reference scenario results, this would be approximately 87,000 trains for the RFC Amber.

The Sensitivity scenario shows that there is another potential of 9 million tonnes extra rail freight transport. With an average volume of 690 tonnes per train, the total number of unique international freight trains would then be around 88,000. Compared to the 72,000 unique trains in 2022, this is a growth of around 22%. This figure can be regarded as a potential maximum growth.

Overall, the Sensitivity scenario can be regarded as a potential maximum growth for rail, considering both economic and infrastructure developments. Compared to the 2022 base year, transport volumes would increase from 43 to 61 million tonnes i.e. by 42%.

7.1.2 OCCURRED AND EXPECTED CHANGES DUE TO THE ESTABLISHMENT OF THE RFCS

In the absence of a consistent historical series of data and information on the operations along the 11 RFCs – worth also considering that the RFCs were established and entered into operation in different years between 2013 and 2020 – an e-survey was conducted as part of the 2024 Joint TMS Update – *2023 11 RFCs Joint TMS Update Survey* – to assess the occurred and expected changes associated with their establishment. The survey involved the Railway Undertakings Advisory Groups (RAGs) and Terminal Advisory Groups (TAGs) of the 11 RFCs. In total, 42 representatives of the RAGs and 30 members of the TAGs submitted valid questionnaires between September 2023 and January 2024.

The survey was conducted to collect the opinion of the 11 RFCs market on three main areas: occurred and expected impact of the RFCs, occurred and expected market developments along the RFCs, and market drivers. The main findings from the survey are summarised in the following bullet points for each of the three areas. Especially regarding the opinion of the RAG and TAG members on the occurred and expected market developments, it is worth noticing that: it reflects their views at the time of submission of the questionnaire (Autumn 2023/January 2024); it represents a partial view of the market as the sample of the respondents is not representative of the market universe; it may contrast with the findings from the statistical review presented in the previous section above, as the opinions relate to the corridors and international trains, whereas national statistics refer to the whole country network and national as well as international traffic.

Occurred and expected impact of RFCs, in the areas of governance, operational efficiency and capacity management

- The respondents' opinion about the changes within the governance area is positive, especially in terms of cooperation with the market, including but not limited to RUs and terminal operators, as well as concerning facilitation of discussion among Member States about the issues affecting the competitiveness of international rail freight transport. The opinion about the progress made regarding cooperation between RFCs and Core Network Corridors (CNCs)/ERTMS horizontal priority is less favourable. The market opinion is negative about the progress made on harmonising international freight rail services' legislative, regulatory, procedural and operational aspects. The expectations of the market players concerning the future impact of the programmes and activities of the RFCs are relatively positive concerning all issues. Respondents consider the cooperation between RFCs and an EU Network of Infrastructure Managers (ENIM) as assumed in the proposal for the new capacity regulation, to be the best governance solution for bringing issues forward.
- The stakeholders' opinion about the changes that occurred within the operational efficiency area is also generally positive, except for the progress made in the promotion of technical and operational

harmonisation of the European railway transport system towards its interoperability. The respondents' expectations concerning the future impact of the programmes and activities of the RFCs are relatively positive concerning all the assessed issues related to operational efficiency. Cooperation between RFCs and an EU Network of Infrastructure Managers (ENIM) is also considered the best-fitting governance solution to bring operational efficiency issues forward.

- The respondents' opinions about the changes that occurred within the capacity management area are predominantly negative. Notwithstanding the market's negative opinion of the progress made since the establishment of the RFCs in this area, the expectations on the future impact of the programmes and activities by the RFCs are rather positive with regard to all the investigated issues related to capacity management. The best governance solution for capacity management improvements is deemed to be the cooperation between the RFCs and an European Network of Infrastructure Managers (ENIM).

Occurred and expected market developments

- The vast majority of the respondents operated or still operate rail services or manage/operate terminals serving trains across at least one border crossing point on any of the RFCs. Most of them also operated or served international rail freight transport before the establishment of the RFCs. The majority of the respondents declare they experienced an increase in their operations since 2013, and most of them also have a positive expectation about the future, expecting overall market growth.
- The majority of the RUs and terminal operators declare the market is stable or growing along the RFC Amber since 2013.
- The prevailing type of international trains operated on the RFCs network consists of intermodal trains, followed by conventional block trains and single-wagon load trains. Most RUs and terminal operators experienced growth in intermodal train operations in the past years, whereas the trend for conventional block and single-wagon load trains is predominantly stable. Most respondents have a positive expectation for the future in terms of traffic growth for all market segments.
- Concerning traffic between logistics nodes, most operations relate to Port to Rail-Road Terminal (RRT) transport, followed by RRT to RRT services and Port to Port operations. Experienced variations by RUs were mostly positive for the Port to RRT or RRT to RRT segments and stable for the Port to Port one. Terminal operators have predominantly experienced growing trends in all market segments in the past years. The vast majority of RUs and terminal operators are expecting positive future trends for the three market segments.
- Regarding service distances, most operations cover distances between 300 km and 900 km, followed by services covering distances longer than 900 km and below 300 km. RUs experienced mostly positive variations for services covering distances longer than 300 km and declared the market is stable for operations below 300 km. Terminal operators have predominantly experienced growing trends in all market segments in the past years. The vast majority of RUs and terminal operators are expecting positive future trends for the three market segments.

Market drivers

- RUs and terminal operators have very similar views about the effects of the main market drivers on the growth of international rail freight transport in the short term, i.e., up until 2030. Most identified drivers are expected to have positive effects as they are assumed to improve rail transport's competitiveness. At the same time, the geopolitical context and socio-economic outlook, as well as the shortfall of the labour force, are perceived as threats.
- The socio-economic outlook is ranked first by the market, followed by infrastructure development and interoperability, policy and economic incentives to promote shift to rail. Increased performance

of rail freight services and harmonisation of procedures and national legislation to improve cross-border operations are the two most relevant market drivers, according to the respondents, if considering both first- and second-ranking options.

- Although indicated as having a potential negative impact on the market, labour shortages and geopolitical context are not ranked among the most critical market drivers. Finally, technological improvements towards better integration and increased efficiency of multimodal logistics chains, better-integrated corridors and terminal capacity management do not seem to be considered priority issues by the RUs and terminal operators.

7.2 STUDY RECOMMENDATIONS

Building on the study's key findings, recommendations have been formulated around two main areas:

- Market developments and targets; and
- Institutional and operational developments.

Market developments and targets

The simulations made in the study demonstrate that major projects, and particularly the availability of an 11 RFCs network in line with TEN-T standards, would significantly increase the competitiveness of rail freight transport. The post-COVID recovery and the recent geopolitical crisis caused delays in the implementation and completion of the projects needed to develop a high-quality 11 RFCs network in line with TEN-T standards. Price increases and shortages of construction materials particularly affected the progress of ongoing and planned projects. A high-quality 11 RFCs network might, furthermore, not be sufficient to achieve the ambitious targets set in the relevant European transport policies, in the absence of a significant change in the structure of the costs of road and rail transport. The following recommendations are proposed to support market development towards the achievement of the EU policy targets:

- *Timely complete the development of a high-quality 11 RFCs network in line with TEN-T standards:*
  - *Building missing links and removing infrastructure bottlenecks* increasing infrastructure capacity by adding new tracks and lines where needed, increasing their speed and improving their gradient, can solve congestion problems, save energy and reduce transport costs as well as improve travel times. Such developments are relevant at the network level, but produce effects also at the individual corridor scale;
  - Achieving the requirements set in the TEN-T Regulation *towards an 11 RFCs network in line with TEN-T standards*, i.e. 740 meter long trains, ERTMS, 22.5 t axle load, intermodal loading gauge, European standard track gauge, electrification, is fundamental to support the development of a Single European Railway Area;
  - *Support intermodal and combined transport*. The intermodal market is the most promising international rail freight market segment, requiring improvement of interconnectivity between main railway lines and terminals, increasing the capacity of the existing terminal infrastructure, investing in technologies to facilitate and speed up transport and transhipment operations, and tracking and making more reliable the transport of intermodal units along logistics chains and within logistics clusters;
  - Stronger cooperation between all involved parties for better effectiveness in the availability and *the use of funds and the definition of investment implementation strategies focussed on those sections of the network with higher market potential*. For over a decade, the sector has

benefited from a stronger TEN-T policy with a dedicated Connecting Europe Facility Fund. Among the different transport modes involved in the TEN-T network, rail and rail cross-border initiatives are treated as a priority. However, the available financial resources are limited overall compared to the financial needs that would be necessary to complete all projects. Investing in infrastructure might not be sufficient, e.g. to be operational, ERTMS also requires rolling stock to be equipped with onboard units.

- *Introduce market regulatory and policy measures to increase the competitiveness of rail freight transport*. Although not a specific subject of this study, regulatory and policy measures might be necessary to facilitate and foster the rail freight market in Europe towards the achievement of higher market shares and EU policy targets. Rail freight transport is generally more expensive and less flexible compared to road transport. Internalising external costs of road transport and/or creating incentives to reduce the costs of rail transport would increase its competitiveness and support the achievement of the ambitious EU policy targets. In this respect, policymakers shall also consider the potential effects on the modal share of measures improving the efficiency of road transport. As emphasised in the above-mentioned study by ERFA[29] regulatory measures facilitating market opening appear also to be relevant in increasing the competitiveness of rail transport (e.g. enforcement of antitrust regulations; unbundling of subsidised public service operations from open market business; and ending direct subsidies to or recapitalization of state-owned freight railway undertakings).

Institutional and operational developments

Recommendations on institutional and operational developments are formulated as follows, according to the findings from the market consultation (2023 11 RFCs Joint TMS Update Survey), conducted as part of this study and the use of the available infrastructure and market dataset to produce the current and future market analysis for the 11 RFCs:

- *Improve capacity management*. Capacity management is considered by the market and also by the analyses and studies at the basis of the proposal for the new capacity regulation, a key area for improvement. Progress was made in the management of Temporary Capacity Restrictions; however capacity planning remains an issue. Digital Capacity Management as an integral part of the European program "Timetable Redesign (TTR) for Smart Capacity Management" is at the core of the proposal for the new capacity regulation, and it is paramount to reaching the Green Deal's targets for the transport sector and the rail freight segment within it.
- *Monitor operational performance*. The revised TEN-T Regulation (EU) 1679/2024 identifies new operational requirements, related to punctuality and dwell times at borders. Furthermore, some infrastructure requirements also depend on operations, such as 740 meter long trains. Investing in infrastructure, albeit needed, is long-lasting and capital-intensive. The competitiveness of international rail freight transport also depends on the improvement of cross-border operations and coordinated planning and management of the rail network at a European scale. An RFCs common KPI framework is already in place, and RNE is also already monitoring infrastructure KPIs, as also graphically represented in CIP. Such activities might be continued in the light of the new set of requirements foreseen in the TEN-T Regulation (EU) 1679/2024, and RFC governance structure, also defined in the Art. 67 of this regulation.

[29] https://erfarail.eu/news/the-european-rail-freight-market-competitive-analysis-and-recommendations

- *Balance network and corridor governance approach*. The analysis of the RFC catchment areas shows that international trains using at least one corridor BCP may actually use more than one RFC. A network approach is more fitting to the planning and management of the network capacity. Geographical specificities and logistics clusters and chains exist that still make the corridor concept useful, especially to support discussion and coordination among IMs and Member States and for a customer-oriented approach aimed at involving RUs and Terminal Operators. This consideration also seems to be in line with the opinions expressed by the RAG and TAG members in the survey conducted as part of this study.

ANNEX 1 – OVERVIEW OF THE NEAC MODEL

NEAC is a freight transport forecast model, which helps to identify the best policy options and infrastructure alternatives at European level. The model is able to produce forecasts of transport flows (both volume and vehicles) for different modes (road, rail, inland shipping, maritime, and other). The model results can be used in transport studies, but also for studying emissions or for use in social cost-benefit analysis.

Over the past decades, NEAC freight transport forecast system has frequently helped to assess and evaluate different policy options at European and national level. The system was used successfully in several projects such as corridor studies (such as North Sea-Med or Rhine-Alpine), Iron Rhine cost-benefit analysis, French international freight transport, Alpine crossings, North-South freight transport markets and safe truck parking. The system helped to get insights to pick the best policy options to make the European transport system more sustainable, resilient and robust.

For the near future, the model is able to assist in studies such as corridor studies, infrastructure projects for rail, road and inland waterways, port studies, safe and secure truck parking, impact of COVID, Russian war of aggression against Ukraine or pricing at both European and national level. These are typically topics that play an important role in shaping the future of Europe. Scenarios for Green Deal or the Reference scenario are used to look at the impacts.

The system comprises of a database and a forecast model. Together they are very helpful:

- The database contains freight transport chains to, from and within Europe. It is based on reliable data such as Comext by mode and commodity, Port-to-Port statistics and socioeconomic data on population and GDP. Furthermore, the database contains mode specific networks for road, rail, inland waterways and sea. Terminals and ports form connection points in the networks. An extra asset in the database are the transport costs for the different modes which help to get insights in policies on modal shift;
- The forecast model is based on reliable methods and have been used in many other transport models in Europe and abroad. Think of ETIS+, Transtools, Worldnet or HIGH-TOOL. The forecast model comprises an economic model, a distribution/mode choice model and assignment models for different modes. The model is able to use different scenarios such as the European Reference or Green Deal package. These help to show the impacts on freight transport in general or on modes more specifically.

ANNEX 2 – 2023 11 RFCS JOINT TMS UPDATE SURVEY COMPLETE RESULTS

This annex is enclosed as a separate file.