Progress towards Federated Logistics through the Integration of TEN-T into A Global Trade Network

D1.5 Simulation based impact of new trade routes on TEN T and disadvantaged regions final version

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Contents

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Glossary of terms and abbreviations used.

Abbreviation/Term	**Description**
BRI	Belt and Road Initiative
CEF	Connecting Europe Facility
CO2	Carbon Dioxide
D1.4	Deliverable 1.4
DG MOVE	Directorate-General for Mobility and Transport
EGTN	European Global Trade Network
ERTMS	European Rail Traffic Management System
EU	European Union
GDP	Gross Domestic Product
IWW	Inland Waterways
NSTR	*Nomenclature uniforme des marchandises pour les Statistiques de Transport, Revisée*
NUTS	*Nomenclature des Unités territoriales statistiques*
OECD	Organization for Economic Cooperation and Development
PEP	Primary Entry Point
PLANET	Progress towards Federated Logistics through the Integration of TEN-T into A Global Trade Network
RFC	Rail Freight Corridor
RRT	Railroad Terminal
RT	Rail Terminal
TEN-T	Trans-European Transport Network
TEU	Twenty-foot Equivalent Unit
UK	United Kingdom
WCM	World Container Model
WTM	World Trade Model

1 Executive Summary

This deliverable discusses in detail the potential impact of intercontinental rail freight on TEN-T, using model simulations and scenario simulations. The present report is structured as follows:

- Chapter 3 establishes the methodology in detail, including simulation approach, description of the models, and scenario development. Four scenarios are included, namely:
    - 2030 base scenario
    - 2050 base scenario
    - Disadvantaged regions growth scenario
    - Intercontinenal corridor improvement scenario
- Chapter 4 reports on the 2030 and 2050 base simulations, including market potential, transport costs, node and infrastructure analysis, and external costs.
- Chapter 5 reports on the disadvantaged regions and corridor scenario simulations, including nodes and infrastructure analysis.

The analysis forecasts a market potential for intercontinental rail freight from China to the EU (import) of 1.1 million TEU in 2030, and 1.6 million TEU in 2050. The increased potential is most pronounced in the EU's Eastern regions, but also notable for existing BRI hubs in Western Europe.

While the amount of traffic to terminals is expected to significantly increase, many terminals either have excess capacity available or have just opened and have not yet seen large numbers of containers. Nevertheless, for a number of terminals targeted upgrades will be conducive for further market uptake of intercontinental rail freight. In addition, it was counciled that the relevant terminals all be given the status of Urban Node, TEN-T rail-road (RRT) and/or core network. It is recommended that member states consider the market potential of the BRI in evaluating which terminals could receive TEN-T RRT status.

For the EU's railway network, most relevant routes are either already seeing upgrades or do not need them to deal with expected future demand. However, the routes between Łuków and Slawkow as well as the route between Slawkow via Skalité to Žilina will need additional improvements to deal with the expected traffic. As both are estimated to be expensive, a study on the effect, need, and benefits of the upgrades should be carried out before committing to funding them. A big uncertainty is the route between Małaszewicze and Skierniewice where upgrades may be required even after the large upgrades by the Polish government are completed, for this reason, a study is recommended here as well. Finally, regarding the TEN-T status of railway lines critical for BRI, most are already classified as belonging to the Core Network Corridors, with a potential gap being the Łuków - Slawkow line.

2 Introduction

Since 2014, the European Union (EU) has taken a leading role in further expanding and improving the quality of its transport networks . The EU's long-term Trans-European Transport Network (TEN-T) policy belongs to the world's vanguard in terms of ambition, geographical scope, and network density. Further advancing the EU's leadership in global transport flows and logistics starts with establishing an understanding of the impact on the TEN-T of global transport and geo-economic trends.

In order to achieve this, Task 1.2 of the PLANET project presents a strategic analysis of the most relevant emerging trade routes which are expected to gradually change global transport patterns, and a simulation of their potential impacts on the TEN-T.

Preparatory activities for the simulation of the new trade routes were carried out and reported on in Deliverable 1.4 (D1.4). The new trade routes under consideration within the framework of this study are the Belt and Road Initiative (BRI), the Arctic Route, and the International North South Corridor. The outcome of the analysis in D1.4 was that the impact of the BRI on TEN-T is the most significant. This route is therefore in the focus of the present analysis and a comprehensive simulation model was developed for identifying the potential impact of this route on TEN-T. This model is one of the models developed under PLANET aimed at representing the freight transport processes in intercontinental corridors that are examined in the project. All these models form PLANET's simulation and modelling capability and are described in D1.3). Earlier analysis showed that the potential impact of the other two trade routes is very limited. These routes are expected to not have a major impact on TEN-T in the short and mid-long term. Therefore, the impact of these routes was simulated in a simplified manner in D1.4.

This deliverable discusses in more detail the potential impact of the BRI on TEN-T using several model simulations. D1.4 described the basics of this model, including the assumptions, the model steps, and the results of simulating the base year. This deliverable builds on this by discussing the results of future simulations for 2030 and 2050 and two scenario simulations, namely the impact on disadvantaged regions and that of improved rail freight corridors. Based on these scenarios, the potential impact of TEN-T has been identified. Some ideas of leveraging the role of intermodal nodes, in particular the inland ones covering comprehensive logistic activities supporting local developments, are elaborated as well. Specifically, the objective of this deliverable is as follows:

- build upon the analysis undertaken in Task 1.2 and use modelling and simulation in order to assess in more detail the expected impact of new trade routes on the TEN-T.
- assess the potential impact regarding disadvantaged regions and their inclusion into the international trading system and integration into the TEN-T.
- test the implementation of simulation capability of PLANET by connecting micro- and macro models.

Chapter 3 elaborates on the simulation capabilities developed for this task. The focus here is on the adjustments to the model for future simulations and the elaboration of the scenarios. Next, Chapter 4 describes the results for the future simulations for the year 2030 and 2050, including the expected impact on regions, nodes, infrastructure, and external costs. The results of the scenario analysis can be found in Chapter 5. Chapter 6 contains the conclusions.

2.1 Mapping PLANET Outputs

The purpose of this section is to map PLANET's Grant Agreement commitments, both within the formal Deliverable and Task description, against the project's respective outputs and work performed.

Table 2-1 Adherence to PLANET's GA Deliverable & Tasks Descriptions

PLANET GA Component Title	PLANET GA Component Outline	Respective Document Chapter(s)	Justification
DELIVERABLE			
Simulation based impact of new trade routes on the TEN-T and disadvantaged regions	Simulation based impact of new trade routes on the TEN-T and disadvantaged regions, final results.	Ch. 4, 5.1, 5.2.	The respective chapters bring forward the results from the future (2030, 2050) scenario analysis of the impact of new trade routes on the TEN-T network.
TASKS			
ST1.2.2 Simulation of the impact of emerging trade routes on the TEN-T and on disadvantaged regions	In this subtask, the scenario simulation will be carried out to deliver the volumes per current and emerging trade routes, for the years 2030 and 2050 for all the TEN-T corridors. Deepsea port volumes, hinterland terminal volumes, and freight flows will be determined using the model, giving insights into the modal split, external costs (emissions, noise, congestion, accidents), and transport costs. Analysis of corridors will reach specific product level to allow impact of technologies (T1.4) on the international flow of some products. Based on the simulation results, potential up- or downgrades of existing TEN-T infrastructure will be identified, as well as missing links and the potential locations of hubs. Also, the impact of emerging routes on disadvantaged regions in the areas around the routes will be assessed.	Ch. 4. Ch. 4.1. Ch. 4.1 Ch. 4.4 Ch. 5.3 Ch. 4.1, 5.1, 5.2 Ch. 5.2	The respective chapters develop the scenario analyses intended and set forth the related impact assessment on TEN-T infrastructure and disadvantaged regions.

ST1.2.3 Intercontinental rail freight expansion and Integration with European RFCs	Under this scenario simulation-based prediction of future bottlenecks in the border crossing terminals will be conducted. Requirements for expansion and interoperability of international train services with the RFC will be investigated using the traffic attraction zone model with identification of key nodes and their accessibility. Corridors lines where to concentrate efforts for longer and heavier trains will be identified.	Ch 4. Ch 5.2	

3 Methodology

To understand the impact of new trade routes on the European transport network, a simulation model has been developed. The purpose of this model for PLANET is to identify requirements from Eurasian rail freight for TEN-T to provide recommendations for national strategies and CEF investments. Specifically, the model is used to understand the following:

- Transport and transhipment volumes for the year 2030 and 2050, for the European network, in particular the TEN-T.
- Insight into deep seaport volumes, hinterland terminal volumes, and freight flows
- Potential up- or downgrades of existing TEN-T infrastructure will be identified, as well as missing links and the potential locations of hubs.
- The impact of emerging routes on disadvantaged regions in the areas around the routes will be assessed.
- Input for analysis on specific product level to allow impact of policies (T1.3) and technologies (T1.4) such as 3D printing on the international flow of some products.

The outline of this model is already described in D 1.4. This chapter describes the modifications to the model to simulate future scenarios. This chapter also discusses the position of the PLANET model within the model capabilities developed within the PLANET project.

3.1 Simulation approach

In the terminology of PLANET's modelling syntax, a simulation is "the operation of a model of an existing or proposed system to evaluate its performance under different configurations and over extended periods of real time. It is used before an existing system is altered or a new system is built to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over-utilization of resources, and to optimize system performance".

Transport modelling simulations are used to predict and analyse the performance of transportation systems. Within the context of the PLANET project, simulations are used to understand the impact of new global trade routes by simulating the movement of goods and cargo through these routes. This helps to evaluate the potential economic benefits and costs of the new routes and identify any potential bottlenecks or other issues that may arise. For example, simulations can be used to predict the impact of new trade routes on terminal capacity, as well as the overall flow of goods through different regions and countries. The simulations can also be used to evaluate the environmental impact of the new routes, such as the potential for increased or reduced greenhouse gas emissions depending on the route choice. The purpose of these transport modelling simulations is to provide decision makers with a better understanding of the potential consequences of new global trade routes and to help them make informed decisions about how to improve transportation systems and meet the needs of the communities they serve.

The simulation developed for this task follows a traditional macro model approach, using trade driven volumes, a fixed sum mode choice, and modelling the present-day. The model steps are shown in schematic form in Figure 3-1.

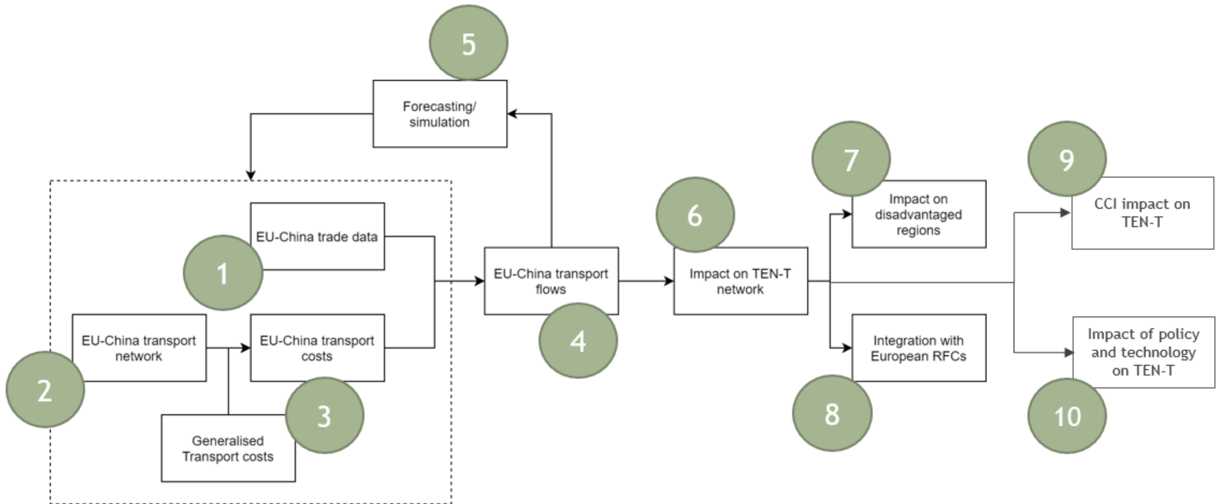


Figure 3-1: Modelling steps

The numbers in Figure 3-1 refer to the following modelling steps:

1. Create a matrix of origin-destination trade data between European and Chinese regions.
2. Develop a comprehensive transport network spanning Europe and China, consisting of intercontinental and continental transport services.
3. Determine the generalized transportation costs of the cargo between European and Chinese regions, including costs such as capital costs, value of time, and reliability costs. Steps 1 to 3 form the basis of the model.
4. Simulate the transport flows by sending the trade data (step 1) over the transport network (step 2) using the transport costs (step 3) and via a Dijkstra shortest path algorithm. In this step, calibration is carried out based on transhipment in European ports for intercontinental sea transport and in rail terminals for intercontinental rail transport. For each OD relationship between China and Europe, a corresponding route is searched. The sum of these routes and the corresponding trade volumes constitutes the total trade between China and Europe.
5. Step 5 includes the development of scenarios, in this case the 2030 and 2050 future scenarios, and the two specific ones (disadvantaged regions and rail freight corridors). Depending on the scenario, the data to the base model in steps 1 to 3 are adjusted. Which adjustments were made are described in section 3.3. A simulation of each scenario takes place (step 4).
6. Based on the simulations of the scenarios, the analysis takes place, which focusses mainly on the impact on TEN-T.
7. A specific analysis was carried out for the impact on disadvantaged regions.
8. In addition, a specific analysis was also carried out for the impact on rail freight corridors.
9. Finally, this model is linked to several other tasks within the PLANET project. First, the output from this model is used for the Corridor Connectivity Index.
10. In addition, this model is used to better understand the impact of policy, technology, and legislation. These last two steps are not part of this deliverable and are described elsewhere.

3.2 Description of the models

The model described in the previous section is based on various existing models, from which datasets and algorithms were used. Components of these models were combined with new data, which together form a model that can be deployed in PLANET to simulate the impact of new trade routes at the macro level and is part of PLANET modelling capabilities.

3.2.1 Existing models

The PLANET model is primarily based on the **Panteia Terminal Model**. This model utilizes input from the **Panteia World Trade Model**, the **Panteia NEAC Model**, as well as any other useful models. These models are described below.

Terminal Model (Panteia)

The Terminal Model is a flexible transport model offering extensive policy and scenario evaluation options. In its core, the terminal modal calculates transport costs and time between regions for various modes of transport and different commodities. It uses a complex network (road and intermodal, including transhipment points) including associated transport costs to establish transport costs from a particular location within the study area (municipality level) to any other area within or outside Europe (NUTS-3 level).

Over the years, the Terminal Model has been used in various projects, including modal shift potential, analysing seaport catchment areas, evaluating the impact of different train lengths on intermodal transport costs, and the evaluation of changes to certain transport routes. The model is written in Python.

NEAC Model (Panteia)

NEAC is a European freight flow database and a multimodal transport model, all in one package, designed for analysing medium to long-distance traffic flows. It was developed in-house by Panteia, combining inputs and experience from a long series of European transport studies. As a highly detailed and flexible system, it has extensive policy and scenario assessment capabilities.

NEAC combines data inputs from a very wide range of trade, transport, and infrastructure databases to support a pan-European multimodal model. The model follows a classical approach using detailed multimodal networks to model route and mode choice. It allows a wide range of scenarios and impacts to be analysed. NEAC-10 models traffic flows as multimodal chains describing the transport of a commodity from its region of production, via transhipment locations to the region of consumption. NEAC-10 has been used extensively for modelling TEN-T networks and corridors. It can model traffic flows at the link level.

World Trade Model (Panteia)

WTM (World Trade Model) is an input-output model of the world economy. It describes deliveries from sector I in country c to demand category j in country c. This model is used to predict trade flows between countries per sector, for example, the (development of the) deliveries of the mining industry in Saudi Arabia to another country, for example, Pakistan, or the deliveries of the metal industry in China to France.

World Container Model

In order to analyse possible shifts in future container transport demand and the impacts of relevant transport policies, the World Container Model (WCM) was developed. The model excels at combining a consistent description of worldwide trade flows, container flows, and transportation services on a global scale, combined with a port and multimodal route choice model.

The multimodal route and port choice procedure is conducted using an improved logistic choice model that considers overlaps between alternative routes in the network. The model considers transport times, tariffs, and the time sensitivity of goods. It describes yearly container flows across the world's shipping routes through 437 container ports around the world, based on trade information to and from all countries, taking more than 800 maritime container line services into account. The model distinguishes between import, export, and transhipment flows of containers at ports, as well as hinterland flows.

The model was calibrated against all available port throughput statistics. Scenario analyses done with the model included the effects of low-speed shipping, increase of land-based shipping costs, major infrastructures such as the Trans-Siberian rail line, and the opening of polar shipping routes. The model is being applied to the European Commission's Trans-European Networks programme and the Rotterdam Port Authority, to develop long term forecasts.

Traffic Attraction Zone model

Finally, the 'disadvantaged regions' scenario, is carried out with close support from NEWOPERA, who has extensive experience in such modelling exercises through the application of the **Traffic Attraction Zone Model** run in 2014 with traffic projection up to 2050. The Traffic Attraction Zone model takes the nodes, and their localization is the focal point of the analysis. Nodes play a major role in the implementation of corridors and networks not only because they are an integrated part of the network infrastructure - as entry or exit points of the networks, or places for transhipment or marshalling yards - but also because they are the centres of organisation of transport. Results are presented based on relevant objectives that are broken down at national, regional and local levels, pointing out major contextual differences. This is done in such a way as to allow for application to a more diffuse level of the transport network. This model is particularly suited for investigating the impact of emerging routes on disadvantaged regions in the areas around the routes. Documentation on the Traffic Attraction Zone Model and a report written on disadvantaged regions provided by NEWOPERA have been used to build the simulation.

3.2.2 Model modifications for PLANET

A PLANET model was developed based on the above models with new inputs in order to meet the PLANET requirements. New model input compromises the following:

- A **trade dataset** of container flows between Europe and China was compiled as model input. This was done for the base year 2019, and for the future years 2030 and 2050. The year 2019 was chosen as the base year because this was the most recent year at the time this dataset was compiled at the beginning of the PLANET project, namely 2020. Moreover, this is the last year when events like the corona crisis and the war in Ukraine impacted trade flows and is therefore the most representative of a 'normal' situation. Therefore, it was not considered necessary to update this dataset over the course of the project. In the trade dataset, a breakdown by commodity group (NSTR classification) and commodity value has been made. The commodity value breakdown is crucial to simulating Eurasian rail transport. Under normal market conditions, the transport time is the most important factor why companies choose Eurasian rail transport over maritime transport. The focus of the simulation is on the imported container flows from China, as these flows lead to containerised transport flows between Europe and China.
- For the simulations, **an intercontinental transport network** has been established. This network consists of three parts, a European network, a Chinese network, and an intercontinental network connecting the European and Chinese networks. The European part of the network was already available in NEAC and has been expanded with current intermodal services. Both the Chinese and intercontinental networks are newly added to the NEAC model. The intercontinental network is

based on existing maritime services and existing Eurasian train services. As Principal Entry Nodes, the terminals, and seaports where these services enter are defined. Whereas the European network has a high level of detail to determine the impact on TEN-T at link level, the Chinese network has been added to the model at a more abstract level. For the 2030 and 2050 scenarios, the network has been expanded to include new Eurasian rail services and new PEPs where container train services are expected to come in from China.

- Finally, generalised transport costs have been defined. For Eurasian rail transport, a detailed cost model has been created consisting of various cost parameters, including most notably waiting time at borders, transit fees, wages, and track access charges. This level of detail makes it possible to simulate the influence of certain innovations that specifically affect one aspect of the transport system.

With a path-finding algorithm used in the Terminal Model and NEAC, the container flows are sent over the network. Due to the high level of detail in Europe, the exact routes that trade flows take can be identified. By analysing these routes, it is possible to determine the impact of the Eurasian rail freight flows on the environment.

3.3 Scenario development

Scenario analysis is an important tool for understanding the potential impact of Eurasian rail freight on the European transport network because it allows for the examination of different potential outcomes based on various assumptions and uncertainties. This helps to identify potential risks and opportunities, and to develop strategies to mitigate or capitalize on them. Additionally, scenario analysis allows to evaluate the sensitivity of the outcomes to changes in key factors such as economic conditions, regulatory environment, new trade lanes and technological developments. Scenario analysis provides valuable insights into the robustness of different strategies and can inform decision-making related to the development and implementation of policies and projects related to Eurasian rail freight and the European transport network.

Table 3-1: Scenarios developed within this task.

Scenario	Description
2030 Scenario	Describes what is to happen in 2030 if current trends and policies continue without any significant changes
2050 Scenario	Describes what is to happen in 2050 if current trends and policies continue without any significant changes
Disadvantaged regions scenario	Describes the impact on disadvantaged regions for the year 2030 if these regions are better connected and have increased trade with China.
Rail freight corridors scenario	Describes the impact on the railway sector and identifies necessary investments for the year 2030 if rail will experience increased efficiency

The scenario method consists of several steps, the first of which is a description of the system under investigation and the factors influencing it, followed by an outline of the development possibilities and a justification of a given decision situation. As a result, many potential images of the future are obtained. The advantage of scenario analysis is the possibility of examining the effects of decisions under changing circumstances. Scenario planning is an important tool for identifying risk factors and areas of uncertainty regarding certain developments. Table 3-1 summarises the scenarios developed within this task. Two types of scenarios were developed, a baseline scenario for the future and specific scenarios.

3.3.1 Future scenario: 2030 and 2050

The baseline scenario is a representation of what is expected to happen in the future if current trends and policies continue without any significant changes. It helps to understand the most likely future scenario while also serving as a reference point for other scenarios to assess the potential impact of the more specific scenarios.

Table 3-2: Modifications to model input for the 2030 and 2050

	2030	2050
Trade data	▪ Increased trade between Europe and China based on OECD country GDP projections. ▪ Increased trade in share of high value goods due to China becoming more advanced economy.	▪ Further increased trade between Europe and China based on OECD country GDP projections. ▪ Further increased trade in share of high value goods due to China becoming more advanced economy.
Transport costs	▪ The relative cost differences between hinterland transport and intercontinental sea transport have been kept the same. ▪ Reduced cross-border time for Eurasian intercontinental rail. ▪ Abolishment of Chinese subsidies	▪ The relative cost differences between hinterland transport and intercontinental sea transport have been kept the same. ▪ Further decrease in cross-border time for Eurasian intercontinental rail
Transport network	▪ Eleven new rail PEPs have been added to the network with direct intercontinental shuttles to China, on top of the nine rail PEPs that were in the model in the 2019 base year. ▪ Shuttle services between the PEPs have been increased	▪ No additional PEPs have been added to the network.

The baseline scenario is carried out for 2030 and 2050. Much focus was placed on mapping the likely developments in 2030, with the 2050 scenario being mainly a further extension of the developments from 2030. The reason for this is that 2030 is closer in time than 2050, which means that the assumptions and uncertainties associated with forecasting further into the future are greater. By focusing on a shorter time horizon, it is easier to make more accurate predictions and to identify potential risks and opportunities more clearly. Many of the changes and developments that are likely to occur by 2030 are already in motion and can be more easily anticipated. Furthermore, a 2030-time horizon can provide a useful frame of reference for corridor and node strategic planning and decision-making, as it allows policy makers and businesses to focus on the most immediate and pressing issues. Thus, the effort put into developing the future scenarios is proportional to the level of uncertainty and the level of detail required. The modifications to model input for 2030 and 2050 are summarized in Table 3-2.

3.3.2 Specific scenarios

Specific scenarios are representation of a possible future state of a system based on a set of assumptions that differ from the baseline scenario. In the case of PLANET, the focus point of the specific scenarios is on disadvantaged regions and the rail freight corridor.

3.3.2.1 *Disadvantaged regions scenario*

Eastern Europe is the gateway for rail transport to and from Asia. In this scenario, considerations are made in case the disadvantaged regions develop very strongly. This involves infrastructural development on the one hand, and socio-economic development on the other. From this analysis, key hubs for China Europe rail transport are identified, which can serve as a starting point to develop more centralized or local strategic management initiatives.

3.3.2.2 *Rail freight corridors scenario*

Europe has always been strongly committed to rail freight transport. In this scenario, rail freight transport is highly efficient and attractive. Low costs due to economies of scale, an extensive rail network, infrastructure investments, fast trains, and efficient terminals, among other things, contribute to many shippers opting for rail freight transport instead of other modes of transport. In this scenario, the Eurasian rail route will be used much more intensively for trade between Asia and Europe. This scenario includes:

- Lower transport costs by rail.
- Decrease in transport time.
- Efficient border crossings.
- More efficient rail terminal operations.

4 Belt and Road Initiative 2030, 2050 scenario analysis

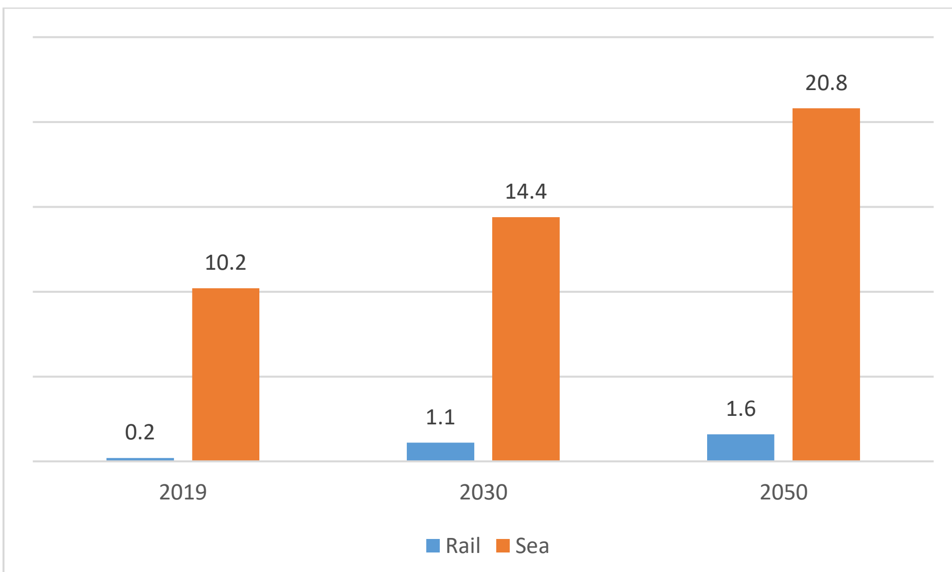
This chapter presents the potential future impact of the Belt and Road Initiative on the TEN-T. First, a global overview of the projected containerised transport flows from China to Europe is presented. Next, this chapter considers the impact of the predicted transport flows on nodes, infrastructure and associated expected external costs. The conclusion is devoted to the implications for TEN-T based on the modelling results.

4.1 Overview

4.1.1 Market potential

An overview of the model results is shown in Figure 4-1. In the base year 2019, some 200,000 TEUs were imported annually from China via rail. In contrast, about 10.2 million containers were imported from China by sea in the same year. Thus, by far the largest share of imported containers comes to Europe via sea, reaching a modal share of around 98% in 2019.

Figure 4-1: Modelled import flows of containers from China to Europe by intercontinental transport mode in TEUs



The strong increase in Eurasian rail transport, already visible in recent years, is expected to continue until 2030. Since the outbreak of the Corona crisis, Eurasian rail transport has already experienced above-average growth. The skyrocketing prices of containerised sea freight from China and Europe have led more and more carriers to use the rail route between China and Europe. As a result, in the years 2020 and 2021, Eurasian rail transport increased faster than what was anticipated. In 2020, Europe imported in total some 335,000 containers from China by rail, in 2021, this rose to 410,000 TEU[2]. Due to the war in Ukraine and

[2] Eurasian Rail Alliance Index (2023) ERAI Railway Analytics and Statistics. [online] Available at: https://index1520.com/en/

its impact on international trade, combined with falling prices for containerised sea transport, the number of containers imported from China fell to 276,000 TEUs in 2022.

The effects of the Corona crisis and the ongoing war in Ukraine are likely to be relatively small in comparison to the potential long-term benefits of the BRI. It is therefore expected that towards the future the trends that led to the strong development of Eurasian rail transport before 2020 will continue.

Based on expected GDP growth and expected developments in Eurasian rail transport, it is possible to forecast the expected market potential of transport volumes on the BRI. It is expected that by 2030, there will be a potential of some 1.1 million containers that can be imported from China to Europe via intercontinental rail. This corresponds to a modal split share of rail transport of 7%, while maritime transport accounts for some 93%.

Towards 2050, the growth will slow down as market potential will be reached after 2030. In 2050, the number of containers imported from China is expected to be around 1.6 million. The main growth towards 2050 comes from GDP growth and an increase in higher-value and time-sensitive goods.

The forecast concerns a market potential, i.e., the maximum number of containers under optimal conditions. Further investments in infrastructure and processes will be needed to reach this market potential, including capacity expansion, infrastructure investments, harmonisation of laws and regulations and acceleration of customs and border procedures. How quickly the market potential will be reached depends on how quickly the necessary investments in infrastructure and processes can be realised.

4.1.2 Transport costs

For some regions in Europe, Eurasian rail transport is more attractive than for others. The extent to which a region invests in BRI infrastructure, such as terminals, serves or infrastructure, depends on how much potential this new route has for the region.

The transport flow simulation is based on the cheapest route from the origin region in China to the destination region in Europe. Based on a combination of transport cost and transport time, a container takes the shortest route, which is either by sea or via Eurasian rail. As higher-value goods are more time-sensitive, the BRI is more likely to be used for these types of goods, as the time factor weighs more heavily in route choice. In this way, it is possible to identify per region and for different types of goods how attractive the BRI is compared to sea transport. This can be seen in the figures below.

When the average generalised transport costs of all origin regions in China are taken for each NUTS3 region, a pattern emerges. This can be seen in Figure 4-2 if Eurasian rail is used, and in Figure 4-3 the maritime option is chosen. The generalised transport costs seen in these figures include the transport costs of the intercontinental leg as well as the hinterland leg and the value of time, in euros per TEU.

Figure 4-2: Average generalised transport costs of Eurasian rail transport per NUTS3 region high value (> 15 €/KG) goods in 2030, in € per TEU.

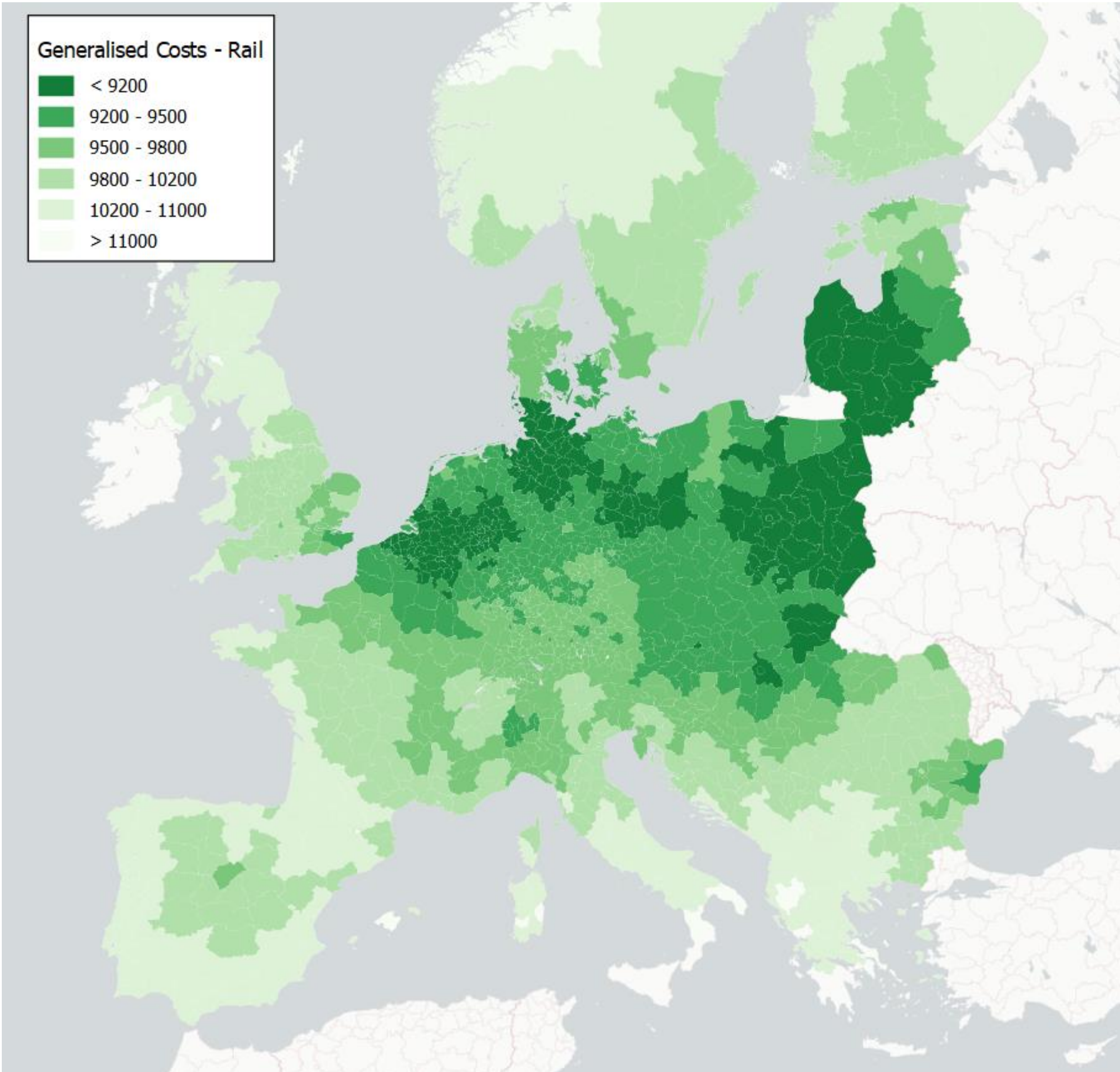


Figure 4-3: Average generalised transport costs of Eurasian maritime transport per NUTS3 region high value (> 15 €/KG) goods in 2030, in € per TEU.

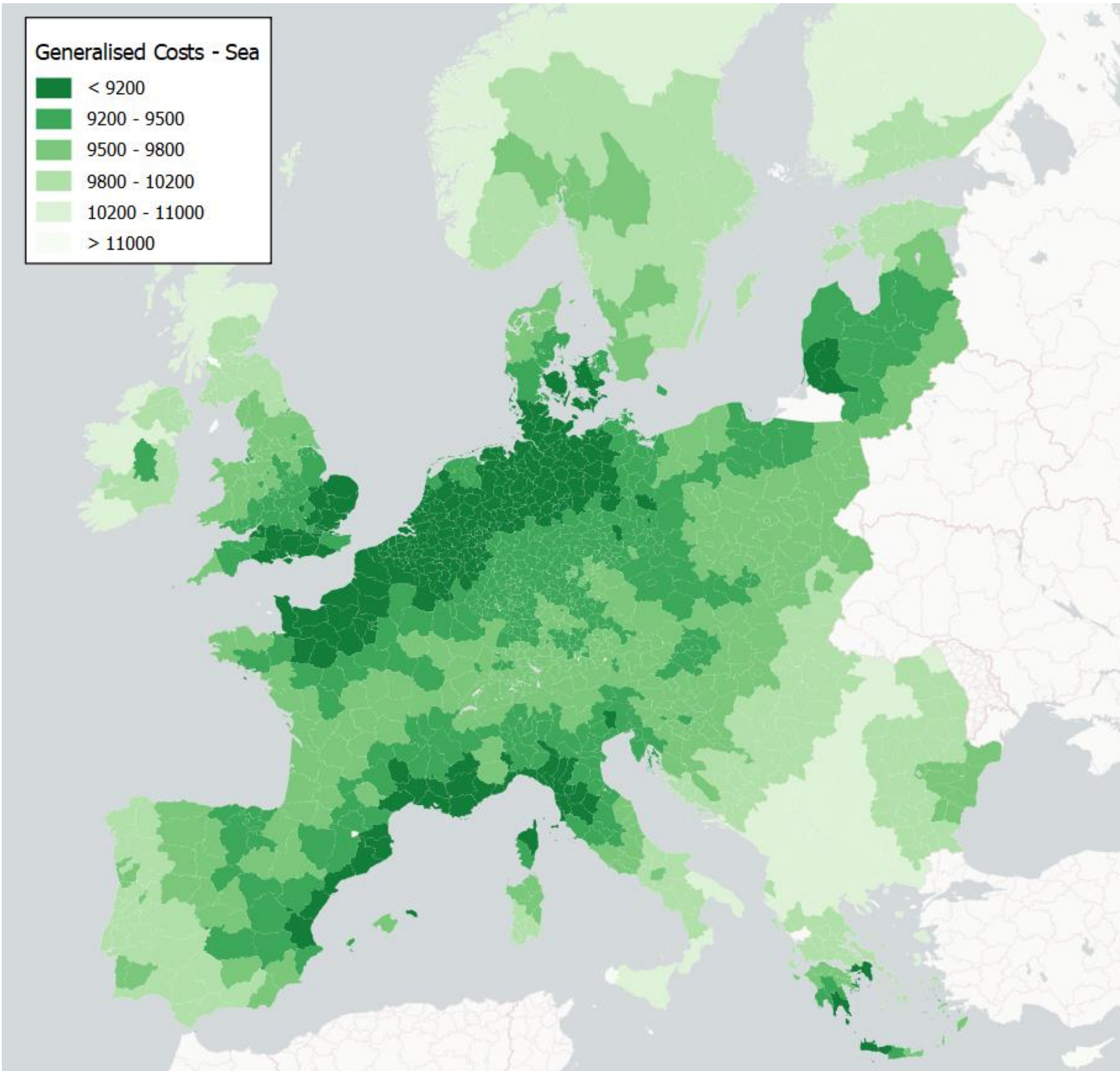


Figure 4-4: Cost difference of Eurasian rail transport compared to maritime transport for high value (> 15 €/KG) goods in 2019.

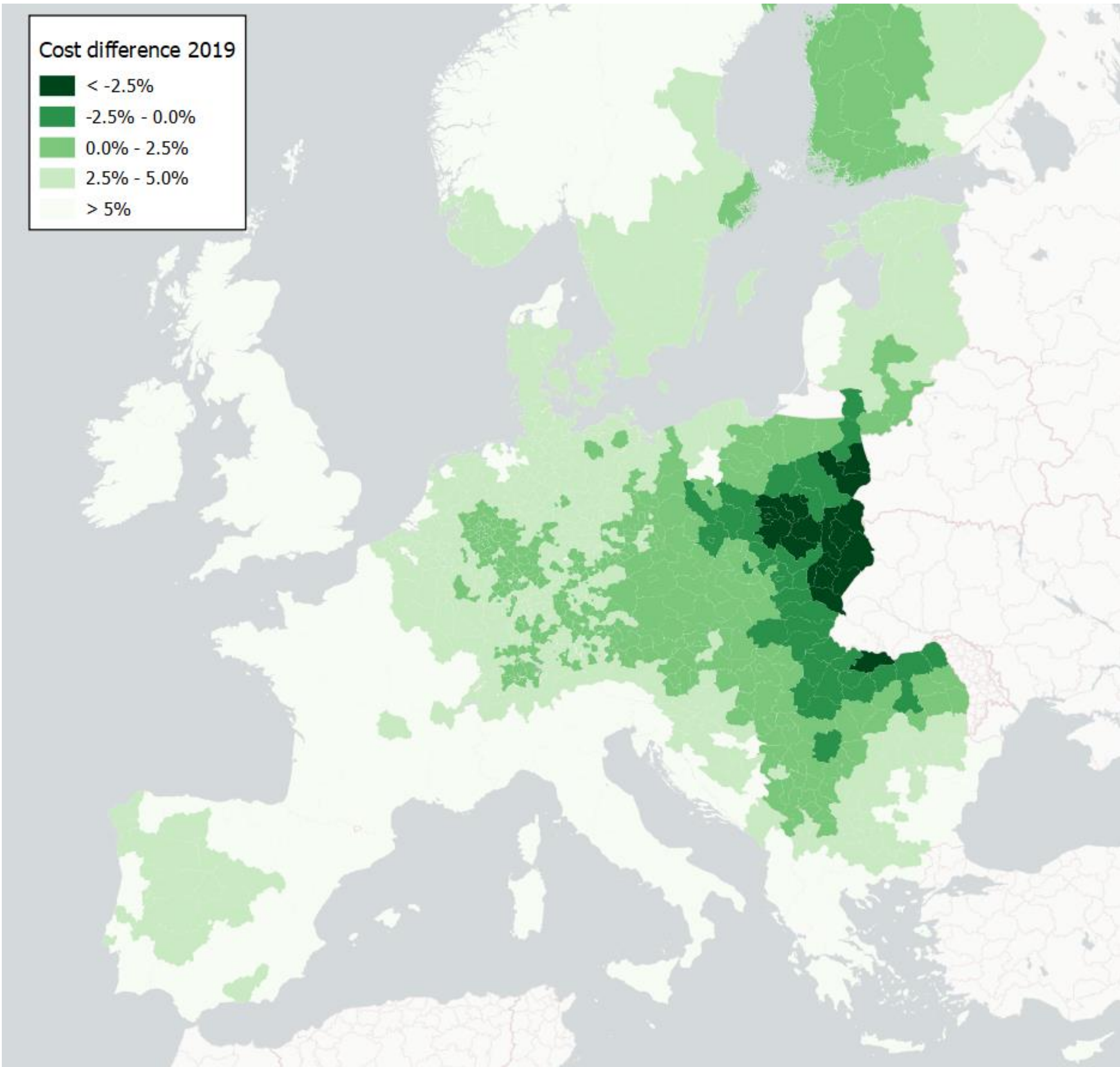


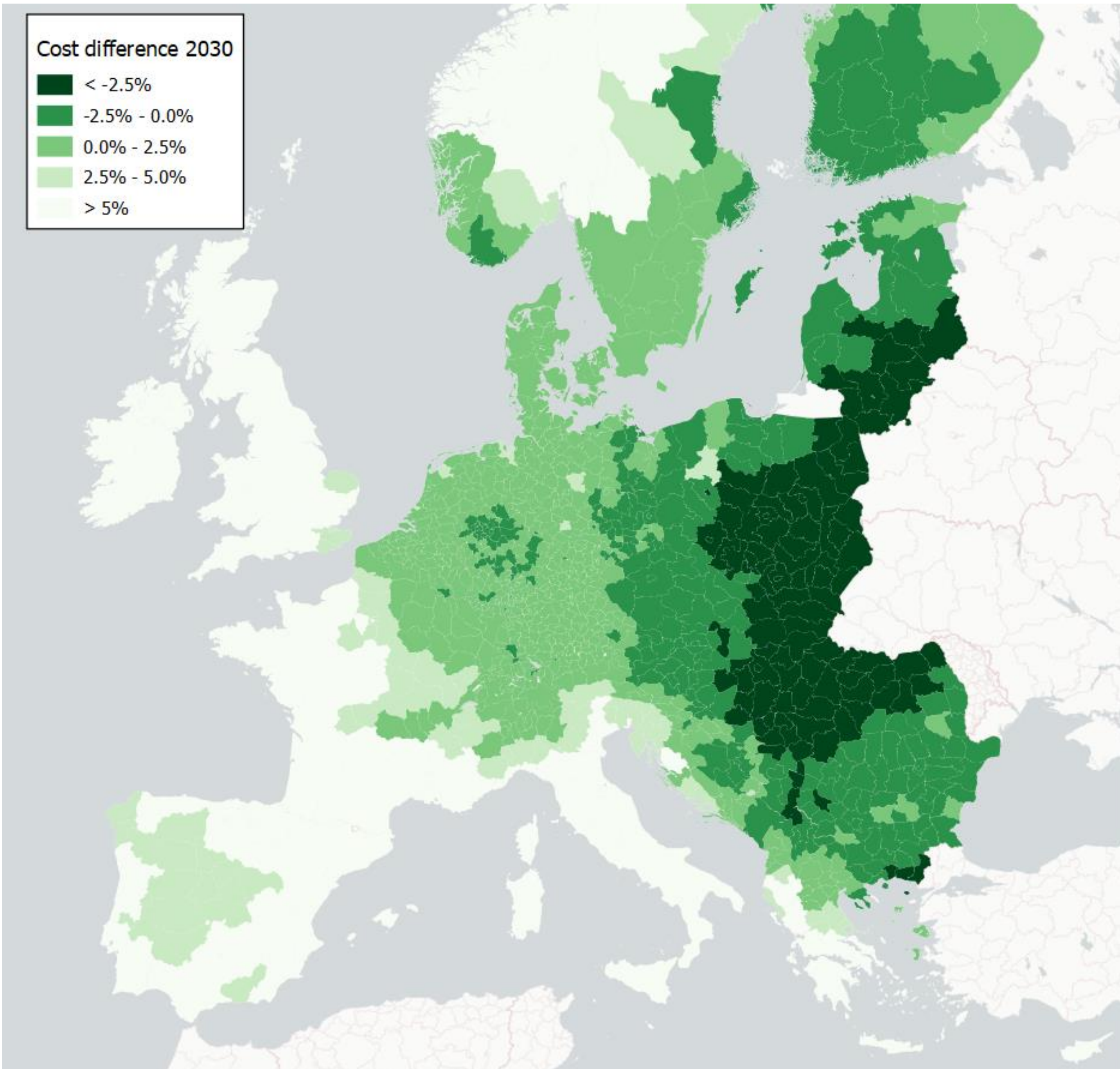
Figure 4-4 shows the attractiveness of Eurasian rail transport compared to sea transport in 2019 for high-value goods worth more than €15 per kilo. The figure shows that Eurasian rail transport is attractive compared to maritime transport under the following two conditions:

- Regions that have direct shuttle services with China, such as Madrid, Hamburg, Tilburg, Lodz, Duisburg, and Finland[3], have a significant advantage when it comes to transport time to China. This is because the proximity of direct rail connections with China minimizes the time it takes to transport goods. In contrast, regions without direct rail connections, like Paris in 2019, must rely on additional last-mile transport to a rail PEP, which increases lead times and makes the overall transport process less efficient. At Małaszewicze, for example, containers can be transported straight from broad gauge on trucks to the European hinterland. An extra transfer to broad gauge is saved, saving about 2 to 3 days of extra travel time compared to other terminals in the European hinterland that do not have a connection to broad gauge.
- In addition to the proximity to China, the distance to seaports is also an important factor in determining the competitiveness of Eurasian rail transport. Regions that are farther away from seaports will typically incur higher transport costs and longer transport times. However, if a region is relatively far from a seaport but close to a rail PEP, this can make Eurasian rail transport more attractive as it compensates for the longer distance to the seaport. This is particularly true for regions in the Baltic Sea, where ocean vessels from China must travel around all of Europe before reaching ports in this region, in comparison to seaports in the Mediterranean Sea, which have shorter shipping times.

Looking at the situation in 2030 in Figure 4-5, it is observed that efficiency improvements will make Eurasian rail transport more attractive compared to intercontinental maritime transport for almost all regions.

[3] Due to the war in Ukraine, rail transport from China to Finland has been temporarily suspended.

Figure 4-5: Cost difference of Eurasian rail transport compared to maritime transport for high value (> 15 €/KG) goods in 2030.



The model shows, looking at the generalised transport costs, while initially Eurasian rail transport was especially competitive with intercontinental sea transport mainly in the Czech Republic, Hungary, Slovakia, Poland, and northern Romania, by 2030, the attractiveness of Eurasian rail transport is shifting westward.

This shift could lead to the following implications:

- **Increased competition among regions**: If regions in the west of Europe become more attractive for Eurasian rail transport, it could lead to increased competition among these regions for a larger share of the market. This could result in increased investment in rail infrastructure and logistics, as well as more aggressive marketing strategies to attract businesses to use rail transport.

- **Changes in trade patterns**: A shift in the attractiveness of Eurasian rail transport could lead to changes in trade patterns, as businesses in regions that become more attractive may shift their exports to Asia via rail instead of sea. This could lead to changes in the flow of goods and money between different regions and countries.
- **Impact on seaports**: A westward shift in the attractiveness of Eurasian rail transport could lead to a decline in the use of seaports in the region. Given the overall share of rail transport in intercontinental trade remains limited, this impact is expected to be limited.
- **Redistribution of jobs and investment**: If some regions lose competitiveness because of a shift in the attractiveness of Eurasian rail transport, it could lead to a redistribution of jobs and investment in logistics, transportation, and other related industries.
- **Changes in the role of rail PEPs**: The role of rail PEPs may also change depending on the attractiveness of the regions. If regions in the west of Europe become more attractive, the role of rail PEPs in those regions could become more prominent, while the role of rail PEPs in other regions could decline. However, the development could also move in the other direction. As rail PEPs in eastern Europe receive more traffic, they can benefit from economies of scale and therefore offer better services and facilities. Thus, they can offer more competition against the well-developed PEPs in western Europe. Hence, it very much depends on which strategy the terminals adopt.

In general, this means the geographical area where choices must be made by policymakers and companies about investments to unlock the full potential of Eurasian rail transport becomes larger and therefore more complex. Based on the simulations, it is possible to better understand where these investments are needed. Possible investments in nodes and infrastructure are described in the following two sections.

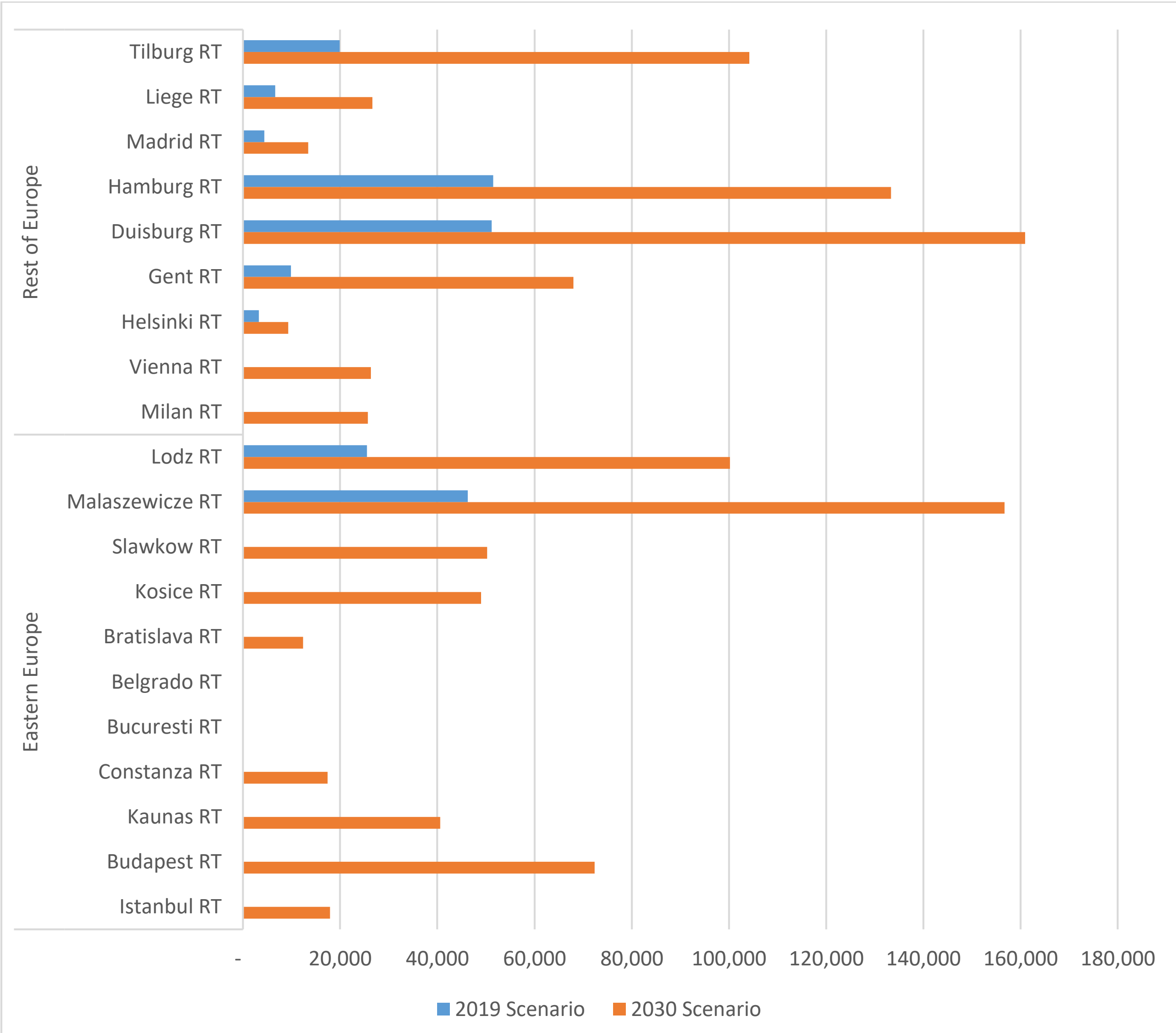
4.2 Node impact

Transport nodes play a key role in the supply chains of containers moving between Europe and Asia. An analysis of the prioritization of rail PEPs can help identify key areas for investment and development, which can improve the efficiency and cost-effectiveness of trade, support economic development, and improve competitiveness in trade with Asia.

Figure 4-6 shows the modelled transhipment by rail PEP in 2030 compared to the baseline case from the year 2019. Several rail PEPs did not yet have regular rail service with China in 2019, hence, these rail PEPs do not yet have transhipment figures for 2019.

The expected transhipment volumes in Figure 4-6 should be seen as the market potential that exists in this region. It is advisable to opt for a regional approach to realise these expected transhipment volumes, for example by spreading the market potential across different terminals in the region according to the availability of capacity. The section below elaborates on the implications for different PEPs, where most transhipment is expected.

Figure 4-6: Modelled transhipment per PEP in 2019 and 2030.



4.2.1 Tilburg RT

The container terminal in Tilburg is in the Northeast of the city. The terminal has three 600-meter-long tracks that are served by reach stackers. The terminal in 2019 handled around 20,000 TEU coming from China per year. This is expected to grow significantly reaching a market potential of 105,000 TEU in 2030.

Access to the tracks is limited and one track is reachable at a time. In addition, the track layout means that trains can only enter from the North via the main line. This means that trains will need to change direction before entering the terminal from the south. Electrification of the track was completed in 2016 at a cost of 1.1 million euro.

Upgrading this terminal likely involves adding a connection from the south side as well as installing a gantry crane. Cost estimates for gantry cranes range between 25,000 and 75,000 euro, although installing and additional costs would push that over 100,000 euro. The additional track connection is much more expensive and based on previous CEF-funds would cost between 1 million and 4 million euro.

Other investments are expected to be needed in the long term, such as an additional gantry crane, an expansion of the storage space, additional reach stackers and the track needs to be lengthened. These additional requirements are much more expensive and based on previous work at a terminal in France/Spain, it would cost some 8 million euro, with around half of that covered by European funding.

4.2.2 Liege RT

The terminal in Liege is a trimodal terminal to the north of the city. The terminal has two tracks and no rail mounted gantry cranes. Instead, the terminal is served by reach stackers, which have a lower handling capacity (15 containers/hour compared to 30 for gantry crane).

The terminal was built in 2015 and is thus relatively new. The current yearly handlings are on the low side compared to the main terminals served from China, Hamburg, and Duisburg. In 2030, terminal is expected to have a market potential of 27,000 TEU per year. The advertised yearly capacity is 200,000 TEU. Not all the infrastructure is yet in place to reach this capacity, but this will be provided in the near future. This terminal is not expected to become a capacity bottleneck.

4.2.3 Hamburg RT

There are many intermodal terminals located in and around Hamburg. Together, these terminals have a yearly handling capacity of around 2.2 million TEU. As the third largest container port in Europe, this means that 1958 weekly freight trains depart from the port towards other intermodal terminals, making it the largest rail port in Europe.[4]

China is already the second largest market for intermodal trains (behind Germany, with 1095) in Hamburg, with 232 trains weekly , compared to 164 for the Czech Republic, 132 for Austria, and 84 for Poland.

The growth of the container shipped from China by rail is expected to be large, just under 133,000 TEU per year. However, because of the large existing handling capacity there is not expected to be an issue with capacity in 2030.

4.2.4 Duisburg RT

There are three terminals around Duisburg that will see significant increases in container trains on the way to 2030. These terminals are:

- Samskip van Dieren Multimodal
- Duisburg-Ruhrort Hafen
- KV-Hub Rhein-Ruhr

[4] Zasiadko, M. (2022, May 9). Trains dominate in moving containers to and from Port of Hamburg. Intermodal News. [online] Available at: https://intermodalnews.eu/2022/05/09/trains-dominate-in-moving-containers-to-and-from-port-of-hamburg/

The KV-Hub Rhein-Ruhr and the Ruhrort Hafen terminal are located close to one another in the port of Duisburg, just north of the city centre, while the Samskip van Dieren terminal is located to the southwest of the city.

The KV-Hub Rhein-Ruhr has 4 tracks of 710 meters that are served by two rail mounted gantry cranes which can handle 30 containers per hour per crane.

The Ruhrort Hafen has many tracks, namely:

- 5x 680 meters
- 1x 780 meters
- 3x 600 meters

These tracks are served by three rail mounted gantry cranes, each of which can handle 30 containers per hour. The total storage capacity of the terminal is limited to 500 TEU interim and 320 TEU at the depot.

The Samskip van Dieren Multimodal Terminal has 8 tracks of 740 meters each that are served by 2 rail mounted gantry cranes that can handle 30 containers per crane per hour.

The combined yearly handling of the three terminals is 1.23 million TEU, which will likely be sufficient to deal with the growth of imported containers from China that is projected for 2030. The expected load is about 161,000 TEU per year in 2030.

Despite this high capacity, there are more upgrades and expansions planned at these (and other) terminals around the city to accommodate more traffic. And as such, further expansion is not required to deal with the traffic expected in 2030.

4.2.5 Lodz RT

The SPEDCONT Terminal Kontenerowy Łódź Olechów is located to the Southeast of the city of Łódź. The terminal has two 720-meter tracks that are served by two rail mounted gantry cranes which have a handling capacity of 30 containers per hour each. The total storage capacity of the terminal is 7500 TEU.[5]

In 2030, the terminal is expected to have a market potential of 100,000 TEU per year. The current capacity of the terminal is around 150,000 TEU per year. This means that capacity may become an issue, although it is not yet critical.

Future investments in the terminal are planned. The owner of the terminal, SPEDCONT, will invest around 16 million euros in 2022 to build/expand the area next to the current terminal. They expect the facility to be completed in 2023. Currently, the area is around 13 hectares, after the project completion, the area in use will be 18 hectares.[6]

At the same time, other investments could improve the capacity of the terminal further by allowing another entry point via rail on the other side of the terminal and modernizing the approach to the terminal by replacing old track. Based on previous CEF funding for projects, this would cost between 1 million and 5 million euro.

[5] Spedcont. (2021, May 19). About us. [online] Available at: https://spedcont.pl/en/about-us/

[6] Zasiadko, M. ed., (2022, August 11). Spedcont to construct new intermodal terminal in Łódź. Intermodal News [online] Available at: https://intermodalnews.eu/2022/08/11/spedcont-to-construct-new-intermodal-terminal-in-lodz/

4.2.6 Ghent RT

The intermodal terminal in Ghent is located in the harbour north of the city next to the water. The terminal is rather small but is expected to grow, with an expected market potential in 2030 is 68,000 TEU.

Currently, there are three tracks with a length of 750 meters available. The terminal does not have rail mounted gantry cranes; instead, there are reach stackers. The terminal is part of the RFC Rhine-Alpine, RFC North Sea-Mediterranean, and RFC North Sea-Baltic.

Works are planned at the terminal, which would create extra sidings, passing tracks, and extra track. These would be conducted between 2019 and 2025 and cost 1.5 million euro. However, these do not address fundamental shortcomings with regard to handling capacity. Rail mounted gantry cranes would significantly boost the capacity of the terminal without hindering operations for the reach stackers. The cost per gantry crane is at least 100,000 euro and with the expected market potential in 2030, at least two would be required.

4.2.7 Małaszewicze RT

The PKP CARGO Centrum Logistyczne Małaszewicze is one of the most important transfer points for containers coming from the east to Europe. Located just across the border from Belarus, the terminal is mostly important for transhipment to and from destinations in China. Transhipment volumes are expected to grow year on year and will serve as one of the main entry points for containers coming from China to the EU. The terminal is part of the RFC North Sea-Baltic and RFC Amber.

In 2018, some 6300 trains crossed the border between Poland and Belarus with the majority passing through the Małaszewicze terminal. Not all of these trains were container trains as besides the function as container transhipment centre the terminal is equipped for handling bulk cargo. The container terminal has five tracks in Russian gauge and five tracks in standard gauge, which are served by four rail mounted gantry cranes. The current handling capacity of the terminal is 223,000 TEU and the expected market potential from China in 2030 is 156. 000 TEU.

The market potential may cause capacity problems in 2030. However, due to the changing position of the EU on trains from Belarus and Russia due to the war in Ukraine[7] the focus of the connections will likely shift southward towards the terminals in Slawkow and Košice. As such, the Małaszewicze terminal may lose some of its importance.

Between 2016 and 2021, an expansion project at the terminal costing some 2.6 million euro was undertaken to modernize the loading zone at the intermodal terminal.[8] This project tackled the following issues:

- Development of railway traffic control systems.
- Increased number of trains served.
- Improved operability.
- Improved safety at rail-road level crossings.

[7] European Commission. (2022, July 27). Commission amends TEN-T proposal to reflect impacts on infrastructure of Russia's war of aggression against Ukraine. [online] Available at: https://transport.ec.europa.eu/news/commission-amends-ten-t-proposal-reflect-impacts-infrastructure-russias-war-aggression-against-2022-07-27_en/

[8] INEA (n.d.). Modernisation of railway infrastructure at the Małaszewicze Transloading Zone. [online]. Available at: https://wayback.archive-it.org/12090/20190615101722/https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2015-pl-tm-0037-s

- Increased participation of Małaszewicze cargo terminal in the clearance of trains in directions from/to EU and eastern countries – Belarus, Russia, Kazakhstan, China.

Further modernization is also planned, as the operator of the terminal has applied for CEF 2 co-financing for the further development of the Małaszewicze terminal. The project is a comprehensive modernization of the infrastructure which seeks to expand the capability of the terminal to handle 1050-meter-long trains on 1520mm track and 750-meter-long trains on 1435mm track. Train speeds should also be increased from 20 to 40 km/h.[9]

Another issue is the state of the road infrastructure around the terminal. Currently, many trucks must queue on local roads because there is not enough room to park on the terminal grounds. Subsidies for this kind of infrastructure have proven difficult to obtain.[10]

To improve the terminal, further funding should be directed towards improving the surrounding infrastructure to allow for further growth. Estimating the cost of these measures is difficult because not all issues are with the terminal itself but also with the surrounding infrastructure. However, improving the road access by improving the intersection with the national road 2 as well as widening the access road to the intermodal terminal (around 3km) should cost less than 9 million per km. This cost is based on the average cost in Poland for highway construction, so the costs for a small road should be a fraction of that.[11]

4.2.8 Slawkow RT

The Euroterminal in Slawkow, Poland, is an important connection to the east as the Russian gauge railway from Ukraine ends at the terminal. As such, the terminals allow for transfers between Russian gauge and standard gauge. This makes integration with other nodes easier and faster. The terminal is also in the heart of many important railway connections to industry and is located on three RFC corridors, namely: Baltic-Adriatic, North Sea-Baltic, and Amber. Furthermore, with the EU policy shift from Belarus and Russia towards Ukraine, there is a lot more traffic expected at the Slawkow terminal.

The terminal has six 850-meter-long tracks, which are divided between Russian gauge and standard gauge. There are two rail mounted gantry cranes with a capacity of 30 containers per crane per hour. Storage capacity is 1800 TEU.

The terminal is expected to handle a market potential of 50,000 imported TEU from China per year in 2030. With a current yearly handling of around 284,000 TEU it is not expected that the terminal will experience capacity issues as there is some room to grow in the current configuration. However, a shift in rail from other terminals as a result of Ukraine focused transport policy will cause issues that require extensive upgrades in the form of additional tracks and gantry cranes, as well as more storage space. Whether this shift occurs depends on the EU stance towards trains to and from China passing through Belarus and Russia. As such, a CEF funded study into the potential shift in traffic from Belarus and Russia to rail lines in Ukraine should be conducted. Based on previous studies, this should cost around 1 million euro.

[9] RailTarget (2022, January 2). Modernization and extension of railway infrastructure in Małaszewicze Poland have applied for significant funds from the EU | RAILTARGET. [online] Available at: https://www.railtarget.eu/technologies-and-infrastructure/modernization-and-extension-of-railway-infrastructure-in-maaszewicz-poland-have-applied-for-significant-funds-from-the-eu-1606.html

[10] Kuś, L. (2022, August 30). Małaszewicze still a key Eurasian transport hub for Chinese logistics companies | IntermodalNews EU. [online] Available at: https://intermodalnews.eu/2022/08/30/malaszewicze-still-a-key-eurasian-transport-hub-for-chinese-logistics-companies/

[11] Więckowski, A. (2017). Differentiated road construction costs. Scientific Journal of Silesian University of Technology. Series Transport, 96, 205-213. ISSN: 0209-3324. DOI: https://doi.org/10.20858/sjsutst.2017.96.19

A more practical issue that can be tackled is that the entry and exit tracks do not allow direct connections in all directions without reversing and it is in part single track before it merges with the main lines. The terminal has not seen major upgrades since 2012, and no new upgrades are planned. The cost of new connections would be rather high and is estimated to be between 5 and 10 million euro because of the complexity of the surrounding area. If additional capacity in the form of tracks and gantry cranes needs to be added the costs could be an additional 10-15 million euro.

4.2.9 Košice RT

There are two intermodal rail terminals in Košice and one in the town of Dobra near the Ukrainian border. This terminal near the Ukrainian border, TKB Dobra, is expected to have a market potential of imported containers from China of 49,000 TEU in 2030. However, this is subject to change as the EU has shifted focus from Belarus and Russia towards Ukraine.[12] Either way, with a capacity of around 200,000 TEU per year the terminal is not at its capacity and room is available until 2030. Currently, the terminal has 90% capacity left over, while in 2030 the terminal is expected to be at around 29% of capacity. Minor infrastructure interventions could further increase capacity, although this is not required for operations in 2030. While the other two terminals in Košice are also able to handle container traffic, they are less well equipped to deal with a large increase in container traffic than TKB Dobra. However, all the terminals are important in the Slovakian strategy to increase the share of freight transport using rail.[13]

The Dobra terminal has 8 tracks with a total usable length of 5378 meters which are divided as follows:
- 2x 579m long track
- 2x 594m long track
- 2x 709m long track
- 2x 807m long track

All these pairs have one track on standard 1435mm gauge and one on 1520mm Russian gauge for transferring between the two gauges.

The terminal has two rail mounted gantry cranes that can provide 30 handlings per hour each. The temporary storage area is quite small for a terminal of this size with 1730 TEU on a footprint of 2640 m^2.

Despite the policy shift and high increase in traffic, the terminal is not expected to reach capacity in 2030. Additional projects are not (yet) planned and are not required for the expected traffic.

4.2.10 Kaunas RT

The Kaunas terminal is expected to have a market potential of around 41,000 TEU imported from China per year in 2030. With a current transhipment capacity of 55,000 TEU there is a slight concern regarding the available capacity.

The layout of the terminal allows for four usable tracks of 450 meters each that are served by a rail mounted gantry crane. The terminal has room for the storage of 1.120 TEU in a storage area of 18,000m^2. As part of the Rail Baltic project, the terminal serves an important function in the European network.

[12] European Commission (2022, July 27). Commission amends TEN-T proposal to reflect impacts on infrastructure of Russia's war of aggression against Ukraine. [online] Available at: https://transport.ec.europa.eu/news/commission-amends-ten-t-proposal-reflect-impacts-infrastructure-russias-war-aggression-against-2022-07-27_en

[13] Ministry of Transport, Construction and Regional Development of the Slovak Republic (2016). Strategic Transport Development Plan of the Slovak Republic up to 2030 – Phase II. [online] Available at: https://www.opii.gov.sk/download/d/sk_transport_masterplan_(en_version).pdf

Two of the tracks in the terminal are 1435mm and two tracks are 1520mm. The transfer of containers between the two gauges via a gantry crane is a strong characteristic of this terminal. It is also needed for transporting containers from Lithuania to Poland, as the Lithuanian network operates on Russian gauge while Poland and the rest of Europe operate on standard gauge. This terminal and the accompanying track connection to Poland have also allowed trains to bypass Belarus. This is beneficial for both political and practical reasons. Politically, because relations between the EU and Belarus are cold and capricious and practically because trains will not have to leave the EU Schengen zone.

Upgrades to this terminal require changes to the track and the addition of another gantry crane but are not very complex. This means that the expected cost for the gantry crane is at least 100,000 euro and the cost for the tracks is expected to be between 1 million and 5 million euro.

4.2.11 Budapest RT

The terminal in Budapest forms an important link with RFC corridors Mediterranean, Orient/East-Med, Rhine-Danube and Amber. There are currently six tracks of 650 meters each served by two rail mounted gantry cranes that can each handle 30 containers per hour. There is a rather large capacity for interim storage of 20,000 TEU.

It is expected that the market potential for imported containers from China for the Budapest terminal is around 72,000 TEU per year in 2030. While no significant capacity issues are expected, there is room for minor infrastructure adjustments to further increase the capacity.

These adjustments are mostly in the connecting infrastructure around the terminal which is some distance away from major roads. The expected cost for these adjustments is below 12 million euro per km, as this is the cost of highways in Hungary.[14]

In addition, because the terminal is located next to the Danube a possible future upgrade may include the creation of a port to create a trimodal terminal. However, this would not increase the capacity of the rail terminal.

4.3 Infrastructure impact

In addition to nodes, infrastructure plays a critical role in enabling transport to and from the nodes and to the final destination. While hinterland transport of containers imported from China represents a small percentage of the overall traffic on the European network, specific routes where China-related traffic is concentrated can be identified.

The figures presented depict the anticipated movement of goods into and out of the rail PEPs. Because of the high concentration of transport flows, the impact on the rail network is much greater than on the road network. From the rail PEPs, the transport flows branch out through the road network to reach their final destinations. The volumes of these last-mile movements by road are minimal, so they are not expected to have a significant impact on infrastructure load. As such, this section focuses specifically on

[14] Więckowski, A. (2017). Differentiated road construction costs. Scientific Journal of Silesian University of Technology. Series Transport, 96, 205-213. ISSN: 0209-3324. DOI: https://doi.org/10.20858/sjsutst.2017.96.19

the rail infrastructure and the necessary preparations to meet the market demand for Eurasian rail transport by 2030.

Figure 4-7: Modelled transport flows of containers from China to European rail PEPs by rail in 2019

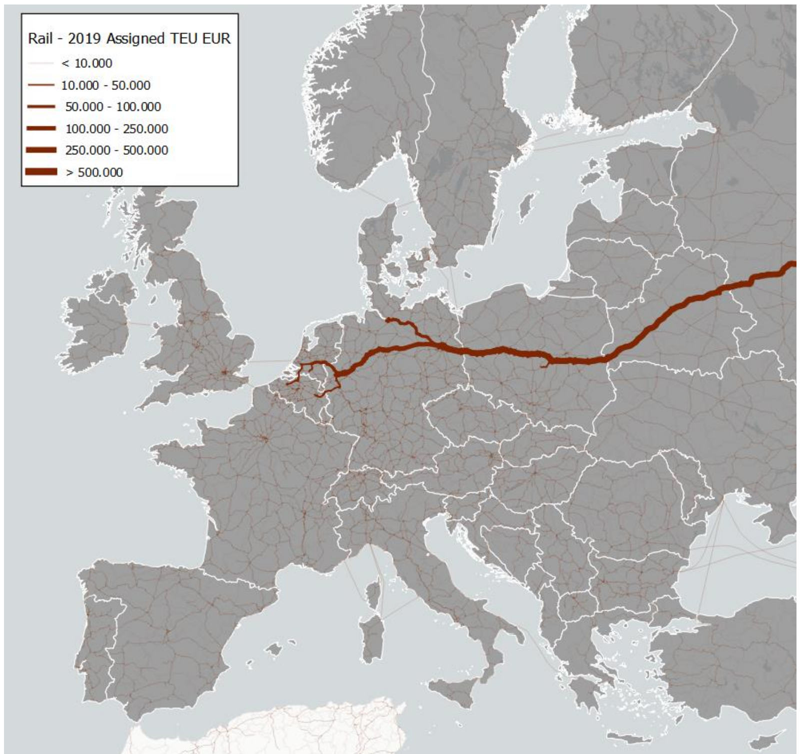


Figure 4-8: Modelled transport flows of containers from China to European rail PEPs by rail in 2030

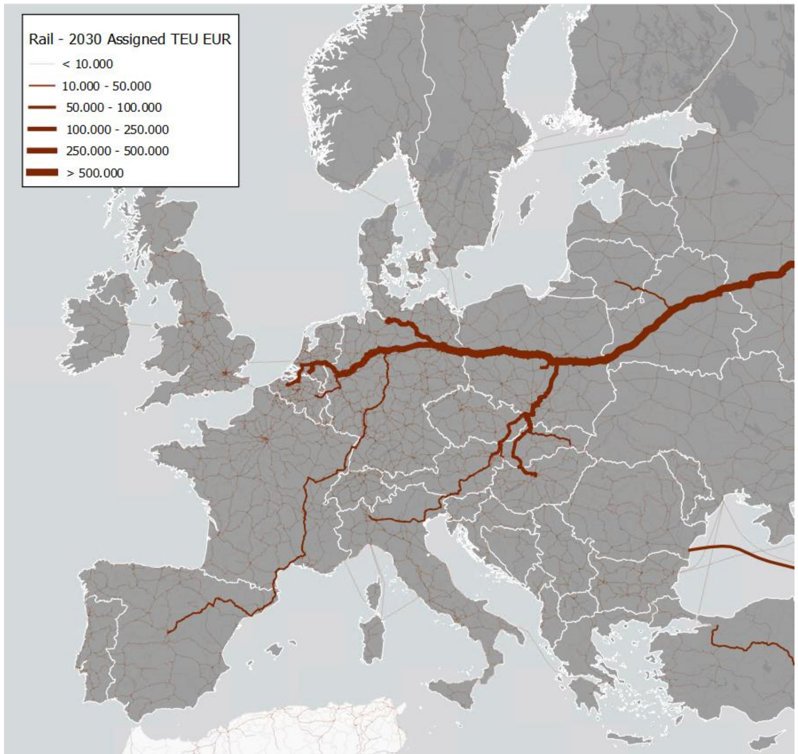


Figure 4-9: Modelled transport flows of containers from European rail PEPs to the hinterland by road in 2019

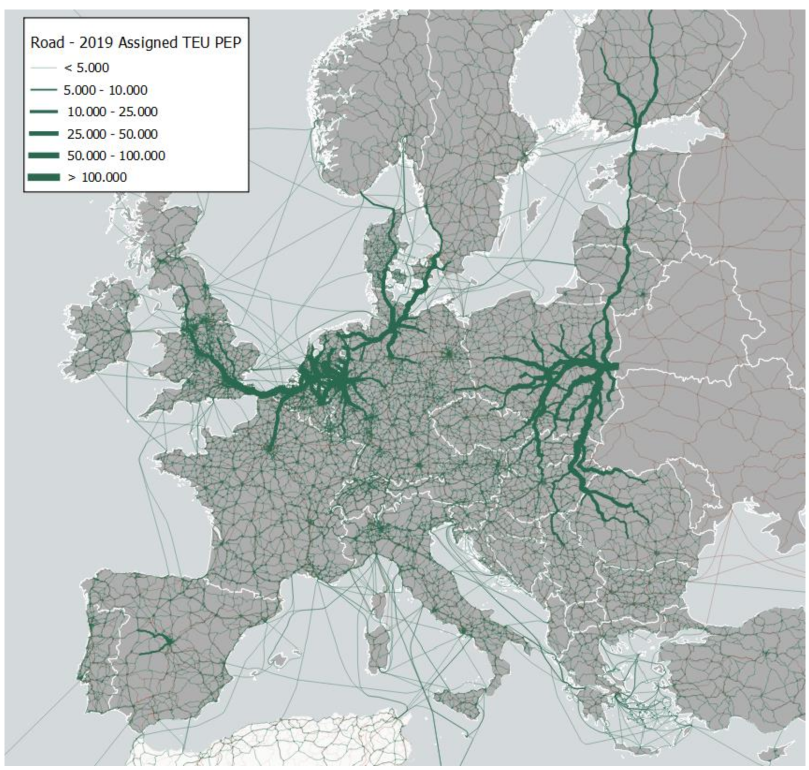
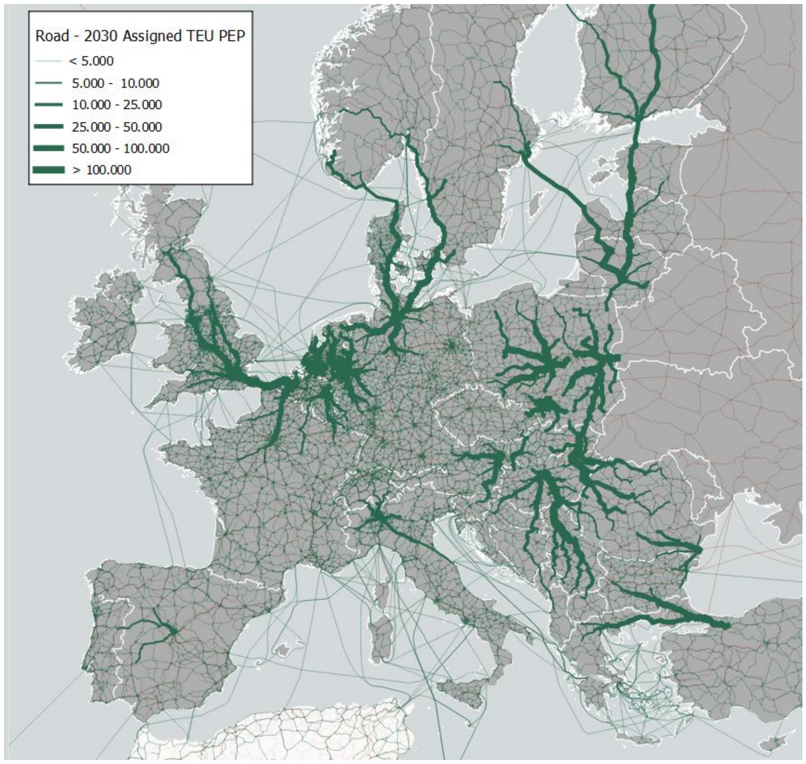


Figure 4-10: Modelled transport flows of containers from European rail PEPs to the hinterland by road in 2030



4.3.1 Małaszewicze – Skierniewice

The stretch of rail between Małaszewicze and Skierniewice is a heavily utilized segment of the European freight rail network and is projected to see increased traffic in the future. This section handles by far the largest share of all trains going on to Europe from China. It is estimated that by 2030, a large increase of 24 intermodal trains per day is expected for this section if the full market potential of the Eurasian rail will be reached. This translates to a TEU increase of 606,000, from 320,000 to 926,000 TEU. The route is well built out and forms part of the eastern branch of the North Sea-Baltic rail freight corridor. As of this writing, capacity is sufficient, but future demand will cause bottlenecks.

From Małaszewicze to Łuków the track is well built out with high max speeds and smooth curves (maximum speed 160 km/h). However, between Łuków and Skierniewice the max speeds along most of the corridor are 70 or 50 km/h, which is limiting throughput and contributing to future capacity problems.

A large improvement project is expected to be carried out between 2024-2027 to modernize the low-speed sections. This will allow operating speeds up to 120 km/h along the entire corridor (as opposed to the currently achieved 40-60 km/h). The entire project is expected to cost 850 million euros and has been given priority by the Polish minister for transport.[15]

With these upgrades, the track will be able to handle much more traffic. There is not much (if any) passenger traffic on this line and so all available capacity can be allocated to freight trains. This project

[15] Kolejowy Portal (2022, January 12). Modernizacja linii kolejowej Skierniewice - Łuków może kosztować około 4 mld zł. [online] Available at: https://kolejowyportal.pl/modernizacja-linii-kolejowej-skierniewice-lukow-moze-kosztowac-okolo-4-mld-zl/

should future proof the infrastructure until 2030, especially because additional growth is not expected as the section of track is the main route trains from Asia currently use. This is likely to change as the European Union has shifted the focus of rail transport from Belarus to Ukraine. However, in the short term, more traffic may be expected because the war in Ukraine means that fewer trains can pass through Ukraine than in peacetime, thereby increasing the number of trains passing through Belarus into Poland. For this purpose, a study is required to estimate the effects of the war in Ukraine on future throughput. This study should address the different possible outcomes the war could have on the number of trains passing through. In the past, these studies were carried out at a cost of between 150,000 and 2 million euros, depending on the level of detail and complexity required. As the topic is limited in scope, the cost of such a study is expected to be on the cheaper end, at around 500,000 euro.

4.3.2 Skierniewice – Berlin

The section of track from Skierniewice to Berlin is a currently highly utilized corridor and is expected to see an increase of 11.7 intermodal trains per day. The amount of yearly TEU's transported is expected to increase from 266,000 to 564,000.

The track is double tracked the whole way, with high speeds allowed on almost all sections. However, there are some restrictions on the speed of freight trains. Polish and German electrification do differ with Poland using 3 kV DC power and Germany using 15kV 16.7Hz AC power. The track is part of the North Sea-Baltic rail freight corridor.

On the Polish part of the line, the maximum train length is often restricted to 600-650 meters.

This section of track is also heavily used for passenger rail. A high-speed rail link from Warsaw to Poznan would alleviate these problems as most of the passenger rail traffic would move to the high-speed line.[16]

There are currently plans to build this high-speed line, but the status of the project is uncertain. Funding has been secured and construction is underway or completed on other projects to increase the train length allowed to 700-750 meters. The total cost is estimated at 606 million euros.[17]

On the German part of the line from the border to Berlin there are upgrades underway to increase the track speed to 160 km/h to match the Polish section where the track is built out for operation at 160 km/h on most of the route.[18]

4.3.3 Łuków – Slawkow

The track section from Łuków to Slawkow will see an increase in TEU transported from 7,000 to 261,000. This means an additional 10 intermodal trains per day (3742% more than at this moment). While the route is double tracked the whole way, there are limits to the speeds on many sections. Especially between Radom and Kielce where speeds can go down to 80 km/h and from Kielce to Slawkow where speeds are 80 km/h on part of the route and sometimes even lower.

[16] European Commission (2014). The study of the North Sea-Baltic core network corridor. [online] Available at: https://transport.ec.europa.eu/system/files/2017-06/north_sea-baltic_study_0.pdf
[17] Railway Pro (2017, March 28). EC confirms the financing of Warsaw-Poznań modernisation. [online] Available at: https://www.railwaypro.com/wp/ec-confirms-financing-warsaw-poznan-modernisation/
[18] Deutsche Bahn (n.d.). BauInfoPortal - Projectbeschreibung Berlin – Frankfurt (Oder) – Bundesgrenze (D/PL) [online] Available at: https://bauprojekte.deutschebahn.com/p/berlin-frankfurt-oder-grenze

Serious capacity bottlenecks are expected on all sections of the line. In fact, the capacity shortage is identified as critical.[19] However, as the route is an important connection from Belarus into the EU the importance of this route will diminish in the future as the EU moves trains over to Ukraine.

In part, the capacity shortage depends on whether the broad-gauge railways through Ukraine can be used (which will lighten the load on this route). But at the same time, the quality of the route is a serious concern. Some projects have been performed to improve the situation. Between Tunel and Radom, the low speeds and low maximum train length have been tackled in two projects costing 112 and 10 million euro respectively.[20] There is also a project ongoing to modernize railway stations along the route, but this does not address the capacity constraints for freight train traffic.[21] There are projects in the planning stages, but these are limited in scope and scale. Between Radom and Deblin as well as between Deblin and Łuków it is indicated that projects are possible after 2020 that would address train lengths allowed and operating speed.[22] Combined, these projects do not adequately address the expected future capacity problems and more investment is needed if the expected throughput is to be achieved in practice.

This investment will need to improve the speeds, maximum train lengths, and quality of the infrastructure. As such, the investment costs are anticipated to be high. The total length of the route is over 300km, while the most critical section is around 140km long. When compared to previous CEF-funded studies and infrastructure funding, it is estimated that the costs would be between 70 and 90 million euros. However, before this, a study should be carried out to better estimate costs and quantify the benefits of upgrading this section of track. In the past, these studies were carried out at a cost of between 150,000 and 2 million euros, depending on the level of detail and complexity required. Given the large section of track and the expected funding need the study cost in this case is estimated to be at least 1 million euro.

4.3.4 Slawkow - Skalité – Žilina

From Slawkow to Žilina via Skalité there is an expected increase in the number of intermodal freight trains of 7.7 trains per day. The amount of TEU's transported is expected to rise from 14,000 to 211,000.

The network between Slawkow and Žilina is not well built out with parts of the network being single tracked, requiring low speeds. This is especially relevant in the section between Skalité and Czechowice in southern Poland. The tracks are very curved in many parts and the alternative route from Skalité to Czechowice also has issues. There is also the gradient to consider, as it reaches 28‰ in the steepest sections. However, despite these limitations, there is not expected to be an issue with capacity in the future on the Slovak part of the network (mostly because of low usage right now). In Poland, capacity issues are expected between Zwardon (on the Slovak border) and Wilkowice Bystra. Unfortunately, not all these issues can be fixed (steep grades cannot be tackled), but some, such as speed and ERTMS can be improved.

As part of investment in the Amber and Baltic-Adriatic RFC corridors ERTMS adoption, increasing maximum train length and removing restrictions is currently being worked on. The planned completion date for these

[19] RFC Amber (2020). Study on bottlenecks along Rail Freight Corridor Amber (RFC Amber) [online]. Available at: https://rfc-amber.eu/assets/downloads/other_public_documents/RFCAmber_bottleneck_study_final.pdf

[20] RFC Amber . (2023) Amber Rail Freight Corridor Implementation Plan. [online]. Available at: https://rfc-amber.eu/assets/downloads/corridor_information_document/Amber%20RFC%20CID%20Book%20Annex_TT2024_v2_final_v4.pdf

[21] European Commission. (n.d.). Modernisation of selected stations on the railway line No. 26 Radom – Dęblin and 8 Radom – Kielce [online].Available at: https://kohesio.ec.europa.eu/en/projects/Q86043

[22] RFC Amber. (2023) Amber Rail Freight Corridor Implementation Plan. [online] Available at: https://rfc-amber.eu/assets/downloads/corridor_information_document/Amber%20RFC%20CID%20Book%20Annex_TT2024_v2_final_v4.pdf

works is 2023. The precise section of track is between Skalité and Zwardon as well as between Žilina and Skalité.[23]

In Poland, the section from Zwardon to Wilkowice Bystra to Bielsko-Biala Lipnik to Bielsko-Biala to Czechowice is part of the line 139 works. This is 67km in total and is currently undergoing reconstruction at a total cost of 76 million euro.[24] Work started in 2021 and the expected completion date is 2027. However, this work is mostly to improve passenger train service in the area.

Further investment, such as double tracking is expected to be expensive as the section runs through difficult terrain, is over long distances (120km in total) and has limited physical space for expansions. Thus, compared to previous CEF-projects the estimated costs are between 65-80 million. While this section of track does span borders, similar projects in the past have had EU funding of around 70-85%, and this is expected in this case as well. A study should be conducted to estimate how much the upgrades to the track would cost and by how much the track's throughput would increase. Compared to previous CEF-studies such a study is estimated to cost around 1 million euro.

4.3.5 Berlin – Hannover

The section of track between Berlin and Hamburg is expected to see an increase of 6.5 trains per day by 2030. The estimated TEU growth is 166,000 (from 168,000 to 334,000). This section of track is part of the North Sea-Baltic corridor but is not seeing new investment from this program. There are no current bottlenecks in this section of the corridor and capacity issues are not expected now or in 2030. There are still some improvements that could be made, however. Not all the track between Berlin and Hannover has the same standards, there are some sections where the maximum train length is lower than the usual 700-740/750 meters. But these restrictions do not need to be removed in order to deal with the expected traffic.

4.3.6 Hannover – Duisburg

The line from Hannover to Duisburg will see an additional 6.2 trains per day in 2030 compared to 2019. This means an increase in TEU from 168,000 to 326,000.

The entire track section is in Germany on a corridor that is well built-out and up to modern standards. Speeds over 100km/h are permitted on the route with some exceptions in urban areas. The entire route is double tracked. The route is part of the North Sea-Baltic corridor but is not part of the upgrades on the corridor, which focus more on the cross-border sections and the eastern part of the network.

4.3.7 Duisburg – Tilburg

The connection from Duisburg to Tilburg is expected to see an additional 4.6 trains per day in 2030. The amount of TEUs transported is expected to increase from 54,000 to 172,000. The track section is part of the Rhine Alpine TEN-T corridor with a small part also in the North Sea-Baltic corridor.

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[23] RFC Amber (2020). Study on bottlenecks along Rail Freight Corridor Amber (RFC Amber). [online] Available at: https://rfc-amber.eu/assets/downloads/other_public_documents/RFCAmber_bottleneck_study_final.pdf

[24] INTOP Warszawa (n.d.). Revitalisation of Railway Line no. 139 at Bielsko Biała Lipnik – Wilkowice Bystra Section. [online] Available at: https://intop.pl/en/realisations/revitalisation-of-railway-line-no-139-at-bielsko-biala-lipnik--wilkowice-bystra-section-,272.html

There are not expected to be bottlenecks on this part of the network. Not much is planned in terms of upgrades and improvements to this piece of infrastructure. As part of the Rhine Alpine corridor there is a project to improve the section between the Dutch/German border to Emmerich and Oberhausen, but this is not the shortest route connection between Duisburg and Tilburg, although it is also used. The work will add an additional track (from 2 to 3) and install ERTMS.[25]

4.3.8 Berlin – Hamburg

The section of track between Berlin and Hamburg is expected to see an additional 3.5 trains per day. This corresponds to a 90,000 TEU increase from 100,000 TEU in 2019 to 190,000 TEU in 2030. The route is part of the North Sea-Baltic.

Currently, this section of the route is not expected to see upgrades to infrastructure as part of the TEN-T corridors. The increase of 3.5 trains per day will likely not be an issue as the section of track is fully within Germany, does not see differences in electrification, is double tracked and allows high speeds (100km/h+).

4.3.9 Ostrava – Vienna

The rail section from Ostrava to Vienna will see an increase of 3.2 trains per day. The TEU's will increase by 83,000, from 7,000 in 2019 to 90,000 in 2030. There will be some strain on the infrastructure as capacity problems already exist on this section of the network. The route allows trains up to 740 meters long in most places and high speeds (100km/h+) can be maintained for almost the entire route (outside Ostrava and Vienna itself). The route is part of the TEN-T corridor Baltic-Adriatic and Orient/East-Med.

Several previous projects have been carried out on all or part of this route:

- The section between Dětmarovice and Petrovice u Karviné on the Polish border was limited in capacity during upgrades being carried out until 2019.
- Modernization of the Ostrava rail junction cost 222 million euro and was completed in 2021.
- ECTS rollout to the whole of the Czech section of the line from Ostrava to Vienna was undertaken between 2016 and 2020 and cost some 24 million euro.

There are differences in electrification with the section from Vienna to the border operating at 15kV 16.7Hz, the southern part of the line in Czechia operates at 25kV 60Hz while the northern part of the line to Ostrava operates at 3kV DC power.[26]

Additionally, the infrastructure around Vienna is limited in capacity, mostly due to heavy use by passenger trains. Upgrading or buying locomotives that can handle all different electrification options is an option in this case, this would cost at least 70,000 euro per locomotive (this is the price at large volumes, e.g., 100).

4.4 External costs

When it comes to selecting a mode of transportation for intercontinental shipping between China and Europe, shippers typically prioritize speed and cost. External costs are not typically a major consideration

[25] INEA (2018). CEF support to Rhine - Alpine Corridor. [online] Available at: https://wayback.archive-it.org/12090/20221204065308/https://ec.europa.eu/inea/sites/default/files/201803_corridor_report_rhinealpine_withcover.pdf

[26] RFC Baltic -Adriatic (2021) Corridor Information Document Section 5 - Implementation Plan Update. Available at: https://cip.rne.eu/apex/download_my_file?in_document_id=10443

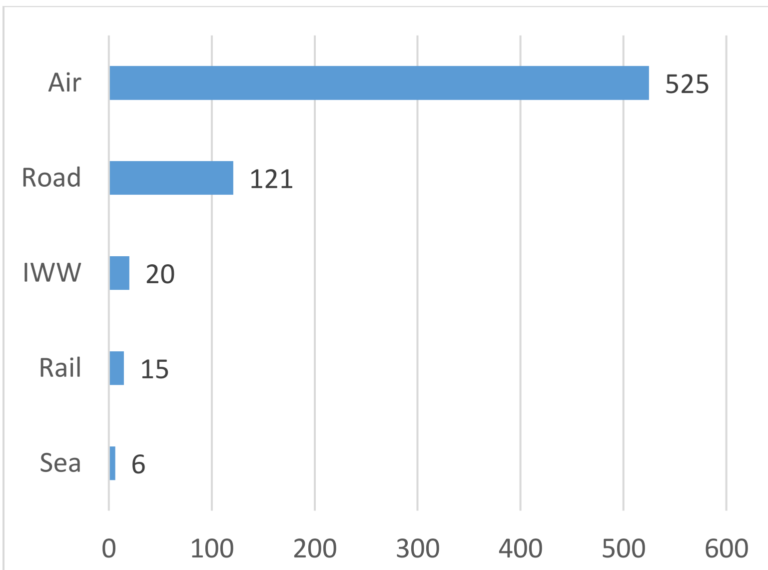
for shippers when making mode choices. However, for policymakers, external costs may be of interest when making investment decisions that consider social value.

4.4.1 Emissions

Looking at CO2 emissions, maritime transport is almost 2.5 times more environmentally friendly per tonne km than rail transport (see Figure 4-11). However, Eurasian rail has the potential to be more climate-friendly than maritime transport for two reasons. First, the Eurasian rail route is almost twice as short as the sea route. And second, rail terminals are 'deeper' in the hinterland, potentially reducing travel distances to destinations and thus saving CO2 emissions.

Eurasian rail transport can be more environmentally friendly than maritime transport, even though maritime transport is more eco-friendly per tonne kilometre. This is illustrated in the example of a route from Chongqing to Frankfurt, where key figures are presented in Table 4-1. This route demonstrates that both the intercontinental and hinterland distances are shorter when using rail transport compared to sea transport.

Figure 4-11: WTW CO2 emissions per mode of transport, in g/tkm



Source: STREAM (2021)

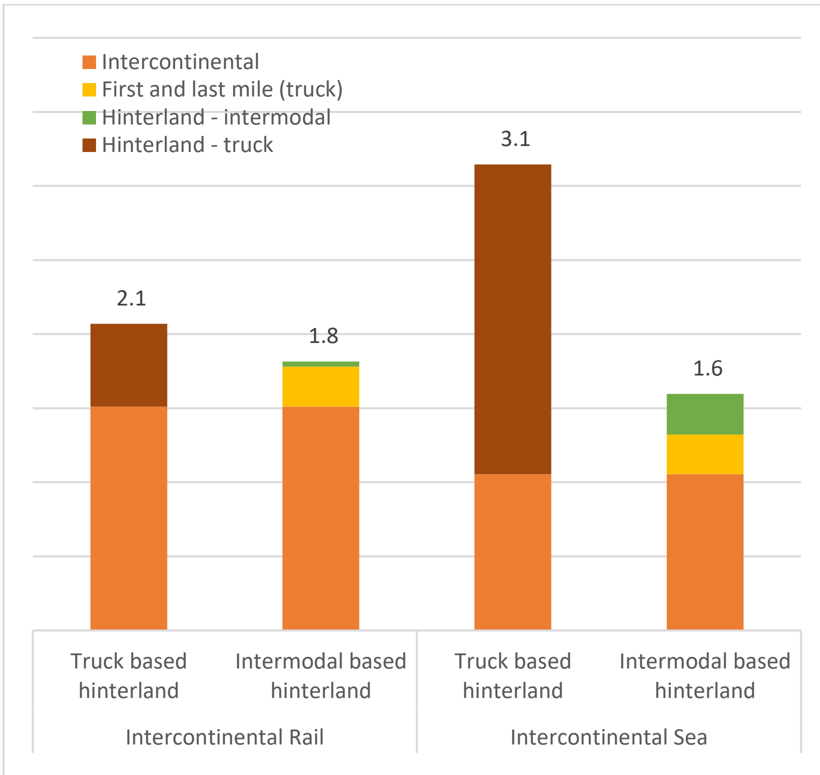
Table 4-1: Key figures of the route from Chongqing to Frankfurt by intercontinental modality

Intercontinental mode	Route	Distance between PEPs in km	Hinterland distance in km
Rail	Chongqing – Duisburg– Frankfurt	10.700	480

Sea	Chongqing – Shenzhen – Rotterdam – Frankfurt	19.000	1.800

Which intercontinental mode is more environmentally friendly also depends on which hinterland transport mode is used. Figure 4-12 shows the emissions for the Chongqing - Frankfurt route depending on the hinterland transport modality.

Figure 4-12: Emissions for container freight between Chongqing-Frankfurt (in tonnes per TEU)

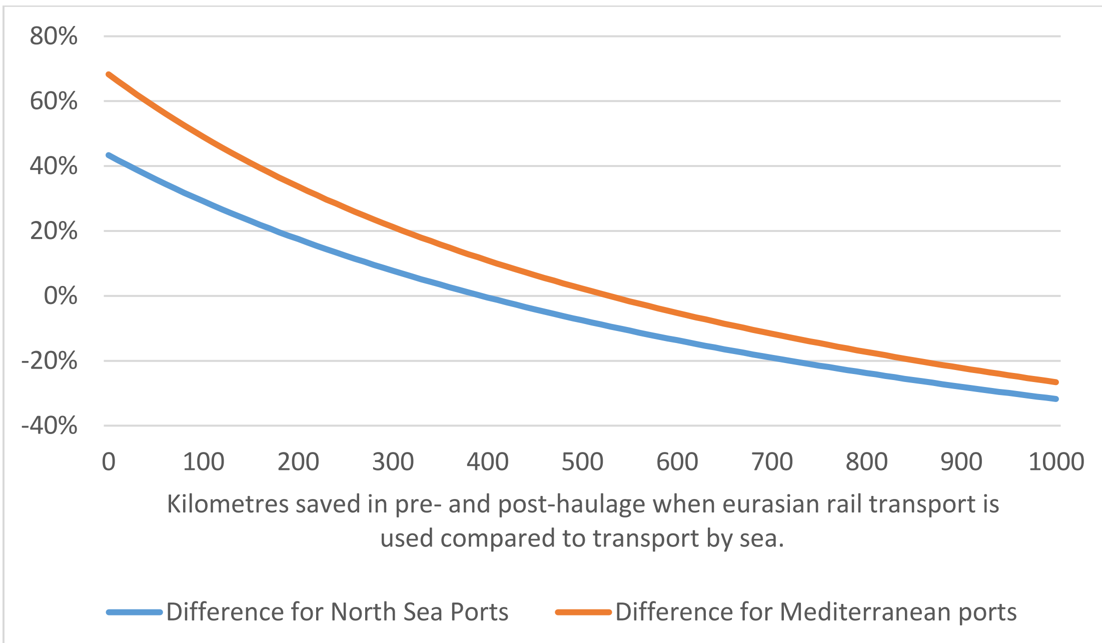


Intercontinental rail transport that utilizes truck-based hinterland transport results in emissions of 2.1 tons of CO2 per TEU. In this scenario, the container is transported by truck from the Chongqing region to the Chongqing terminal, then by train to Duisburg, and finally by truck to its destination in Frankfurt. An alternative option is to use intermodal hinterland transport, in which the container travels by rail from Duisburg to Frankfurt. This approach reduces truck ton-kilometres, resulting in total emissions of 1.8 tons of CO2 per TEU. Utilizing intermodal hinterland transport can save 0.3 tons of CO2 for a container originating in China.

The same calculation can be applied to intercontinental sea transport. In this case, the container travels from Chongqing to the port in Shenzhen by truck, then by ship to Rotterdam, before continuing to Frankfurt. When the hinterland transport is done by truck in both China and Europe, the total emissions for the route are 3.1 tons of CO2 per kilometre. This results in emissions that are almost 50% higher than truck-based hinterland transport via the Eurasian rail. The CO2 savings of intercontinental sea transport do not outweigh the additional emissions from the longer truck trip for hinterland transport.

However, if the hinterland transport from Chongqing to Shenzhen and from Rotterdam to Frankfurt is done intermodally, the total CO2 emissions for the route are 1.6 tons per container. This option is also more environmentally friendly than the intercontinental rail option because it uses intermodal hinterland transport.

Figure 4-13: Difference in emissions from Eurasian Rail transport compared to maritime transport, Depending on the difference in pre- and post-haulage.



In summary, whether Eurasian rail transport can be environmentally friendly depends very much on how hinterland transport takes place per truck. A further analysis (see Figure 4-13) shows that Eurasian rail freight can be greener than maritime transport under the following conditions:

- When it saves **~400 road truck kilometres** in China and Europe when the North Sea ports are used.
- When it saves **~530 road truck kilometres** in China and Europe when the Mediterranean Ports are used.

Because the distance from China by sea to Mediterranean ports is shorter than to northern seaports, more savings in truck kilometres are needed to offset the additional CO2 emissions generated when using Eurasian rail transport.

4.4.2 Other external costs

Besides emissions, there are other external costs related to transport. The 'Handbook on the external costs of transport' published by DG MOVE in 2019 provide cost figures for different categories of external costs.

These values only apply to the EU, these are considered useful nonetheless because there are no good values available for intercontinental transport that compare rail to maritime.

The main external costs categories used by DG MOVE and the associated external costs in € per ton kilometre (2016 values) are shown in Table 4-2. According to DG MOVE, noise, congestion and habitat damage costs for maritime transport are considered negligible or non-existent and thus not considered.

This table shows that at €1.63 per tonne kilometre, the external costs of rail transport are almost two and a half times higher than maritime transport, where external costs total €0.62. In practice, rail external costs will be slightly lower because one-third of the costs are noise costs. Eurasian rail transport, on the other hand, mainly passes through sparsely populated areas. Nevertheless, if external costs are taken into account, maritime transport is more attractive than intercontinental rail transport.

Table 4-2: Average external costs for EU 28 freight transport by cost category for rail and maritime transport.

Cost category	Rail[27] (€-cent/tkm)	Maritime (€-cent/tkm)
Accident costs	0.10	0.001
Noise costs	0.50	n.a.
Congestion costs	0.04	n.a.
Habitat damage costs	0.25	n.a.
Air pollution	0.34	0.40
Climate change	0.25	0.16
Well-to-tank emissions	0.15	0.06
Total external costs	1.63	0.62

Source: DG MOVE (2019). Handbook on the external costs of transport

Table 4-3 Modelled total external costs for China-EU intercontinental rail and maritime transport, per year

Cost category	2019 (Million euro's)	2030 (Million euro's)	2050 (Million euro's)
Rail	3.9	19.5	27.5
Maritime	101.2	158.5	372.6
Total	105.1	278.0	400.1

The total external costs of the modelled container import flows can be found in Table 4-3. Although maritime transport accounts for the largest share of external costs, the external costs for intercontinental rail transport are higher per tonne kilometre. Thus, for policymakers, this is an additional factor to consider in decision-making. With the promotion of Eurasian rail transport comes additional external costs that should preferably be offset.

[27] For rail transport, the assumption has been made that 50% of distance travelled is by diesel trains and 50% by electric trains.

4.5 Conclusion

While the amount of traffic to terminals is expected to significantly increase many terminals either have excess capacity available or have just opened and have not yet seen large numbers of containers. The Railport Brabant, the terminals in Łódź, Ghent, Małaszewicze, Budapest and Sławków do require upgrades to deal with the additional demand in 2030. The upgrade cost for Ghent is based on the need for 2 gantry cranes to increase the throughput in the terminal. The Brabant and Sławków terminals require additional work on the tracks, especially to facilitate entry to the terminals. This is somewhat expensive, especially if the land needs to be acquired. The terminals in Małaszewicze and Budapest require work on the surrounding road infrastructure to allow trucks better access which can be very expensive for even small sections. The greatest priority should be given to the terminals in Brabant and Sławków as these changes are not just needed for 2030 but problems will arise much sooner with the expected increase. In addition, the terminal in Košice should be well monitored as the expected traffic may increase due to a shift in EU policy in which case upgrades may be needed, although the terminal currently has sufficient capacity.

Table 4-4: Investment needed in terminals to exploit the expected market potential of the BRI.

Terminal	Bottleneck in 2030?	Upgrades ongoing	Estimated study cost	Estimated upgrade cost
Railport Brabant	Yes	No	-	1.5m-4m
Liège Trilogiport	No	Yes	-	-
Hamburg rail terminal	No	No	-	-
Duisburg rail terminal	No	Yes	-	-
SPEDCONT Terminal Kontenerowy Łódź Olechów	Maybe	Yes	-	1m-5m
Ghent	Yes	Yes	-	0.2m
PKP CARGO Centrum Logistyczne Małaszewicze	Yes	Yes	-	<27m
Euroterminal Sławków	No	No	-	-
TKD Dobra (Košice)	No	No	-	-
Kaunas rail terminal	Yes	No	-	1m-5m
Budapest rail terminal	No	No	-	12m

Looking at the TEN-T status of the different terminals, the following conclusions can be drawn:

- Currently, several terminals are located in cities that are not classified as **Urban Nodes**, including Tilburg, Liege, Ghent, Małaszewicze, Košice and Kaunas. However, the TEN-T proposal upgrades most of them to Urban Node status, with the exception of Małaszewicze. Given the expected transhipment volumes in Małaszewicze resulting from the BRI, it is advisable to give this city the status of Urban node as well. However, as this is a politically sensitive issue from a geostrategic point of view, the question is whether this is also desirable for the European Commission, and it does not appear that this is likely to happen.

- Besides Urban Node status, terminals can also be given a status as a **TEN-T railroad terminal** (RRT). In the TEN-T proposal, it is stated that Member States can propose terminals to receive the TEN-T RRT status based on a market and prospective analysis of multimodal freight terminals on their territory. Currently, the terminals in Tilburg, Liège and Ghent do not have RRT status and the terminals in Małaszewicze and Košice have comprehensive status. The remaining terminals have core status. It is recommended that member states consider the market potential of the BRI in evaluating which terminals could receive TEN-T RRT status. Based on the market potential, it seems like an especially interesting option to give the terminals in Tilburg and Ghent TEN-T status anyway.

Table 4-5: TEN-T status of critical terminals

Terminal	Country	Current TEN-T Urban Node	Proposed Urban Node status	Current TEN-T RRT status	Proposed TEN-T RRT status
Railport Brabant	Netherlands	No	Comprehensive	No	No
Liège Trilogiport	Belgium	No	Core	No	No
Hamburg rail terminal	Germany	Core	Core	Core	Core
Duisburg rail terminal	Germany	Core	Core	Core	Core
SPEDCONT Terminal Kontenerowy Łódź Olechów	Poland	Core	Core	Core	Core
Ghent	Belgium	No	Core	No	No
PKP CARGO Centrum Logistyczne Małaszewicze	Poland	No	No	Comprehensive	Comprehensive
Euroterminal Sławków	Poland	Core	Core	Core	Core
TKD Dobra (Košice)	Slovakia	No	Core	Comprehensive	Comprehensive
Kaunas rail terminal	Lithuania	No	Core	Core	Core
Budapest rail terminal	Hungary	Core	Core	Core	Core

Most routes are either already seeing upgrades or do not need them to deal with expected future demand. However, the routes between Łuków and Slawkow as well as the route between Slawkow via Skalité to Žilina will need additional improvements to deal with the expected traffic. As both are estimated to be expensive, a study on the effect, need, and benefits of the upgrades should be carried out before committing to funding them as well as taking into consideration the EU policy shift from trains via Belarus and Russia to Ukraine. In addition, there are many routes that do not require upgrades but are receiving them for other reasons that ensure the network will become more robust. A big uncertainty is the route between Małaszewicze and Skierniewice where upgrades may be required even after the large upgrades by the Polish government are completed, for this reason, a study is recommended here as well.

Table 4-6: investment needed in rail lines to exploit the expected market potential of the BRI.

Route	Bottleneck in 2030?	Upgrades ongoing	Estimated study cost	Estimated upgrade cost
Małaszewicze - Skierniewice	Yes	Yes	0.5m	-
Skierniewice - Berlin	No	Yes	-	-
Łuków - Slawkow	Yes	Yes	1m	70m-90m
Slawkow - Skalité - Žilina	Yes	Yes	1m	65m-80m
Berlin - Hannover	No	No	-	-
Hannover - Duisburg	No	No	-	-
Duisburg - Tilburg	No	Yes	-	-
Berlin - Hamburg	No	No	-	-
Ostrava - Vienna	No	Yes	-	-

Table 4-7: TEN-T status of critical rail lines

Route	Country	Current TEN-T status	Part of TEN-T corridors	Change in proposed TEN-T status
Małaszewicze - Skierniewice	Poland	Core	Yes	No change
Skierniewice - Berlin	Poland, Germany	Core	Yes	No change
Łuków - Slawkow	Poland	No	No	Extended core
Slawkow - Skalité - Žilina	Poland, Slovakia	Core	Yes	No change
Berlin - Hannover	Germany	Core	Yes	No change
Hannover - Duisburg	Germany	Core	Yes	No change
Duisburg - Tilburg	Germany, Netherlands	Core	Yes	No change
Berlin - Hamburg	Germany	Core	Yes	No change
Ostrava - Vienna	Czechia, Austria	Core	Yes	No change

Looking at the TEN-T status (see Table 4-7) of the different critical rail sections, the following conclusions can be drawn:

- Most critical railway lines are classified as belonging to the Core Network Corridors and thus already have the main TEN-T status. No further upgrade in TEN-T status is possible here.
- A potential gap in TEN-T is the Łuków - Slawkow line. This line serves all rail PEPs in Central and Eastern Europe from the main border crossing point Małaszewicze. The Polish government and the European Commission already have this section in their sights and propose in the TEN-T proposal to include it as an extended core. Given the importance of this section in accessing the rail PEPs located in Central and Eastern Europe, the recommendation is to further upgrade it to at least Core status, so that the deadline of the TEN-T commitments is in 2030 instead of 2040.

However, as using this border crossing point is a politically sensitive issue from a geostrategic point of view, the question is whether this is also desirable for the European Commission, and it does not appear that this is likely to happen.

5 Specific scenario analysis

This chapter presents the potential future impact of the Belt and Road Initiative on the European Transport Network in the context of two scenarios: the disadvantaged regions scenario and the rail freight corridors scenario.

5.1 Disadvantaged regions scenario

Disadvantaged regions in Europe refer to those areas that are facing economic, social, and territorial challenges, compared to other regions in the EU. These regions are characterized by lower levels of economic growth, higher unemployment, depopulation, and lower standards of living, among other factors. Examples of disadvantaged regions in Europe include some rural areas, industrial regions in transition, and regions affected by structural changes in the economy.

Disadvantaged regions in the context of PLANET and the EGTN concept are defined as those that are most eligible for the support of the Cohesion Policy - EU’s funding program aimed at reducing economic, social, and territorial disparities among regions in the EU. It is one of the main instruments for implementing the EU's regional policy and aims to create more balanced development across the EU. The policy provides funding for infrastructure, innovation, and environmental projects in the least developed regions, with the goal of promoting growth, competitiveness, and employment.

Under the Cohesion Policy there are three categories of regions:

1. Less developed regions: These are regions with a Gross Domestic Product (GDP) per capita of less than 75% of the EU average. These regions are eligible for the highest level of funding from the EU's Cohesion Fund.
2. Transitionally developed regions: These are regions with a GDP per capita between 75% and 90% of the EU average. They receive a lower level of funding compared to less developed regions, but still benefit from EU support.
3. More developed regions: These are regions with a GDP per capita of more than 90% of the EU average. They receive the lowest level of funding from the Cohesion Fund and are expected to finance their own development projects.

The classification of regions into these categories is based on a Eurostat calculation. In the context of PLANET, the ‘less developed regions’ are classified as the disadvantaged regions.

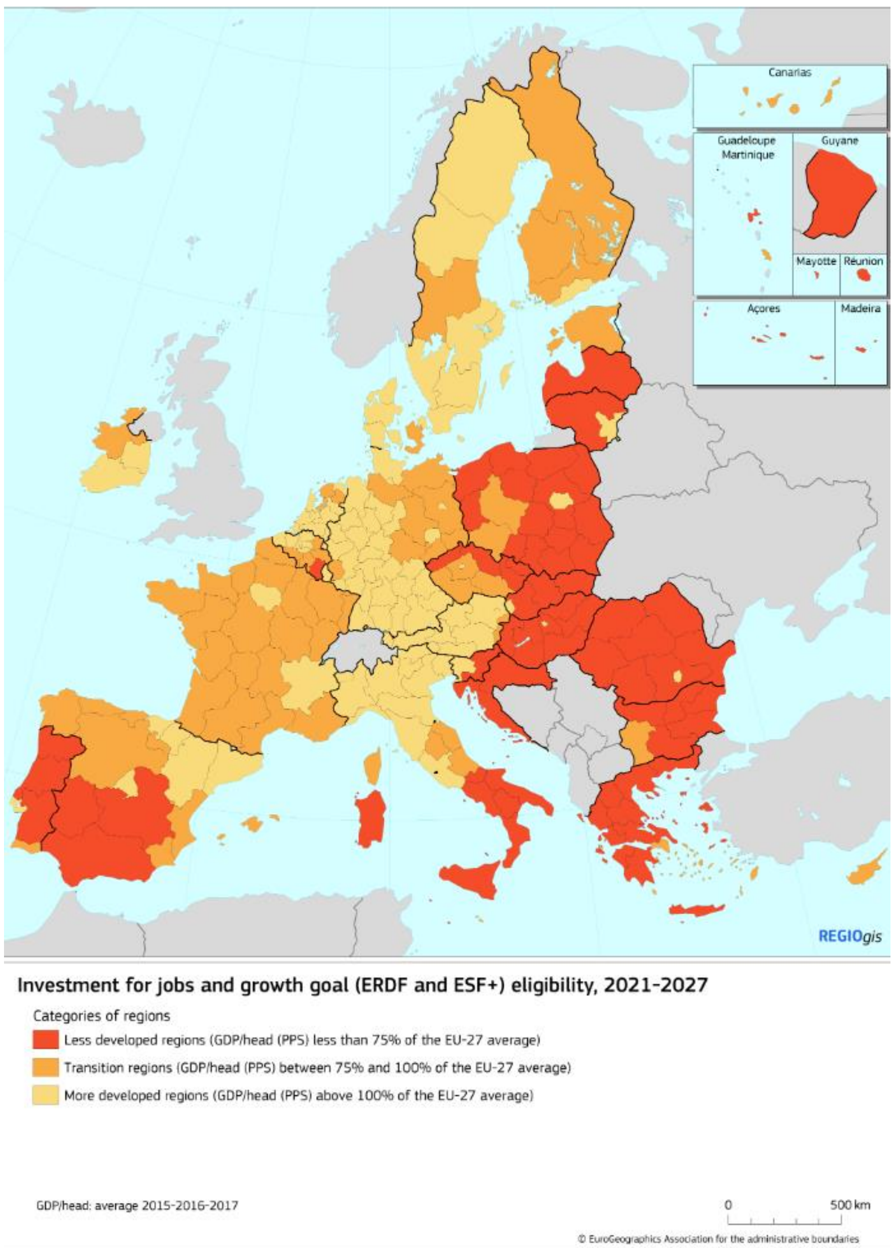
The aim of the simulation is to identify the priorities of infrastructure investments in disadvantaged regions. In doing so, it helps decision-makers determine the most effective and efficient ways to invest in infrastructure in the region. The goal of this simulation is to support the EU's aim of promoting balanced regional development and reducing disparities across the EU.

This simulation is based on the 2030 scenario simulation. In addition to the assumptions in the 2030 scenario, the following adjustments have been made for this scenario:

- Due to increased economic growth leading to increased investments in infrastructure in the disadvantaged regions, this scenario assumes that the rail PEPs in the disadvantaged regions have become more attractive for shippers to use for Eurasian rail transport, compared to rail PEPs in other areas of Europe. This assumption is integrated into the modal by adapting the attractiveness parameter of the rail PEPs in the disadvantaged regions. The attractiveness parameter refers to the qualitative aspects that determine the node choice of shippers (instead of the generalized costs), such as the quality of the hinterland connections per node or shippers’ preferences. The value of this parameter was established in the base year of 2019 based on the calibration of the model, in order to correct for the differences between the observed and the calculated values by the model. For 2030, the same values of the attractiveness parameter as for 2019 are used. In this scenario, the attractiveness of the rail PEPs in the disadvantaged regions is increased by 5%.

- Due to the economic growth in the disadvantaged regions assumed in this scenario, there is also more trade between the disadvantaged regions and China. Therefore, the total trade volume between China and the disadvantaged regions has increased by 5%, compared to the trade as it was in 2030.

Figure 5-1: Cohesion Policy eligibility 2021-2027



Source: European Commission

5.1.1 Overview

In the disadvantaged regions scenario, an increase in trade from China is observed due to a more favourable environment for trade and investment. Several factors contribute to this, including:

- Improved access to markets due to better transportation infrastructure, such as better equipped rail PEPs and more direct shuttle services to China, and improved trade connections.
- Economic growth in the disadvantaged regions, which can increase demand for goods and services, both domestically and in China.
- Increased foreign direct investment from China in disadvantaged regions can create jobs, stimulate economic activity, and increase trade.
- Technological advancements, such as automation and digitalisation can make it easier for businesses in disadvantaged regions to participate in trade with China and increase their competitiveness.

In such a scenario, we see an increase in trade between China and these regions, resulting in more intensive use of Eurasian rail transport as well. An overview of intercontinental transport volumes by rail in this scenario compared to the baseline 2030 scenario is shown in Table 5-1.

Table 5-1: Modelled import flows of containers from China by rail, comparison between the 2030 scenario and the 2030 disadvantage regions scenario

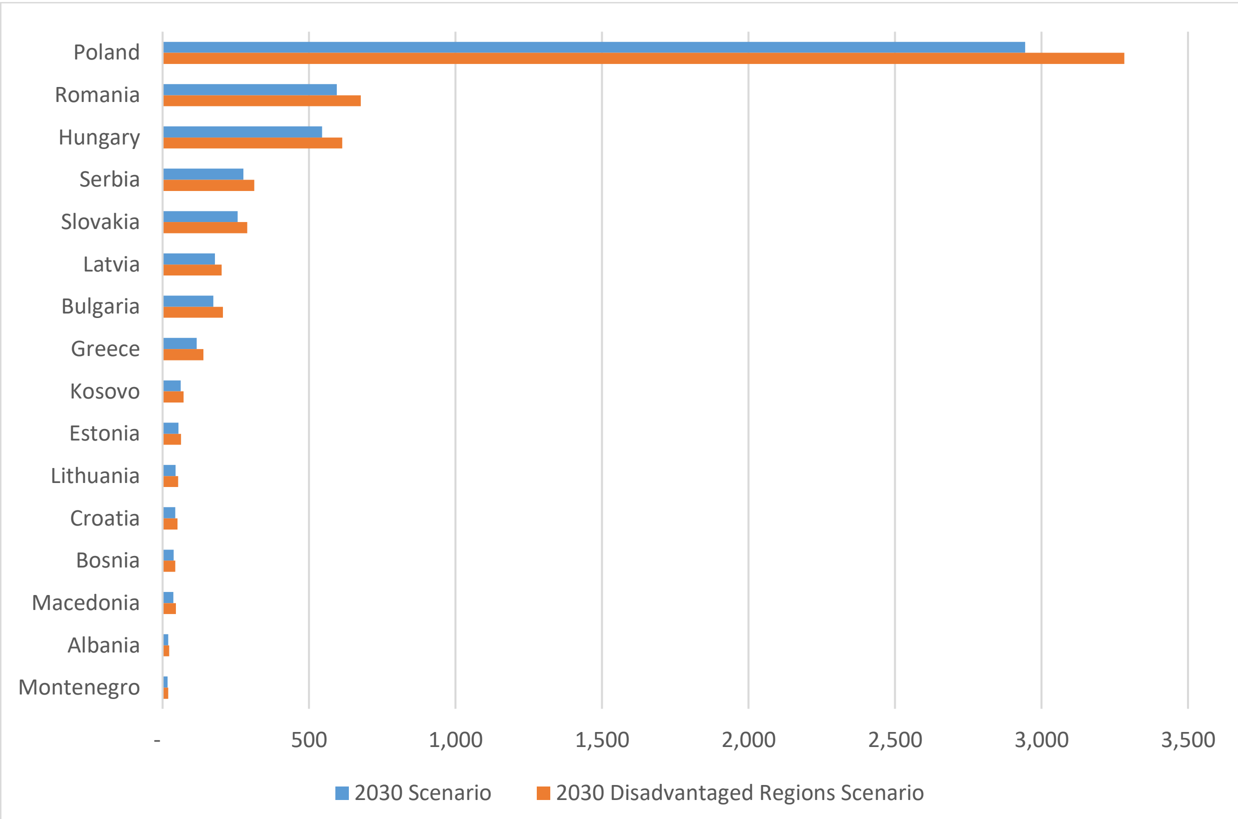
	2030 Scenario	2030 Disadvantaged Regions Scenario	Difference
Volume (in TEu)			
Disadvantaged regions	432,000	487,000	+ 55,000
Rest of Europe	653,000	659,000	+ 6,000
Share			
Disadvantaged regions	40%	43%	+ 3 pp
Rest of Europe	60%	57%	- 3 pp

Due to increased trade with China and improved access to Chinese markets, it is expected that Eurasian rail transport will increase by around 55,000 TEUs, or an increase of +13%. It is also expected that the market share of the disadvantaged regions in total Eurasian goods transport will increase from 40% in the baseline scenario to 43% in the disadvantaged regions scenario.

A breakdown by country of the imported container flows from China by rail is given in Figure 5-2. This figure is mainly a reflection of the size of the market and trade in high-value goods in a particular country, and to a lesser extent a reflection of the geographical proximity of the country to China. Figure 5-3 is a geographical representation of this data.

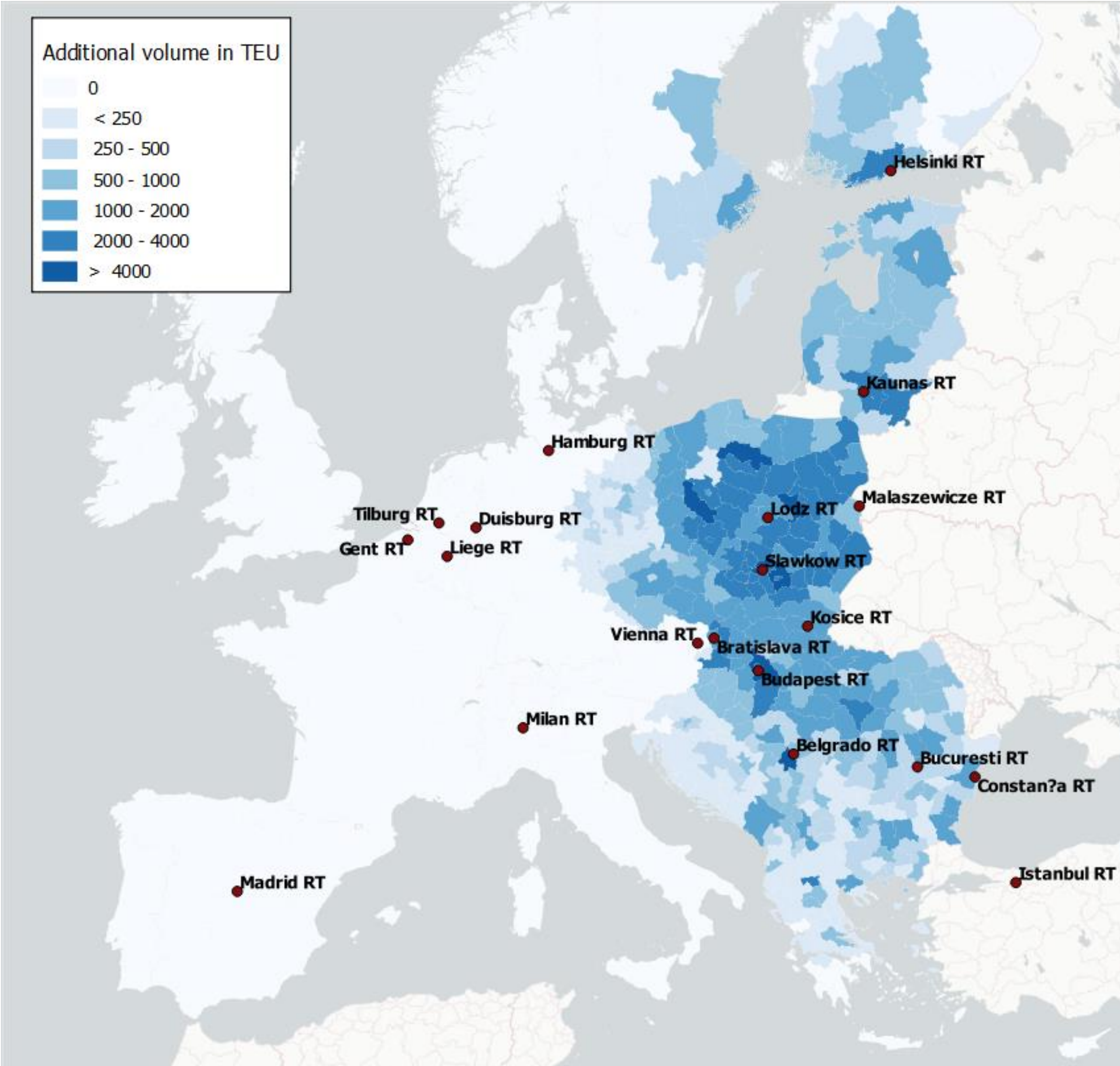
The figure depicts that some regions outside the disadvantaged regions have supplementary trade with China through rail PEPs in the disadvantaged regions, but these quantities are insignificant and therefore, it cannot be stated that better connectivity in the disadvantaged regions leads to a change in trade from central/western Europe to these regions.

Figure 5-2: Modelled number of trains[28] arriving from China by rail per country in the 2030 baseline scenario and the disadvantaged regions scenario.



[28] Assuming an average of 80 TEU per train.

Figure 5-3: Additional modelled import flows of containers from China by rail per NUTS3 region in the 2030 disadvantaged regions scenario compared to the baseline scenario.



As Poland is already relatively well positioned for Eurasian rail transport, the percentage increase is relatively low. Between the 2030 baseline scenario and this specific scenario, the increase in trade by rail for Poland is +12%. This is the lowest relative increase in trade of all countries in the disadvantaged regions. An overview of the percentage increase per country can be seen in Figure 5-4. A geographical representation of this data is shown in Figure 5-5.

The lower cost of Eurasian rail transport convinces these shipping companies to choose this still more expensive, but faster mode of transport.

Figure 5-4: Percentual increase of modelled import flows of containers from China by rail per country in the 2030 baseline scenario and the disadvantaged regions scenario.

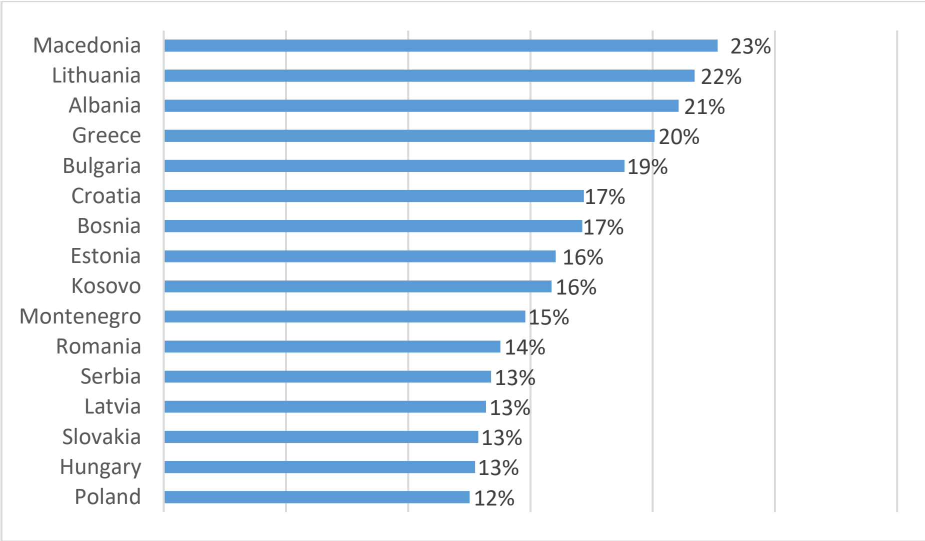
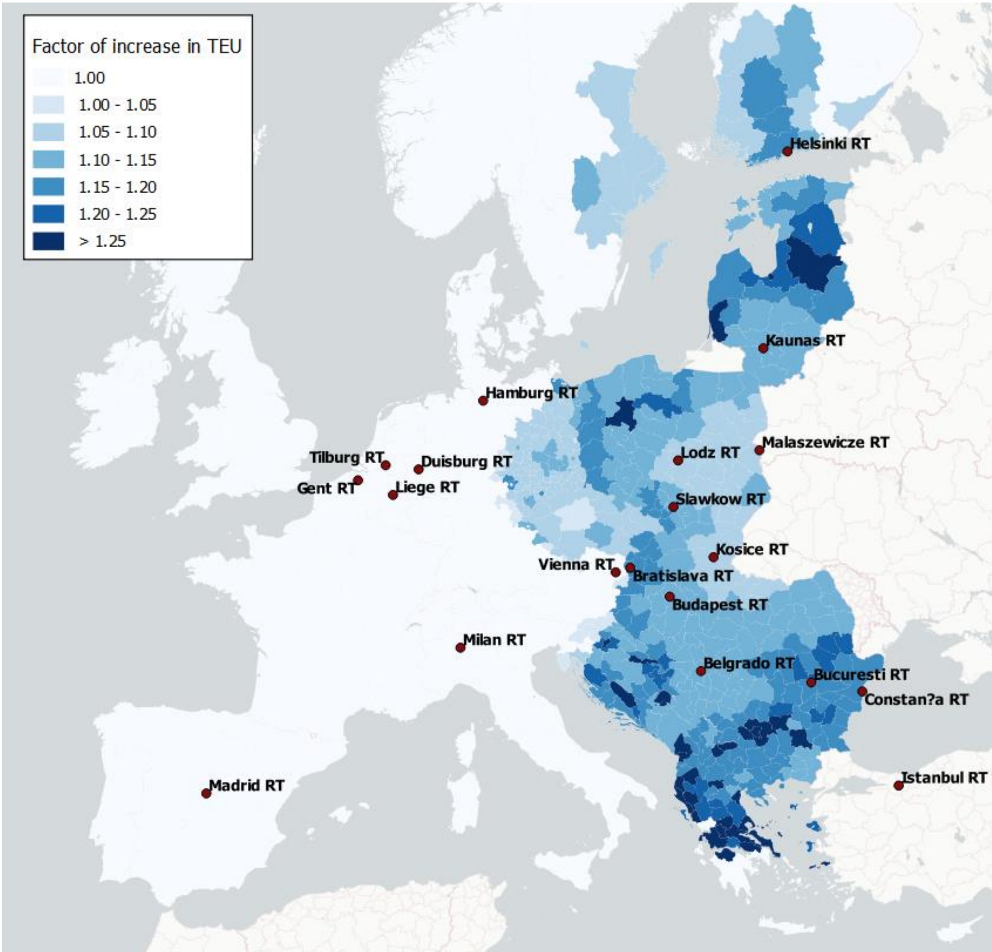


Figure 5-5: Factor increase of modelled import flows of containers from China by rail in the 2030 disadvantaged region scenario compared to the 2030 baseline scenario.



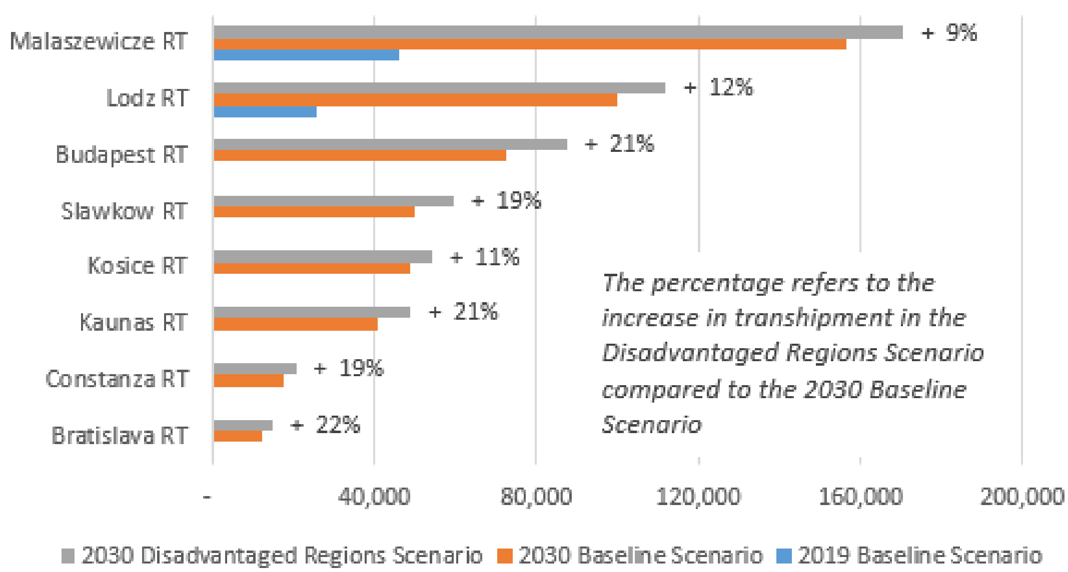
The most relative gains can be made in the countries that are on the theoretical border where the generalised transport costs of sea transport and rail transport are very similar. These are the countries of Macedonia, Lithuania, Albania, Greece, and Bulgaria, all of which see an increase of over 20%. By making Eurasian rail transport more attractive in these countries, a so-called "tipping point" is reached .

Most of the trade to these regions will continue to be by sea, making it the most important mode of trade with China. In the baseline 2030 scenario, it is expected that about 19% of imported containers will be shipped by rail, while in the 2030 scenario for disadvantaged regions , this percentage is expected to be 21%.

5.1.2 Node analysis

Looking at the nodes, the following picture becomes visible. Extra transhipment is to be expected at each terminal located in the disadvantaged regions. The terminal expected to benefit most depends on several factors. The largest extra transhipment is to be expected at terminals with little competition from other terminals in their hinterland, thus having a relatively large hinterland, such as Kaunas and Budapest. In Košice, for example, the expected transhipment is lower because the hinterland is more limited and faces competition from Slawkow (which also has a connection to the broad railway gauge) and Budapest. However, if the train route through Ukraine can be used again, the expectation is that the competitiveness of the Košice terminal will greatly increase. The Kaunas terminal serves the Baltic states, parts of northern Poland, and through short sea also parts of Sweden.

Figure 5-6: Modelled import flows of containers from China by rail per terminal in the 2019 baseline scenario, 2030 baseline scenario and the disadvantaged regions scenario.



Based on this, the conclusion is that not specifically one terminal is best positioned to serve the disadvantaged regions. There is sufficient market potential to pursue a broad development of multiple terminals in this region. Moreover, this also strengthens the region for other non-China-related trade.

In addition, investing in multiple rail terminals in a region contributes to the resilience of the transport network by creating redundancy. If one terminal fails, the presence of additional terminals allows alternative routes to be used and maintains the flow of goods. Multiple terminals enable better distribution and localisation of goods, increasing the overall flexibility and resilience of the network.

5.1.3 Infrastructure analysis

Figure 5-7: Additional modelled import flows of containers from China by rail in the 2030 disadvantaged region scenario compared to the 2030 baseline scenario.

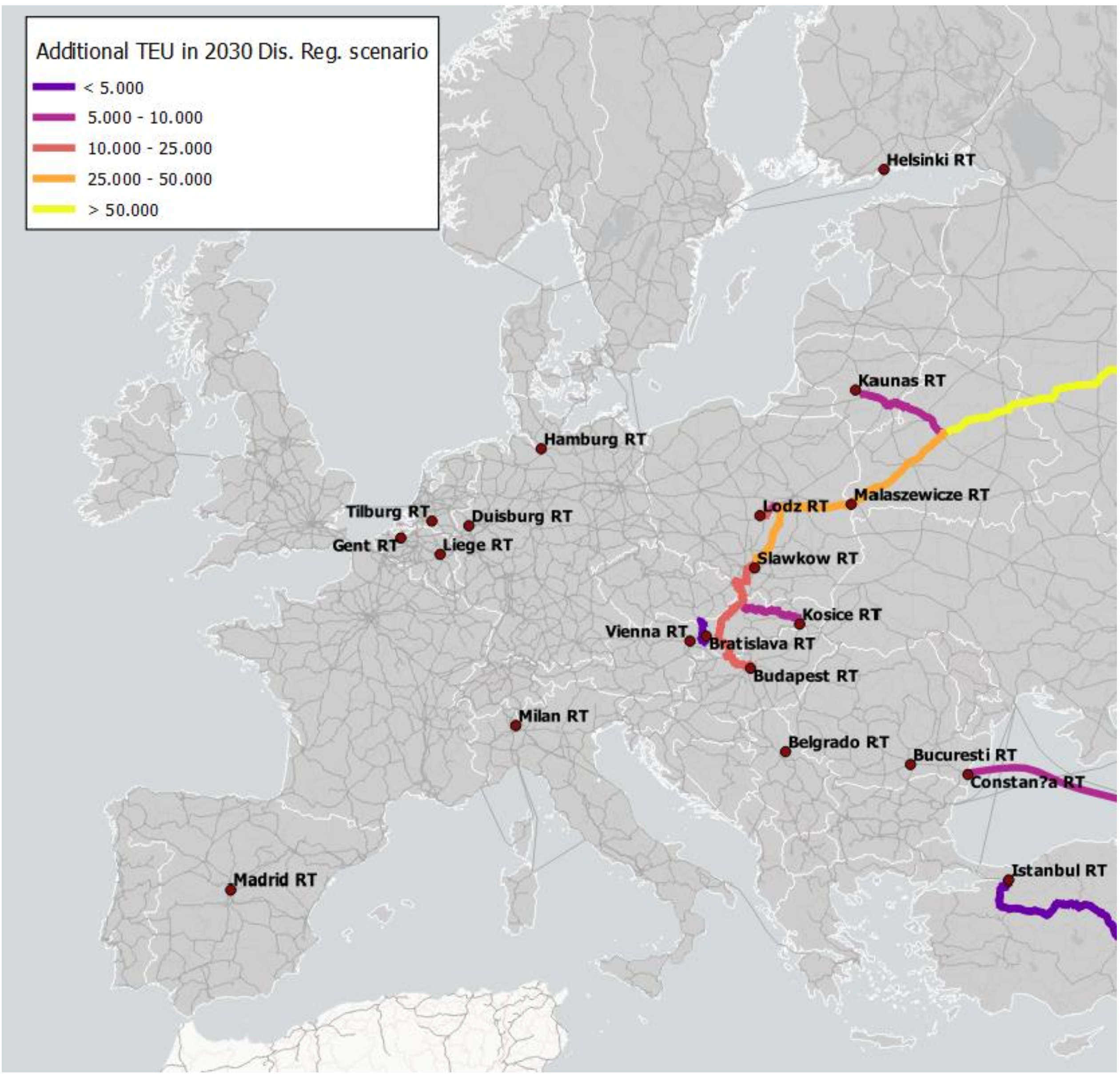


Table 5-2: Additional modelled import flows of containers from China by rail in the 2030 disadvantaged region scenario compared to the 2030 baseline scenario – per section.

Route	Additional TEU	Increase in traffic
Małaszewicze - Łuków	+ 45.000	+ 4%
Lodz terminal access link	+ 12.000	+ 12%
Łuków - Slawkow	+ 33.000	+ 12%
Slawkow - Skalité - Žilina	+ 23.000	+ 10%
Žilina - Košice	+ 5.000	+ 11%
Žilina – Budapest/Bratislava	+ 18.000	+ 21%
BY border - Kaunas	+ 9.000	+ 21%

This scenario sees an increasing number of trains going to the disadvantaged regions in Eastern Europe. Figure 5-7 shows where this increase is expected. The volumes belonging to different sections can be seen in Table 5-2.

The largest increases in absolute volumes compared to the 2030 baseline scenario are visible at the beginning of the corridor: the section after Małaszewicze and the Łuków-Sławków route (which in this scenario handles all train traffic to the southern terminals without the option to go through Ukraine). The largest relative increases in traffic are the access sections to Budapest and Kaunas, because the largest relative increases in handling volumes are visible here, as shown in section 5.1.2.

5.2 Rail freight corridor scenario

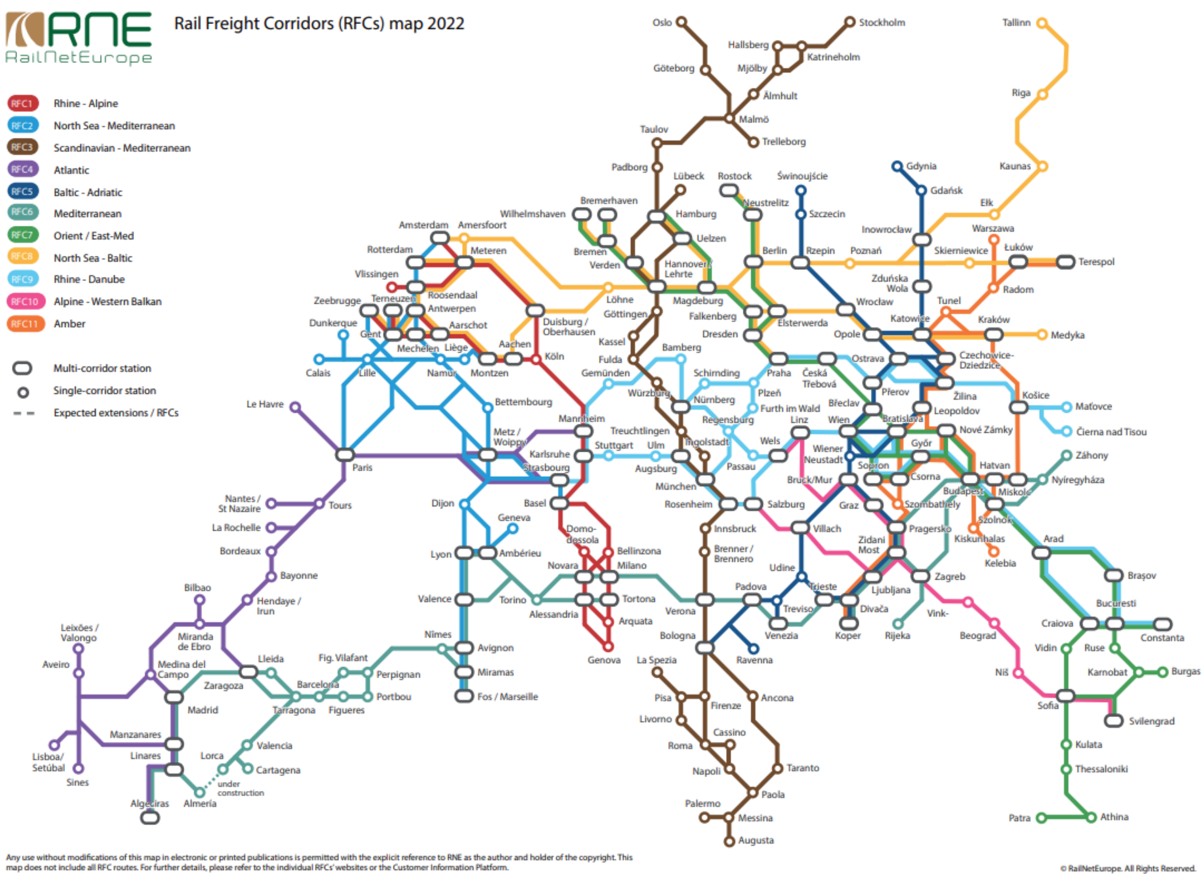
The European rail network for competitive freight, regulated by Regulation (EU) No. 913/2010[29], took effect on November 9, 2010. The Regulation mandated Member States to establish international Rail Freight Corridors (RFC) with a market-oriented approach to address the following three main objectives:

- Enhance cooperation between infrastructure managers on critical issues such as path allocation, deployment of interoperable systems, and infrastructure development.
- Strike a balance between freight and passenger traffic along the RFCs by providing sufficient capacity for freight in accordance with market demand and meeting common punctuality targets for freight trains.
- Foster intermodality between rail and other modes of transportation by integrating terminals into the management process of the corridor.

The regulation established nine RFCs, which became operational in the years after. RFC ten and eleven were added later based on Commission Implementing Decision (EU) 2017/177 and (EU) 2018/500. All RFCs are shown in Figure 5-8 and listed in Table 5-3. The RFCs connect the major ports, industrial centers, and capitals of the EU and are designed to improve the efficiency and competitiveness of rail freight transport. Each RFC has specific infrastructure upgrades, capacity enhancements, and operational improvements planned to optimize rail freight transport and provide a fast, reliable, and sustainable mode of freight transport that can compete with road and sea transport and help reduce congestion and emissions.

[29] Regulation (EU) No 913/2010 of the European Parliament and of the Council of 22 September 2010 concerning a European rail network for competitive freight. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32010R0913

Figure 5-8: Map of the Rail Freight Corridors



Source: RailNetEurope

Table 5-3: The eleven Rail Freight Corridors

#	Name
1	Rhine -Alpine
2	North Sea – Mediterranean
3	Scandinavian – Mediterranean
4	Atlantic
5	Baltic – Adriatic
6	Mediterranean
7	Orient / East-Med
8	North Sea – Baltic
9	Rhine – Danube
10	Alpine – Western Balkan
11	Amber

It has been a long-standing goal of the EU to improve the competitiveness and efficiency of the rail sector. In the Sustainable and Smart Mobility Strategy, the EU has set the target of doubling rail freight traffic by 2050. But not only to take advantage of the competitive advantage of rail transport compared to other modes, rail freight is also key to achieving the sustainability goals formulated in the Green Deal. In recent years, the EU has put a lot of effort into facilitating a modal shift in goods transportation. Rail transport is much more sustainable than road transport, while also being more sustainable than inland waterway transport per unit of transport. In addition, rail transport has a larger geographical reach than inland waterways because it is not dependent on waterways, making it particularly important for intermodal transport in Eastern Europe, where there are few waterways and where the BRI connects to Europe. The RFCs are key to the realisation of the EU's transport policy goals. Therefore, the aim of the simulation is to identify the priorities of infrastructure rail investments for RFCs.

The RFC scenario is derived from the 2030 scenario simulation, with the following modifications in addition to the assumptions made in the 2030 scenario:

- Due to increased investments in rail freight leading to increased efficiency of rail freight, this scenario assumes that all rail PEPs have become more attractive for shippers to use for Eurasian rail transport. This assumption is integrated into the modal by adapting the attractiveness parameter of the rail PEPs in Europe. The attractiveness parameter refers to the qualitative aspects that determine the node choice of shippers (instead of the generalized costs), such as the quality of the hinterland connections per node or shippers' preferences. The value of this parameter was established in the base year of 2019 based on the calibration of the model, in order to correct for the differences between the observed and the calculated values by the model. For the 2030 scenario, the same values of the attractiveness parameter as for 2019 are used. In this scenario, the attractiveness of the rail PEPs is increased by 5%.
- Additionally, it is assumed that as a result of investments in rail transport along the entire BRI rail corridor, the efficiency of the corridor will increase. The assumption is made that the capital costs for using the BRI will decrease by 5% and the speed will increase by 5%.

In summary, this means that the general costs of rail transport across the entire intercontinental supply chain are expected to decrease by approximately 5%. The extent to which these investments in rail transport take place depends on several factors, including the availability of public funds to invest in the necessary rail infrastructure, as well as the degree to which technological progress makes rail transport more efficient. If the goal of doubling rail transport by 2050 is to be achieved, significant investments are required, whether through European support or other means.

It is currently unclear to what extent these assumptions will become reality. This scenario should be seen as a high-growth scenario for rail transport, providing an answer to the question of where investments should be focused if policymakers want to facilitate future growth in rail transport.

5.2.1 Overview

An overview of intercontinental transport volumes in the RFC scenario compared to the baseline 2030 scenario is shown in Table 5-4.

Table 5-4: Modelled import flows of containers from China, comparison between rail and sea for the 2030 scenario and the 2030 RFC scenario

	2030 Scenario	2030 RFC Scenario	Difference
Volume (in million TEu)			
Rail	1.1	1.6	+ 0.5
Sea	14.4	13.8	- 0.6
Share			
Rail	6.9%	10.8%	+ 3.9 pp
Sea	93.1%	89.2%	- 3.9 pp

Due to the improved efficiency of the BRI, it is expected that Eurasian rail transport will increase by around 0.6 million TEUs, or an increase of +60%. It is also expected that the market share of Eurasian rail freight in total Eurasian goods transport will increase from 6.9% in the 2030 baseline scenario to 10.8% in the RFC scenario.

It has been noted that a slight reduction in transportation expenses results in a significant increase in the usage of the BRI. The following changes have been observed:

- A shift towards the west of the border in Europe, where Eurasian rail transportation is more cost-effective than sea transportation (see Figure 5-9 and Figure 5-10). This shift has made areas in Europe, previously not suitable for Eurasian rail transportation, now attractive for this mode of transport. Furthermore, areas that were already receiving cargo through this intercontinental mode have become even more appealing.
- A shift towards the east of the border in China, where Eurasian rail transportation is more economical than sea transportation. This shift mirrors the previous point: it is expected that areas in China where Eurasian rail transportation is cost-competitive will be utilized more, while this mode is now also suitable for new regions, particularly in Eastern China. This shift has a significant impact on the estimated BRI volumes as a considerable number of goods come from the eastern provinces of China. Additionally, this will result in areas in Europe, already attractive for Eurasian rail transportation, receiving more cargo as new areas in China are opened up.

In conclusion, it is projected that in the RFC scenario, areas already attractive for Eurasian rail transportation will be used more extensively, while areas previously not suitable for Eurasian rail transportation will now be attractive.

Figure 5-9: Cost difference of Eurasian rail transport compared to maritime transport for high value (> 15 €/KG) goods in the 2030 baseline scenario.

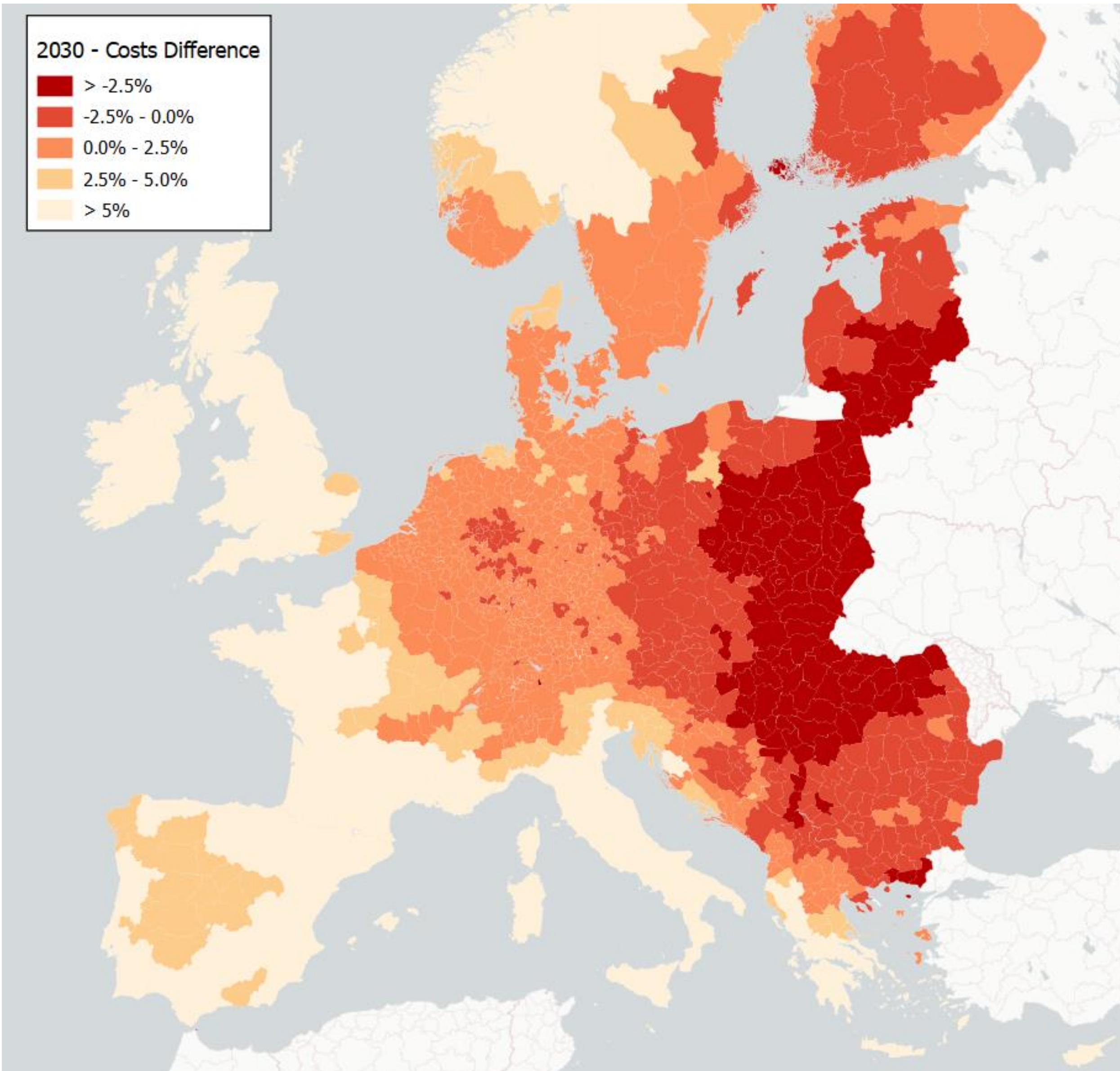


Figure 5-10: Cost difference of Eurasian rail transport compared to maritime transport for high value (> 15 €/KG) goods in the 2030 RFC scenario.

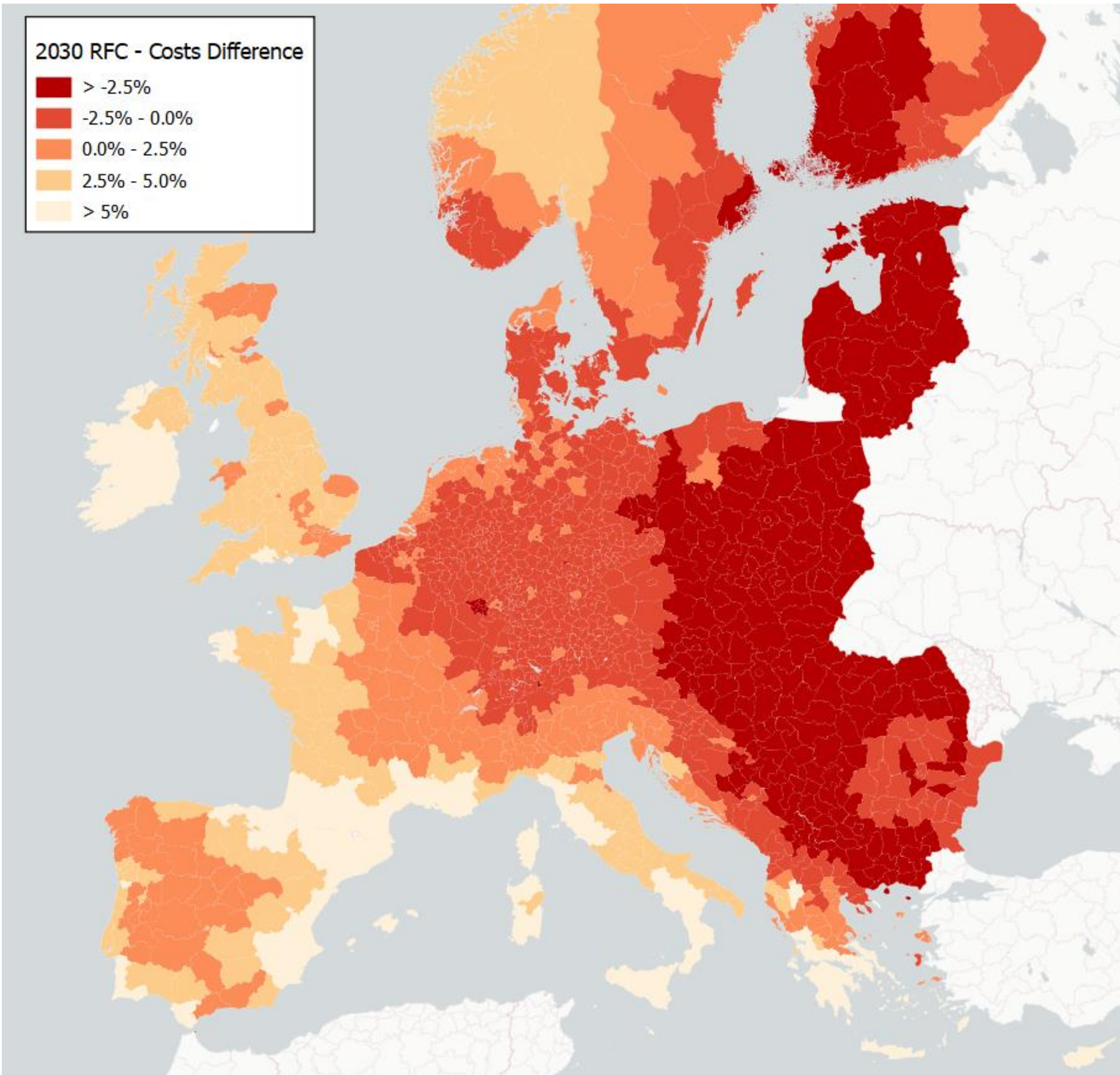
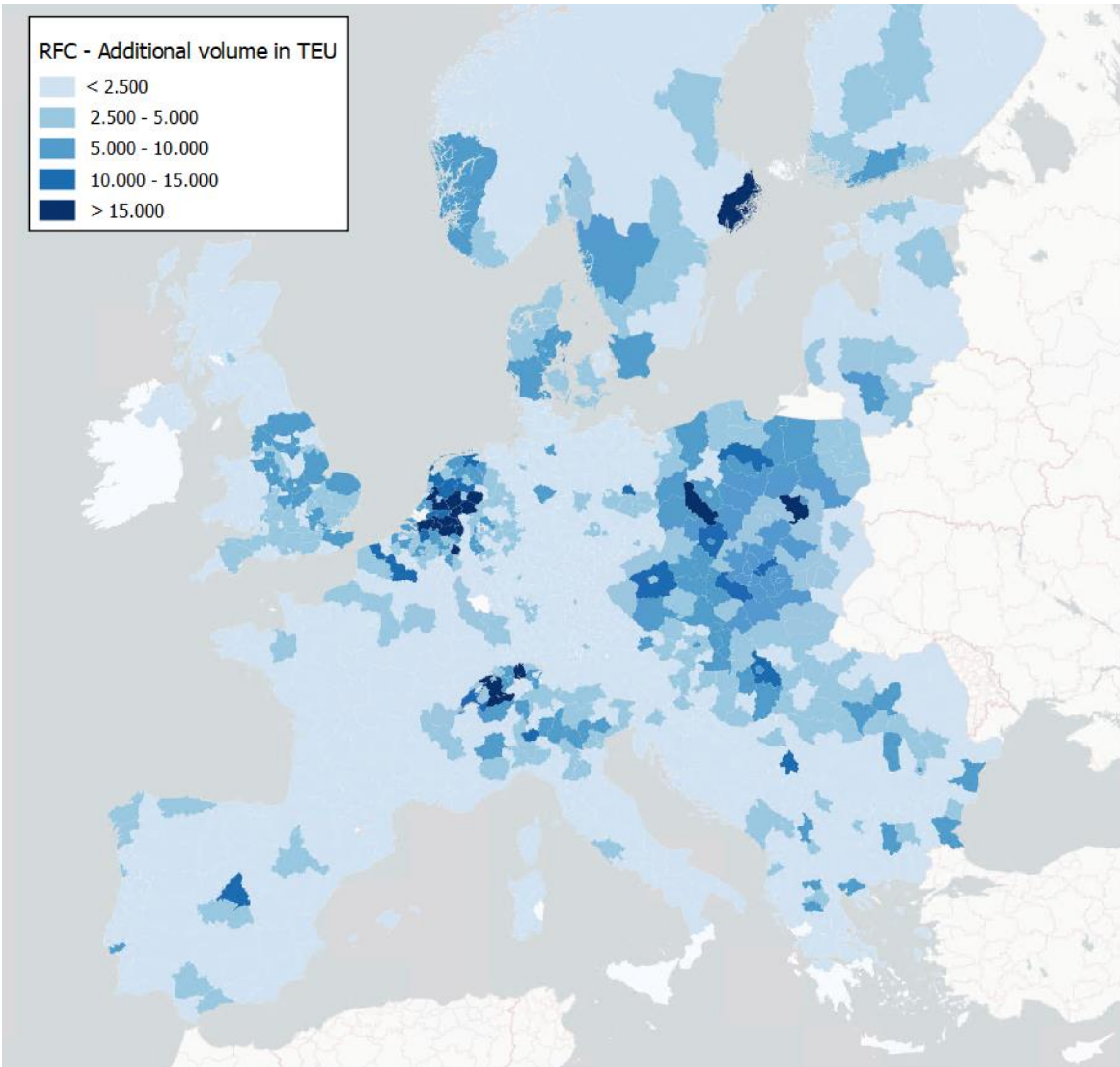


Figure 5-11 depicts, by NUTS3 region in Europe, the number of additional TEUs that are expected to arrive in Europe via the Belt and Road Initiative (BRI) in the RFC scenario, compared to the 2030 baseline scenario. The greatest rise is expected to occur in the eastern regions of Europe, owing to the growing accessibility of the eastern regions of China where a significant amount of production takes place. Additionally, there will also be a significant increase in TEUs in the western regions of Europe, including Madrid, Switzerland/northern Italy, the Benelux region, the UK, and southern Scandinavia.

Figure 5-11: Additional modelled import flows of containers from China by rail per NUTS3 region in the 2030 RFC scenario compared to the baseline scenario.



5.2.2 Node analysis

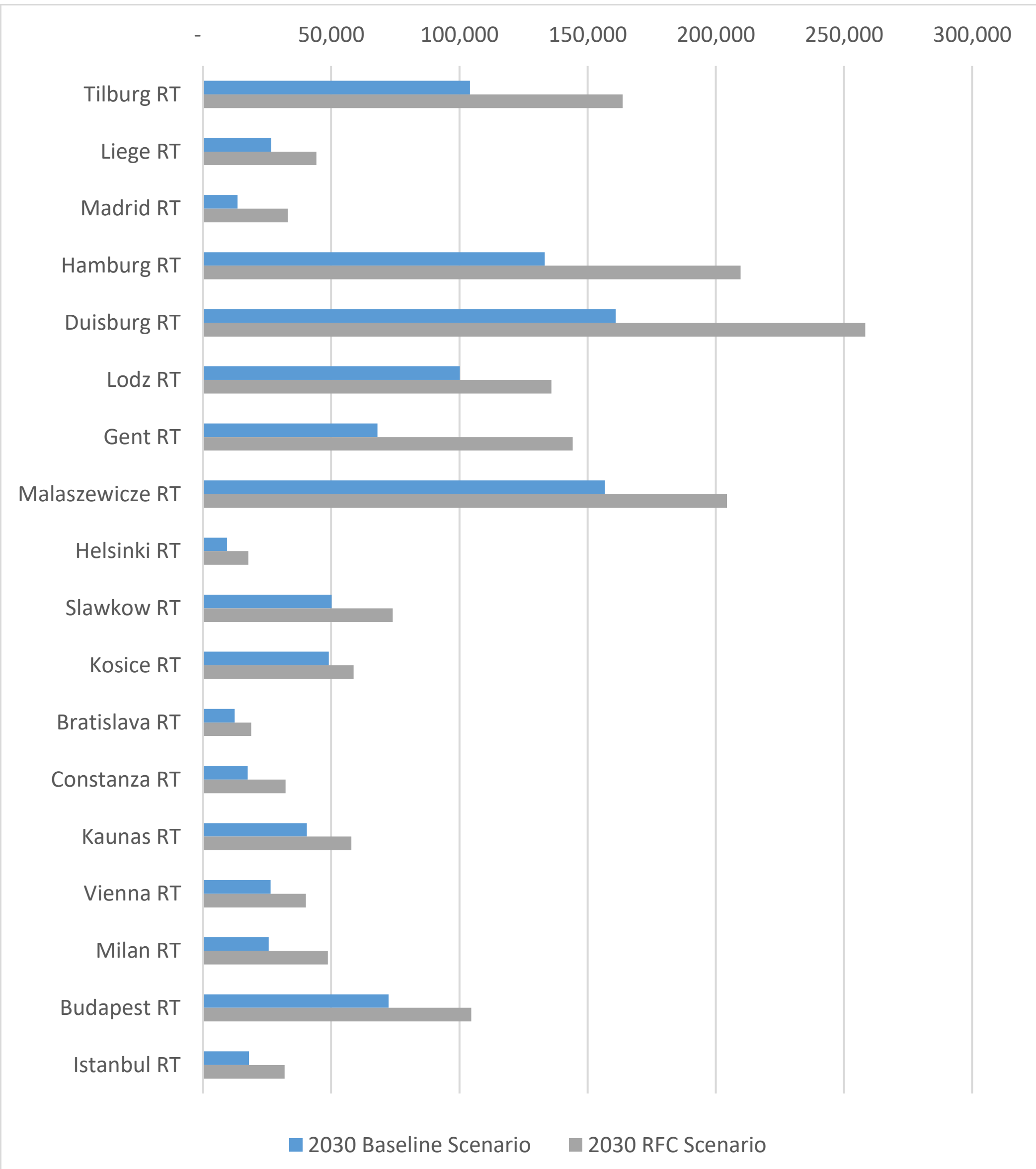
The increase in transhipment per node in the RFC scenario compared to the 2030 baseline scenario is shown in Figure 5-12. The following can be seen:

- The largest absolute increases in TEU can be seen in Hamburg, Duisburg, Tilburg, and Gent. These are terminals located in regions with a lot of trade with China and therefore see the largest absolute increases. Furthermore, these terminals benefit from opening up new markets in China.
- The largest percentage increases in TEU take place in Madrid, Milan, and Gent. These terminals are located in regions where the cost reduction in the RFC is expected to be the turning point for many entrepreneurs to use the BRI. The size of the hinterland also plays a role. For example, in

the model calculations, Gent serves the entire UK market, causing the volumes to rise so strongly, faster than, for example, Tilburg.

- The smallest percentage increases in TEU can be seen in Małaszewicze and Lodz because a relatively high percentage of high-value goods already go via the BRI, so there is little additional profit to be made. The increase in Košice is also limited, which is due to the relatively small hinterland due to competition from nearby terminals in Slawkow and Budapest. However, it is expected that transhipment growth in Košice will increase sharply when the connection via Ukraine is back in use.

Figure 5-12: Modelled import flows of containers from China by rail per terminal in the 2030 baseline scenario and the 2030 RFC scenario.

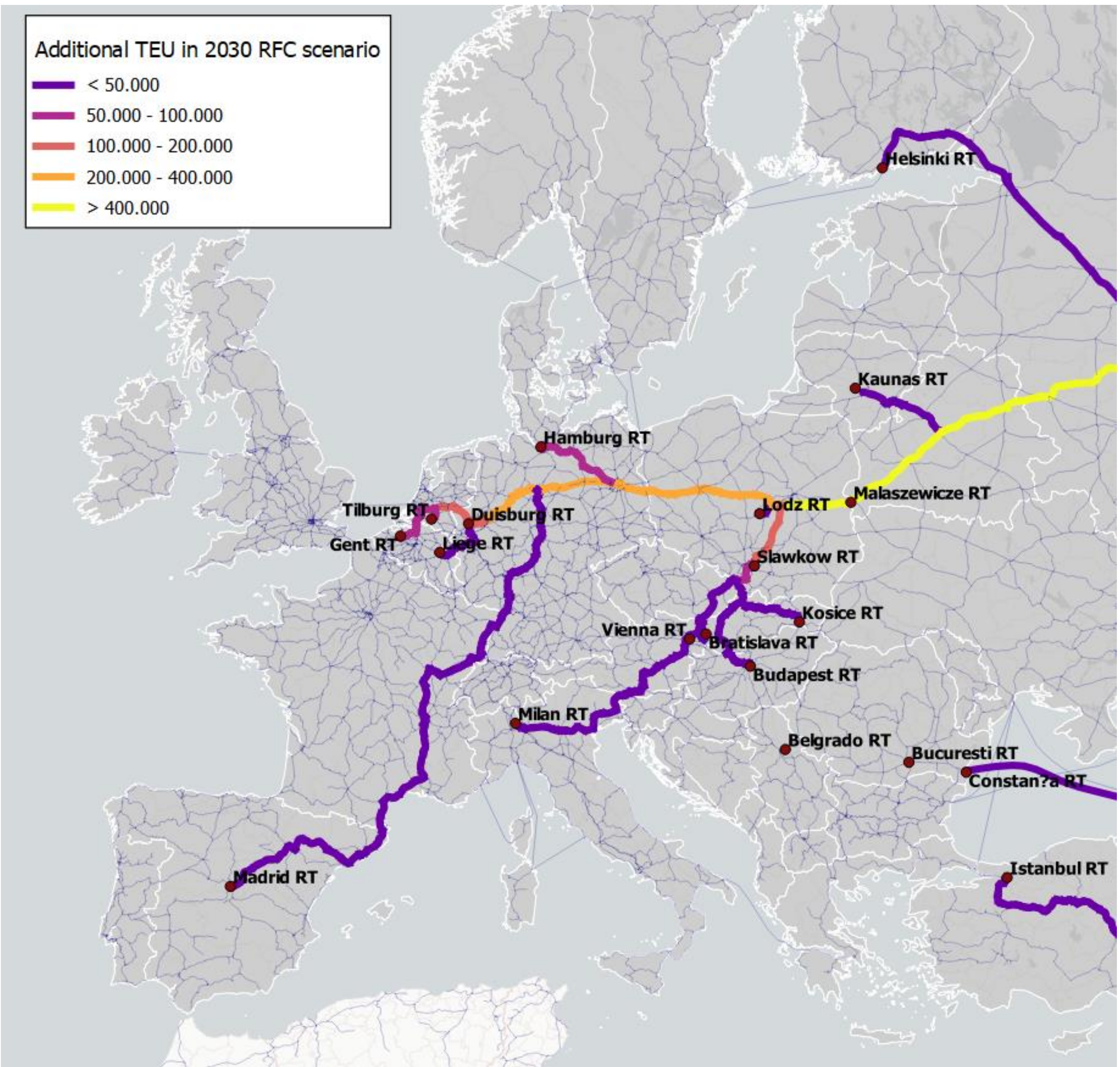


In short, terminals in the area around the "turning point" and with a large hinterland benefit the most. It is important to keep in mind that the expected transhipment volumes should be seen as the market potential that exists in this region. It is advisable to opt for a regional approach to realize these expected transhipment volumes, for example, by spreading the market potential across different terminals in the region according to the availability of capacity.

5.2.3 Infrastructure analysis

Overall, this scenario sees an increasing number of trains across the whole network. Figure 5-13 shows where this increase is expected. The volumes belonging to different sections can be seen in Table 5-5.

Figure 5-13: Additional modelled import flows of containers from China by rail in the 2030 RFC scenario compared to the 2030 baseline scenario.



The largest increases in absolute volumes compared to the 2030 baseline scenario are visible at the entry point of the trains in Europe: the section after Małaszewicze has in the RFC scenario a market potential of an additional half a million TEU, which is equivalent to an increase of 54%. A large volume increase compared to the 2030 baseline scenario is also expected for the section Skierniewice – Berlin (+347.000) and Berlin – Duisburg (251.000). The largest increase percentage wise is expected on the main route towards the west, with a +68% increase expected on the Skierniewice – Berlin section, a +70% increase on the Berlin – Duisburg section and a 79% increase on the Duisburg – Tilburg section.

Table 5-5: Additional modelled import flows of containers from China by rail in the 2030 RFC scenario compared to the 2030 baseline scenario – per section

Route	Additional TEU	Increase in traffic
Małaszewicze - Łuków	+540.000	+ 54 %
Łuków - Slawkow	+ 110.000	+ 46 %
Slawkow - Skalité - Žilina	+ 85.000	+ 46 %
Žilina - Košice	+ 10.000	+ 20 %
Žilina – Budapest/Bratislava	+ 32.000	+ 45 %
BY border - Kaunas	+ 17.000	+ 43 %
Skierniewice - Berlin	+ 347.000	+ 68%
Berlin - Hamburg	+ 76.000	+ 57%
Berlin - Duisburg	+ 251.000	+ 70%
Duisburg - Tilburg	+ 136.000	+ 79%

While the forecasted market potential of the transport volumes subject to uncertainty and bias, they still provide understanding of where the largest increases in volumes are expected and therefore where investments are needed. An increase in volume can be found across the corridor. As shown in Table 5-6, with in total six, a large number of the RFCs are located on the routes of trains from China. Most of the increase in traffic can be seen on the North Sea Baltic Corridor, but cooperation between all the RFCs is needed to manage all flows.

Table 5-6: Key sections for Eurasian rail and the corresponding RFC

Route	RFC
Małaszewicze - Łuków	North Sea – Baltic and Amber
Łuków - Slawkow	Amber
Slawkow - Skalité - Žilina	Baltic – Adriatic and Amber
Žilina - Košice	Rhine – Danube
Žilina – Budapest/Bratislava	Amber, partly Baltic – Adriatic and Orient/East-Med
BY border - Kaunas	North Sea – Baltic
Skierniewice - Berlin	North Sea – Baltic
Berlin - Hamburg	North Sea – Baltic, Orient/East-Med and partly Scandinavian - Mediterranean
Berlin - Duisburg	North Sea – Baltic, partly Orient/East-Med
Duisburg - Tilburg	North Sea – Baltic, partly Rhine – Alpine

5.3 Impact of policy and legislation impact scenario

The PLANET project includes an examination of another scenario, the Policy and Legislation Impact Scenario. The objective of this scenario is to assess the effect of specific advancements in policy and legislation on the projected transportation volumes of the BRI. Based on an evaluation of policy documents, legislation and the results of a technological advancements analysis, the input parameters for the PLANET model have been revised.

At the time this deliverable is being written, the scenario is still undergoing development. A workshop took place in December 2022 to determine the values of the input parameters for the model. Currently, the estimated values are being transformed into input parameters for the PLANET model. The table below lists the estimated input parameters.

Table 5-7: Example of input parameters for the strategic model in the policy and legislation scenario.

Input parameter for the strategic model	**% value change**	
	2030	**2050**
Total transportation cost per mode		
• *Rail*	-5%	-20%
• *Road*	0%	-15%
• *IWW*	+5%	-25%
• *Maritime*	+10%	-20%
Load factor per mode		
• *Rail*	+10%	+25%
• *Road*	+5%	+15%
• *IWW*	+10%	+20%
• *Maritime*	0	+10%
Reliability per mode		
• *Rail*	+5%	+20%
• *Road*	+5%	+15%
• *IWW*	+10%	+20%
• *Maritime*	+5%	+10%
Transport speed per mode		
• *Rail*	0	+20%
• *Road*	+5%	+10%
• *IWW*	+5%	+20%
• *Maritime*	0	+15%

5.4 Conclusions

Whether or not the disadvantaged regions scenario and the RFC scenario becomes reality may change the prioritisation of investments in the European transport network. Chapter 4 identified possible investments based on the 2030 baseline scenario. This chapter identified points on the network that could be prioritised should a particular alternative scenario materialise.

The results are summarised in the tables below. For both the PEPs and key infrastructure sections, it is indicated whether, based on the scenario, they are prioritised.

Table 5-8: Prioritization of the terminals in all three scenarios.

Terminal	Investment need 2030	Disadvantaged regions scenario	RFC scenario
Railport Brabant	+	0	++
Liège Trilogiport	0	0	++
Hamburg rail terminal	0	0	++
Duisburg rail terminal	0	0	++
SPEDCONT Terminal Kontenerowy Łódź Olechów	+	+	+
Ghent	+	0	++
PKP CARGO Centrum Logistyczne Małaszewicze	++	+	+
Euroterminal Sławków	+	++	+
TKD Dobra (Košice)	0	+	+
Kaunas rail terminal	+	++	+
Budapest rail terminal	+	++	+
Milan	0	0	++
Constanța	0	++	++

0 = low priority, + is higher priority, ++ highest priority.

The baseline scenario is the primary factor in determining the prioritization process because it provides the most accurate and relevant reference point for making decisions. The investments in the baseline should drive the prioritization process. The outcomes of both scenarios can also play a role in determining the prioritization, depending on the goals of the policy. When considering the alternative scenarios, terminals located in disadvantaged regions with large hinterlands are prioritized for investment, including Slawkow, Kaunas, Budapest, and Constanța. These first three terminals also have a higher priority in the 2030 baseline scenario, making them the most attractive targets for investment. The terminals in western Europe, as well as Milan, are considered the most important for prioritization in the RFC scenario. Except for the Tilburg rail terminal, these terminals are not expected to experience any major bottlenecks in 2030.

It is important to note that this prioritization is meant to meet the market potential in the region. It is advisable to opt for a regional approach to realise these expected transhipment volumes, for example by spreading the market potential across different terminals in the region according to the availability of capacity.

When it comes to infrastructure investments, the Łuków-Sławków, Sławków-Skalité-Žilina, and to a lesser extent Małaszewicze-Skierniewice sections are expected to take priority. In the disadvantaged regions scenario, it is expected that the largest increases in volumes will occur on the Žilina-Budapest/Bratislava and BY border-Kaunas sections. However, as there are no major bottlenecks expected in the 2030 baseline scenario for these sections, they will not have a high priority overall. The disadvantaged regions scenario confirms that the Łuków -Sławków and Sławków-Skalité-Žilina sections are a priority. In the RFC scenario, the largest increases in absolute volumes compared to the 2030 baseline scenario are expected at the point where trains enter Europe. However, no bottlenecks are expected in the 2030 baseline scenario for the sections west of Łódź. The RFC scenario confirms that the Łuków-Sławków and Sławków-Skalité-Žilina sections, as well as the Małaszewicze-Skierniewice section, are a priority.

Table 5-9: Prioritization of the sections in all three scenarios.

Route	Investment need 2030	Disadvantaged regions scenario	RFC scenario
Małaszewicze - Skierniewice	+	0	+
Skierniewice - Berlin	0	0	++
BY border - Kaunas	++	+	+
Slawkow - Skalité - Žilina	++	+	+
Berlin - Hannover	0	0	++
Hannover - Duisburg	0	0	++
Duisburg - Tilburg	0	0	++
Berlin - Hamburg	0	0	+
Ostrava - Vienna	0	0	+
Žilina - Košice	0	+	0
Žilina – Budapest/Bratislava	0	++	+
BY border - Kaunas	0	++	+

0 = low priority, + is higher priority, ++ highest priority.

6 Conclusions

This deliverable discussed in detail the potential impact of the BRI on TEN-T, using model simulations for 2030 and 2050 and two scenario simulations, namely the impact on disadvantaged regions and rail freight corridors. The analysis forecasts a market potential for intercontinental rail freight from China to the EU (import) of 1.1 million TEU in 2030, and 1.6 million TEU in 2050. The increased potential is most pronounced in the EU's Eastern regions, but also notable for existing BRI hubs in Western Europe.

While the amount of traffic to terminals is expected to significantly increase many terminals either have excess capacity available or have just opened and have not yet seen large numbers of containers. Nevertheless, for a number of terminals targeted upgrades will be conducive for further market uptake of intercontinental rail freight. In addition, it was counciled that the relevant terminals all be given the status of Urban Node, TEN-T rail-road (RRT) and/or core network. It is recommended that member states consider the market potential of the BRI in evaluating which terminals could receive TEN-T RRT status.

For the EU's railway network, most relevant routes are either already seeing upgrades or do not need them to deal with expected future demand. However, the routes between Łuków and Slawkow as well as the route between Slawkow via Skalité to Žilina will need additional improvements to deal with the expected traffic. As both are estimated to be expensive, a study on the effect, need, and benefits of the upgrades should be carried out before committing to funding them. A big uncertainty is the route between Małaszewicze and Skierniewice where upgrades may be required even after the large upgrades by the Polish government are completed, for this reason, a study is recommended here as well.

Regarding the TEN-T status of railway lines critical for BRI, most are already classified as belonging to the Core Network Corridors, with a potential gap being the Łuków - Slawkow line.

A further increase of economic competitiveness in Europe's disadvantaged Eastern regions is expected to lead to a limited but significant increase of BRI potential in these areas. Upgrading multiple rail terminals in the region is expected to further contribute both to its competitiveness and to the resilience of the transport network.

A high-growth scenario, based on extensive investments and efficiency improvements along the intercontinental corridor, yields an increase of the economic potential by 2030 of some 0.5 million TEUs: from 1.1 to 1.6 million. It is projected that in this RFC scenario, areas already attractive for Eurasian rail transportation will be used more extensively, while areas previously not suitable for Eurasian rail transportation will now become attractive. Whether or not the disadvantaged regions scenario and the RFC scenario becomes reality may change the prioritisation of investments in the European transport network.

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