Study on the TEN-T Core Network Corridor Rhine-Alpine

Final Report

December 2017

Disclaimer

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Abbreviations

BLN	Billion
CEF	Common European Framework
CEMT	Conférence Européenne des Ministres des Transports
CNC	Core Network Corridor
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
DG MOVE	European Commission – Directorate General for Mobility and Transport
e.g.	for example
EC	European Commission
EIB	European Investment Bank
ERTMS	European Rail Traffic Management System
ESIF	European Structural and Investment Funds
ETIS	European Telecommunication Informatics Services
EU	European Union
FTE	Full Time Equivalent
GDP	Gross Domestic Product
i.e.	Id est
ID	Identification (number)
IT	Information Technology
ITS	Intelligent Transportation System
IWT	Inland Waterway Transport
IWW	Inland Waterways
km	Kilometres
KPI	Key Performance Indicator
LNG	Liquefied Natural Gas
m	Metres
Mio	Million
MCA	Multi-Criteria Analysis
MTMS	Multimodal Transport Study
MoS	Motorways of the Sea
MS	Member State
NUTS	Nomenclature des unités territoriales statistiques
OPT	Operational Programmes on Transport
pkm	Person kilometres
RFC	Rail Freight Corridor

RFC1	Rail Freight Corridor Rhine-Alpine
RIS	River Information Services
RRT	Rail–Road Terminals
t	Tonnes
TEN-T	Trans-European Transport Network
TMS	Transport Market Study
VTMS	Vessel Traffic Management System

Country Codes (ISO 3166):

BE	Belgium
CH	Switzerland
DE	Germany
FR	France
IT	Italy
NL	the Netherlands

Core Network Corridors:

BAC	Baltic-Adriatic
NSB	North Sea-Baltic
MED	Mediterranean
OEM	Orient-East Med
SCM or ScanMed	Scandinavian-Mediterranean
RALP	Rhine-Alpine
ATL	Atlantic
NSM	North Sea-Mediterranean
RD	Rhine-Danube

1 Introduction

On 17 April 2015, the European Commission published the invitation to tender MOVE/B1/2014-710 "Studies on the TEN-T Core Network Corridors and support of the European Coordinators". The announced studies are the logical follow-up of the nine corridor studies that have been carried out in 2014 also on behalf of the European Commission (Phase 1). Following the TEN-T regulation 1315/2013 and the CEF regulation 1316/2013, these studies constitute the main basis for drawing up corridor Work Plans by the European Coordinators approved by the concerned Member States in May 2015 (for Work Plan I) and in December 2016 (for Work Plan II).

The current study (second phase) is carried out by the same consortium as for the first phase with HaCon Ingenieurgesellschaft mbH (Germany) (lead partner); KombiConsult GmbH (Germany); Panteia B.V. (the Netherlands); PricewaterhouseCoopers Advisory SpA – PwC (Italy); Rapp Trans AG (Switzerland) and Stratec S.A. (Belgium).

This study is elaborated for and in close cooperation with:

- Dr Paweł Wojciechowski, European Coordinator for the Rhine–Alpine Corridor,
- Mr Lukasz Wojtas, Advisor of the Coordinator,
- European Commission, DG MOVE, Unit B.1,

the Members States, the participants of the Rhine-Alpine Corridor Forum, the stakeholders and with the other Corridor Consortia.

This report summarises the main findings of the comprehensive analyses of the Rhine-Alpine Corridor resulting from an iterative work flow which started with the first phase of the corridor study running from 2013 to 2014 and was continued with the second phase study phase in the period from 2015 to 2017.

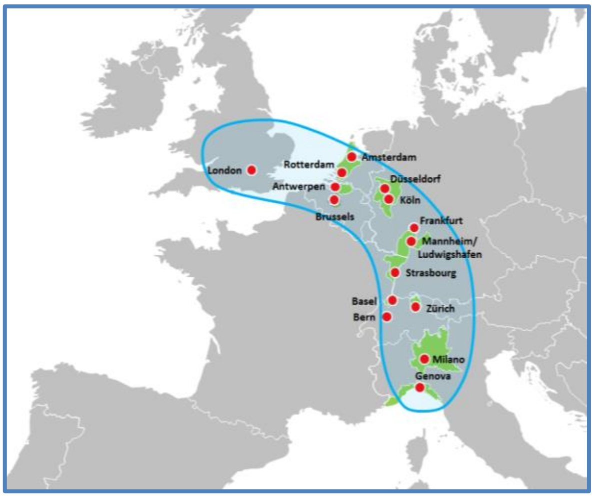
2 Executive Summary

The Rhine-Alpine Corridor

The Rhine-Alpine Core Network Corridor is one of the nine corridors of the Core Network, defined in the Trans-European Network for Transport (TEN-T), based on Regulations (EU) 1315/2013 and 1316/2013.

The regions it encompasses count among the most densely populated and economically strongest in Europe. Altogether, more than 70 million people live, work and consume in the catchment area of the Rhine-Alpine Corridor. Leading manufacturing and trading companies, production plants and distribution centres are located within. The Corridor runs through the so-called "Blue Banana", which includes major EU economic centres such as Brussels and Antwerp in Belgium, the Randstad region in the Netherlands, the German Rhine-Ruhr and Rhine-Neckar regions, the Basel and Zürich regions in Switzerland and the Milan and Genoa regions in Northern Italy (cf. Figure 1).

Figure 1: Europe's "Blue Banana



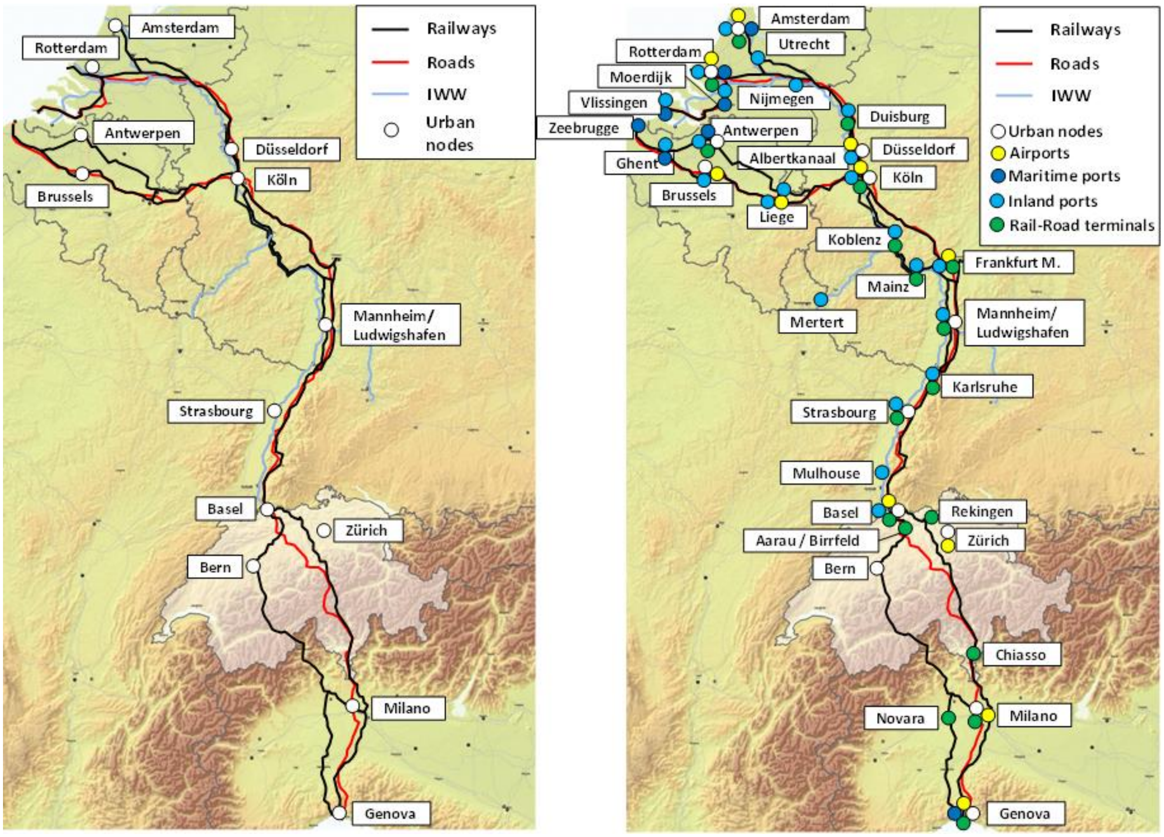
The Rhine-Alpine Corridor runs through five Member States and Switzerland. France was added to the catchment area of the Corridor in light of the relevance of inland waterways and their ports along the river Rhine.

In agreement with the Member States and dialogue with the Corridor Forum, the rivers Moselle and Neckar in Germany as well as the French inland ports on the Rhine (Strasbourg and Mulhouse) and Mertert on the Moselle in Luxembourg have been integrated for further analysis. Inland waterways in Belgium are not included in the Rhine-Alpine Corridor, but are of importance for its strategy and further development; information on them has been used for the transport market study analysis.

The main branches of the Rhine-Alpine Corridor are:

- Genova – Milano – Lugano – Basel;
- Genova – Novara – Brig – Bern – Basel;
- Basel – Karlsruhe – Mannheim – Mainz – Koblenz – Köln;
- Köln – Düsseldorf – Duisburg – Nijmegen/Arnhem – Utrecht – Amsterdam;
- Nijmegen – Rotterdam – Vlissingen;
- Köln – Liège – Brussels – Ghent;
- Liège – Antwerp – Ghent – Zeebrugge.

Figure 2: Outline of the Rhine-Alpine Corridor



Source: Regulation 1316/2013 Annex 1, Part 1 / HaCon

Compliance with the technical infrastructure requirements

The TEN-T Regulation 1315/2013 sets out the transport infrastructure requirements for each of the transport modes and the connected infrastructure components. To achieve an up-to-date overview on the current compliance of the Rhine-Alpine Corridor with the requirements of the TEN-T Regulation, the technical parameters of the Corridor have been analysed for all sections and infrastructure nodes.

The analyses have shown that most of the infrastructure characteristics of the Rhine-Alpine Corridor are compliant with the TEN-T requirements. Nevertheless, there are yet some issues to be addressed. For rail, in particular ERTMS deployment is a challenge. Freight trains with a length of 740 m cannot be operated without restrictions in Italy, while timetabling limitations apply in Germany and Belgium. There is a need for short sections in the Netherlands to develop the required levels for maximum axle load of 22.5 tonnes. Freight line speed of 100 km/h is realised on the Corridor with only limited exceptions mostly due to operational reasons. Concerning multimodality, currently only eleven of in total 65 identified intermodal terminals provide transhipment tracks of at least 740 m length. The IWW network is fully compliant with the requirement of the CEMT class of IV. Nevertheless, some of the Rhine sections are not navigable during extreme aridity and low-water. This applies in particular for the German section between Koblenz and Iffezheim. Insufficient minimum height under the bridges limits accessibility to Swiss ports. Insufficient lock capacity and mooring places, especially near Lobith, a vital cross-border section between the Netherlands and Germany, emerge as critical priorities. Lock capacity is also an issue along the Neckar and Moselle rivers. For airports, the main compliance issue for the airports along the Rhine-Alpine Corridor are the missing connections to the rail network in Basel, Milano Linate, Genoa and Rotterdam.

Traffic flows on the Corridor today and in the future

During the first study in 2014, a transport market study was carried out. The Rhine-Alpine Corridor constitutes one of the busiest freight routes in Europe. Strong links are between Germany, the Netherlands and Belgium. These flows add up to 307.2 million tonnes, 83% of the total international freight activity of the Corridor. Commodity-wise, the main cross-border commodities are: machinery and transport equipment, fuel products (liquid and dry bulk), building material and ores. The favoured mode of transport for these commodities (hinterland transport) is inland waterways followed by road.

For current passenger demand, expressed in number of trips, three major bidirectional traffic flows have been identified: between Belgium and the Netherlands, between Germany and Switzerland and between Germany and the Netherlands representing 25%, 23% and 19% of total traffic respectively. The dominant mode for international passenger flows in the Corridor is road. Air transport represents only a small part (4.1%) of total passenger demand. The main flows are identified between Germany and Switzerland, the Netherlands and Switzerland as well as Germany and Italy.

Future volumes have been analysed based on various national forecasts. They pointed out the importance of sea transport (especially for Belgium, the Netherlands and Italy), the sovereignty of road in the cases of Germany, Italy and the Netherlands and an expected growth for rail transport in Switzerland, Germany and the Netherlands. The modal shift effects of the Work Plan measures were calculated. In order to depict the potential effect of changes on the Corridor, the transport market study looked at the transport performance of the relevant sections. A model was employed using three runs: 2010 (basis), 2030 (baseline) and 2030 (compliance). The baseline forecast used GDP assumptions for 2030. The "compliance" to TEN-T standards scenario was defined considering a number of assumptions, such as full compliance with the TEN-T requirements, seamless interoperable railways, interoperable tolling systems and LNG fuel for ships.

With regard to the baseline run, the freight demand expected a moderate growth up to 2030 with an increase of 1.7% per year for all transport modes (road, rail and inland waterways), resulting in a total growth of about 40% for each transport mode. Applying the policy interventions on the compliance scenario, these 2010-2030 growth rates change to 36% for road, 55% for rail and 41% for inland waterway.

Regarding modal split, rail demonstrates the highest growth trend, followed by slightly lower growth for road and inland waterways. By 2030, rail is projected to grow by 55% (instead of 41% without the TEN-T interventions). This is mainly due to the expected decrease in travel costs and times that make rail a more attractive option for hinterland transport.

Plan for the removal of physical and technical barriers

One of the main goals of the updated corridor study was to identify and describe all projects necessary for the completion of the Corridor. This final project list is originally based on the project list of the 2014 corridor study. This 2014 list was updated and enriched with the 2015 CEF projects, selected CEF 2016 proposals, national transport plans, operational programmes on transport (OPT) and the Rail Freight Corridor implementation plans. Throughout the entire process, several consolidation rounds with the Members States and Corridor Forum stakeholders ensured a harmonious and well-coordinated project list.

The final project list of 2017 consists of 318 projects; it also includes projects which have been already implemented but were not completed when the Regulation 1315/2013 was set into force in 2013. Compared to the 2014 Work Plan, this means an increase by 42 projects and compared to the Work Plan of 2016 an increase by 101 projects. This growth is mainly due to additional projects which have been added by the Member States or other stakeholders, but also because of the optimised methodology of the handling of overlapping projects.

Technical compliance

The study on the Rhine-Alpine Corridor identifies prominent critical issues hampering the operation of this major European transport connection in line with the provisions of Regulation 1315/2013. The plan for the removal of physical and technical barriers presents assumptions on the compliance with Regulation 1315/2013 by 2030, based on the expected contributions of the identified planned projects to the Corridor's development. The results are pictured in the following Figure 3 for rail, Figure 4 for IWW and Figure 5 for road.

Figure 3: Rail compliance by 2030 overview

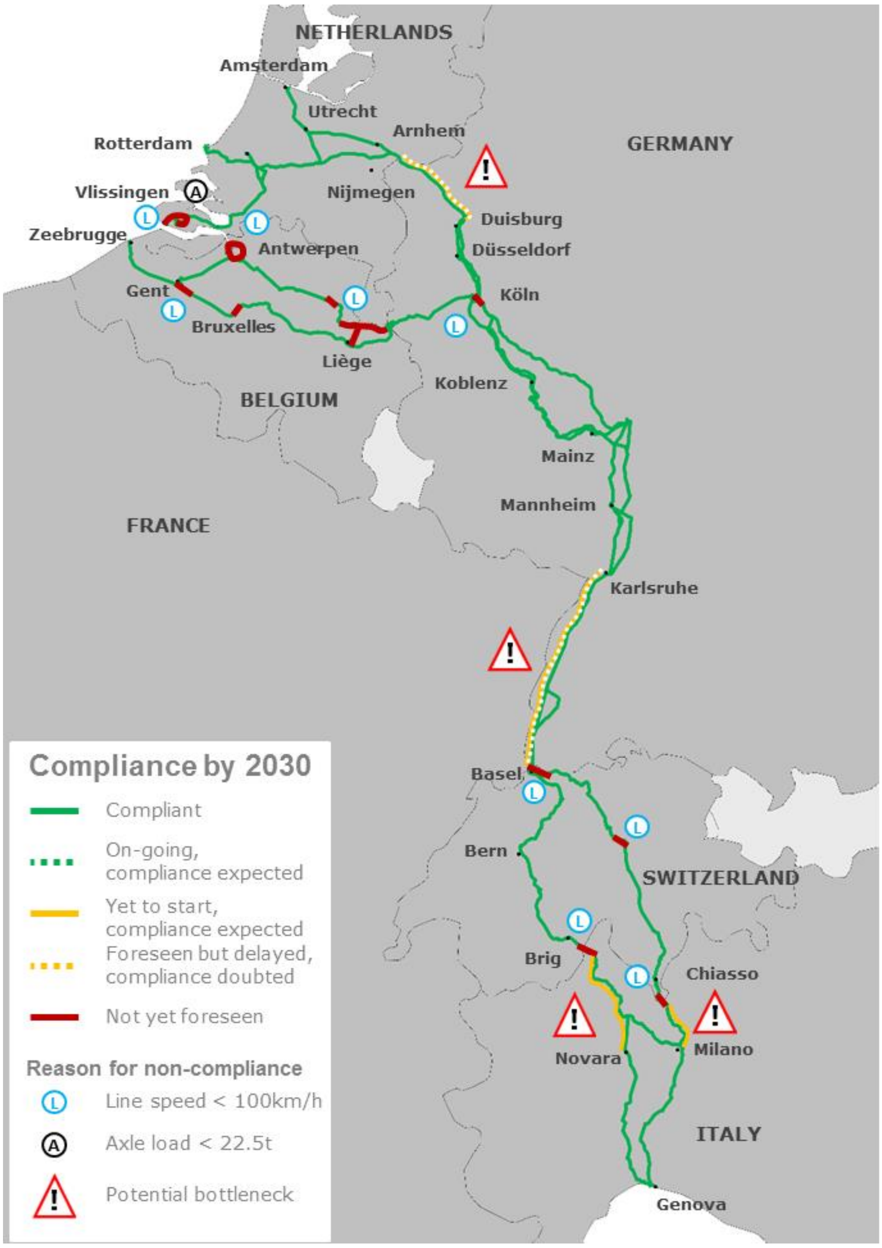


Figure 4: IWW compliance by 2030 overview

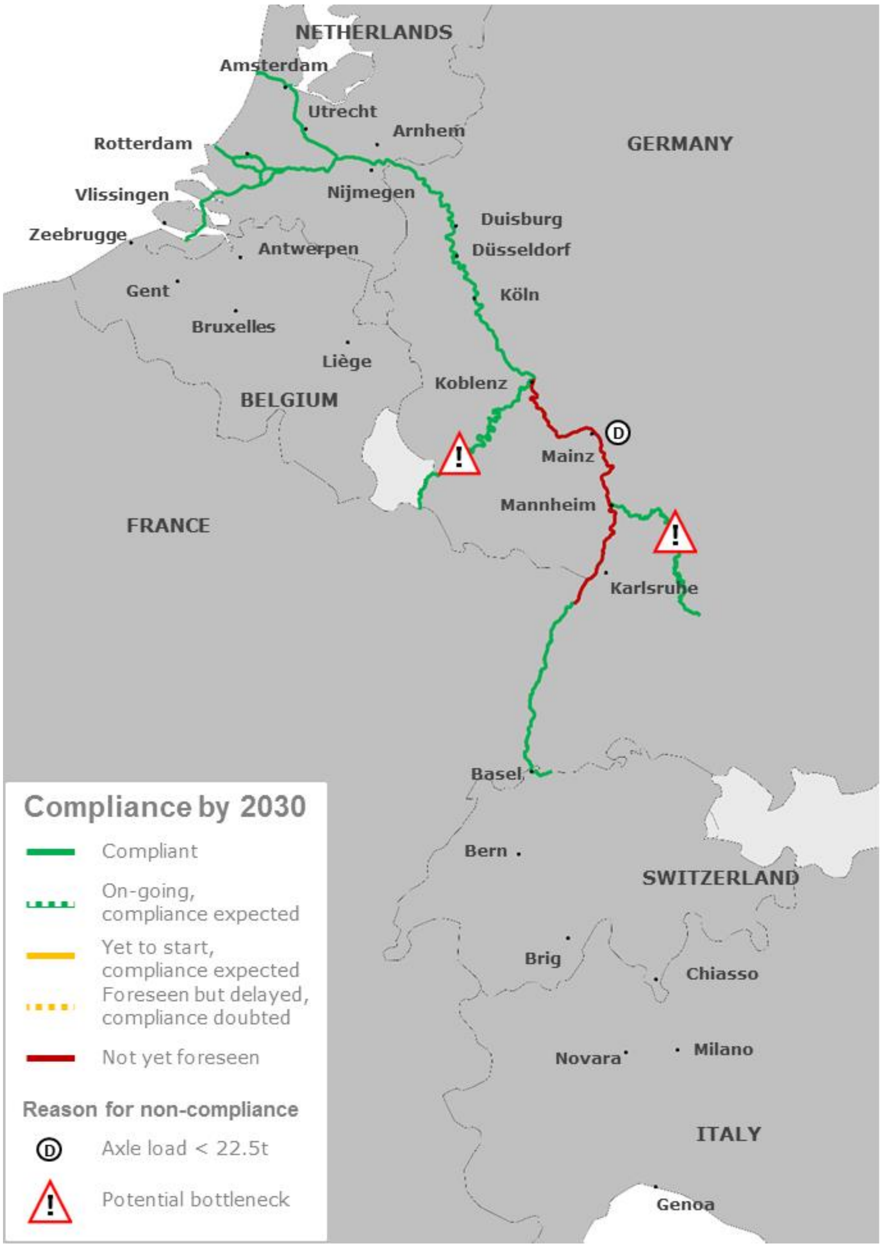
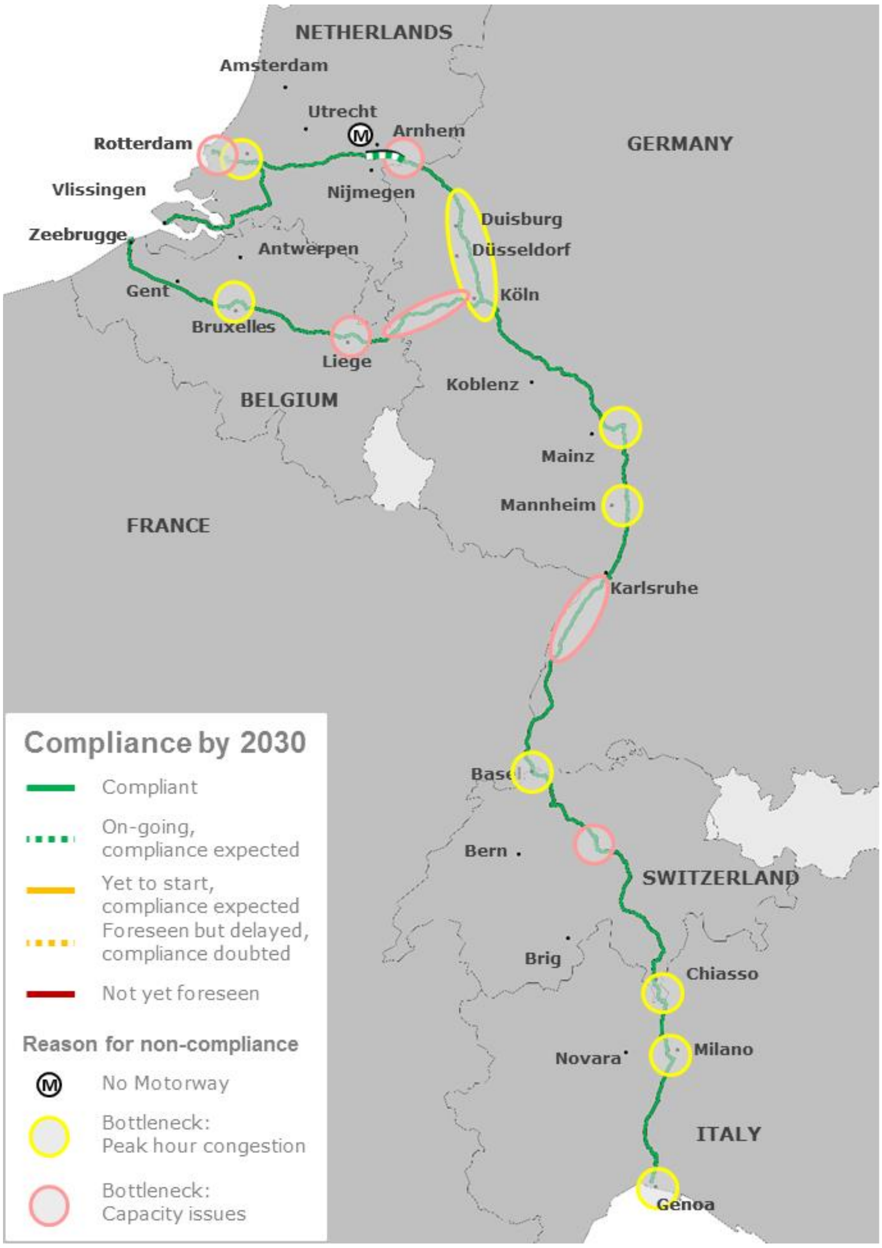


Figure 5: Road compliance by 2030 overview



Administrative and operational barriers

In addition to physical and technical bottlenecks, also administrative and operational barriers hinder the operation and further development of the Rhine-Alpine Corridor. Both have an important impact on the attractiveness of transport routes and modes and thus influence transport demand and modal share.

It has to be noted that this analysis represents the status of 2017 and that it is not possible to accurately predict future policy changes which might impact the identified administrative and operational barriers. They relate mainly to changing infrastructure provision at borders, severe issues in the infrastructure like different rail voltages impairing operations or administrative issues preventing seamless flows along the Corridor. A detailed analysis is presented in chapter 3.5.

Urban nodes

Urban nodes are defined as an "urban area where the transport infrastructure of the trans-European transport network, such as ports including passenger terminals, airports, railway stations, logistic platforms and freight terminals located in and around an urban area, is connected with other parts of that infrastructure and with the infrastructure for regional and local traffic"[1]. Urban nodes are further specified as starting points (first mile), final destination (last mile) and/or points of transfer within or between different transport modes for freight and passengers on the TEN-T network.

A compliance check of CNC lines within the urban nodes has been performed. In general, results of the analysis show a light discrepancy in terms of corridor lines compliance between different European countries involved in the Rhine-Alpine Corridor. Dutch, Belgian, Swiss and German nodes are almost completely compliant while French and Italian nodes show some more bottlenecks. In particular, urban nodes such as Strasbourg, Milano, Genova, Brussels and Köln are characterised by two non-compliant parameters per node. On the other hand, corridor lines in Amsterdam and Rotterdam are totally compliant while Antwerpen, Düsseldorf, Basel and Mannheim only present one not compliant parameter per node. A detailed analysis is presented in chapter 3.6.

Innovation

Innovative projects refer to measures across the EU Member States which involve the use of new technologies improving in some manner parts of the current transport system. A specific definition of "innovation" has been used to identify and classify innovation projects along the nine Core Network Corridors.

For the innovation deployment, 288 projects have been evaluated on their contribution to innovation. 71 projects, or 25%, have been identified as innovative based on the applied definition. The share of innovation projects on the Rhine-Alpine Corridor is relatively high compared to the average of 23.5% for all nine Core Network Corridors. The total investments for the 71 projects sum up to 4.6 billion EUR. This amount demonstrates that innovation is not costly, compared to infrastructure projects. The detailed analysis is presented in chapter 3.7.1.

Environmental impact

For the quantification of emissions the EU Reference scenario 2016 is applied. Freight traffic is forecasted to increase from 129 billion tkm today to 156 billion tkm by 2030 (road, rail and inland waterway). The fastest growing sector in the reference scenario is rail (at 1.8% per annum). Passenger traffic (road, rail and aviation), is forecasted to increase from 165 billion pkm today to 190 billion pkm by 2030. Here, the fastest growing sector is aviation (at 1.8% per annum).

According to the analysis conducted for the period 2015 – 2050, the emissions for road will decrease, while at the same time their number of passengers and tonnes of freight will increase. Compared to 2015, the emissions from rail will be constant in 2030 but would slightly increase in 2050. For inland waterway transport (IWT) the emissions will increase slightly until 2050. Aviation is a sector where the number of passengers will constantly increase between 2015 and 2050 (+76%). In the same period, the emissions will only slightly increase.

Total emissions in 2015 for road, rail, IWT and aviation on the Corridor are 18.9 million tonnes of CO_2 equivalent. Based on the forecasted traffic volumes and the increase of energy efficiency, emissions of 16.9 million tonnes of CO_2 equivalent in

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[1] TEN-T Regulation 1315/2013

2030 and 16.6 million tonnes in 2050 for the reference scenario are forecasted. A detailed analysis is presented in chapter 3.7.2.

Overall investment analysis of the Rhine-Alpine Corridor

The overall investment costs of all the projects in the Rhine-Alpine project list sum up to a total of 100.3 billion EUR. For 53% of the projects total complete financial information[2] is available, and hence these are eligible for this analysis. The corresponding amount (41.1 billion EUR) is divided into the financial sources sustaining each one of the analysed projects' cost:

The financial sources of the projects, which contain complete information of financing, are identified as follows:

- MS/public grant: 39.3 EUR billion, or 95.6% of the total;
- EU Grants (CEF, ESIF): 0.7 billion EUR, or 1.7% of the total;
- Private/own resources: 1.1 billion EUR, or 2.7% of the total.

The breakdown of funding by EU grants shows following situation:

- CEF/ TEN-T: 0.7 billion EUR, or 99.8% of the total;
- ESIF: 0 EUR;
- Other: 0.02 billion EUR, or 0.2% of the total.

The analysis leads to the following conclusion: would the same EU funding ratio (i.e. the above identified 1.7% for EU grants) be applied to the entire corridor investment amount, it can be expected that over the next years 1.7 billion EUR or CEF funding will be necessary. A detailed analysis is presented in chapter 3.8.

Summary of actions already accomplished

Since the first Work Plan published in May 2015, a great progress has already been made throughout the entire Rhine-Alpine Corridor and all transport modes. In total, 16 infrastructure projects and important studies have been completed and implemented. The total investment sum of these measures amounts to 13 billion EUR. Important and representative projects are highlighted and described in the Work Plan of the Corridor. These are:

- the **Gotthard Base tunnel** running through the Swiss Alps;
- the new **Intermodal hub Rhine-Ruhr** in Duisburg;
- the new Belgian **motorway A11** connecting Bruges and Knokke-Heist in West Flanders;
- the upgrade of the **rail connection of Maasvlakte 2** in the port Rotterdam; the improved **rail accessibility to the Milano Malpensa** airport;
- the **ground-breaking of the rail line between Zevenaar - Emmerich – Oberhausen.**

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[2] Complete financial information means that the whole project costs are covered by source of financing, e.g. for a project which cost is € 10 million there are 8 million covered by State funding and 2 covered by EU funding.

Estimation of socio-economic impact of the Corridor to jobs and growth

An analysis of the growth and jobs impact of the corridor development was performed by applying a multiplier methodology based on the findings of the study "*Cost of non-completion of the TEN-T*[3]".

The projects for which cost estimates are available and that are planned to be implemented over the period 2016 until 2030 were taken into evaluation, they amount to an investment of 96.6 billion EUR. The implementation of these projects on the Corridor will lead to an increase of GDP over the period 2016 until 2030 of 743 billion EUR in total. Further benefits will occur also after the year 2030.

The investments will also stimulate additional employment. The direct, indirect and induced job effects of these projects will amount to about 2.14 million additional job-years created over the period 2016 to 2030. It can be expected that also after 2030 further job-years will be created by the projects. A detailed analysis is presented in chapter 8.

Remark: Executive Summaries in Dutch, French, German and Italian language are included in the Annex I.

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[3] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

3 Conclusions from the previous tasks

The Rhine-Alpine Corridor connects the most important European industrial regions along the so-called “Blue Banana”, which is also closely connected to the other Core Network Corridors. The second Corridor study has shown that the Rhine-Alpine Corridor already today is well-developed which makes it a "forerunner" for other corridors. Infrastructure has generally a high compliance with the requirements of the TEN-T regulation. Intermodality plays an important role in particular for freight transport and there are numerous projects enabling further corridor development.

The final project list of 2017 consists of 318 projects; it also includes projects which had been already implemented but were not completed when the Regulation 1315/2013 was set into force in 2013. Compared to the 2014 Work Plan, this means an increase by 42 projects and compared to the Work Plan of 2016 an increase by 101 projects. This shows that the stakeholders have a high interest in the improvement of transport infrastructure. In this context, it has to be noted that the realisation of projects and measures in the Corridor does not only positively affect the development of infrastructure but also additional employment and the creation of additional GDP.

Participation and discussions in the Corridor Fora and working groups have shown that the development of the Corridor is a border-crossing task. Stakeholders have to live the corridor’s philosophy of a borderless Europe. Against this background, already today international initiatives have been established.

Naturally there is still some work to be done until 2030. This includes e.g. the removal of identified bottlenecks and existing operative and administrative barriers, an accelerated implementation of ERTMS and the increase of stability of intermodal transport. In particular, the Rastatt accident has shown that multimodal transport routes need efficient redundancies - otherwise concerned freight flows will shift to road.

Requirements of citizens and residents have to be considered. In particular noise in an important topic. Therefore, the pilot initiative on rail noise is an essential step which will also help to improve the acceptance of infrastructure projects in general which can otherwise be significantly delayed by objections of people directly concerned.

3.1 Compliance with the technical infrastructure parameters of the TEN-T guidelines

To achieve an up-to-date overview on the compliance of the Rhine-Alpine Corridor with the requirements of the TEN-T Regulation, the technical parameters of the Corridor have been analysed for all sections and infrastructure nodes. The compliance analysis compares the current (infrastructure) parameters with the target values set for the year 2030. The analysis uncovered the respective deficits on single corridor sections and nodes. To assist monitoring the achievement of the objectives, Key Performance Indicators (KPI) have been defined across all corridors that measure the extent to which target values are realized.

The results of the analysis with regard to major parameters are presented below:

- **Railway** transport: ERTMS-equipped infrastructure, interoperability and safety of national networks, full electrification, line speed of at least 100 km/h, axle load of at least 22.5 t, the possibility of running trains with a length of 740 m as well as rail connection to multimodal nodes;
- **Road** transport: reduction of congestion, interoperability on the network, safety, availability of clean fuels and reduction of emissions;

- **Seaports**: rail connections to the seaport, availability of alternative fuels, on-shore activities and intermodal connections;
- **Inland ports** and **inland waterways** transport: minimum of CEMT class IV, adequate capacity of transport, continuous bridge clearance, good navigability, RIS and efficient interconnection of ports with railway lines and roads;
- **Air** transport: rail connection to the airport, implementation of the Single European Sky, availability of clean fuels;
- **Multimodality** and **intermodality** on the Corridor: interconnection of transport modes at the nodes, real-time information in the transport chain, communication to the users at the stations, for rail-road terminals transhipment track length of at least 740 m, full electrification of the terminals rail tracks, the ability of handling all types of loading units.

Most infrastructure characteristics of the Rhine-Alpine Corridor are compliant with the TEN-T requirements. Table 1 lists only the infrastructure characteristics which deviate most from the requirements; infrastructures that comply fully with the criteria are not listed. It must be considered, however, that although infrastructures are compliant, other operational restrictions - such as noise emission prevention - limit full conformity.

Table 1: Compliance with TEN-T requirements

	NL	BE	DE	FR	CH	IT	Total
Railways							
Train length ≥ 740 m	100%	100%[4]	100%[5]	-	100%	0%	87%
Line speed ≥100 km/h	95%	82%	100%[6]	-	90%	100%	95%
ERTMS deployment	50%	18%	0%	-	26%	0%	12%
Roads							
Availability of clean fuels	available	available	available	-	available	available	100%
Inland waterways							
Min. draught 2.5 m	100%	-[7]	74%	90%	100%	-	82%
Min. height under bridges 5.25 m	100%	100%	100%	100%	100%	-	100%

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[4] Operation of 740 m long trains is theoretically possible in Belgium and Germany. Restrictions e.g. due to capacity bottlenecks during peak hours are likely to occur (cp. text above); however, it is not possible to mathematically measure the impact of these restrictions on the compliance, hence the 100% compliance rate in the table.

[5] See footnote 6.

[6] There are some speed limit restrictions for junctions in the area around Köln (10 km in total).

[7] See footnote 4

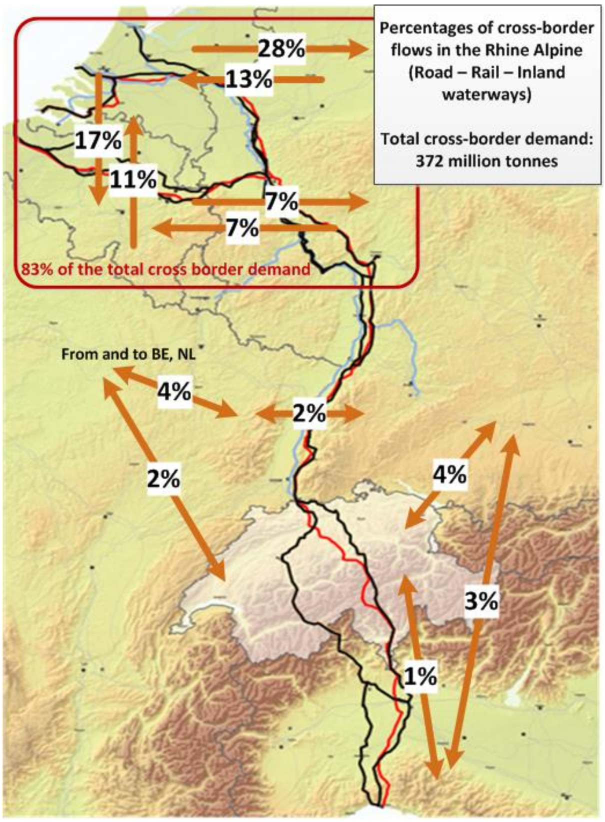
3.2 Results of the transport market study

The purpose of the Multimodal Transport Market Study (MTMS) for the Rhine-Alpine Corridor is to analyse the current and prospective market conditions along the Corridor, with current and future utilisation levels of transport modes.

3.2.1 International freight transport demand

Current market characteristics[8] show that for cross-border traffic within the Rhine-Alpine Corridor rail transport has a share of 12%, road 34%, and inland waterways 54%. The cross-border traffic volume was estimated at 372 million tonnes in 2010 (cf. Figure 3). This covers 37% of the total estimated demand in the catchment area including all traffic flows (international and domestic). Total demand is estimated slightly above 1 billion tonnes.

Figure 6: Cross-border freight international demand



Country-wise, the Corridor shows strong links between Germany, the Netherlands and Belgium. Figure 3 demonstrates that the main corridor flows are between these three countries with a combined transport volume of 307.2 million tonnes which represents 83% of the total international freight activity. The highest import and export flows are between Germany and the Netherlands with 152 million tonnes, representing 41% of the cross-border corridor demand. Commodity-wise, the main cross-border commodities identified are: machinery and transport equipment, fuel products (liquid and dry bulk), building material and ores. The favoured mode of transport for these commodities (hinterland transport) is inland waterways followed by road, which has been confirmed by individual port statistics.

Today, intermodal transports to and from Italy are mostly mainland connections, but with the improved connection between the Port of Genoa and the hinterland, the volumes moving to Switzerland and Southern Germany are also expected to grow.

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[8] ETISplus, 2010

International passenger transport demand

For passenger demand, expressed in number of trips, three major bidirectional traffic flows have been identified: between Belgium and the Netherlands, between Germany and Switzerland and between Germany and the Netherlands, representing 25%, 23% and 19% of total traffic respectively.

The dominant mode for international passenger flows in the Corridor is road, covering 87% of the total trips (in 2010[9] more than 95,000 thousand trips for all international flows and almost 67,000 thousand trips for the three major bidirectional flows). Rail represents almost 9% of the total international traffic flows with the main traffic flow observed between Italy and Switzerland, followed by the flow between Germany and Switzerland. Other major rail flows are between the Netherlands and Germany as well as Belgium and the Netherlands. Air transport represents only a small part (4.1%) of total passenger demand. The main flows are identified between Germany and Switzerland, the Netherlands and Switzerland as well as Germany and Italy.

3.2.2 Market forecasts

The MTMS evaluated the available European and national forecasts so as to provide insight on the potential growth in the Corridor countries.

National forecasts for freight transport

The various national forecasts investigated in the MTMS in general pointed out the importance of sea transport (especially for Belgium, the Netherlands and Italy), the sovereignty of road for Germany, Italy and the Netherlands and the expected growth for rail in Switzerland, Germany and the Netherlands. A national German forecast [10] indicates few changes in the projections, especially in relation to the total growth (which is more moderate in Germany), and the modal share of rail (higher due to lower road traffic). A national scenario was also published in the Netherlands[11] , indicating that freight demand for road is expected to grow faster than rail and inland waterways. The Belgian report of the Federal Planning Bureau[12] forecasts that road transport will still be the dominant mode by 2030 with a share of 70%.

Model forecasts for freight transport

In order to depict the potential effect of changes on the Corridor, the MTMS analysed the transport performance of the relevant sections. A model was employed using three runs: 2010 (basis), 2030 (baseline) and 2030 (compliance). The baseline forecast used GDP assumptions for 2030. The "compliance" scenario was defined considering a number of assumptions, such as full compliance with the TEN-T requirements as well as a broader concept of seamless interoperable railways and a trend of wide-spread introduction of road tolling[13].

With regard to the baseline run, the freight demand expected a moderate growth up to 2030 with an increase of 1.7% per year for all transport modes (road, rail and inland waterways), resulting in a total growth of about 40% for each transport mode. Applying the policy interventions on the compliance scenario, these 2010-2030 growth rates change to 36%, 55% and 41% respectively (Table 2).

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[9] Source: ETISplus (2010)

[10] Verkehrsverflechtungsprognose 2030 (2014)

[11] CPB/PBL (2015), Toekomstverkenning Welvaart en Leefomgeving, Cahier Mobiliteit, Den Haag: Planbureau voor de Leefomgeving

[12] Perspectives de l'évolution de la demande de transport en Belgique à l'horizon 2030 (2015)

[13] In line with existing legislation on road charging

Table 2: Mode performance on the Rhine-Alpine links

	Relative growth (2010-2030) without TEN-T interventions	Relative growth (2010-2030) with TEN-T interventions
Road	40%	36%
Rail	41%	55%
IWW	39%	41%

For the baseline scenario, the growth is fairly even for all concerned transport modes. When applying the compliance scenario, however, the growth volumes shift from road to rail, which has by far the highest relative growth. This is mainly due to the expected decrease in travel costs and time which makes rail a more attractive option for hinterland transport.

Table 3: Modal split for the Corridor alignment

	2010	2030 without TEN-T interventions	2030 with TEN-T interventions
Road	28.8%	28.8%	27.5%
Rail	20.4%	20.5%	22.2%
IWW	50.8%	50.7%	50.3%

Table 3 confirms the observations made above. The impact of TEN-T compliance is mainly reflected on rail which is expected to increase both its share and volumes, while road transport slightly declines. Inland waterway transport remains almost unaffected by the compliance scenario. Therefore due attention will need to be given to measures that further strengthen inland waterways, also because there is potential for a possible market update (cp. chapter 4).

3.2.3 Conclusions of transport market study

The analysis at origin/destination level demonstrates a significant growth potential for the central part of the Corridor, especially for rail in the areas close to Köln, Frankfurt and Mannheim, as well as in Switzerland and Italy.

For inland waterways, the links from Rotterdam - following the Rhine - to Duisburg and Frankfurt are the busiest on the network. For road, the largest potential for growth is demonstrated around urban areas. These capacity needs by 2030 were also confirmed in the supply side analysis for the Corridor, in terms of both network and terminal capacity. Potential capacity problems in the Netherlands (related to the lock of Amsterdam and the high throughput times) will emerge in the period until 2030.

The road network demonstrates a more evenly distributed flow, with the exception of traffic around urban nodes. This is an important issue for road transport as the analysis identified urban areas as the highest growth potential. Next to the network limitations causing congestions around urban nodes, the capacity of rail-road terminals could also be affected by the potential growth.

By implementing the measures needed to comply with the TEN-T requirements, a modal shift from road to the more environmentally friendly rail transport will occur by 2030. Inland waterway transport will only be very slightly affected by the compliance scenario. If the requirements are not met, the modal split is expected to stay at the same levels.

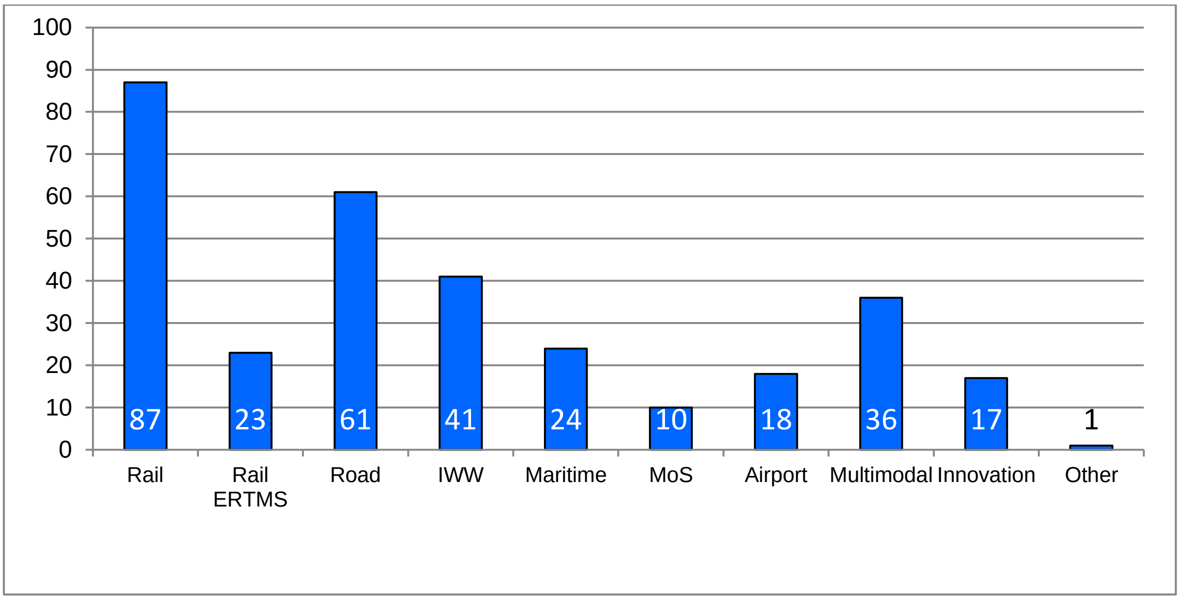
3.3 The identified projects (studies and works based on the project list)

One of the main goals of the revised corridor study was to identify and describe all projects necessary for the completion of the Corridor. This final project list is originally based on the project list of the 2014 corridor study described in the first Work Plan. This 2014 list was updated and enriched with the 2015 CEF projects, selected CEF 2016 proposals, national transport plans, operational programmes on transport (OPT) and the Rail Freight Corridor implementation plans. Throughout the entire process, several consolidation rounds with the Members States and Corridor Forum stakeholders ensured a harmonious and well-coordinated project list.

The final project list of 2017 consists of 318 projects; it also includes projects which have been already implemented but were not completed when the Regulation 1315/2013 was set into force in 2013. Compared to the 2014 Work Plan, this means an increase by 42 projects and compared to the Work Plan of 2016 an increase by 101 projects. This growth is mainly due to additional projects which have been added by the Member States or other stakeholders, but also because of the optimised methodology of the handling of overlapping projects.

Regarding the categorisation of projects, it has to be emphasized that each project is allocated to only one category although many measures could have been assigned to more than one.

Figure 7: Total number of Corridor projects by category

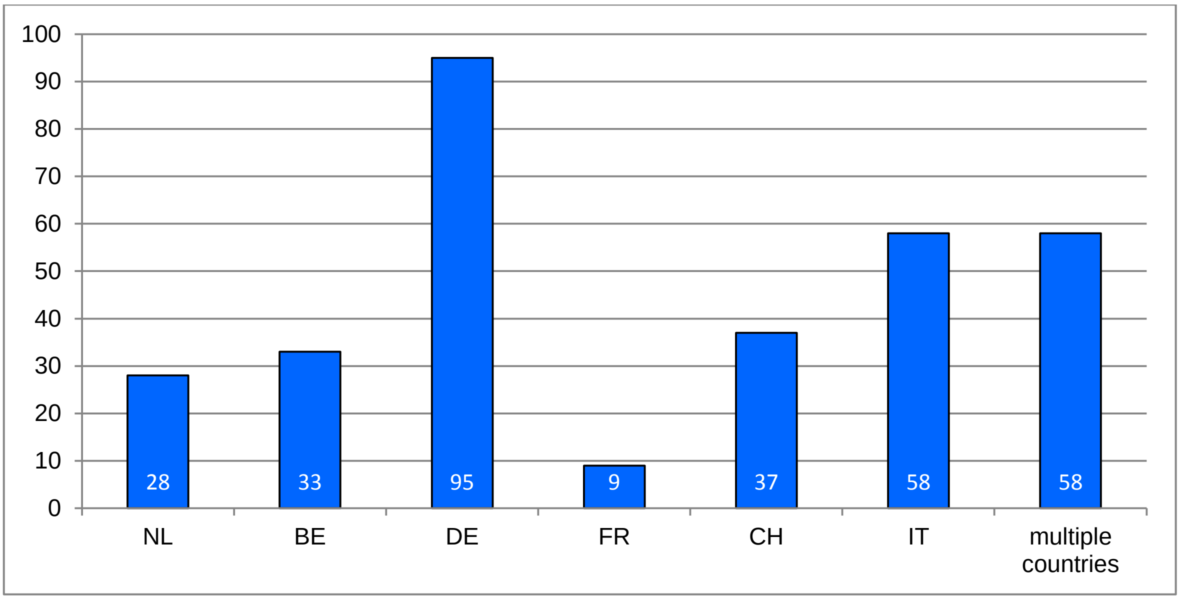


Source: KombiConsult, based on RALP project list – status: April 2017

Figure 7 emphasises the importance of "Rail" (including 23 ERTMS-related measures) and "Multimodal". "Rail" has by far the lion's share of all projects, accounting for in total 87 projects, which amounts to 27 % of the total measures. These projects include a vast range of measures, from noise reduction measures to new constructions of high speed passenger lines. Compared to that, the other modes of transport (namely "Road" and "IWW") have fewer upgrades planned. Multimodality also plays an important role for seamless transportation chains on the Rhine-Alpine Corridor, pointed out by in total 36 related projects. Finally, this presentation indicates a lack of innovative measures, with only 17 projects belonging to the category "Innovation". This low number of "Innovation" is however explained by the categorisation which favours the "classical" transport mode since projects can belong to one category only.

Looking at the project shares per country, it can be said that the number of projects per country is more or less proportional to the corridor share of the respective country. For example, France which is only involved with the inland ports of Strasbourg and Mulhouse, only accounts for 9 (3%) projects. In contrast, Germany, representing about half of the corridor network length (see Figure 8), also leads the project ranking; 95 projects (30%) are allocated to Germany. Comparing the country shares with the analysis of the second Work Plan in 2016 it becomes obvious that the projects concerning multiple countries have more than doubled. This shows that stakeholders are already inspired by the idea of the Corridor and that there is a strong development and trend towards a well-connected, seamless Europe.

Figure 8: Number of projects by country



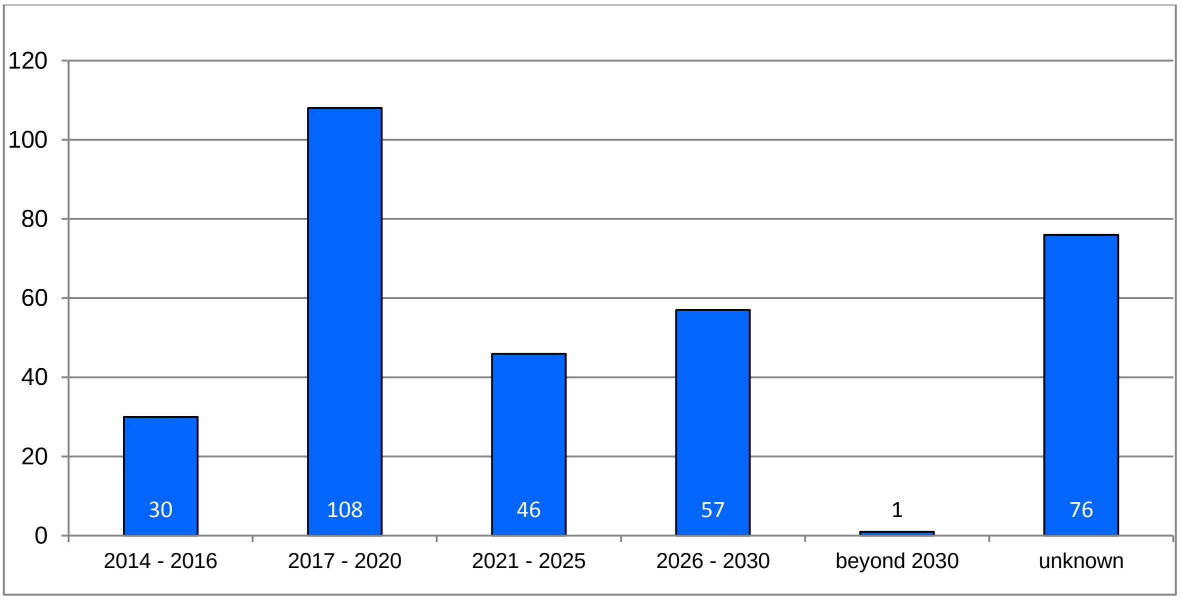
Source: KombiConsult, based on RALP project list – status: April 2017

The planned implementation time of the projects is shown in Figure 9. However, not all of these 318 projects can safely be expected to be finalised before 2030. For 76 projects, the implementation dates is unknown. For most of these projects, the finalisation is most likely before 2030, but no detailed information is available. Additionally, some long-term projects might be delayed so that their actual implementation will be well beyond 2030 - even though their official finalisation date states "before 2030". Only for one project it is known that the completion date will be after 2030.

For the others, a grouping of the completion year into the clusters was done: "2014 - 2016" (projects completed since the adoption of the Regulations and within the present reporting time), "2017 – 2020" (projects to be completed in the present financing period), two more intervals until 2030 (the target date for the core network infrastructure to meet the Regulation's requirements) and finally the projects with the a completion date after 2030.

A total of 30 projects (9%) have already been completed by the end of 2016. The vast majority of the projects, namely 108 (34%) are expected to be completed by 2020, another 46 projects (14%) are to be implemented until 2025, another 57 projects (18%) by 2030 respectively.

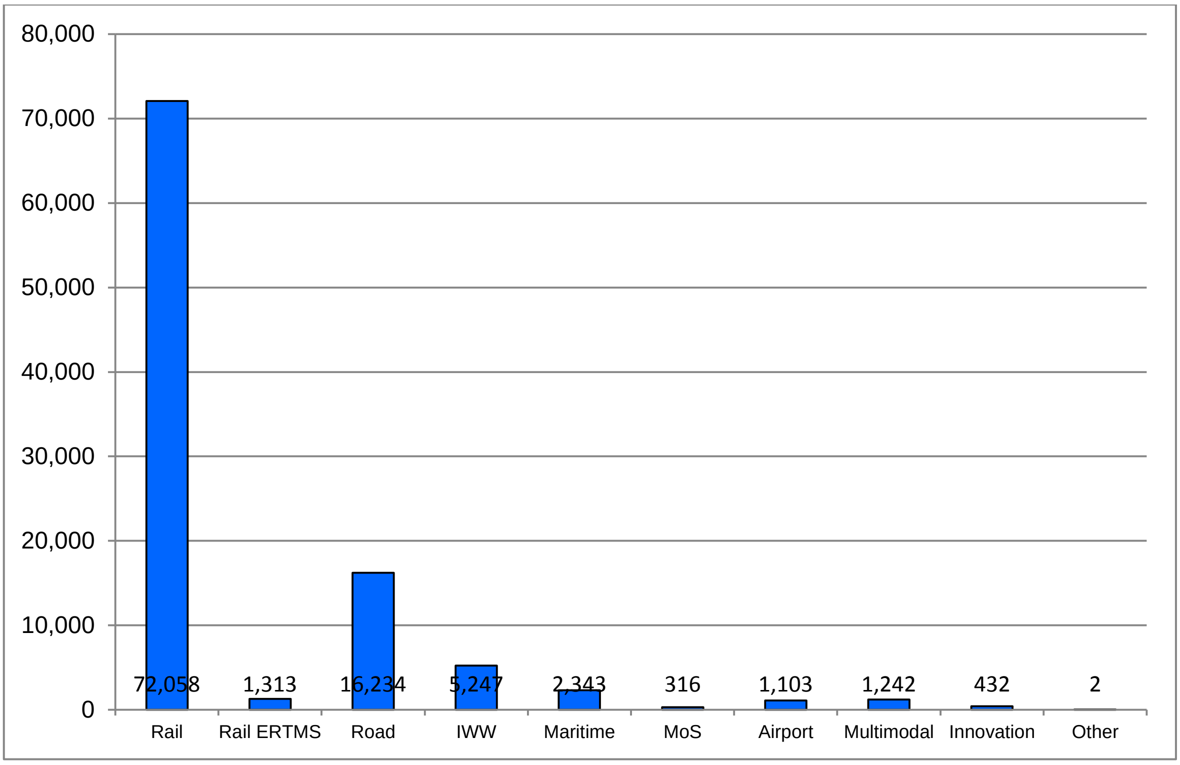
Figure 9: Planned implementation of projects



Source: KombiConsult, based on RALP project list – status: April 2017

The planned investment per project category shows that rail and ERTMS have by far the highest needs for infrastructural upgrades followed by road projects.

Figure 10: Investments per category in million EUR



Source: KombiConsult, based on RALP project list – status: April 2017

3.4 Future challenges on the Rhine-Alpine Corridor

The ultimate objective of the TEN-T development is to close existing gaps, remove bottlenecks and eliminate technical barriers that exist between the transport networks of EU Member States, strengthening the social, economic and territorial cohesion of the Union and contributing to the creation of a single European transport area. This global objective can be further specified:

- Improving cross-border sections;
- Eliminating missing links;
- Interoperability/compliance with TEN-T standards;
- Developing multimodality;
- Enhancing last-mile connection;
- Tackling Externalities/Sustainability/Innovation;
- Considering impacts on urban areas;
- Improving capacity and removing bottlenecks.

Critical issues can be defined as everything that hinders or prevents the fulfilment of the above mentioned corridor objective by 2030. The critical issues can be divided into technical compliance issues, (capacity) bottlenecks as well as administrative and operational barriers. The methodology of identifying these critical issues as well as the issues themselves are described and analysed in the following sub-chapters.

3.4.1 How to identify the Critical Issues

In general, the identification of critical issues is based on the technical compliance analysis of the Rhine-Alpine core network, the development of the transport market and the resulting capacity issues by 2030 as well as the analysis of the comprehensive list of projects along the Rhine-Alpine Corridor. In addition, critical issues were discussed in the Corridor Fora and Working Groups with several stakeholders.

For the first Work Plan, a technical compliance analysis was being performed. It compares the currently deployed infrastructure with the official TEN-T requirements and shows where these standards are not met. With the continuation of the studies on the TEN-T Corridors, the fulfilment of the compliance has been monitored and further discussed with relevant stakeholders and Member States to keep the compliance analysis of the Rhine-Alpine core network up-to-date.

The list of projects along the Rhine-Alpine Corridor was finalised in early summer 2017 in an iterative process. It also involved several consolidation rounds with the Members States and Corridor Forum stakeholders to ensure a harmonious and well-coordinated project list.

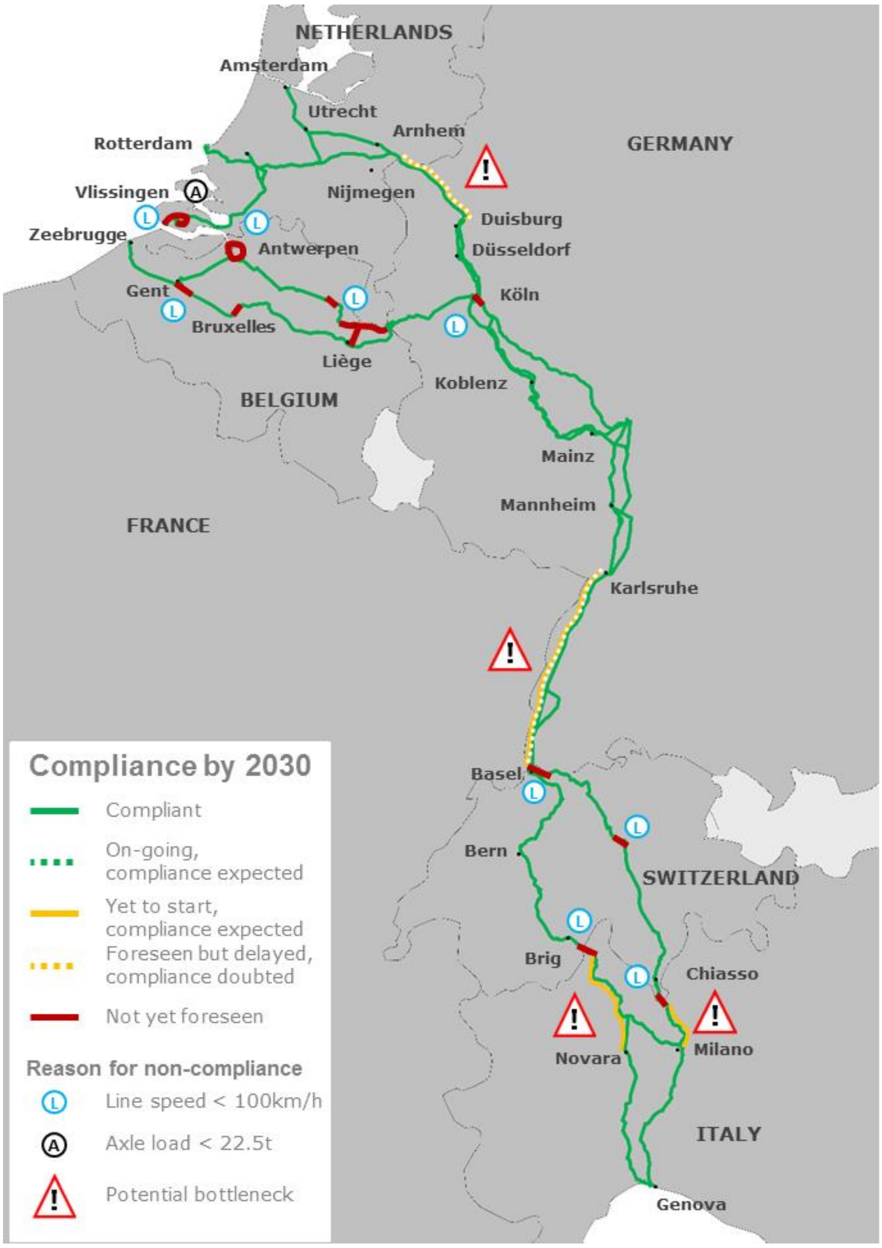
The technical issues were then identified by checking which of the highlighted compliance issues are not tackled by an infrastructure project before 2030. The development of the transport market in combination with the identified infrastructure projects allows for the recognition of future capacity bottlenecks. More critical issues like rail noise were perceived during the Working Group meetings with expert stakeholders.

3.4.2 Technical compliance

This chapter presents the results of the technical compliance analysis of the Rhine-Alpine core network for road, rail and inland waterways.

For rail, the main compliance issue is the line speed limitation. It is required by TEN-T standards that the entire core network shall allow at least 100 km/h. However, several sections especially in Belgium and Switzerland do not meet this requirement. In addition, in the Vlissingen area the allowed axle load is lower than 22.5 t. Moreover, there are some potential bottlenecks where identified infrastructure projects are not to be expected to be implemented before 2030 (e.g. Karlsruhe – Basel) or their finalisation date is unknown.

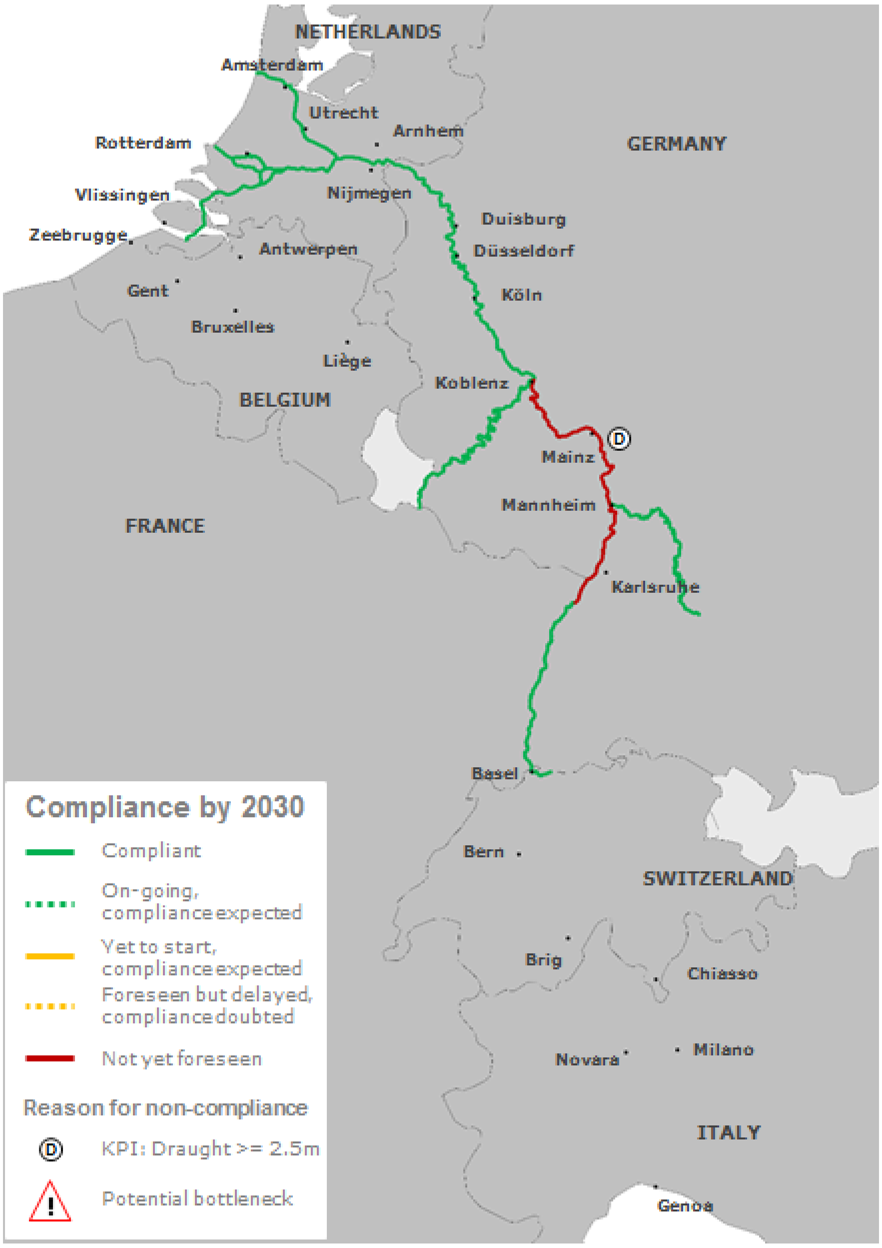
Figure 11: Rail compliance by 2030 overview



Source: Rapp Trans

For the inland waterways on the Rhine-Alpine Corridor, only one compliance issue is identified. The draught of the Rhine between Koblenz and Iffezheim is partially below 2.5 m.

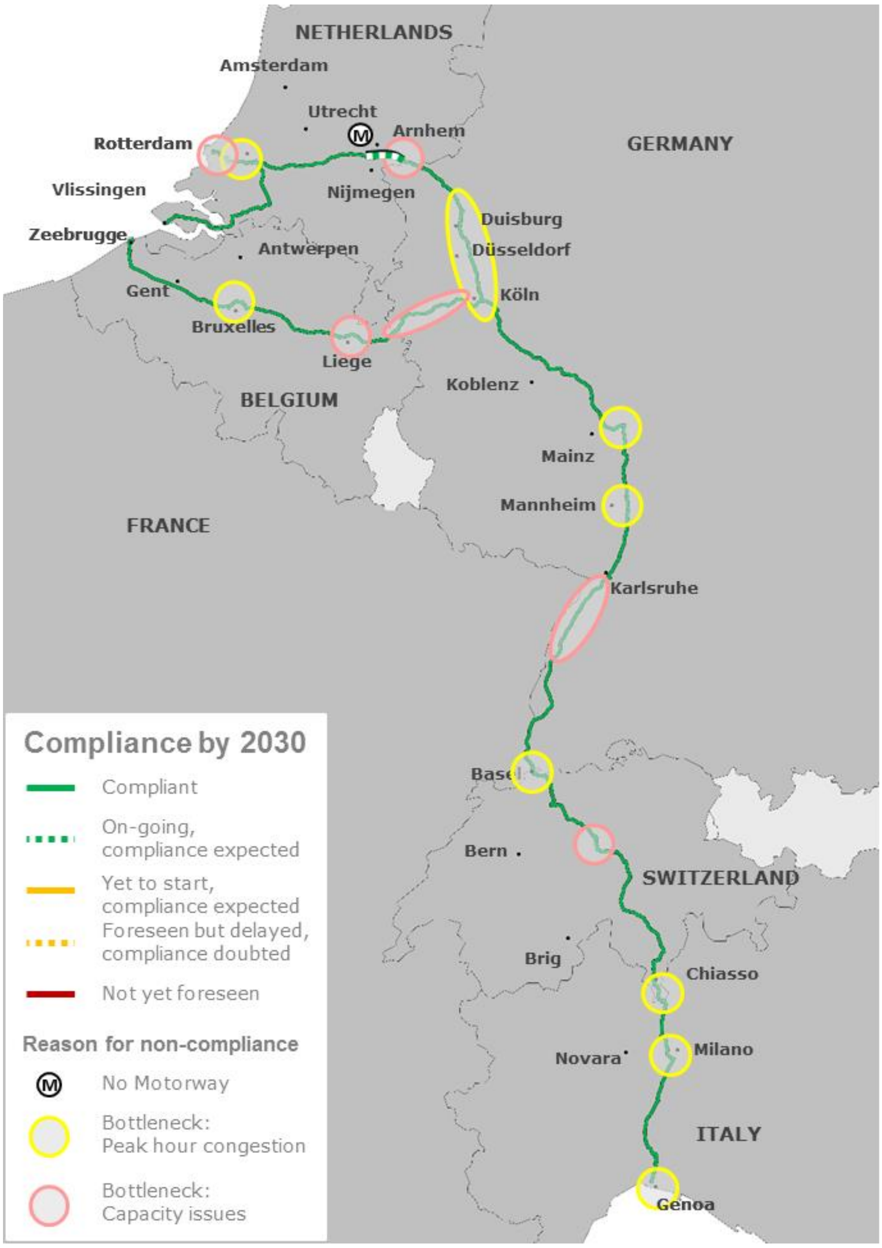
Figure 12: IWW compliance by 2030 overview



Source: Rapp Trans

The road transport infrastructure along the Rhine-Alpine Corridor is in a mature state. Relating to the TEN-T regulation compliance check, only one section is not classified as a motorway yet (see Figure 13). The map highlights the identified bottlenecks and the sections that do not yet comply with the regulation. Congestion bottlenecks refer specifically to the urban areas where congestion occurs frequently. It can be seen that bottlenecks are not exclusively limited to cross-border sections and urban nodes, but are distributed across the entire Corridor.

Figure 13: Road compliance by 2030 overview



Source: Rapp Trans

3.4.3 Persisting bottlenecks

The global corridor objectives should be fulfilled until 2030. Nevertheless, from today's perspective it cannot be guaranteed that this target will be fully accomplished. This has different reasons:

- for identified bottlenecks at the moment no projects have been defined, for example the rail line speed limitations on short sections in seaports and urban nodes e.g. Ring of Antwerp;
- planned or running projects will not be finished until 2030; the most important example is the Karlsruhe – Basel rail project which is expected to be finished in 2042;
- possible delay of important infrastructure projects e.g. due to lengthy permitting procedures and extensive process of civil participation;
- some bottlenecks cannot be solved due to insurmountable physical or external barriers, for example capacity issues in urban areas or securing a sufficiently extended fairway depth along the Rhine river.

3.5 Administrative and operational barriers

In addition to the aforementioned physical and technical bottlenecks, also administrative and operational barriers hinder the operation and further development of the Rhine-Alpine Corridor. Both have a high impact on the attractiveness of transport routes and modes and thus influence transport demand and modal share.

It has to be noted that this analysis represents the status of 2017 and it is not possible to accurately predict future policy changes which might impact the identified administrative and operational barriers. They relate mainly to changing infrastructure provision at borders, severe issues in the infrastructure like different rail voltages impairing operations or administrative issues preventing seamless flows along the Corridor.

For **rail transport**, the main operational barriers stem from the historically founded interoperability issues in the national rail networks. These interoperability issues occur on the cross-border sections, where voltage, signalling and safety systems change. These directly jeopardize continuity of passenger and freight flows on both sides on the border and negatively influence travel time as well as transport costs. Regarding rail safety systems, the future implementation of ERTMS will provide a big step forward. Differences in rail voltage and different signalling systems require the employment of cost-intensive multi-system locomotives which compromises the competitiveness of rail transport.

Inland waterway transport is less impacted by operational and administrative barriers than other transport modes. More important are the external conditions of water levels, fuel prices and navigability (without accidents) for the success of inland navigation. The interoperability is widely ensured and a common classification system for waterways and barges is in place. A current challenge is the deeper integration of ICT services in inland waterway transport which support seamless international transport chains.

For **road transport**, two important barriers have been identified mainly resulting from different legislations. This concerns especially different tolling systems along the Corridor. For the Netherlands, toll fees are currently under study. Different budgeting systems lead to incoherence in technical equipment of trucks. The night time driving ban for heavy vehicles in Switzerland poses a capacity challenge on sections leading from Italy and Germany into Switzerland for parking facilities and border crossings.

Despite these issues, the coordination between corridor countries has been actively promoted. Dedicated working groups e.g. for ports and inland waterways have been initiated for the identification, discussion and solving of existing barriers. Also a variety of projects involves multiple stakeholders from different countries. This international cooperation ensures a harmonised long-term increase of interoperability across countries involved.

3.6 Urban nodes

Urban nodes are defined as an "urban area where the transport infrastructure of the trans-European transport network, such as ports including passenger terminals, airports, railway stations, logistic platforms and freight terminals located in and around an urban area, is connected with other parts of that infrastructure and with the infrastructure for regional and local traffic[14]". Urban nodes are further specified as starting points (first mile), final destination (last mile) and/or points of transfer within or between different transport modes for freight and passengers on the TEN-T network.

Urban nodes shall be connected with multimodal links to achieve long-term sustainable mobility on the comprehensive network. The overall goal of the urban node network development is the appropriate interconnection of passenger and freight flows between all modes involved, for example the connection between airports and TEN-T railway lines. Furthermore, a seamless connection between the (long-distance) TEN-T infrastructure and regional / local traffic and urban freight delivery on the last-mile shall be achieved. Finally, urban bottlenecks are to be removed leading to the enhancement of multimodal transport solutions and a shift towards more sustainable mobility for both freight and passenger.

According to the TEN-T Regulation 1315/2013 and the results of the CNC studies, the Rhine-Alpine Corridor core network is characterised by thirteen urban nodes, located in six European countries.

The Strasbourg node was added to the RALP Corridor due to the importance of the Alsace region for the inland waterway transport between the North Sea ports. Frankfurt am Main is one of the biggest urban centres within the Rhine-Alpine Corridor. Rail and road corridor lines on the south-west of the Frankfurt area are an important part of the Rhine-Alpine Corridor while the inland waterway in the node (river Main) belongs to the Rhine-Danube core network. The nodes in Switzerland have been chosen in coordination with the Swiss Ministry of Transport (BAV). Even though Zürich and Bern have been identified as important urban nodes, their connection to road, rail and IWW corridor core network is very limited.

A compliance check of CNC lines within the urban nodes has been performed. The compliance check addressed the requirements of the regulation and has been carried out for the urban nodes according to the KPIs of the project list. In particular, rail parameters taken into account were: train length (≥740 m), axle load (≥22.5 t), speed (≥100 km/h), electrification and capacity utilisation. Road sections have been analysed with regard to the parameter "express road/motorway".

Moreover, a last-mile connection compliance check has been carried out for each urban node in order to investigate whether a seamless connection between the (long-distance) TEN-T infrastructure and regional / local traffic and urban freight delivery on the last mile is achieved. The rail connection of inland ports, trimodal terminals and rail-road terminals to the core network has been analysed according to the parameters axle load, electrification and train length. Rail connections to airports have been evaluated on the basis of heavy rail connection. Only rail parameters have been taken into account as similar road criteria do not exist due to its flexibility allowing seamless connections.

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[14] TEN-T Regulation 1315/2013

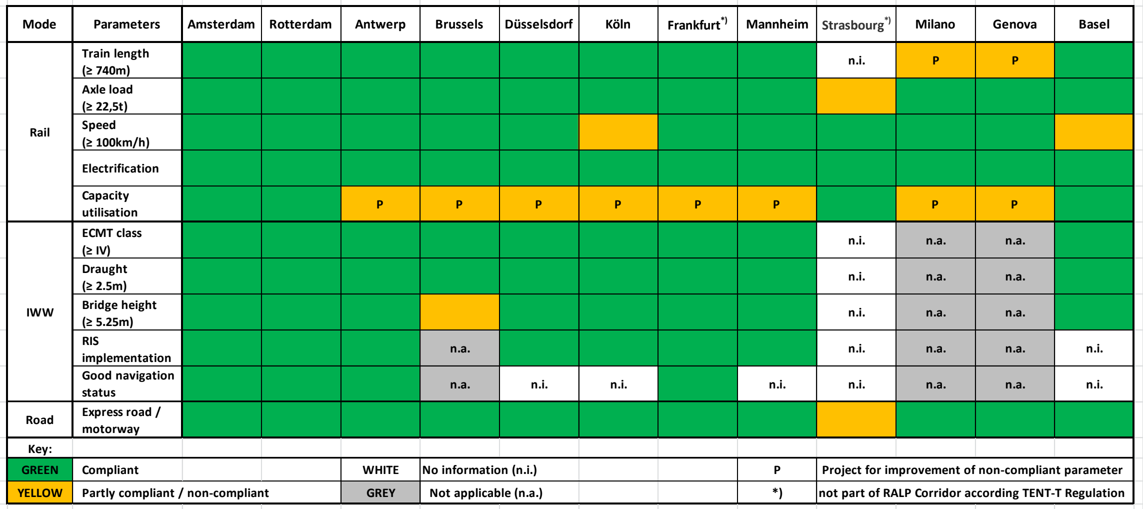
In addition, improvement projects with reference to non-compliant sections or in case of particular relevance for the urban node have been pointed out.

Corridor rail lines within the urban nodes suffer of different bottlenecks. About 80% of the analysed rail parameters per node are compliant while about 20% of them do not meet the requirements on at least one rail section within the urban node. The rail parameter most afflicted by bottlenecks is "capacity utilisation", which is compliant in about 35% nodes only. Moreover, the train length and speed criteria are only partially fulfilled in 2 nodes. On the other side, the entire rail network on the Corridor is electrified. Projects focusing on the total or partial resolution of the above mentioned bottlenecks basically refer to the improvement of the capacity resolution. No projects with the purpose of achieving speed 100 km/h and axle load 22.5 t requirements on the non-compliant sections have been identified.

Corridor lines for inland waterways have been analysed for eight urban nodes. Except of one bottleneck in Brussels ("height under bridges"), all IWW parameters per node taken into account are compliant with the regulation. No projects have been foreseen for the resolution of this bottleneck.

The road network of the Rhine-Alpine nodes is almost fully compliant with the TEN-T regulation.

Table 4: Corridor lines compliance check on the Rhine-Alpine urban nodes



Mode	Parameters	Amsterdam	Rotterdam	Antwerp	Brussels	Düsseldorf	Köln	Frankfurt*)	Mannheim	Strasbourg*)	Milano	Genova	Basel
Rail	Train length (≥ 740m)	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	n.i.	🟨 P	🟨 P	🟩
	Axle load (≥ 22,5t)	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟨	🟩	🟩	🟩
	Speed (≥ 100km/h)	🟩	🟩	🟩	🟩	🟩	🟨	🟩	🟩	🟩	🟩	🟩	🟨
	Electrification	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	Capacity utilisation	🟩	🟩	🟨 P	🟨 P	🟨 P	🟨 P	🟨 P	🟨 P	🟩	🟨 P	🟨 P	🟩
IWW	ECMT class (≥ IV)	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	n.i.	n.a.	n.a.	🟩
	Draught (≥ 2.5m)	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	n.i.	n.a.	n.a.	🟩
	Bridge height (≥ 5.25m)	🟩	🟩	🟩	🟨	🟩	🟩	🟩	🟩	n.i.	n.a.	n.a.	🟩
	RIS implementation	🟩	🟩	🟩	n.a.	🟩	🟩	🟩	🟩	n.i.	n.a.	n.a.	n.i.
	Good navigation status	🟩	🟩	🟩	n.a.	n.i.	n.i.	🟩	n.i.	n.i.	n.a.	n.a.	n.i.
Road	Express road / motorway	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟨	🟩	🟩	🟩
Key:													
GREEN	Compliant			WHITE	No information (n.i.)				P	Project for improvement of non-compliant parameter			
YELLOW	Partly compliant / non-compliant			GREY	Not applicable (n.a.)				*)	not part of RALP Corridor according TENT-T Regulation			

Source: HaCon

In general, results of the analyses show a light discrepancy in terms of corridor lines compliance between different European countries involved in the Rhine-Alpine Corridor. Dutch, Belgian, Swiss and German nodes are almost completely compliant while French and Italian nodes show more bottlenecks. In particular, urban nodes such as Strasbourg, Milano, Genova, Brussels and Köln are characterised by two non-compliant parameters per node. On the other hand, corridor lines in Amsterdam and Rotterdam are totally compliant while Antwerpen, Düsseldorf, Basel and Mannheim only present one non-compliant parameter per node.

Based on the official TENtec interactive maps, showing the CNC elements in the respective urban areas, three layers (charts) have been elaborated for the urban nodes with different content:

- Layer I: Overview on the urban node including entire corridor infrastructure;
- Layer II: Analysis of the corridor lines;
- Layer III: Analysis of the last-mile connections.

The charts are attached in the Annex II.

3.7 Wider Elements of the Work Plan

The Wider Elements of the Work Plan address the negative impacts (such as externalities and climate change) the Corridor might suffer from. In order to provide recommendations for the Member States, measures to address those negative impacts (e.g. a risk assessment of climate change impacts and vulnerabilities), are depicted per country.

3.7.1 Innovation Deployment

Innovative projects refer to projects across the EU member states which involve the use of new technologies improving parts of the current transport system. A specific definition of "innovation" has been used to identify and classify innovation projects along the nine Core Network Corridors. This definition means that innovative corridor projects have to contribute to at least one of the elements below:

- Telematics (including ERTMS level 3);
- Data sharing and real-time predictive analysis;
- Efficient management and governance structures;
- Innovative transport services;
- Significant safety and security improvements;
- Low carbon and decarbonisation;
- Innovation dissemination;
- Cybersecurity and data protection;
- Climate change resilience and transport greening;
- Other reduction of externalities, e.g. minimisation of rail noise.

For the innovation deployment, 288 projects have been evaluated on their contribution to innovation. 71 projects, or 25%, are seen as innovative referring to the definition above. The total investments for these projects amount to 4.6 billion EUR on the Rhine Alpine Corridor. This amount demonstrates that innovation is not costly compared to infrastructure projects.

The identified corridor innovation projects are 100% transferable. "Transferable" means applying the same innovation solution in another location. Projects on the Rhine-Alpine Corridor are 35% scalable. Scalable means applying the solution in a new field, or that the project has multiplier effects.

Of the 71 innovative projects, 14% have been categorised as "radical and incremental innovation", i.e. state-of-the-art. To some degree these state-of-the-art projects set new standards for the next decades, to be applied along the whole Corridor. The other 86% consist of "catch-up innovation"; these are known as projects related to innovation which is transferable innovation across the EU. The catch-up innovation has usually already been successfully implemented in a region or country.

In terms of transport modes, road has the most innovation projects, followed by maritime and MoS, IWW, rai, and finally airport projects. Of the road category, most of the innovation projects are on alternative fuels and safe and secure parking. Concerning ERTMS, no project confirms the use of baseline 3 in the deployment phase. ERTMS Baseline 3 is the most innovative form of telematics in rail.

As mentioned before, the projects grouped as "innovative" have relatively low costs per project compared to the straightforward infrastructure-related projects. Road innovation projects have the highest total costs on the Corridor.

The following provides a horizontal view of the innovation analysis performed for the nine TEN-T Core Network Corridors. This work is the result of an independent assessment prepared by the consultant teams of all corridors, on the basis of a methodology previously agreed.

During their work, the corridor teams collected a vast number of data and information on innovative projects. It was thus decided to compare the results using key indicators. In all of them it was ensured that information was available for all corridors.

The share of innovation projects of the Rhine-Alpine Corridor is slightly higher (25%) than the overall average of 23.5% in all nine Core Network Corridors. However, the total number of projects is relatively low on the Rhine-Alpine Corridor, therefore the number of innovation projects is consequentially also below average. The innovation projects were further categorized according to their contribution in the framework of the TEN-T regulation: telematic applications, sustainable freight transport initiatives, safety improvement, contribution to development of European technological industry and transport efficiency improvement through data sharing. All five policy objectives are being addressed by projects in all corridors. With the exception of the issue of 'Contribution to the development of European technological industry' each policy issue is addressed by at least 10% of the innovative projects. Hence it can be concluded that there are no major 'gaps' identified, only corridors where increased attention to specific topics may be considered. For the Rhine-Alpine Corridor, similarly to the North-Sea Baltic Corridor and the North-Sea Mediterranean Corridor, there is a higher focus on decarbonisation and less attention to the contribution to the development of European technological industry. For decarbonisation it is interesting to note that the focus is not on modal shift but on the deployment of alternative fuels, although there is a potential for future modal shift towards inland waterways (chapter 4).

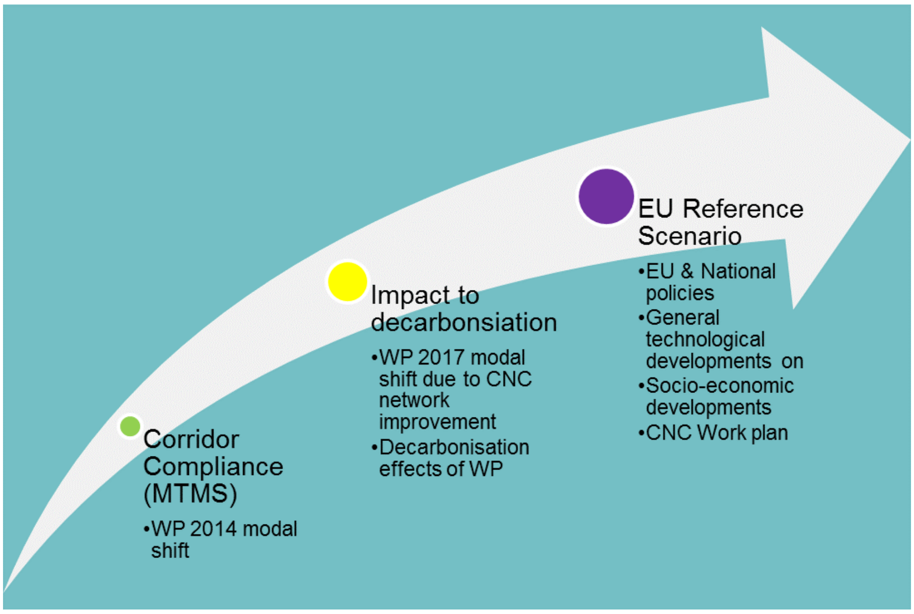
The innovative projects show a very high level of transferability, meaning that TEN-T can potentially position as a space for deploying transport innovations in a larger scale, helping project promoters better develop their innovations before transferring them to wider environments. On the Rhine-Alpine Corridor, all projects are seen as transferable (100%). This number is only matched by the Scandinavian-Mediterranean Corridor. The Rhine-Alpine Corridor has a below-average number of projects that is scalable compared to the other eight corridors.

3.7.2 Modal shift and impact to decarbonisation and climate change adaptation

Modal shift and impact to decarbonisation

The modal shift and decarbonisation effects of the Corridor Work Plan are measured by a modelling exercise. It is based on the 2014-MTMS study and the EU-Reference scenario 2016 study. The MTMS provides a compliance scenario for the corridor networks. This scenario indicates an expected modal shift. The impact to decarbonisation exercise models the network improvements from the 2017 Work Plan and takes into account the decarbonisation effects of the Corridor. This also has effects on the modal shift. Finally, the EU reference scenario study results also provide input for modal shift and decarbonisation. It includes EU and national policies on the topic, a broad perspective on technological developments for logistics operations, vehicle efficiency, and clean fuels and finally the CNC Work Plan. Therefore, this leads to the strongest expected modal shift and decarbonisation. The concept is visualised in Figure 14 below.

Figure 14: Total project costs in million EUR by cost classes



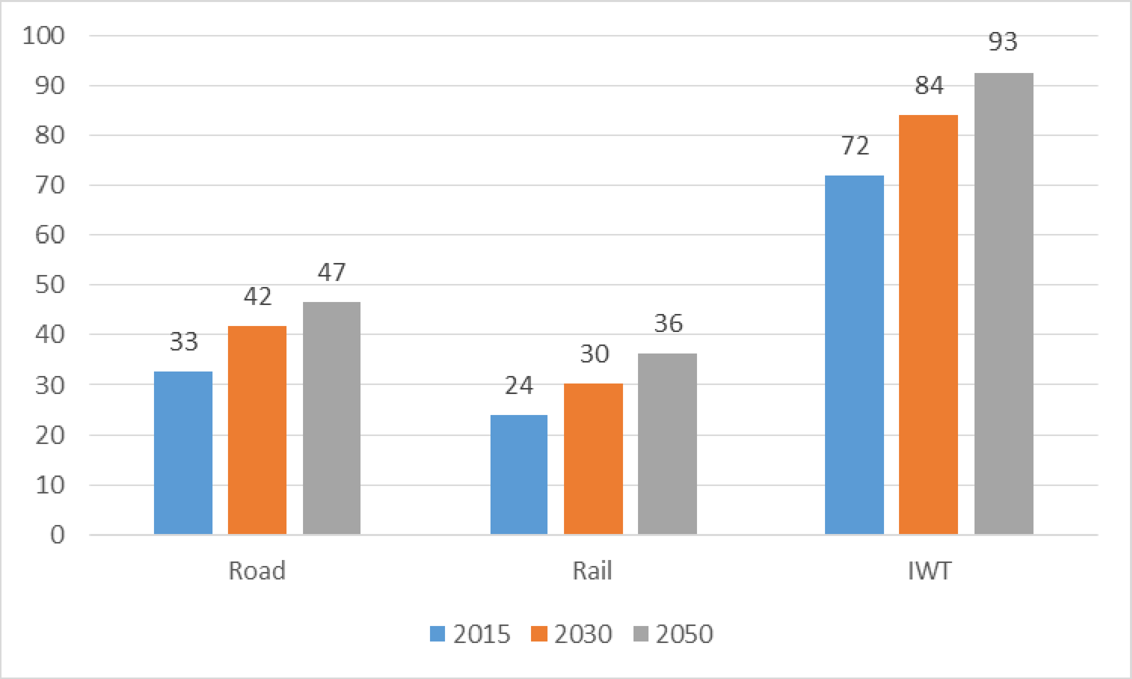
Source: Panteia

Translating the results from the EU reference scenario to EU corridor results leads to results for a corridor-specific reference scenario:

- The Rhine-Alpine Member States account for a relatively high share of transport activity (around 35% of the EU28 total). However, the forecasted passenger traffic growth and freight traffic growth is slightly below the EU28 average. Passenger traffic is expected to increase from 165 billion pkm today to 219 billion pkm by 2030 (road, rail and aviation) in the reference scenario. The fastest growing sector is aviation (at 1.8% per annum). Freight traffic is forecasted to increase from 129 billion tkm today to 156 billion tkm by 2030 (road, rail, and inland waterway) in the reference scenario. The fastest growing sector is rail (at 1.8% per annum).
- With regards to the emissions of the RALP Member States, there currently are 18.9 million tonnes of CO_2 equivalent being emitted by passenger and freight transport. By 2030, this is calculated to decrease to 16.9 million tonnes of CO_2 equivalent in the reference scenario. The traffic on the Corridor will increase, but transport and energy efficiency will also increase, leading to a lower environmental impact in the reference scenario.

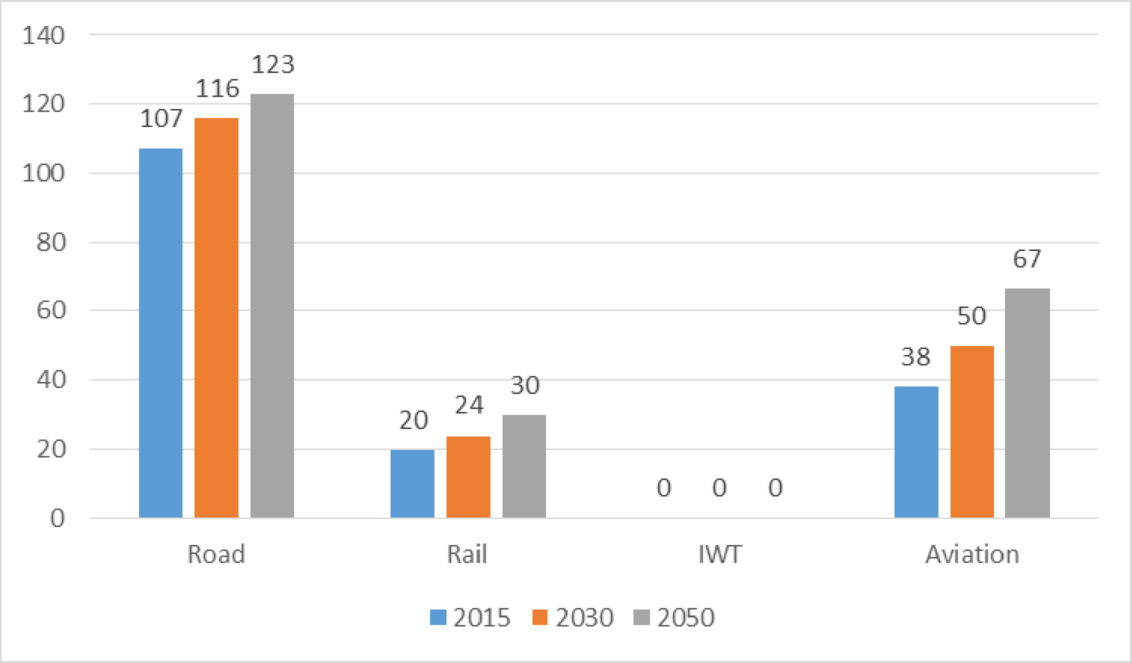
The results are presented in detail in Figure 15 to Figure 17 below.

Figure 15: Tonnes of freight kilometres (billion) per mode of transport, Reference scenario



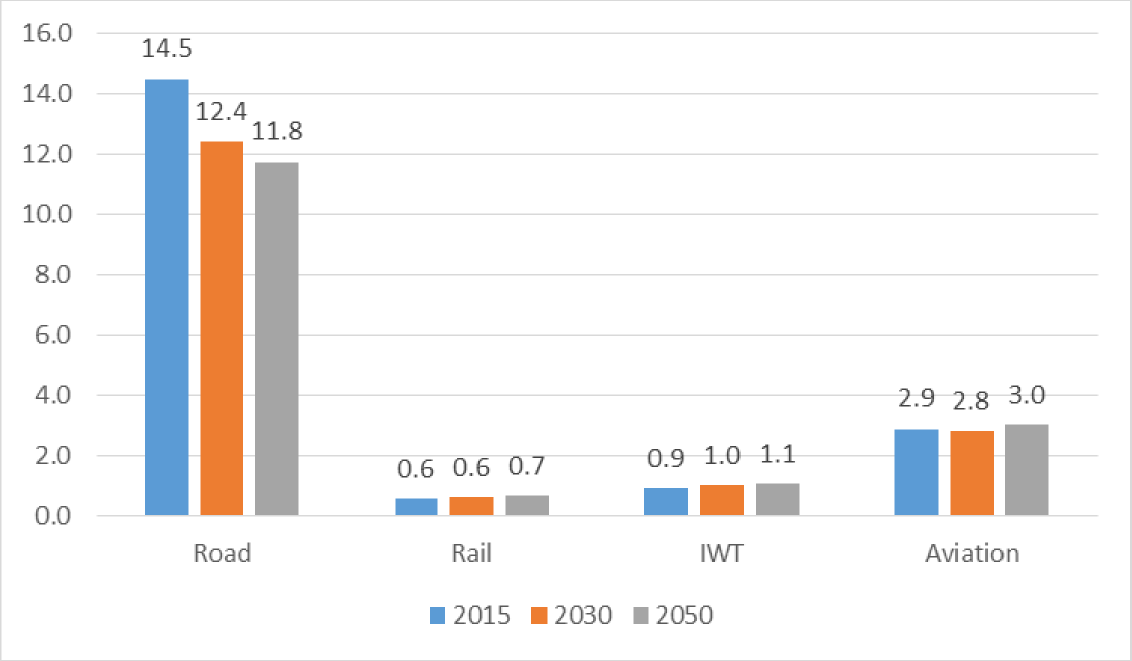
Source: Panteia

Figure 16: Number of passengers kilometres (billion) per mode of transport, Reference scenario



Source: Panteia

Figure 17: Emissions from freight and passenger transport, Reference scenario



Source: Panteia

The next step of the analysis is to present a Corridor Work Plan scenario which includes the effects of the projects from this Work Plan. Most effects are expressed in network benefits. This is part of a concerted approach for all nine Core Network Corridors to obtain results on modal shift and impact to decarbonisation. The aim of the task is to simulate the impact of the Corridor Work Plans for six corridors upon modal share, as part of a wider analysis of the impact upon de-carbonisation. An EU wide network model was used. For this exercise, the mode split and traffic assignment routines were used, the traffic forecast for the corridor studies was pre-calculated from the EU Reference Forecast (published 2016).

Furthermore, a link has been made with the project list and the topic of "Mitigation of Environmental Impacts". 33 projects contribute directly to decarbonisation of transport. The main contribution is on alternative fuels. The CNG and LNG projects are the most observed. Electricity or hydrogen is the second most observed category.

Climate Change Adaptation

The Climate Change Adaptation work started with identifying the national strategies on adaptation to climate change. A common result from the analyses is that this topic is not fully matured in all corridor countries. This means that there are sectoral results, but commonly on the Corridor there is not one national public strategy in which transport infrastructure is fully integrated.

Based on this knowledge, the expected climate effects were identified and a risk analysis was being performed, identifying risks based on: threat probability (Low, Medium, High), Exposure of the infrastructure (Low, Medium, High), Criticality for the network (Low, Medium, High).

The topics and effects are mostly known for years. Nevertheless, these are still of high importance for the Corridor. Identified **high** climate risks on the Corridor are:

- Rail buckling and road degradation in Southern Europe due to higher summer temperatures.

- Increased precipitation and floods and heavy rains, winds and lightning. Risks throughout the Corridor for the modes road, rail and especially aviation. For rail, the added risk is that tracks are often near rivers, leading to increased river flooding risk.
- More frequent droughts in inland areas and more precipitation at sea areas lead to risks for inland waterway transport. The risks of this are highest upstream. However, due to the long distance nature of inland waterway transport, the effects are present throughout the Corridor.

There are three projects identified which deal with climate resilience. All three projects are linked with RIS, meaning that these projects inform about the consequences of climate change (fairway conditions) on short term, but do not specifically prevent it on medium or long term.

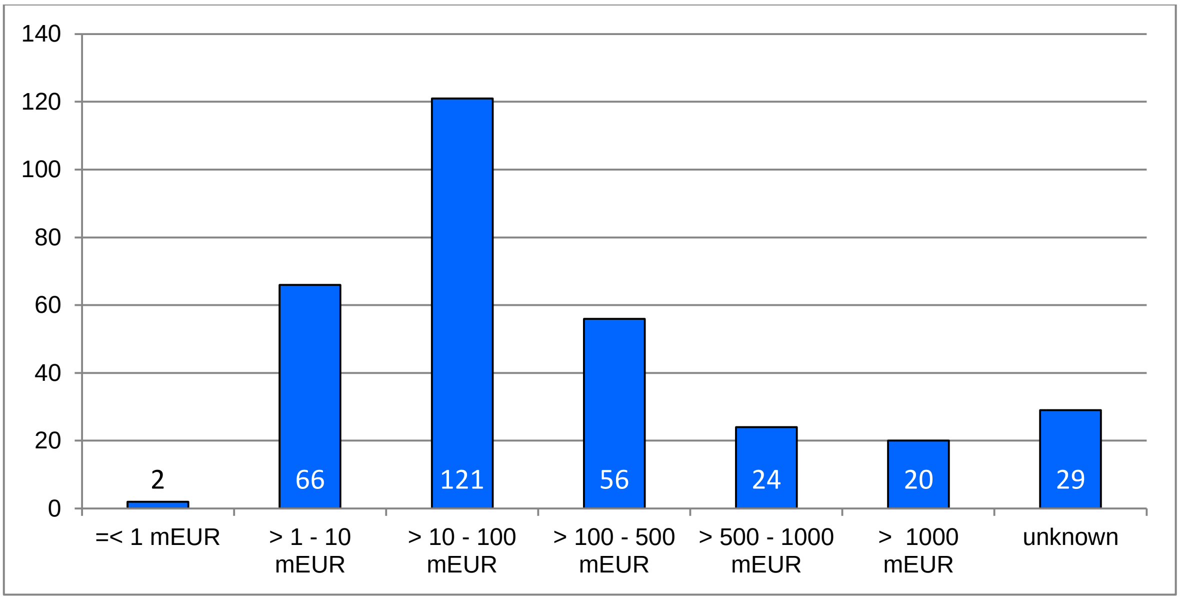
3.8 Infrastructure funding and financial sustainability of projects

The total project costs identified for the Rhine-Alpine Corridor sum up to 100.3 billion EUR, which means an increase by about 11.5 billion EUR or 11 % compared to the 2016 list. However, for 29 projects (9% of the projects), the total costs are still classified as "unknown".

The allocation of project costs into cost classes presents a high range from only 90,000 EUR up to more than 12 billion EUR per project. As Figure 18 depicts, almost all of projects are in the lower cost categories up to 500 million EUR project costs (243 projects or 76%).

Particularly, IWW, Rail, Road and Multimodal projects are mostly assigned to the cost classes of up to max. 100 million EUR. Projects with total costs of more than 100 million EUR mostly belong to rail and road infrastructure. In total, about 72% of the overall projects costs refer to rail, followed by road (16%). Furthermore, projects with costs of more than 1 billion EUR are mostly linked to rail (14 projects), whereas only four projects are assigned to road and two to IWW.

Figure 18: Total project costs in million EUR by cost classes



Source: KombiConsult, based on Rhine-Alpine project list – status: April 2017

As Figure 19 shows, 41.0% of the overall costs are assigned to projects in Switzerland (with a share of 11.6% on the number of projects, cf. Figure 8) meaning that Swiss projects have an above-average volume. However, cost information is only partly available for Swiss projects (26 of 37).

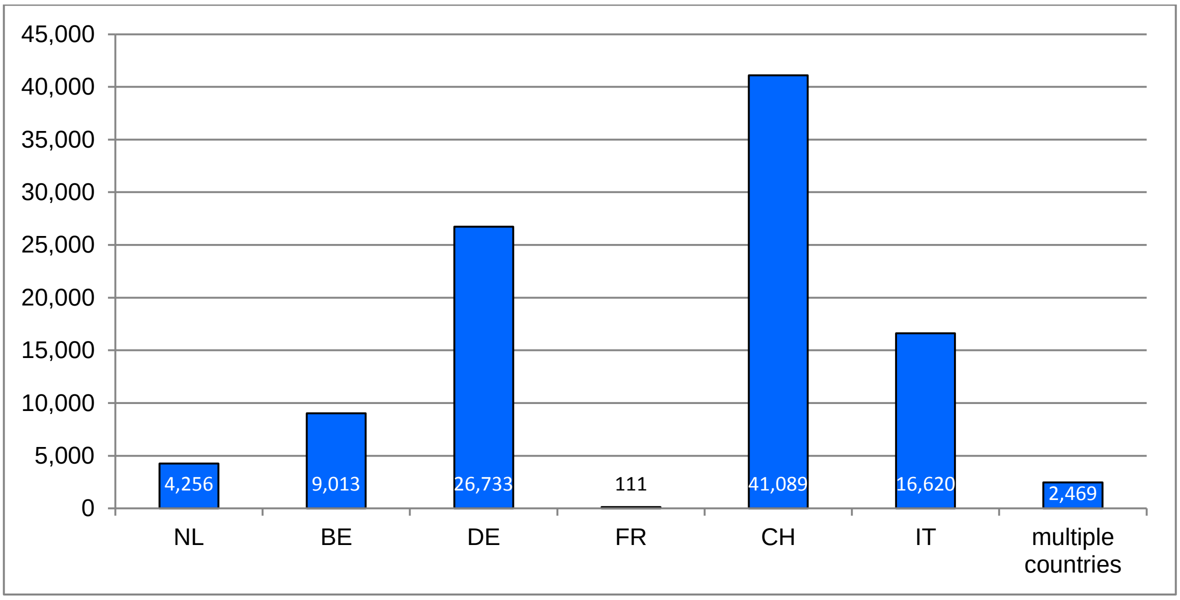
For Germany, a total investment volume of almost 27 billion EUR has been recorded representing a share of 26.7% on the overall costs. Altogether, 95 projects have been identified of which 80 are provided with information on cost figures.

Italy represents a cost volume of 16.6 billion EUR which is a share of 16.6% of the identified overall costs. The total number of Italian projects amounts to 58, for 47 of which information on costs is available.

Belgium has a relatively small project cost share with in total 9 billion EUR (9%). This is also due to the fact that for Belgian projects almost one third (10 out of 33) no information on costs was available. The Netherlands contribute with projects worth 4.3 billion EUR (4.2%). Here only four projects have unknown costs.

The French part in the costs is relatively small because only the inland ports of Strasbourg and Mulhouse have been considered.

Figure 19: Total project costs in million EUR by country



Source: KombiConsult, based on Rhine-Alpine project list – status: April 2017

Out of the total investment sum of 100.3 billion EUR, only for 53% of the projects complete and thorough financial information[15] is available, and hence these are eligible for the analysis. The corresponding amount (41.1 billion EUR) is divided into the financial sources sustaining each one of the analysed projects' cost:

The financial sources of the projects, which contain complete information of financing, are identified as follows:

- MS/public grant: 39.3 EUR billion, or 95.6% of the total;
- EU Grants (CEF, ESIF): 0.7 billion EUR, or 1.7% of the total;
- Private/own resources: 1.1 billion EUR, or 2.7% of the total.

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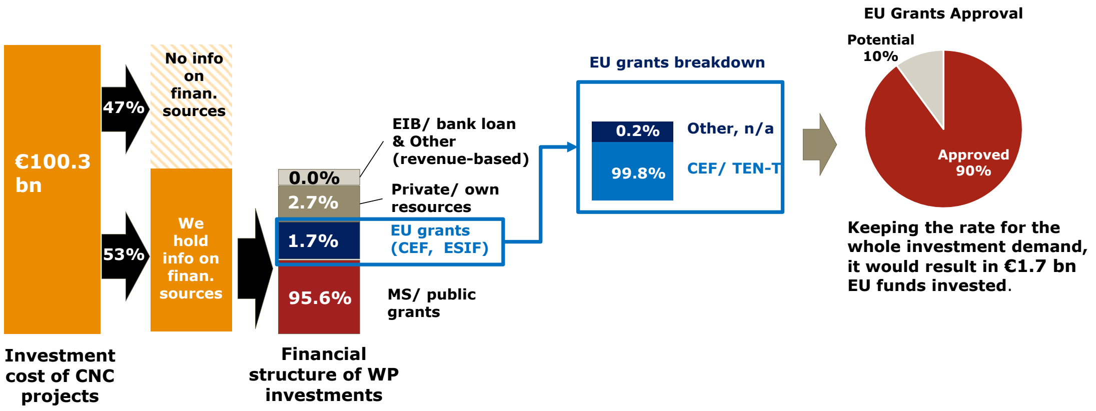
[15] Complete financial information means that the whole project costs are covered by source of financing, e.g. for a project which cost is € 10 million there are 8 million covered by State funding and 2 covered by EU funding.

The breakdown of funding by EU grants shows following situation (see Figure 20):

- CEF/ Ten-T: 0.7 billion EUR, or 99.8% of the total;
- ESIF: 0 EUR;
- Other: 0.02 billion EUR, or 0.2% of the total.

The analysis leads to the following conclusion (see Figure 20): would the same EU funding ratio (i.e. the above identified 1.7% for EU grants) be applied to the entire corridor investment amount, it can be expected that over the next years, about 1.7 billion EUR or CEF funding will be necessary.

Figure 20: Analysis of the funding and financing sources for the Rhine-Alpine Corridor

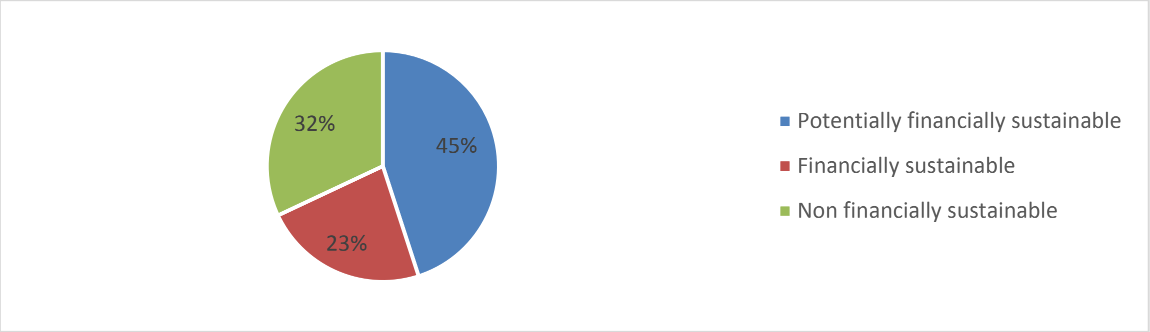


Source: PwC

Among the projects for which complete information is on hand, approximately 17% was identified as financially sustainable. An additional 40% of the projects could be financially sustainable if properly structured. In terms of investment amounts, these represent 23% and 45%, respectively, of the total amount of capital expenditure of the entire set of projects with available financial information (see Figure 21).

Would the same percentages apply to the investment amount relative to all the projects included in the Work Plan, approximately 23 billion EUR capital expenditures would be relative to financially sustainable projects, and 45 billion EUR would be relative to projects which could be sustainable, if properly structured[16].

Figure 21: Financial sustainability assessment for Rhine-Alpine Corridor



Source: PwC

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[16] As per definition, it does not mean that the entire capital expenditure can necessarily be sustained with other-than-grant funding sources. It however means that at least part of the investment can be sustained through financing.

4 Potential market uptake of environmentally-friendly transport modes

The first step in analysing a potential market uptake is to identify environmentally friendly transport modes with underutilised capacity. Only rail and inland waterway transport are considered in this analysis as the other transport modes are not sufficiently environmentally friendly.

The Rhine-Alpine Corridor study of 2014 presented a supply side analysis. There, the capacity situation was described as problematic for the Upper Rhine valley as well as on the sections Venlo/Zevenaar – Duisburg and Antwerpen – Düsseldorf. In the Upper Rhine valley, the utilisation rate comes close to 99%, an indicator that there is no available spare capacity at the time of the study. Since the largest transport flows are on said sections, the capacity issues have a significant impact on the entire corridor. Furthermore, the 2014 Corridor study shows that inland waterway transport (IWT) has abundant capacity left. This would allow to potentially transfer some of the transport volumes from roads to inland waterways. This means that out of the two transport modes considered sufficiently environmentally friendly, only inland waterway has the spare capacity for a potential market uptake. Therefore, this chapter will focus on inland waterways - in particular on containerisable goods. "Containerisable" is freight currently transported by road which can be containerised and bundled into multiple container loads, to be then transported by inland waterway (including pre/end haulage by road). Bulk goods are not part of this analysis, as inland waterway and railways already have a high market share of bulk goods.

4.1.1 Macro analysis container shift potential study

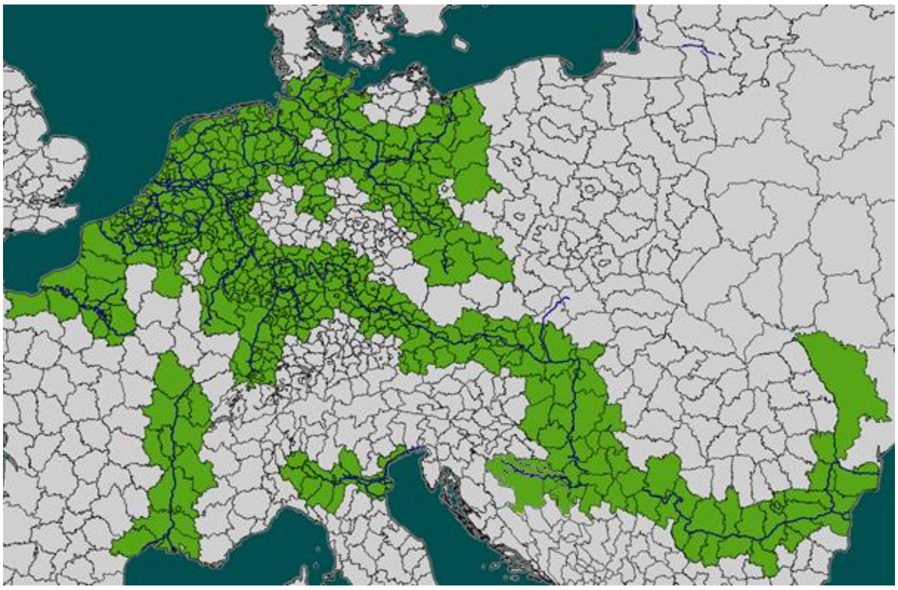
The main objective of the analysis of modal shift potential' is to identify individual transport flows that, brought together, could bring enough volume to operate a liner service between two (or more) Inland Terminals. A top-down approach has been used to determine the multimodal market potential. Hereafter, the step-by-step methodology and the specifications behind the model are explained. A number of selection criteria have been used in order to further determine the continental multimodal potential:

- All regions that are connected to the CEMT class IV inland waterway network (TEN-T and all other waterways) have been selected. This includes both interconnected and isolated waterway regions. Moreover, non-connected regions that are within a range of a 100 kilometres from a CEMT IV waterway have been included, as well as;
- Containerized goods have been selected. These goods are suitable for containers, however not all goods necessarily need to be transported in a container. There are mostly goods that are currently being transported by road, but it excludes specifically of bulk goods (crude oil, coal, iron ore and dry bulk, sand and gravel);
- Two distance criteria have been applied:
    - Regarding the selection of relevant regions for a potential modal shift to IWT, the regions have been selected which have access to the IWT network using pre-/end haulage over a distance of maximum 100 km;
    - The origin and destination (O/D) transport distance for road haulage should be at least 200 km. If the O/D are both located directly along waterways ("wet locations"), IWT is already considered as competitive to road haulage. However, if locations are situated far away from waterways ("dry locations"), pre-/end haulage is needed resulting in an increase of the break-even distance. For dry-dry locations, the break-even distances are

between 180 and 200 km. The market potential should, however, be a direct result of comparing the intermodal with the road transport costs. Therefore, no pre-selection was made on distance classes for road haulage. Short distance transports by road (i.e. between South Switzerland and Italy) are thus also considered in this analysis.

The above highlighted assumptions and criteria define the scope for the continental container transport model. The scope is illustrated in the Figure 22 below on NUTS3 level. For road transport, the ETISplus road matrix has been used (year 2010).

Figure 22: Overview scope market potential continental container market (NUTS3 regions)



Source: Panteia

The definition of relevant NUTS3 regions results in a road O/D matrix presenting information the following variables:

- Origin (NUTS3 level);
- Destination (NUTS3 level);
- Tonnage transported of containerized goods between selected regions;
- Region types[17]: IWT-connected regions both on isolated as on interconnected waterways.

The resulting selection of transport between O/D pairs was assigned to the existing network to help identify the study areas for continental multimodal potential. The service network for the transport of continental containers via IWT has been designed following from upon existing and, possibly, planned barge services[18].

Based on the availability of inland container terminals, combined with existing and planned barge services, a hub and spoke network is foreseen as the most promising solution to connect the various O/D’s and branches of the network.

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[17] *The ETISplus O/D-matrix can also present the tonnage transported from/to maritime regions for road transportation. However, given that this study focusses on the potential shift of continental road transport this transport flow has not been taken into account.*

[18] *ETISplus terminal database (2010), completed with information from IDVV, VNF, NPI (Navigation, Ports et Intermodalité) and Schifffahrt, Hafen, Bahn und Technik*

4.1.2 Potential of intermodal transport

In order to determine the modal shift potential from direct road transport to intermodal transport via barge for continental containerized cargo for every O/D pair as selected in the scope, the costs of intermodal transport were compared to direct road transport. When it is proven that intermodal transport is indeed cheaper than pure road transport, there is potential for modal shift.

Adding terminals to the network

The cost model is set up by assigning a selection of (inland) container terminals to the IWT networks (closed + EU Interconnected) where containers can be transhipped from inland shipping to road transport and vice versa. Also planned inland container terminals have taken into account. For the simplicity of the model, in certain NUTS3 regions with a high density of (inland) container terminals (along the Rhine and in the Netherlands and Belgium) not all possible terminals have been taken into consideration. For neighbouring terminals within the same NUTS3 region, the differences in transport costs to and from all destinations in that region are considered to be relatively small.

Waterway and ship characteristics

For determining inland waterway transport costs for all container barge services, the characteristics of each inland waterway has been taken into consideration:

- Either dimensions of the vessels based on the barge services or the maximum permissible vessel dimensions according to PC Navigo software;

Figure 23: Information about PC Navigo

PC-Navigo is a full blown voyage planner and navigation system for the inland waterways; it literally shows you the way in these waters. Depending on which version is used (Europe, Benelux, Netherlands, Germany, France) voyages can be planned and during navigation the GPS provides position information and velocity. The software contains all operating hours, dimensions, communication data, VHF channels and other information about all bridges and locks in the waterways network. The program checks for stoppages or limitations that may block your passage. Many bridges and locks have pictures that can be shown to provide information about the local situation. The voyage planning process shows all details of navigation hours, the progress one can make, and the total time of the planned voyage. Bridge clearances, although the assumption is made that container vessels can pump ballast water in order to create clearance to pass "low" bridges.

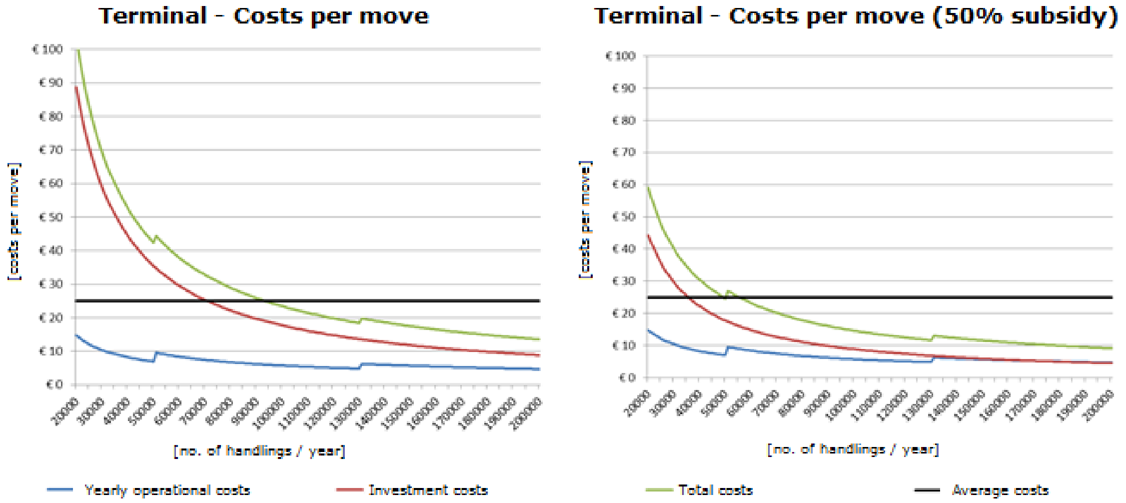
Source: PC Navigo (2015): http://www.pcnavigo.com/en/pc-navigo-2/really-long-uitleg/

- The amount of locks on the route according to PC Navigo software;
- The flag of the vessel influences the vessel costs. Costs information is obtained from the yearly Panteia costs models (costs per hour). Trip times differ depending on fairway characteristics: sailing upstream implies different speeds than sailing downstream, and so do load factors, vessel sizes, etc.;
- A ship is assumed to load 70% of its container capacity;
- Two thirds of the containers on board are assumed to be loaded, others are assumed to be empties that need to be repositioned. This way, also empty return loads are taken in to account.

Handlings costs and rental container

Based upon the network of barge services, the number of transhipments made per O/D relation has been determined. Transhipments (moves) are multiplied by 25 EUR. For additional operational transhipments also 25 EUR per move have been added. In general, two moves are needed at terminals with a hub function (ship – shore and shore – ship). The costs for the rental / use of containers are assumed to be 15 EUR per unit.

Figure 24: Handling costs in IWT



Source: Hub en Spoke in de Containerbinnenvaart (2014), Panteia et al.

Pre- and end haulage

Costs for pre- and end haulage to and from the container terminals in the network are based on the distances in the road network in ETISplus. The model uses the distance from industrial areas within NUTS3 regions to/from the terminals. The costs for pre/end haulage are determined by a cost function based on these distances. It should be noted that variable costs add up from 0.47 EUR per kilometre to 0.65 EUR per kilometre. The costs for trucks are based on the variable and fixed costs for trucks plus fixed costs for drivers originating from the country where the terminal is situated. Information about costs originates from Panteia costs models. A different time-distance relation is specified in the costs-function, making direct road transport cheaper than intermodal road transport for the same distance.

Intermodal costs – Lowest costs algorithm

The model calculates out of 5,122 (O/D's) x 972 (terminals) = about 2,500,000,000 options for the cheapest transport relations.

Direct trucking scenarios

For direct trucking per O/D destination, the model choses the lowest costs based upon several truck and driver combinations. For international traffic, the cheapest truck and the cheapest driver of the two countries involved are selected.

For road transport the (direct) transport costs have been calculated for three different scenarios, namely:

1. No return load - low road efficiency (50%);
2. Return load in 80% of the cases, 20% no return load (EU average based on Eurostat statistics) – medium road efficiency;
3. Return load in 100% of the cases – high road efficiency (100%).

Potential continental containerized cargo via IWT

For each O/D, the costs of intermodal transport are automatically compared to direct trucking. When intermodal transport via barge is less expensive for a specific O/D, the amount of cargo (in tonnes) following from the transport of continental cargo by road transport for that specific O/D (NUTS3 level) as selected in ETISplus based on the scope, is shifted from road transport to intermodal transport by barge.

The sum of individual O/D relations leads to a total potential of continental containerized cargo to be shifted to intermodal transport, which can be illustrated in maps or specified through matrices (for the various scenarios). Based upon the cost functions for intermodal transport by barge and direct trucking, including the pre-set criteria and assumptions above, the selection of freight flows from the ETISplus continental road transport matrix follows automatically.

4.1.3 Results macro analysis continental cargo study

The total potential of the three various scenarios is given in Figure 25 below. These are the current road volumes that can be containerised and shifted to inland waterways (including pre- and end haulage) in a cost efficient manner.

Figure 25: Rhine-Alpine Corridor volume that can be shifted to IWT (in million tonnes)

Regions	Low potential	Medium potential	High potential
Total RALP corridor	198.4	86.7	33.2

Source: Panteia

Figure 26 presents information on the maximum of the potential per scenario chosen per commodity group.

Figure 26: Rhine-Alpine Corridor volume that can be shifted to IWT per commodity group (in million tonnes)

Regions	Low potential	Medium potential	High potential
Agricultural and food products	49.7	20.2	7.9
Energy products and chemicals	38.0	16.9	6.3
High end building materials	21.5	6.4	2.0
End products & other	89.2	43.2	17.1
Total RALP corridor	**198.4**	**86.7**	**33.2**

Source: Panteia

The largest commodity group with potential is “End products & other”. Included in this group are products already containerised in road transport. Further, there are “Semi-finished metal products”, all types of “Machinery and equipment” and all types of “End products”. The second largest group is “Agricultural and food products”. This consists of “Raw agricultural materials”, “Hops”, “Animal foods”, “Wood and cork”, “Beverages and foodstuffs”.

5 Cooperation with the Rail Freight Corridor

In 2010, the EU Regulation 913/2010 for a European rail network for the implementation of competitive rail freight transport entered into force. It was elaborated with the overall purpose to increase rail freight's attractiveness and efficiency with a focus on international traffic, in order to increase its competitiveness and modal share on the European transport market. To achieve this, the Regulation has the general objective to improve the conditions for international rail freight by reinforcing collaboration at all levels along selected Rail Freight Corridors (RFC) with the aim to:

- Strengthen the cooperation between infrastructure managers on key aspects such as allocation of train paths, deployment of interoperable systems and rail infrastructure development;
- Find the right balance between freight and passenger traffic along the RFCs, giving adequate capacity for freight in line with market needs and ensuring that common punctuality targets for freight trains are met;
- Promote intermodality between rail and other transport modes by integrating terminals into the Corridor management process.

Altogether, nine Rail Freight Corridors have been defined. Together, they form the rail freight backbone of the European Core Network Corridors. The alignment of the RFCs will be adapted over time (until 2020) to fit with "their" respective Core Network Corridors. They will continue to evolve in the context of the Regulation 913/2010, but shall also profit from the TENT-T Regulation instrument and thereby be boosted considerably[19]. Article 48 of the TEN-T Regulation states that "adequate coordination shall be ensured between the Core Network Corridors and the rail freight corridors provided for in Regulation (EU) No 913/2010, in order to avoid any duplication of activity, in particular when establishing the Work Plan or setting up working groups."

As a basis for any cooperation and sharing of work it is therefore necessary to outline the main differences between the two corridor frameworks (shown in the following Figure 27).

Figure 27: Comparison of CNC and RFC - scope and structure

Topic	Core Network Corridors	Rail Freight Corridors
Legal basis	Regulation (EU) 1315/2013	Regulation (EU) 913/2010
Main objectives	Infrastructure development	Harmonisation of business and technical conditions
Transport modes & types	Multimodal (rail, road, aviation, inland waterways and ports); Passenger and freight	Rail transport Freight only
Governance structure	EU Coordinator (plus advisor) Secretariat (consortium)	Executive Board Management Board
Stakeholder involvement	Corridor Fora	Advisory groups

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[19] *Core Network Corridors – Progress Report of the European Coordinators, June 2014*

Focussing on the pure infrastructure development in the context of the RFCs, the following technical requirements have to be fulfilled:

- 740 m train length;
- 22.5 t axle-load;
- 100 km/h line speed;
- ERTMS equipment;
- Electrification.

In November 2013, the Rail Freight Corridor Rhine-Alpine (RFC 1) was the first corridor which was set into operation. In 2014, during the first phase of the Rhine-Alpine CNC study, already a close cooperation was initiated between the RFC 1 with their management team and the CNC Rhine-Alpine. This cooperation has been continued in the second phase of the CNC study. It consists of the following actions and measures:

- Corridor Fora: since the first Corridor Forum in 2014, both representatives of the management board of the RFC 1 and the national rail infrastructure mangers (Prorail, Infrabel, DB Netz, SBB and RFI) are invited to the forum meetings.
- The European Coordinator participated in the RFC Executive Board meeting in November 2016; the corridor advisor participated in several other ExBo meetings.
- Representatives of DG Move have visited/actively taken part on the International Corridor Rhine-Alpine Conferences (e.g. 2014 in Genoa and 2015 in Antwerp). In 2016, the RFCs were part of the TEN-T days in Rotterdam.
- Corridor alignment: in 2014, two meetings between the representatives of the DG Move, the RFC 1 and the Corridor consultants have been carried out in Brussels. An important item which has been discussed is the difference in the rail alignment of the CNC corridor compared to the RFC 1. It was clarified by the CNC consultants that the rail alignment of the CNC was determined by the European Commission and the Member States and cannot be changed. It has been decided that with the reporting for the first corridor study, the alignment of both corridors are shown. Above that, an explanation was coordinated: *Although both the "TEN-T Core Network Corridor Rhine-Alpine" and the "Rail Freight Corridor Rhine-Alpine (RFC1)" cover the same geographical area (namely Rotterdam – Genoa), the elaboration of the TEN-T Core Network Corridor Study and the RFC 1 Implementation Plan are based on different European regulations (for RFC 1: Regulation (EU) No 913/2010, for the TEN-T Core Network Corridor: Regulations (EU) No 1315/2013 and (EU) No 1316/2013) and thus have different methodologies. This leads to discrepancies in the rail alignment and in the allocation of rail freight nodes. Due to that fact, both documents are of limited comparability!*
- ERTMS: RFC Rhine-Alpine has agreed to verify and update, if necessary, the respective ERTMS deployment plan which was part of the first phase of the Rhine-Alpine Corridor CNC study.
- Projects which are part of the RFC 1 implementation plan will also be considered in the Rhine-Alpine Corridor CNC studies. Projects will be integrated in the Rhine-Alpine Corridor CNC project list but are subject to a final decision of the Member States.
- Intermodality: Combined transport plays a very important role in both corridor developments. Hence, in 2017 the CNC consultants have presented their

findings on the relevant intermodal terminal infrastructure in the terminal advisory group (TAG) of the RFC.

The above mentioned activities demonstrate the previous cooperation between the RFC and CNC Rhine-Alpine. This proven cooperation will be further continued.

6 Mapping of projects

6.1 Objective criteria for the mapping exercise

For the mapping (clustering) of projects, a common methodology was set up for all CNC corridors. This methodology consists of:

- Key objective criteria to cluster investments on the Corridor based on the corridor characteristics and taking into consideration all the aspects developed in the work on the "Wider elements of the Work Plan";
- A proposal for a classification of projects or their groups/categories in the 2017 project list.

Based on the common methodology applied by all Core Network Corridors, there are two criteria groups to be used for corridor project mapping. Projects already concluded and project containing only studies have not been taken into account.

1. Project relevance: related to the purpose of the intervention and its capacity to meet TEN-T and EU priorities, as set by Regulations 1315/2013 and 1316/2013 (reflected by the technical parameter and bottlenecks tackled by the intervention).
2. Project maturity: derived by the assessment of project's technical and institutional readiness, financial/economic maturity and social/environmental maturity.

The proposed methodology is based on the evaluation of all projects and related investments on a case-by-case basis, weighing up the different benefits of a project with the requirement for financial return on investment, examining its socio-economic and financial viability via well-established and widely applied tools, such as the Multi-criteria Analysis (MCA).

Multi-Criteria Analysis enables both quantitative and qualitative criteria to be considered rendering a final project score. It should be, however, emphasised that a MCA does not provide a definitive solution, rather a rational and structured basis for guiding decision-making. The application of the MCA ensures that the project's economic characteristics are not the only rating criterion, while other critical aspects, such as regional cohesion, environmental impacts, policy, etc. can also be applied. MCA provides a logical approach, whereby any criteria (both quantitative and qualitative) and their relative importance can be taken into account.

As mentioned above, the mapping exercise evaluates two main aspects: Project maturity for the implementation (financial, technical, institutional, and environmental) and Project Relevance as the ability to unlock the potential of all transport modes and significantly contribute to achieving corridor development and objectives as defined by the Trans-European Transport Network (TEN-T) policy as part of EU's common transport policy:

- Ensure economic, social and territorial cohesion and improved accessibility across the EU;
- Create sustainable quality jobs for the regions;
- Sustain or increase competitiveness;
- Improve cross-border links;
- Enhance interoperability;
- Ensure intermodality;
- Mitigate bottlenecks affecting the entire corridor functionality;

- Innovation deployment;
- Impact of climate change on existing infrastructure and measures to enhance resilience;
- Impact on the greenhouse gases, noise and other externalities;
- Development of transport infrastructure with a view to allowing the smooth functioning of the internal markets.

Rationale for project maturity

To evaluate each of the project maturity criteria (technical, institutional, financial, environmental) it is necessary to rate and award points for each project according to the following levels: Low maturity level = 0; Medium maturity level = 0.5, High maturity level = 1. The general assumption is that each maturity criteria has the same relative importance and accordingly following simple calculation can be applied:

$$Project\ Maturity\ Indicator = \frac{Tm + Im + Fm + Em}{4}$$

Tm: Technical Maturity; Im: Institutional Maturity; Fm: Finically Maturity; Em: Environmental Maturity

Once each project has been assessed against the criteria and awarded with the number of points for relevance and maturity, it is necessary to incorporate the relative importance criteria by applying the following weighting factors:

Figure 28: Weighing factors

Criteria groups	Weighting factors
Project relevance	0.6
Project maturity	0.4

Higher weight has been assigned to project relevance, given that the aim of the exercise is to assess contribution on the corridor development as defined by the Regulation. However, maturity has also a significant weight, since the actual progress in the implementation of the Corridor is strictly related to the full readiness of the projects since the amount of time available for their completion is now relatively limited if compared to the typical multi-year time span needed to achieve the full project cycle from the planning stage to the finalization of work.

To this end, project relevance and maturity can be assessed according to several criteria which will contribute, with different weights, to the definition of the overall score of the project.

Clusters identified

The clustering exercise is based on the transport modes: each project is related to a specific mode. There are three clusters identified (together with a residual cluster) which mainly reflect the project relevance according to TEN-T priorities as stated by the Regulation. In addition, new technologies and innovation projects according to art. 33 a-d of Reg. 1315/2013 were assessed in a separate clustering exercise avoiding any connection with any transport mode.

- Cluster 1: generally, pre-identified projects as listed in Reg. 1316/2013 annex I-part II and last-mile rail/IWW links to RRT, airports, seaports and inland ports, always belong to Cluster 1; as well as ERTMS, MoS and SESAR Projects. This is coherent with the general theoretical structural of TEN-T Regulation;

- Cluster 2: other telematics applications (VTMIS, RIS, ITS etc.) depending on the transport mode;
- Cluster 3: mostly projects contributing to safe & security, capacity expansion, and last mile connectivity;
- Residual cluster: the projects not specifically addressing any requirement of the Regulation.

6.2 Results of the mapping exercise

For the Rhine–Alpine Corridor, project periodisation was applied to all 318 projects included in the 2017 project list. After excluding all the completed projects and projects that only include a study, 206 remain as input for this exercise. The project clustering was performed in close cooperation with the consultants responsible for other tasks of the study, because this exercise relies heavily on previous elaborated results e.g. the analysis of the project list and the elements of the Work Plan. They are building the baseline of the clustering exercise.

Rhine – Alpine corridor project list clustering results

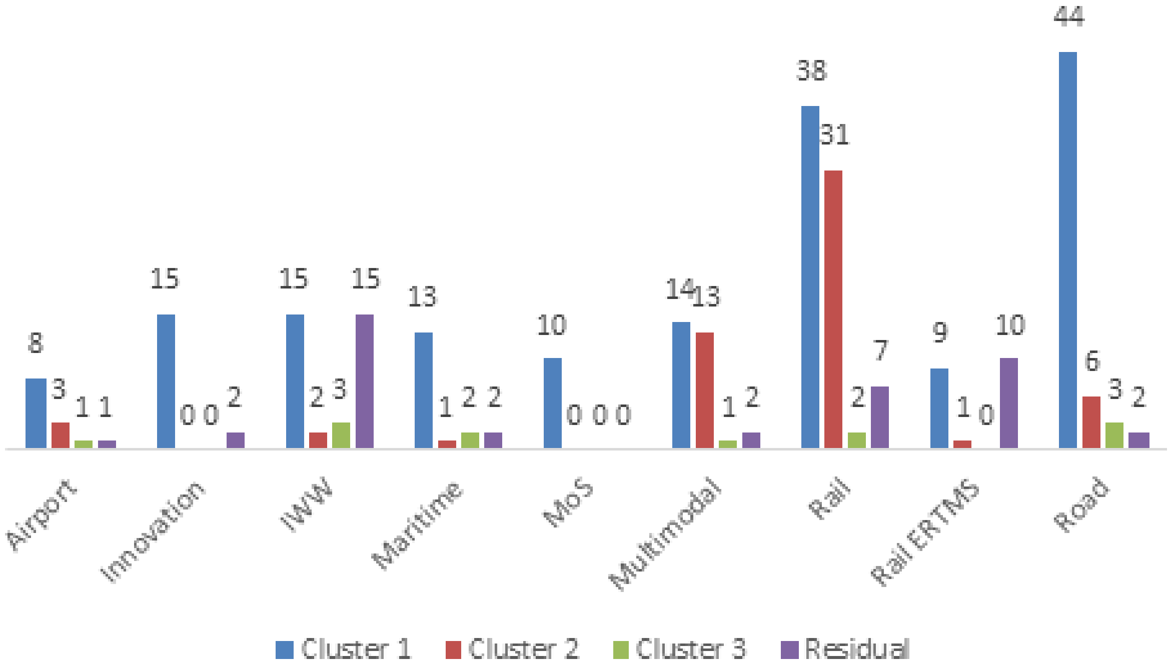
The aim of the clustering exercise is to determine the relevance of each project. The relevance is related to the purpose of the intervention and its capacity to meet TEN-T and EU priorities (as set by Regulations 1315/2013 and 1316/2013). Each of the different clusters is conceived as a set of projects capable to address different levels of technical requirements and likely to produce a certain level of impacts on the CNC infrastructure per each transport mode.

Relevance

Figure 29 presents the number of projects in each of the clusters for each category.

From the viewpoint of the clustering, inland waterway related projects are less likely to have a high relevance. In contrast, road projects are often categorised in Cluster 1. One other noteworthy aspect is that Cluster 3 is relatively uncommon in the Rhine-Alpine Corridor.

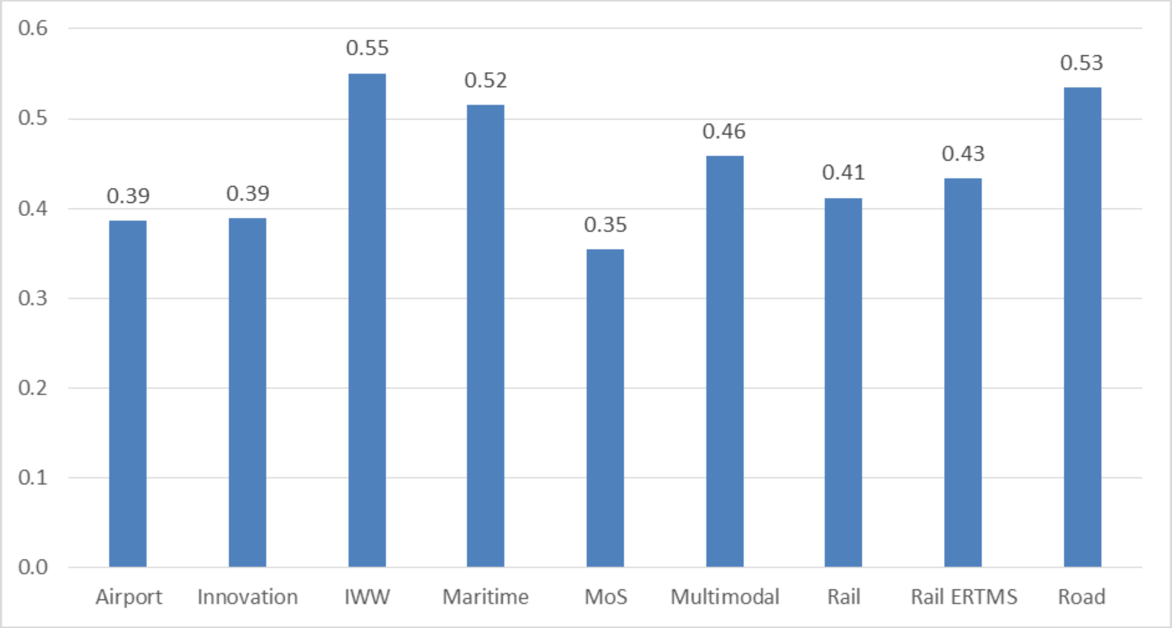
Figure 29: Rhine-Alpine Corridor projects clustered per project category breakdown



Maturity

Figure 30 presents the average maturity for projects in each category on a scale of 0 to 1. The closer to 1, the more mature a project is. On average, inland waterway and road projects are measures with the highest "readiness" on the Corridor. For this exercise, MoS (Motorways of the Sea) projects are less mature compared to the other categories. However, it is important to note that the MoS category includes a lower amount of projects than the other modal categories.

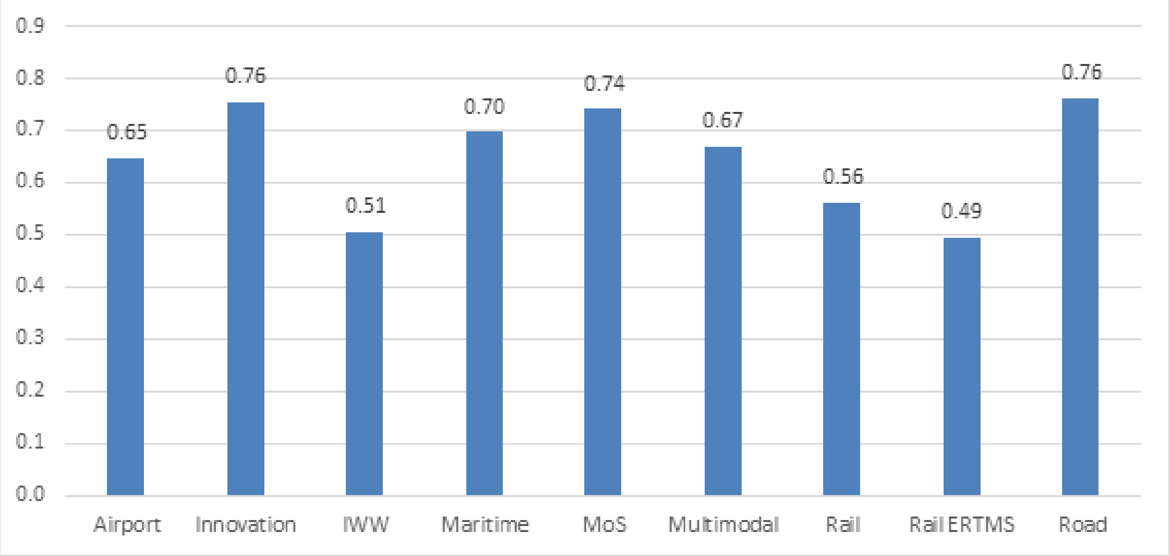
Figure 30: Average Rhine-Alpine Corridor project maturity per category



Project Ranking

The project ranking is presented by average in the Figure 31 below. It shows that road and innovation projects are ranked high (on average). In particular, inland waterway and rail ERTMS projects score lower in terms of project ranking. The high cost of ERTMS is reflected in this ranking. Innovation projects score high with relative low costs and medium relevance.

Figure 31: Average Rhine-Alpine Corridor project ranking per category

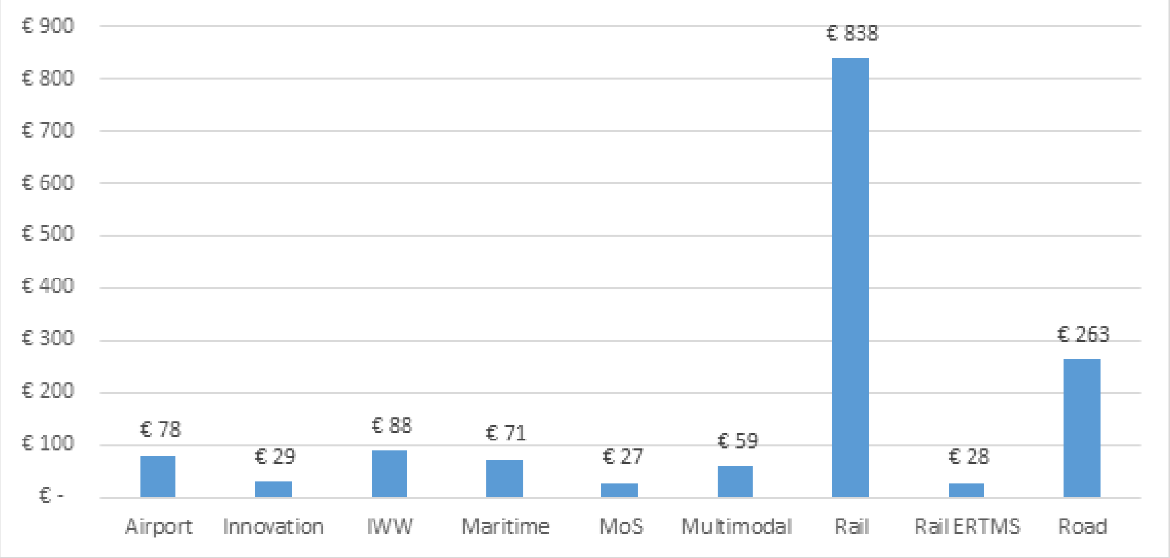


Project Costs

Rail projects have by far the highest average costs per project. Next follow the roads projects. Innovation, rail ERTMS, and MoS projects have a relative low average project cost. This is not unusual since innovative projects are relatively inexpensive in general. For ERTMS, the projects on retrofitting locomotives with ERTMS related equipment are also included in this category, thereby reducing the average cost of ERTMS projects.

Figure 32 below shows the average costs a project in each category.

Figure 32: Average Rhine-Alpine Corridor project costs per category (in Mio €)



7 Summary of actions already accomplished

To achieve an up-to-date overview on the compliance of the Rhine-Alpine Corridor, the technical parameters of the TEN-T Regulation have been analysed for all sections and infrastructure nodes. The results of the compliance analysis have also been cross-checked with the thorough KPI analysis performed for the Corridor.

Furthermore, this chapter gives an overview on projects and actions already accomplished since 2014. It considers all work done until January 2017 or until the last date an accurate status of work progress was available. Special remarks are made, where applicable, on the ongoing projects with foreseen finalisation until end of 2017.

As the first phase of the Corridor studies concentrated on the compliance with the standards set by Regulation 1315/2013, most of the gathered achievements relate to these technical compliance targets. In contrast to the analysis of the project list, which was elaborated in parallel, the description of the actions already accomplished does neither contain any statistical analysis of the projects, nor an assessment of their costs.

7.1 Rail

From the project list, a number of improvement projects were identified with a finalisation status of December 2016 or earlier. The Table 5 below represents these results.

Table 5: Rail projects finalised until 2016 and their contribution to the corridor development

ID	Project name	Member state(s)	Section or node	KPI impact on non-compliant sections	Other impacts
6060	"Regionaltangente-West (RTW)", Planning of direct rail link connecting the area West of Frankfurt/Main with the airport and the city	DE	Airport rail connection	Study finalised	
6180	Support to the long term implementation of the TEN-T network in the development of Corridor A/1 Rotterdam–Genoa required by the regulation (EU) no. 913/2010 and conversion of governance structure to a European Rail Freight Corridor 1 (2013 - 2015)	NL, BE, DE, CH, IT			

ID	Project name	Member state(s)	Section or node	KPI impact on non-compliant sections	Other impacts
6181	Preparatory studies for the implementation of additional measures on ERTMS Corridor Rotterdam-Genoa and ERTMS Corridor Antwerp-Basel-Lyon	NL, BE, DE, CH, IT			
6193	Upgrade to 4 tracks - Basel Bad - Basel SBB	CH	Basel Bad - Basel SBB		Elimination of potential bottleneck
6200	Gotthard base tunnel	CH	Erstfeld - Biasca	Line speed	gradient, speed limitations, resolution of physical bottlenecks
6226	Renewal Brig signal box	CH	Brig		

On 1st June 2016, the new Gotthard base tunnel was officially opened and is in operation since December 2016. The finalisation is a big milestone for the freight rail corridor operations due to the removal of inclines and the modern outfit with safety and management systems. For passenger rail the tunnel reduces the travel times between north and south by 30 minutes. The full rail freight efficiency will be enabled once the Ceneri base tunnel is opened and all feeder lines are completed.

As a main arteria for rail, the line between Emmerich and Oberhausen connects the Rhine-Ruhr metropolitan area to the north with the Netherlands, in particular with the North Sea ports: it forms the direct link to the Betuwe line. To the south, the route is the rail backbone of the Rhine-Alpine Corridor, continuing through Cologne, the Rhine valley and Basel to Northern Italy. The main goals of the project are the extension of line capacity, the improvement of transport quality and the separation of passenger and freight transport.

7.2 Inland Waterways

On the IWW network there are some works accomplished since 2014. Especially the study on RIS on the corridor sections was concluded.

Table 6: IWW projects finalised until 2016 and their contribution to the corridor development

ID	Project name	Member state(s)	Section or node	Works
6061	Safeguarding and adaptation of waterway access from the port of Cologne	DE	Köln	Infrastructure works - rehabilitation
6077	Consolidation and strengthening of the Upper Rhine	DE, FR, CH	Upper Rhine	Study
6103	Vessel Traffic Management Centres of the Future RIS	NL, DE	Rhine	RIS

7.3 Roads

On the corridor roads three projects have been finalised. On Swiss sections, the upgrading of a motorway on the CH-DE border in Basel (Project ID 6213) and the Intersection Härkingen - Intersection Wiggertal (Project ID 6218). The project was funded in the PEB (Programm Engpassbeseitigung) of the Swiss Federal roads office. In the Netherlands, the ViA15 road project study on missing links on the Rhine-Alpine Core Network Corridor aiming to improve cross-border road connection by reducing congestion, improving robustness and inter-modality has been concluded. As the technical compliance of the corridor roads is already highly compliant, this project, as well as most other road projects on the Rhine-Alpine Corridor, contribute to securing sufficient capacity and preventing bottlenecks.

In Belgium, the A11, which connects Bruges and Knokke-Heist in West Flanders, was opened in September 2017. The new route runs over 12km, has three exits, nine wildlife crossing structures which will allow wild animals to traverse safely and 15 kilometres of new bike paths. The key elements are the two mobile bridges over the Baudouin Canal, the first of its kind on European motorways. The A11 was built to provide a better access to the port of Zeebrugge, to improve the quality of life and to promote the tourism in the region. The motorway is an important part of the road network in West Flanders as it provides a fast connection between the N31 in Bruges and the N49 in Knokke-Heist. The aim was also to separate the local traffic from the freight traffic to or from the port of Zeebrugge to improve the fluidity of the traffic.

7.4 Ports

In the Port of Rotterdam the rail connection of the Maasvlakte 2 has been upgraded. The project increases the capacity of the Port railway line and extends the capacity on shunting yards and junctions. Also Kijfhoek will be adjusted to increase the capacity and electrification of the emplacement Europoort. The project is part of the large action to improve the port of Rotterdam, which includes also the Maasvlakte 2.

7.5 Airports

A study on the construction of an underground line section at the Frankfurt airport was finalised in 2015 (Project ID 9012). The study advances the new construction of the S-Bahn line between Frankfurt Airport and its main train station, including a new S-Bahn station "Gateway Gardens" located at the airport's Terminal 2. The resulting project is set to ensuring the sustainability of intermodal transport links at Frankfurt Airport.

There is one project completed in 2017 (Project ID 6811), concerning Milan's Malpensa International Airport MXPT2-Raillink, providing a rail connection between Terminal 1 and 2 – The project consists of the construction of the rail link between Terminal 1 and Terminal 2 of Malpensa.

7.6 Multimodality

In 2016, the upgrade of the tri-modal terminal in Neuss (Project ID 6860) was concluded. The upgrade consisted of the construction of two rail-mounted gantry cranes, an additional transhipment track and two facilities for interim storage of hazardous goods containers.

The Intermodal Hub Rhine-Ruhr represents a new generation of intermodal gateway terminals. Duisburg was chosen as a location because it offers excellent connections to the main rail axis in Europe. Main function is the transhipment of loading units between trains, ensuring a seamless pan-European connection between the maritime ports and the hinterland.

8 Estimation of socio-economic impact

The Rhine-Alpine consortium carried out an analysis of the impact of growth and jobs on the corridor applying a multiplier methodology based on the findings of the study "Cost of non-completion of the TEN-T" carried out by Fraunhofer [20].

8.1 Methodology

The "growth and jobs" effects of the corridor projects have been calculated using so-called "multipliers" resulting from the methodology of the Fraunhofer-Study of 2015. The multipliers allow estimating the respective growth and jobs effects if the costs are known.

The calculation was first being applied in January 2017 on the basis of the 2016 list of projects and the "multipliers" quoted from the Fraunhofer-Study. It was presented and discussed in a joint meeting with the Commission in March 2017. On that basis, a second calculation was made for the Final Project List. The multipliers were changed by the consultancy company MFIVE, which also contributed to the Fraunhofer-Study.

Table 7: Growth and Jobs multipliers

Category of project	GDP multiplier	Jobs multiplier
Cross-border projects	16,8	37.000
Innovation projects	17,7	38.700
Other projects	4,35	16.300

Source: MFIVE

The way of clustering the projects was agreed upon in a joint meeting with MFIVE, HaCon and KombiConsult and distributed to the nine corridor consortia.

Different steps were applied one after the other to filter the projects and their known project list categories:

- All projects of the "cross border" category are directly applied with the respective "cross-border project" multipliers.
- Projects of the categories "innovation" and "Rail ERTMS" belong to the "innovation" multiplier; in the other categories, projects related with clean fuels and telematic applications such as RIS and ITS are also included here; from the remaining (rail) projects 10% of the costs were estimated to be ERTMS-related; the total of these cost form the basis for the innovation multipliers.
- The remaining 90% of the (rail) projects costs and the costs of all other projects which were not classified before cumulate into the cost relevant for the residual multiplier.

The following Figure 33 visualizes this principle. After the costs have been cumulated into the criteria, the respective multipliers have been applied.

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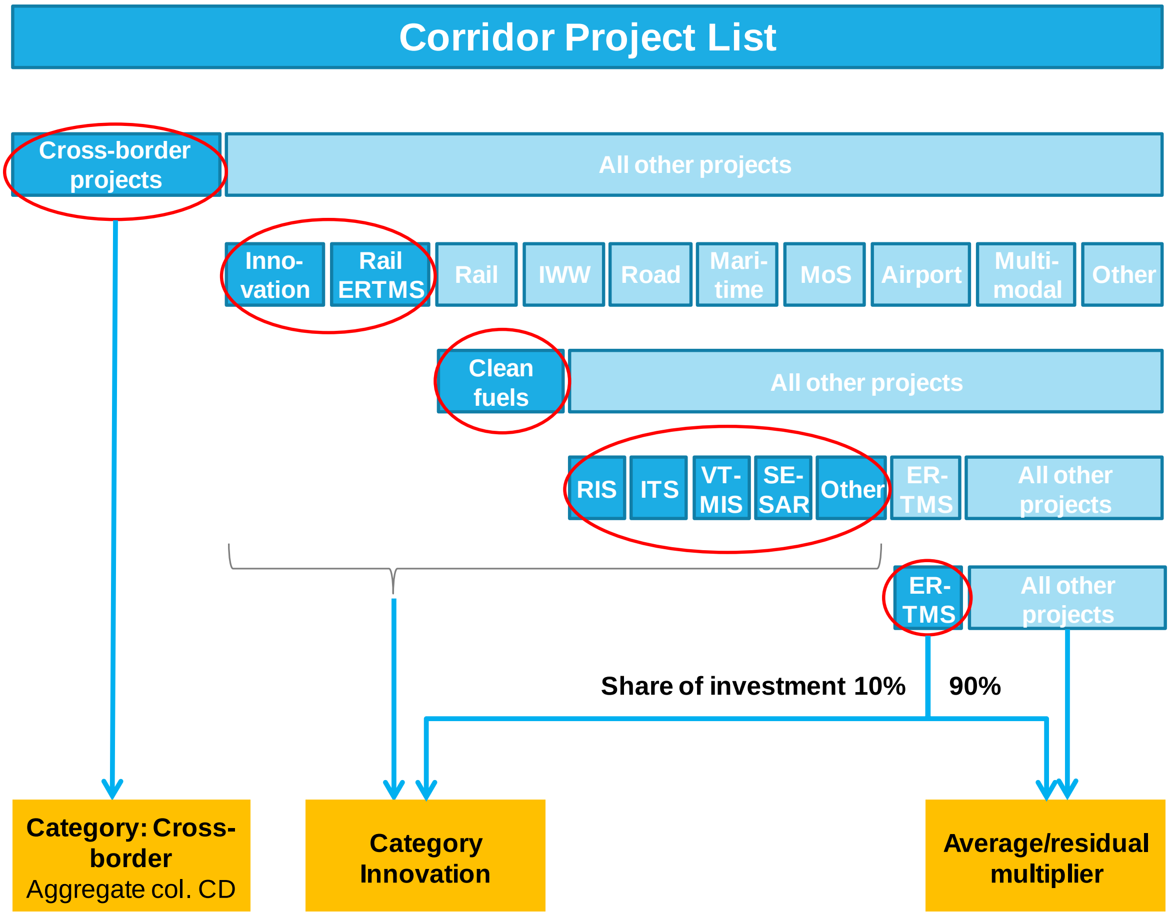
[20] Fraunhofer Institut für System und Innovationsforschung (ISI), Cost of non-completion of the TEN-T, Final Report, June 2015.

Figure 33: Aggregation of Project List categories to multiplier categories



Source: MVIVE

8.2 Socio-economic impact

The calculation of growth and jobs effects depends on the selection of projects. The Commission decided to include only ongoing or planned projects with a completion date 2016 and beyond. This time clustering differs from the time clustering used in the rest of the study, which considers all the projects with an implementation date of 2014 or later. The difference amounts to 16 projects which all were implemented between 2014 and 2016.

For 29 of the remaining 302 projects, no total cost figure is available. These projects were neither part of the analysis. The total cost of the remaining 273 projects adds up to 99.6 billion EUR. The projects are supposed to create an additional accumulated GDP of 743 billion EUR and 2.14 million job-years (full time equivalent) until 2030.

The next step is to determine the contribution of the Rhine-Alpine Corridor to the total TEN-T Core Network. In order to sum up the corridor specific data, it has to be ensured that each project is counted only once: 195 projects with an investment volume of 91.9 billion EUR are in the “responsibility” of the Rhine-Alpine Corridor (consortium) and fulfil the selection criteria (completion earliest 2016 and known costs). Their realisation would result in an additional accumulated GDP of 678 billion EUR and (rounded) 1.96 million job years in the time until 2030.

Table 8: Growth and Jobs created in and by the Rhine-Alpine Corridor projects in the period until 2030

	Number of projects	Total Costs (billion EUR)	GDP created (billion EUR)	Job-years created (FTE) (million)
Entire Rhine-Alpine Corridor	273	99.6	743	2.14
RALP Corridor contribution to all nine Core Network Corridors	195	91.9	678	1.96

Source: KombiConsult, based on RALP project list, status: 24/04/2017

9 Pilot Initiatives

Pilot initiatives or “Flagships” are defined as an important instrument to facilitate the corridor development by addressing selected topics of the Issues Papers of the European Coordinators matching the particularities of the Corridor. Stakeholders have been invited to generate at least one project which are addressing Issues Papers’ topics, such as clean fuels, ITS, noise, environmental impact, safety or urban nodes[21]. Considering this, the Pilot initiative shall cover a significant part of the Corridor and can consist of bundles of smaller measures which together bring countable benefits in a short-term period of 3 to 4 years. Transferability of results to the other Core Network Corridors should be ensured.

During in the Working Group meetings of the Rhine-Alpine Corridor in 2017, numerous topics for Pilot Initiatives had been identified and discussed. Within a coordination process considering all proposals of the nine Core Network Corridors, it has been decided for the Rhine-Alpine Corridor to develop a Pilot Initiative focussing on the sustainable reduction of rail noise. This initiative is presented in more details in the Work Plan.

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[21] Issues Papers of the European Coordinators published in 2016

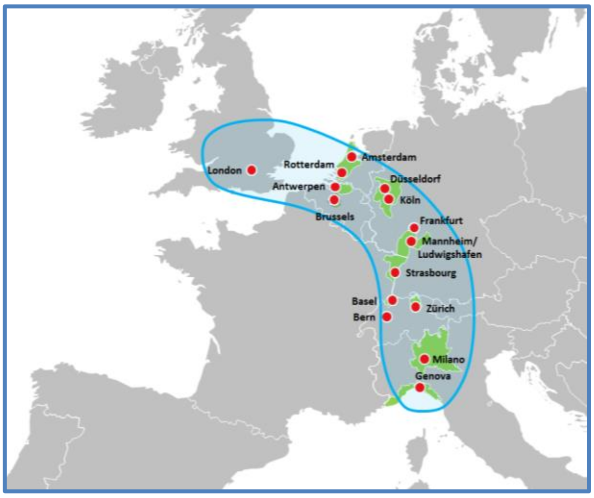
ANNEX I– Executive Summary (Dutch)

De Rijn-Alpine-Corridor

De kernnetwerkcorridor Rijn-Alpine is één van de negen corridors gedefinieerd in het Trans-Europese Netwerk voor Transport (TEN-T), gebaseerd op Verordening (EU) 1315/2013 en 1316/2013.

De regio's binnen de corridor vallen onder de meest dichtbevolkte en economisch sterke regio's van Europa. Bij elkaar opgeteld wonen, werken en consumeren er meer dan 70 miljoen mensen in het gebied van de Rijn-Alpine corridor. Ook zijn er vooraanstaande producenten, handelsondernemingen, fabrikanten en distributiecentra te vinden. De corridor loopt door de zogenaamde 'Blauwe Banaan' met belangrijke Europese economische centra als: Brussel & Antwerpen (België), de Randstad (Nederland), het Ruhrgebied & Rijn-Neckar regio (Duitsland), regio Bazel & Zurich (Zwitserland) en de regio Milan & Genua (Noord-Italië) (zie figuur 1).

Figuur 1: Europa's 'Blauwe Banaan'

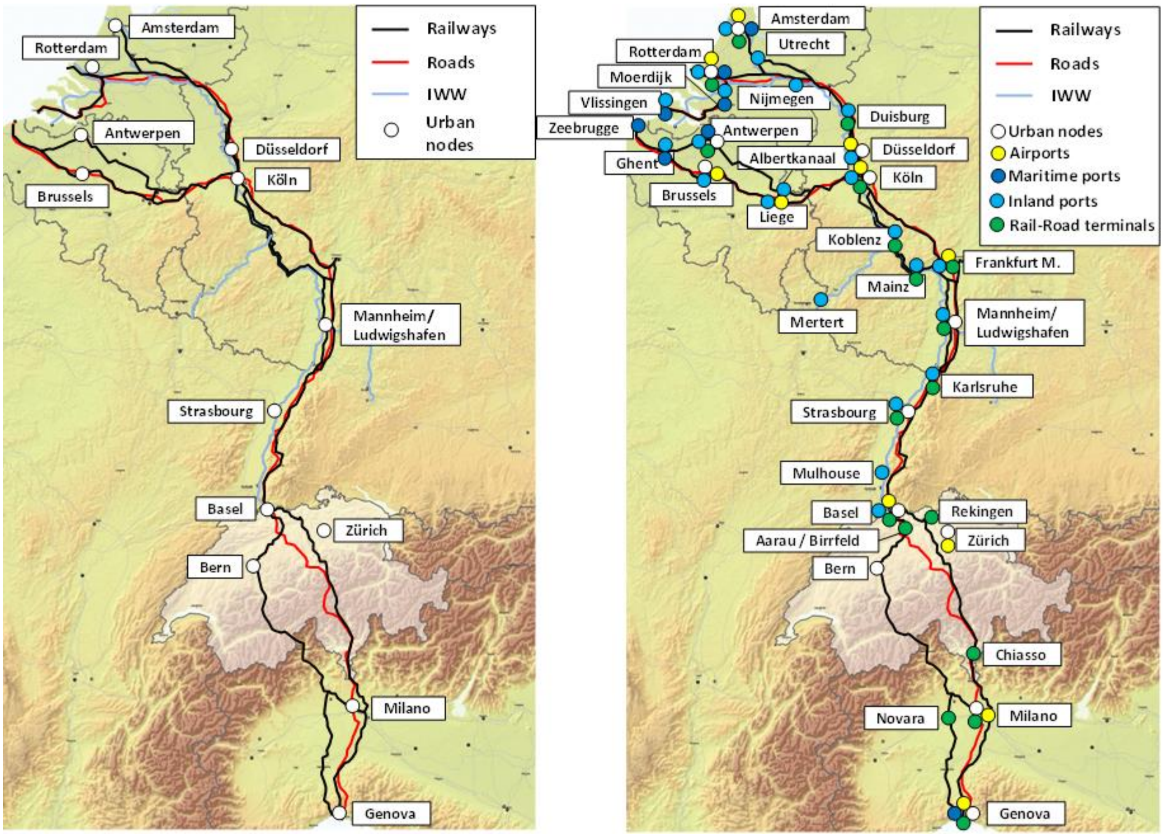


De Rijn-Alpine-Corridor loopt door Zwitserland en vijf Europese lidstaten. Frankrijk is toegevoegd aan de corridor door de relevante binnenvaartwegen en binnenhavens gelegen aan de Rijn. In overeenstemming met de lidstaten en in dialoog met het Corridor Forum, zijn de rivieren Moselle en Necker (Duitsland), de Franse binnenhavens aan de Rijn (Straatsburg en Mulhouse) en Mertert aan de Moezel (Luxemburg) opgenomen voor verdere analyse. De binnenvaartwegen van België zijn niet opgenomen in de Rijn-Alpine-Corridor, maar zijn wel van belang voor de strategie en verdere ontwikkeling van de corridor. Informatie over deze vaarwegen is gebruikt in de analyse van de transport markt studie.

De hoofdassen van de Rijn-Alpine-Corridor zijn:

- Genua – Milaan – Lugano – Bazel;
- Genova – Novara – Brig – Bern – Bazel;
- Bazel – Karlsruhe – Mannheim – Mainz – Koblenz – Keulen;
- Keulen – Düsseldorf – Duisburg – Nijmegen/Arnhem – Utrecht – Amsterdam;
- Nijmegen – Rotterdam – Vlissingen;
- Keulen – Luik – Brussel – Gent;
- Luik – Antwerpen – Gent – Zeebrugge.

Figuur 2: Overzicht van de Rijn-Alpine-Corridor



Bron: Regulation 1316/2013 Annex 1, Part 1 / HaCon

Conformiteit van de technische infrastructurele vereisten

Het TEN-T Regelement 1315/2013 stelt de technische infrastructurele vereisten vast voor elk vervoersmiddel en de daaraan gerelateerde infrastructurele componenten. Om een actueel overzicht te krijgen van de huidige conformiteit van de Rijn-Alpine-Corridor met de vereisten van de TEN-T regelementen, zijn de technische parameters van alle onderdelen en infrastructurele knooppunten van de corridor geanalyseerd.

De analyses laten zien dat de meeste infrastructurele kenmerken van de Rijn-Alpine-Corridor in lijn zijn met de TEN-T vereisten. Toch zijn er een aantal zaken nog niet aangekaart. Voor spoorvervoer is met name de uitrol van ERTMS een uitdaging. Vrachttreinen met een lengte van 740 meter kunnen in Italië niet worden ingezet zonder restricties terwijl er sprake is van een begrenzing van de tijdsvensters in Duitsland en België. In Nederland is er een kort baanstuk bij Vlissingen wat kan worden verbeterd naar het vastgestelde niveau van een maximale asdruk van 22,5 ton, in combinatie met een snelheid van 100km/u. Met een aantal kleine uitzonderingen (veelal vanwege operationele redenen), worden er snelheden van 100 km/u behaald op de vrachtlijn van de corridor. Voor wat betreft multimodaliteit, op dit moment zijn er slechts 11 van in totaal 65 geïdentificeerde intermodale terminals die over overslagspoor beschikken van 740 meter of meer. Het binnenvaartnetwerk is volledig in lijn met de vereisten van CEMT klasse IV. Desondanks zijn er delen van de Rijn niet bevaarbaar tijdens laagwater en extreme droogte. Dit is met name het geval tussen Koblenz en Iffezheim in Duitsland. Onvoldoende minimum brughoogtes zorgen voor een gelimiteerde toegankelijkheid van Zwitserse binnenhavens. Onvoldoende capaciteit bij sluizen en aanlegplaatsen is een belangrijk aandachtspunt. Voor de binnenvaart is Lobith een cruciaal grensovergangspunt tussen Nederland en Duitsland, op deze locatie is er vraag naar ligplaatsen. Ook op de Neckar en Moezel vormt sluiscapaciteit een probleem. Het grootste probleem rondom conformiteit voor wat betreft vliegvelden is het gebrek aan verbinding met het spoornetwerk in Bazel, Milaan Linate, Genua en Rotterdam.

Huidige en toekomstige verkeerstromen op de corridor

Gedurende de eerste studie in 2014 is er een transport markt studie uitgevoerd. De Rijn-Alpine-Corridor is één van de drukste vrachtroutes in Europa, en beslaat sterke grensoverschrijdende verbindingen tussen Duitsland, Nederland en België. De volumestroom tussen deze landen bedraagt 307,2 miljoen ton. Dit is goed voor 83% van de totale internationale vracht activiteit op de corridor. Kijkend naar goederengroepen, de goederen die hoofdzakelijk de grens overschrijden zijn: machines en transportmiddelen, brandstoffen (vloeibaar en droge bulk), bouwmaterialen en delfstoffen. De meest gekozen vorm van transport van deze goederen (achterland transport) is binnenvaart, gevolgd door wegvervoer.

Voor huidig personenvervoer, uitgedrukt in het aantal reizen, zijn er drie grote bidirectionele verkeerstromen geïdentificeerd: tussen België en Nederland, tussen Duitsland en Zwitserland en tussen Duitsland en Nederland. Deze stromen vormen respectievelijk 25%, 23%, en 19% van het totale verkeer. Personenvervoer vindt vooral plaats over de weg. Luchtverkeer vormt slechts een klein deel (4,1%) van het totale personenvervoer op deze corridor. De grootste stromen zien we tussen Duitsland en Zwitserland, Nederland en Zwitserland en Duitsland en Italië.

Op basis van relevante nationale studies zijn toekomstige volumes geanalyseerd. Deze voorspelingen tonen het belang aan van maritiem transport (voornamelijk voor België, Nederland en Italië), soevereiniteit van wegen in Duitsland, Italië en Nederland en de verwachte groei van spoortransport in Zwitserland, Duitsland en Nederland. De modal shift effecten van de maateregelen uit het corridor Werk Plan zijn berekend. Om het potentiele effect van veranderingen op de corridor te schetsen heeft de transport markt studie gekeken naar de prestaties op gebied van transport op de relevante secties. Er is een model toegepast dat gebruik heeft gemaakt van drie runs: 2010 (basis), 2030 (referentiescenario) en 2030 (conformiteit). De schatting van het referentiescenario heeft gebruik gemaakt van aannames voor BBP van 2030. De ‘conformiteit’ met het standaard TEN-T scenario is gedefinieerd op basis van een aantal aannames zoals conformiteit met de TEN-T voorwaarden, vloeiende interoperabiliteit op spoorwegen, interoperabiliteit van tolsystemen en LNG als brandstof voor schepen.

Kijkend naar de resultaten van het model in het referentiescenario wordt er tot 2030 een jaarlijkse toename verwacht van 1,7% in de vraag naar vrachtvervoer van alle modaliteiten (weg, spoor en binnenvaart). Dit resulteert voor elke modaliteit in een totale groei van ongeveer 40%. Wanneer we beleidsmaatregelen hierop loslaten in het conformiteitsscenario verandert de groei tussen 2010 en 2030 naar 36% voor wegvervoer, 55% voor spoorvervoer en 41% voor binnenvaarttransport. Kijkend naar de modal split laat spoorvervoer de hoogste groeitrend zien. Tot 2030 wordt er verwacht dat spoorvervoer zal toenemen met 55% (in tegenstelling tot 41% in het referentiescenario zonder TEN-T maatregelen). Dit komt voornamelijk door de verwachte afname van reiskosten en reistijd waardoor spoorvervoer een aantrekkelijkere optie wordt voor vervoer naar het achterland.

Plan voor het verwijderen van fysieke en technische barrières

Eén van de hoofddoelen van de geüpdatete corridor studie is het identificeren en beschrijven van alle projecten die nodig zijn voor het voltooien van de corridor. De uiteindelijke projectenlijst was oorspronkelijk gebaseerd op de projectenlijst van de corridor studie uit 2014. Deze lijst is geüpdatet en verrijkt met de CEF projecten uit 2015, geselecteerde CEF projecten uit 2016, nationale transport plannen, operationele programma’s over transport (OPT) en de implementatie plannen van de Rail Freight

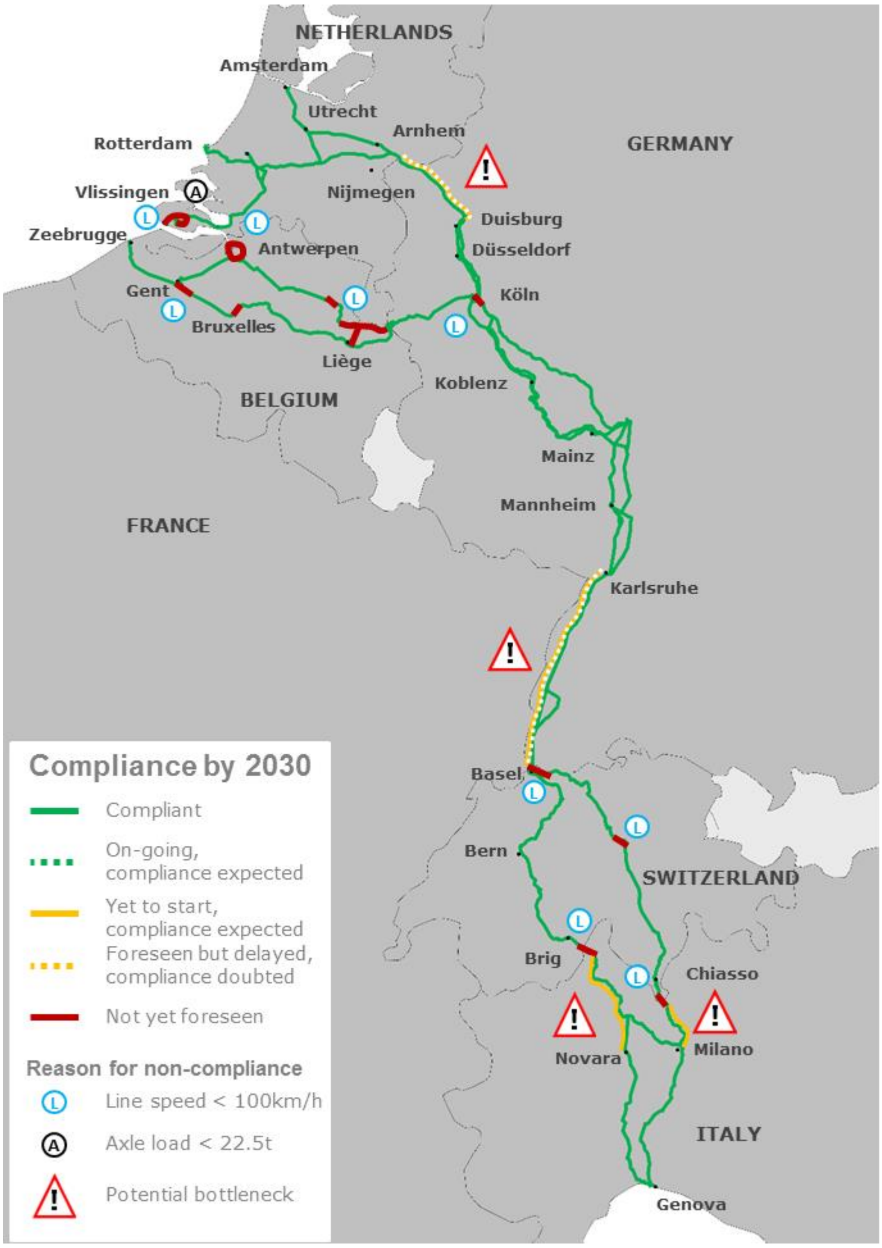
Corridor. Gedurende dit hele proces hebben verschillende consolidatierondes met lidstaten en Corridor Forum stakeholders geleid tot een harmonieuze en gecoördineerde projectenlijst.

De uiteindelijke projectenlijst van 2017 bestaat uit 318 projecten. De lijst bevat ook projecten die al zijn begonnen maar nog niet afgerond toen het Regelement 1315/2013 werd bekrachtigd in 2013. In vergelijking met de Werk Plannen van 2014 en 2016 betekent dit een toename van respectievelijk 42 en 101 projecten. De toename is voornamelijk te danken aan projecten die zijn toegevoegd door de lidstaten of stakeholders, maar ook door de optimalisatie van de methodologie met overlappende corridors.

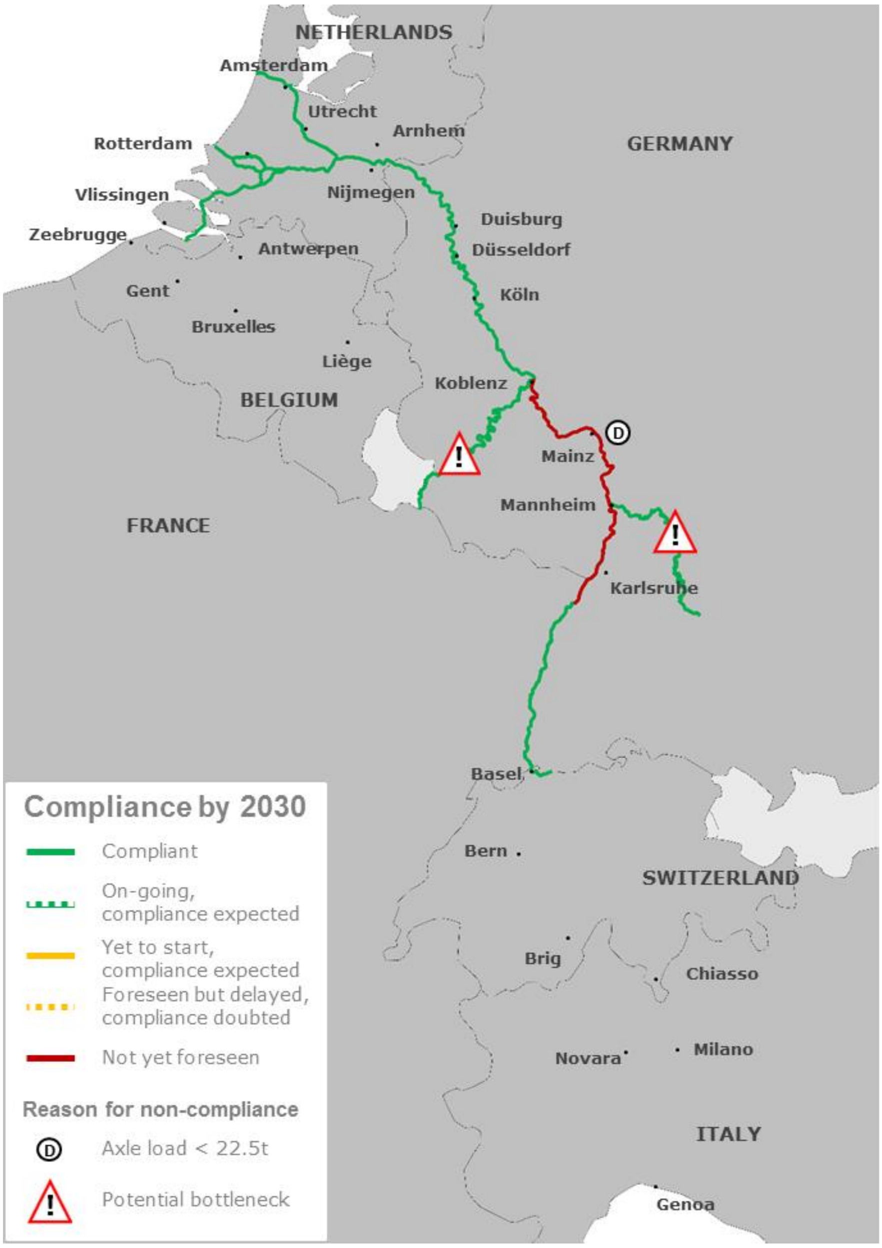
Technische conformiteit

De studie naar de Rijn-Alpine-Corridor identificeert prominente, cruciale problemen die het opereren van deze belangrijke Europese transportverbinding volgens de richtlijnen van het Regelement 1315/2013 belemmeren. Gebaseerd op de verwachte bijdrage aan de ontwikkeling van de corridor door geplande en erkende projecten, zal het plan om fysieke en technische barrières te verwijderen in 2030 gebruik maken van aannames conform het Regelement 1315/2013. De resultaten voor spoor-, binnenvaart- en wegvervoer zijn weergegeven in de volgende figuren.

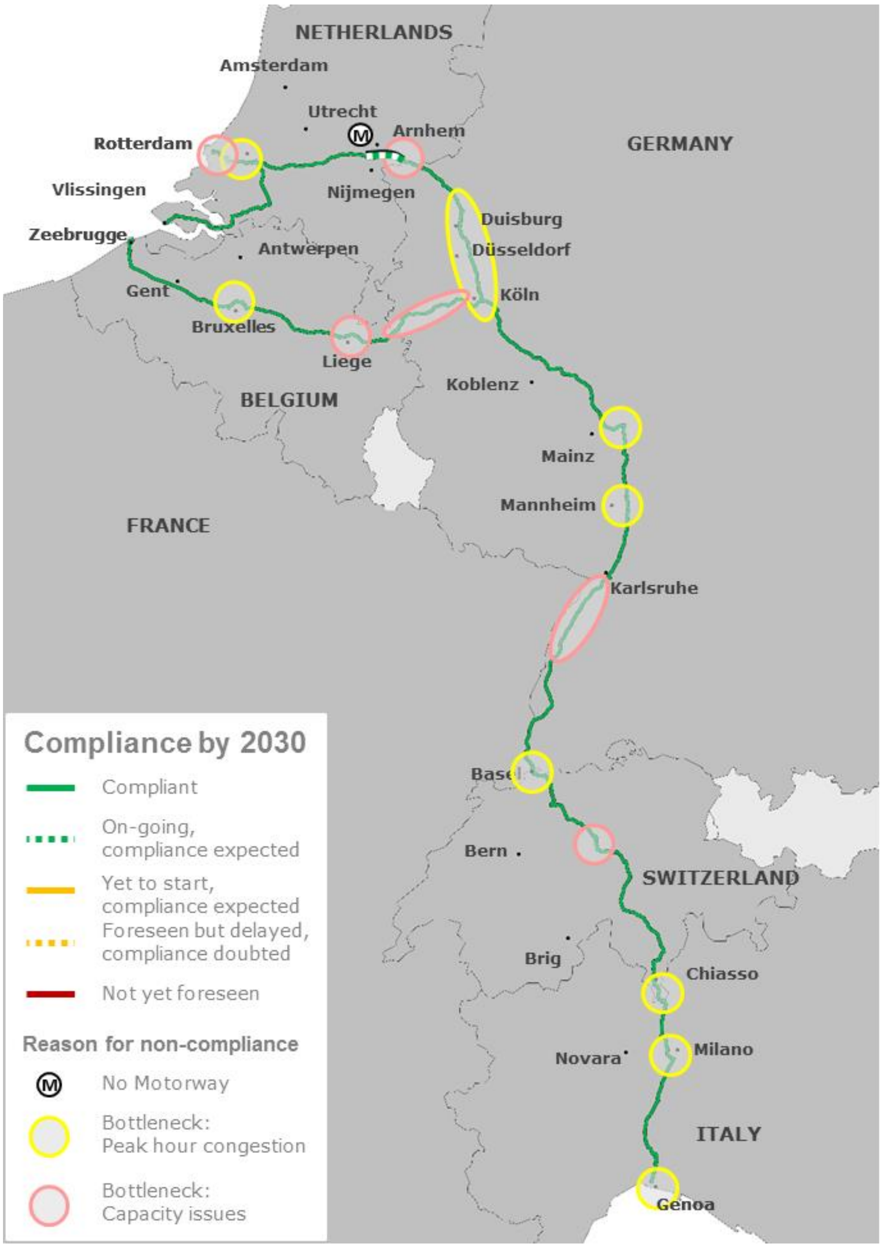
Figuur 3: Overzicht conformiteit 2030 - Spoor



Figuur 4: **Overzicht conformiteit 2030 - Binnenvaart**



Figuur 5: Overzicht conformiteit 2030 - Weg



Administratieve en operationele barrières

Naast de fysieke en technische knelpunten zijn er ook administratieve en operationele barrières die het opereren en het verder ontwikkelen van de Rijn-Alpine-Corridor hinderen. Beide hebben een belangrijke impact op de aantrekkelijkheid van transport routes en vervoersmiddelen. Hierdoor beïnvloeden ze ook de vraag naar vervoer en de samenstelling van de gebruikte vervoerswijzen.

Deze analyse geeft de status voor het jaar 2017 weer. Het is niet mogelijk is om toekomstige beleidsveranderingen die impact hebben op administratieve en operationele barrières exact in te schatten. Deze barrières staan voornamelijk in relatie tot het veranderen van infrastructurele voorzieningen bij grenzen. Infrastructurele problemen, zoals verschillen in spoorvoltages die operaties en administratieve zaken hinderen, belemmeren vloeiende vervoersstromen op de corridor. In hoofdstuk 3.5 volgt een gedetailleerde analyse.

Stedelijke knooppunten

Stedelijke knooppunten zijn gedefinieerd als "stedelijke gebieden waar de transportinfrastructuur van het trans-Europese transport netwerk -*waaronder havens (en passagiersterminals), vliegvelden, treinstations, logistieke platformen en vrachtterminals gelegen in- en in de buurt van stedelijk gebieden*- is verbonden met andere delen van infrastructuur en infrastructuur voor regionaal en lokaal verkeer"[22]. Stedelijke knooppunten worden verder omschreven als startpunten (first mile), eindpunten (last mile) en/of overstap/overslag punten tussen verschillende modaliteiten voor vracht- en personenvervoer op het TEN-T netwerk.

Onder de stedelijke knooppunten is er een conformiteitscheck met CNC richtlijnen uitgevoerd. In algemene zin werpen de resultaten licht op de discrepantie in termen van conformiteit van corridor lijnen binnen het stedelijke gebied van de verschillende Rijn-Alpine-Corridor landen. Nederlandse, Belgische, Zwitserse en Duitse knooppunten voldoen bijna volledig aan de conformiteit terwijl de Franse en Italiaanse knooppunten meer knelpunten kennen. Met name knooppunten als Straatsburg, Milaan, Genua, Brussel en Keulen worden gekenmerkt door twee non-conforme parameters per knooppunt. Aan de andere kant beschikken de stedelijke corridor lijnen in Antwerpen, Düsseldorf, Bazel en Mannheim over slechts één non-conforme parameter in de knooppunten en tonen de knooppunten in Amsterdam en Rotterdam volledige conformiteit. In hoofdstuk 3.6 volgt een gedetailleerde analyse.

Innovatie

Innovatieve projecten refereren naar projecten binnen de lidstaten waarbij gebruikt wordt gemaakt van nieuwe technologieën ter verbetering van (delen) van het huidige transportsysteem. Er is een specifieke definitie van 'innovatie' gebruikt voor het identificeren en classificeren van innovatieve projecten op de negen corridors van het hoofdnetwerk.

Voor de inzet van innovatie zijn er 288 projecten geëvalueerd op basis van bijdrage aan innovatie. 71 projecten (een kwart van het totaal) zijn, op basis van de toegepaste definitie, geïdentificeerd als innovatief. Het aandeel van innovatieve projecten op de Rijn-Alpine-Corridor is relatief hoog in vergelijking met het gemiddelde van 23,5% voor alle negen corridors van het hoofdnetwerk. De totale investering voor de 71 projecten bedraagt 4,6 miljoen euro. Dit bedrag laat zien dat innovatie, in vergelijking met infrastructurele projecten, niet duur hoeft te zijn. In paragraaf 3.7.1 volgt een detailleerde analyse.

Impact op het milieu

Voor het kwantificeren van emissies is het EU Referentiescenario 2016 gebruikt. Volgens schattingen zal het vrachtverkeer toenemen van 129 miljard tonkilometer (2017) naar 156 miljard tonkilometer in 2030 (weg, spoor en binnenvaartvervoer). De snelst groeiende sector in het referentiescenario is spoorgoederenvervoer (met 1,8% per jaar). Passagiersvervoer (weg, spoor en luchtvervoer) stijgt naar verwachting van 165 miljard reizigerskilometer (2017) naar 190 miljard reizigerskilometer in 2030. De snelst groeiende sector binnen passagiersvervoer bedraagt luchtvaart (1,8% per jaar).

Volgens de analyse die is uitgevoerd voor de periode 2015 – 2050 zullen de emissies van het wegvervoer dalen. Tegelijkertijd zal het aantal reizigers en het volume toenemen. In vergelijking met 2015 zullen de totale emissies van spoorvervoer gelijk blijven tot 2030 en lichtelijk toenemen tot 2050. Ook voor de binnenvaartsector zullen emissies tot 2050 lichtelijk toenemen. De luchtvaartsector is een sector waar het aantal reizigers constant zal blijven stijgen tot 2050 (+76%). In dezelfde periode nemen de emissies naar verwachting lichtelijk toe.

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[22] TEN-T Regulation 1315/2013

De totale uitstoot van weg-, spoor-, binnenvaart- en luchtvervoer op de corridor was in 2015 gelijk aan 18,9 miljoen ton CO_2–equivalent. Gebaseerd op de geschatte vervoerde volumes en toename van energie-efficiëntie, wordt verwacht dat de uitstoot daalt naar 16,9 miljoen ton CO_2–equivalent in 2030 en 16,6 miljoen ton CO_2–equivalent in 2050. In paragraaf 3.7.2 is een detailleerde analyse.

Algehele investeringsanalyse voor de Rijn-Alpine-Corridor

De som van de investeringskosten van alle projecten in de Rijn-Alpine projectenlijst bedraagt 100,3 miljard euro. Voor 53% van de projecten is volledige financiële informatie beschikbaar, dit zijn dan ook de projecten meegenomen in de berekening van de totale investeringskosten. Het corresponderende bedrag (41,1 miljard euro) is onderverdeeld in financiële bronnen die elk een kostenpilaar vormen binnen de geanalyseerde projecten.

De financiële bronnen van de projecten die volledige informatie wat betreft financiering bevatten, zijn als volgt geïdentificeerd:

- MS/publieke gunning: 39,3 miljard euro, of 95,6% van het totaal;
- EU gunningen (CEF, ESIF): 0,7 miljard euro, of 1,7% van het totaal;
- Private/eigen bronnen: 1,1 miljard euro, of 2,7% van het totaal.

De verdeling van financiering door EU gunningen laat het volgende zien:

- CEF/ TEN-T: 0,7 miljard euro, of 99,8% van het totaal;
- ESIF: 0 euro;
- Andere: 0,02 miljard euro, of 0,2% van het totaal.

De analyse leidt tot de volgende conclusie: wanneer dezelfde EU financieringsratio (de hierboven geïdentificeerde 1,7% voor EU gunningen) zou worden toegepast op het investeringsbedrag van de gehele corridor, is de verwachting dat er de komende jaren 1,7 miljard euro CEF financiering nodig is. Een gedetailleerde analyse volgt in hoofdstuk 3.8.

Samenvatting van geslaagde acties

Sinds de publicatie van het eerste Werk Plan in mei 2015 is er veel voortgang geboekt op de gehele Rijn-Alpine-Corridor. Dit geldt eveneens voor alle modaliteiten binnen de corridor. In totaal zijn er 16 infrastructurele projecten en belangrijke studies afgerond en geïmplementeerd. De totale investeringssom van deze maatregelen bedraagt 13 miljard euro. Belangrijke en representatieve projecten zijn uitgelicht en beschreven in het Werk Plan van de corridor:

- De **Gotthard Base tunnel** door de Zwitserse Alpen;
- Het nieuwe **Intermodale hub Rhine-Ruhr** in Duisburg;
- De nieuwe Belgische **snelweg A11** die Brugge verbindt met Knokke-Heist in West-Vlaanderen;
- De upgrade van de **spoorverbinding van Maasvlakte 2** in de haven van Rotterdam; de verbeterde **toegankelijkheid per spoor van het vliegveld Milano Malpensa**;
- De start van werkzaamheden aan de **spoorverbinding tussen Zevenaar - Emmerich – Oberhausen.**

Inschatting van de sociaaleconomische impact van de corridor op werkgelegenheid en economische groei

Een analyse van de impact op economische groei en werkgelegenheid door ontwikkeling van de corridor is uitgevoerd gebruikmakende van een methodologie gebaseerd op de bevindingen van de studie "*Cost of non-completion of the TEN-T*[23]".

Er zijn projecten geëvalueerd waarvan de kostenramingen beschikbaar zijn en die gepland staan om tussen 2016 en 2030 te worden geïmplementeerd. Deze projecten zijn goed voor een investering van 96,6 miljard euro. De implementatie van deze projecten op de corridor moet leiden tot een toename in het BBP van in totaal 743 miljard euro in de periode 2016 – 2030. Daarnaast zullen baten ook aanhouden na 2030.

Ten slotte zullen de investeringen leiden tot een toename van werkgelegenheid. De directe, indirecte en afgeleide effecten op werkgelegenheid door deze projecten zullen leiden tot een toename van 2,14 miljoen baan-jaren tussen 2016 en 2030. Verwacht wordt dat er ook na 2030 baan-jaren door de projecten worden gecreëerd. Een gedetailleerde analyse volgt in hoofdstuk 8.

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[23] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

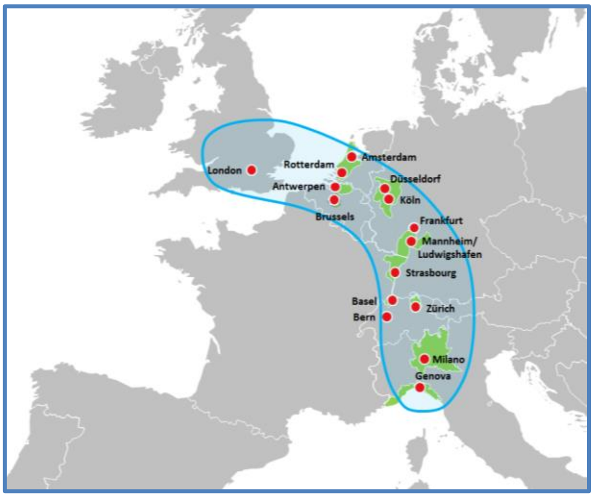
ANNEX I– Executive Summary (French)

Le corridor Rhin-Alpes

Le corridor du réseau central Rhin-Alpes est l'un des neuf corridors du réseau central définis dans le réseau transeuropéen de transport (RTE-T) sur base des règlements (UE) 1315/2013 et 1316/2013.

Les régions qu'il traverse comptent parmi les plus densément peuplées et plus actives économiquement d'Europe. Au total, plus de 70 millions de personnes vivent, travaillent et consomment dans le bassin versant du corridor Rhin-Alpes. Des entreprises de premier plan – industries, commerces, centres de distribution, … - sont situés sur son tracé. Il traverse la "Banane bleue", qui comprend les principaux centres économiques de l'UE tels que Bruxelles et Anvers en Belgique, la région de Randstad aux Pays-Bas, les régions allemandes Rhin-Ruhr et Rhin-Neckar, les régions de Bâle et Zurich en Suisse et les régions de Milan et de Gênes en Italie du Nord (cf. Figure 1).

Figure 1: La "Banane bleue" européenne



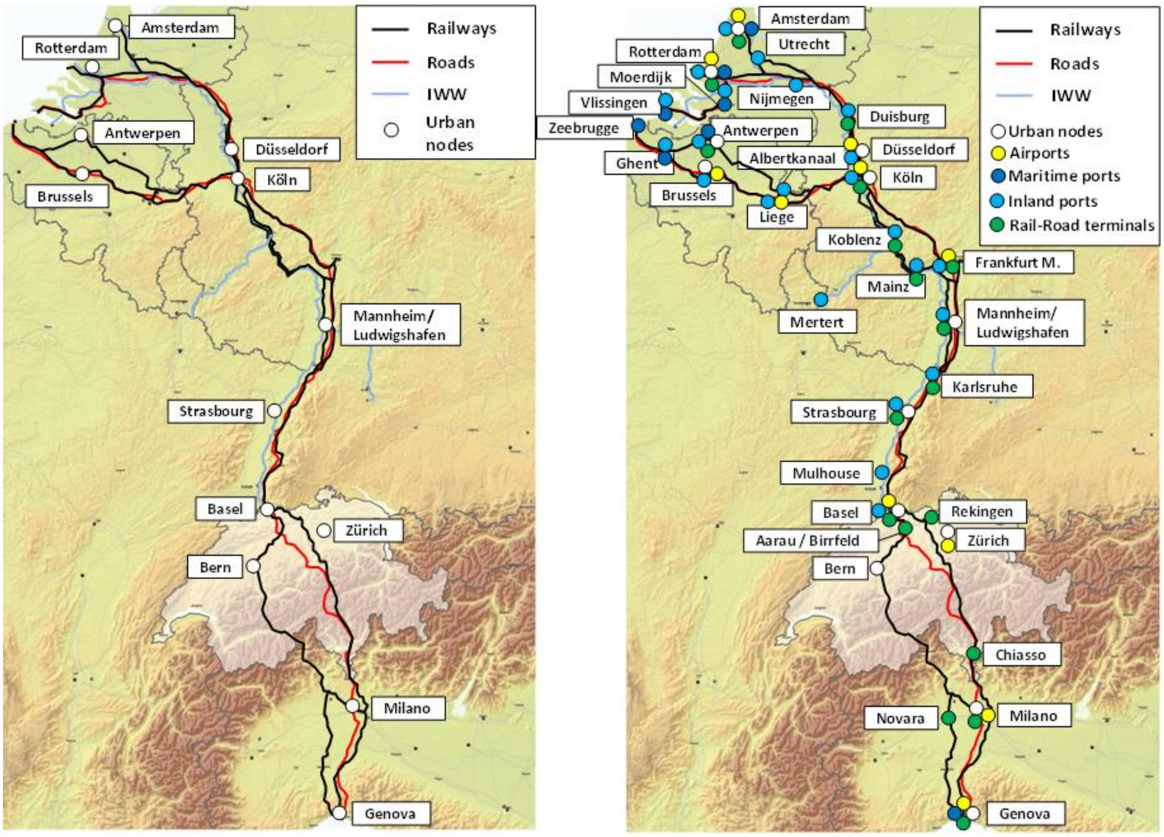
Le corridor Rhin-Alpes traverse cinq États membres et la Suisse. La France a été ajoutée à son tracé du fait de l'importance de la voie navigable rhénane et de ses ports sur la rive française.

En accord avec les États membres et à la suite des dialogues ayant eu lieu lors des Forums du Corridor, les rivières Moselle et Neckar en Allemagne ainsi que les ports intérieurs rhénans français (Strasbourg et Mulhouse) et luxembourgeois (Mertert sur la Moselle) ont été intégrés pour une analyse plus approfondie. Les voies navigables intérieures en Belgique ne sont pas incluses dans le corridor Rhin-Alpes, mais sont importantes pour sa stratégie et son développement ultérieur ; des informations à leur sujet ont été utilisées pour l'analyse de l'étude du marché des transports.

Les principales branches du corridor Rhin-Alpes sont:

- Gènes – Milan – Lugano – Bâle ;
- Gènes – Novare – Brigue– Berne – Bâle ;
- Bâle – Carlsruhe – Mannheim – Mayence – Coblence – Cologne ;
- Cologne – Dusseldorf – Duisbourg – Nimègue/Arnhem – Utrecht – Amsterdam ;
- Nimègue – Rotterdam – Flessingue ;
- Cologne – Liège – Bruxelles – Gand ;
- Liège – Anvers – Gand – Zeebruges.

Figure 2: Le tracé du corridor Rhin-Alpes



Source : Règlement 1316/2013 Annexe 1, Partie 1 / HaCon

Conformité aux exigences techniques de l'infrastructure

Le règlement RTE-T 1315/2013 définit des exigences techniques pour chaque mode et élément constitutif de l'infrastructure. Pour dresser une vue d'ensemble actualisée de la conformité du corridor Rhin-Alpes aux exigences du règlement RTE-T, les paramètres techniques du corridor ont été analysés pour toutes les sections et tous les nœuds le constituant.

Les analyses ont montré que la plupart des caractéristiques de l'infrastructure du corridor Rhin-Alpes sont conformes aux exigences du RTE-T. Néanmoins, quelques non-conformités demeurent. Pour le rail, le déploiement d'ERTMS reste le défi le plus important. En outre, les trains de fret d'une longueur de 740m ne peuvent être exploités sans restriction en Italie alors que des limitations d'horaires s'appliquent en Allemagne et en Belgique. Aux Pays-Bas, de courtes sections ne répondent pas à l'exigence d'une charge maximale par essieu de 22,5 tonnes. La vitesse minimale requise des trains de fret de 100 km/h est atteinte partout sur le Corridor avec seulement quelques exceptions, principalement pour des raisons opérationnelles. En ce qui concerne la multimodalité, seuls onze des 65 terminaux intermodaux identifiés disposent actuellement de voies de transbordement d'une longueur d'au moins 740m. Le réseau fluvial est entièrement conforme aux exigences de la classe CEMT IV. Néanmoins, certaines sections du Rhin ne sont pas navigables pendant les périodes d'extrême aridité et de basses eaux. Cela vaut en particulier pour la section allemande entre Coblence et Iffezheim. Un tirant d'air insuffisant sous certains ponts limite l'accessibilité aux ports suisses. Des capacités d'éclusage et d'amarrage insuffisantes, en particulier près de Lobith, une section transfrontalière vitale entre les Pays-Bas et l'Allemagne, sont des priorités essentielles. La capacité d'éclusage est également insuffisante sur le Neckar et la Moselle. Pour les aéroports, le principal enjeu de conformité est le manque de connexions au réseau ferroviaire pour les plateformes de Bâle, Milan Linate, Gênes et Rotterdam.

Les flux de trafic sur le Corridor aujourd'hui et dans le futur

Une étude de marché du secteur des transports a été réalisée lors de la première étude de 2014. Le corridor Rhin-Alpes constitue l'un des axes de fret les plus fréquentés d'Europe. Des liens économiques étroits sont établis entre l'Allemagne, les Pays-Bas et la Belgique. Ces flux totalisent 307,2 millions de tonnes, soit 83% de l'activité de fret international sur tout le Corridor. Les principaux produits échangés entre les différents pays sont : les machines et le matériel de transport, les produits combustibles (liquides et solides en vrac), les matériaux de construction et les minerais. Le mode de transport privilégié pour ces marchandises (transport dans l'arrière-pays) est la voie d'eau intérieure suivie de la route.

Pour la demande actuelle en voyageurs, exprimée en nombre de voyages, trois flux de trafic bidirectionnels majeurs ont été identifiés : entre la Belgique et les Pays-Bas, entre l'Allemagne et la Suisse et entre l'Allemagne et les Pays-Bas respectivement 25%, 23% et 19% du trafic total. Le mode dominant pour les flux de passagers internationaux dans le Corridor est la route. Le transport aérien ne représente qu'une petite partie (4,1%) de la demande totale de passagers. Les principaux flux sont identifiés entre l'Allemagne et la Suisse, les Pays-Bas et la Suisse ainsi qu’entre l'Allemagne et l'Italie.

Les volumes projetés ont été analysés en fonction de diverses prévisions nationales. Ils soulignent l'importance du transport maritime (notamment pour la Belgique, les Pays-Bas et l'Italie), la domination du mode routier en Allemagne, en Italie et aux Pays-Bas et la croissance attendue du transport ferroviaire en Suisse, en Allemagne et aux Pays-Bas. Les effets du report modal attendu des mesures du Plan de travail ont été calculés. Afin de représenter l'effet potentiel des changements sur le Corridor, l'étude de marché du secteur des transports a examiné les performances des sections concernées. Un modèle a été utilisé en utilisant trois horizons : 2010 (base), 2030 (référence) et 2030 (conformité au RTE-T). Les prévisions de référence ont utilisé les hypothèses de PIB pour 2030. Le scénario de conformité aux normes RTE-T a été défini en tenant compte de plusieurs hypothèses telles que la pleine conformité avec les exigences RTE-T, des chemins de fer interopérables sans interruption, des systèmes de péage interopérables et la disponibilité du GNL pour les navires.

En ce qui concerne la tendance au fil de l’eau, il a été estimé que la demande en fret suivrait une croissance modérée jusqu'en 2030 avec une augmentation de 1,7% par an pour tous les modes de transport (route, rail et voies navigables), soit une croissance totale d'environ 40% pour chaque mode. En appliquant les interventions politiques sur le scénario au fil de l’eau, ces taux de croissance 2010-2030 passent à 36% pour la route, 55% pour le rail et 41% pour la navigation intérieure.

En ce qui concerne la répartition modale, le rail affiche la croissance tendancielle la plus élevée, suivi d'une croissance légèrement plus faible pour la route et les voies navigables intérieures. D'ici 2030, avec Plan de travail, le trafic ferroviaire devrait augmenter de 55% (contre 41% sans les interventions du RTE-T). Cela est principalement dû à la diminution attendue des coûts et des temps de déplacement qui font du rail une option plus compétitive pour le transport dans l'arrière-pays.

Planification de l'élimination des obstacles physiques et techniques

L'un des principaux objectifs de la mise à jour de l'étude de corridor est d'identifier et de décrire tous les projets nécessaires à l'achèvement du corridor. Cette liste finale de projets est à l'origine basée sur la liste de projets de l'étude de 2014. Cette liste a été mise à jour et enrichie avec les projets CEF 2015, les propositions sélectionnées du CEF 2016, les plans nationaux de transport, les programmes opérationnels de transport et les plans de mise en œuvre du corridor de fret ferroviaire. Tout au long du processus, plusieurs cycles de consolidation avec les parties prenantes des États membres et du Forum du Corridor ont permis d'établir une liste de projets harmonieuse et bien coordonnée.

La liste définitive dans sa version de 2017 comprend 318 projets ; elle inclut également des projets qui ont déjà été mis en œuvre mais qui n'ont pas été achevés lorsque le règlement 1315/2013 a été mis en vigueur en 2013. Comparé au plan de travail 2014, cela signifie un ajout de 42 projets et, par rapport au Plan de travail de 2016, de 101 projets. Cette croissance est principalement due à des projets supplémentaires qui ont été ajoutés par les États membres ou d'autres parties prenantes, mais aussi à la méthodologie optimisée retenue pour gérer les projets qui se chevauchent.

Conformité technique

L'étude du corridor Rhin-Alpes a identifié les principaux points noirs qui entravent le fonctionnement de cette importante liaison européenne, conformément aux dispositions du règlement 1315/2013. Le plan d'élimination des obstacles physiques et techniques a pris des hypothèses concernant la conformité au Règlement 1315/2013 d'ici à 2030 sur la base des contributions attendues des projets qui ont été identifiés avec la méthodologie expliquée dans le paragraphe précédent. Les résultats sont illustrés ci-dessous pour le rail (Figure 3 les voies navigables (Figure 4) et la route (Figure 5).

Figure 3: Aperçu de la conformité du mode ferroviaire en 2030

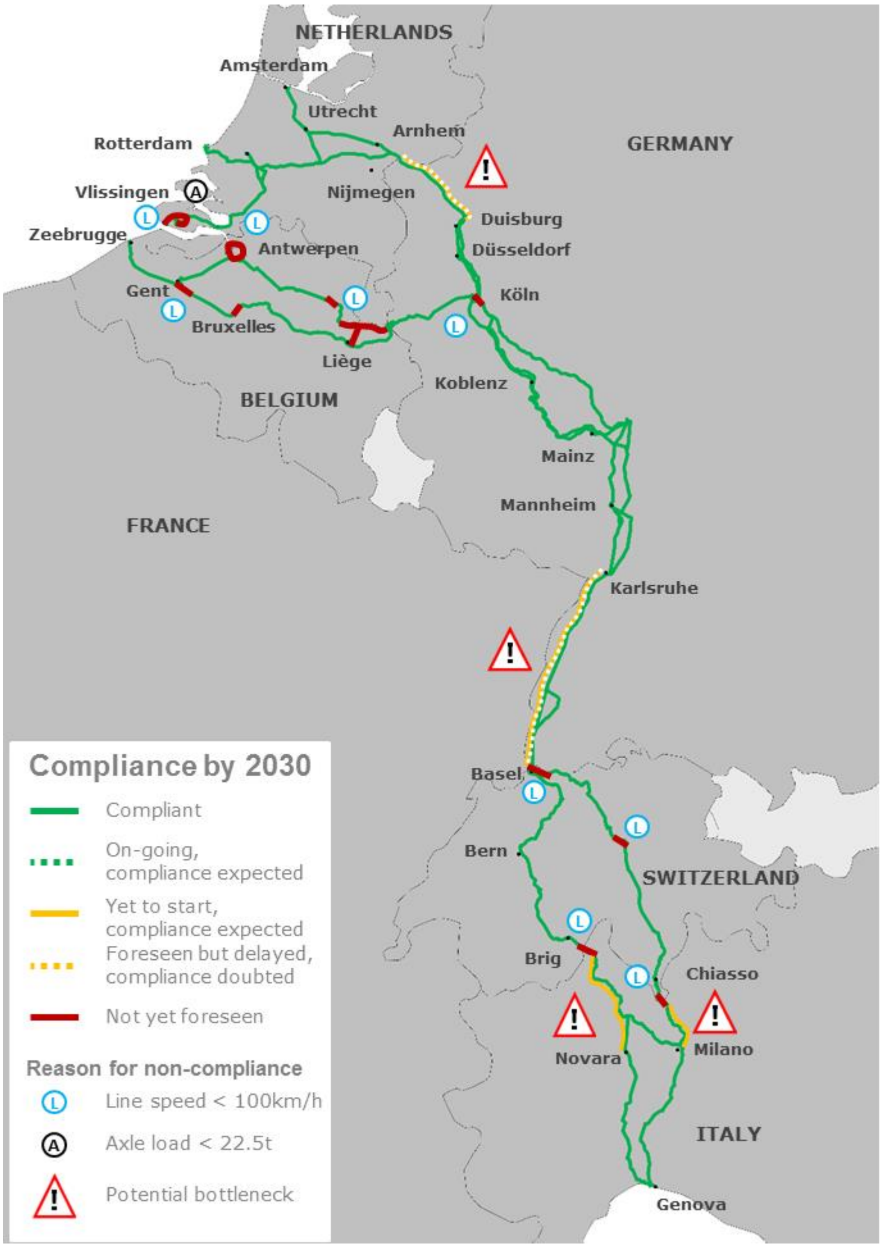


Figure 4: Aperçu de la conformité du mode fluvial en 2030

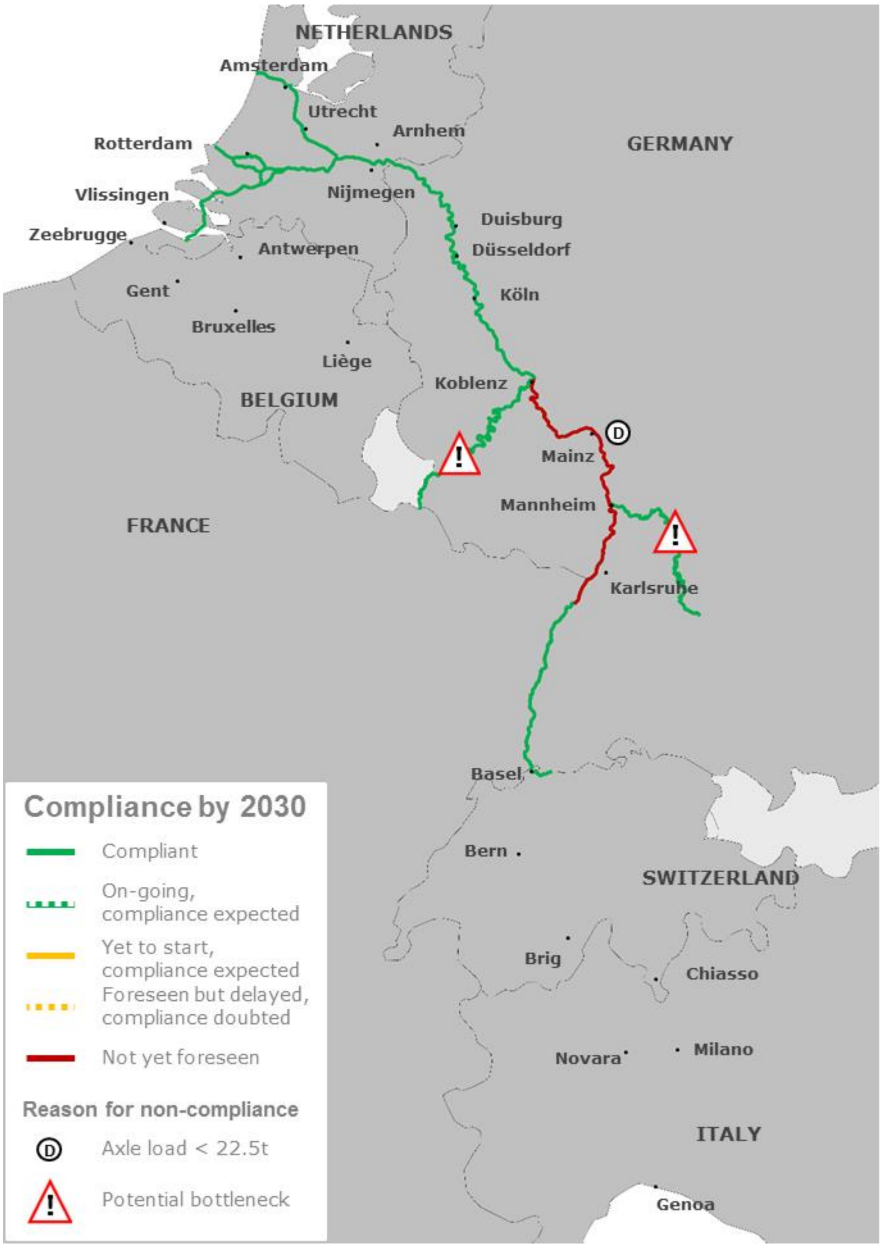
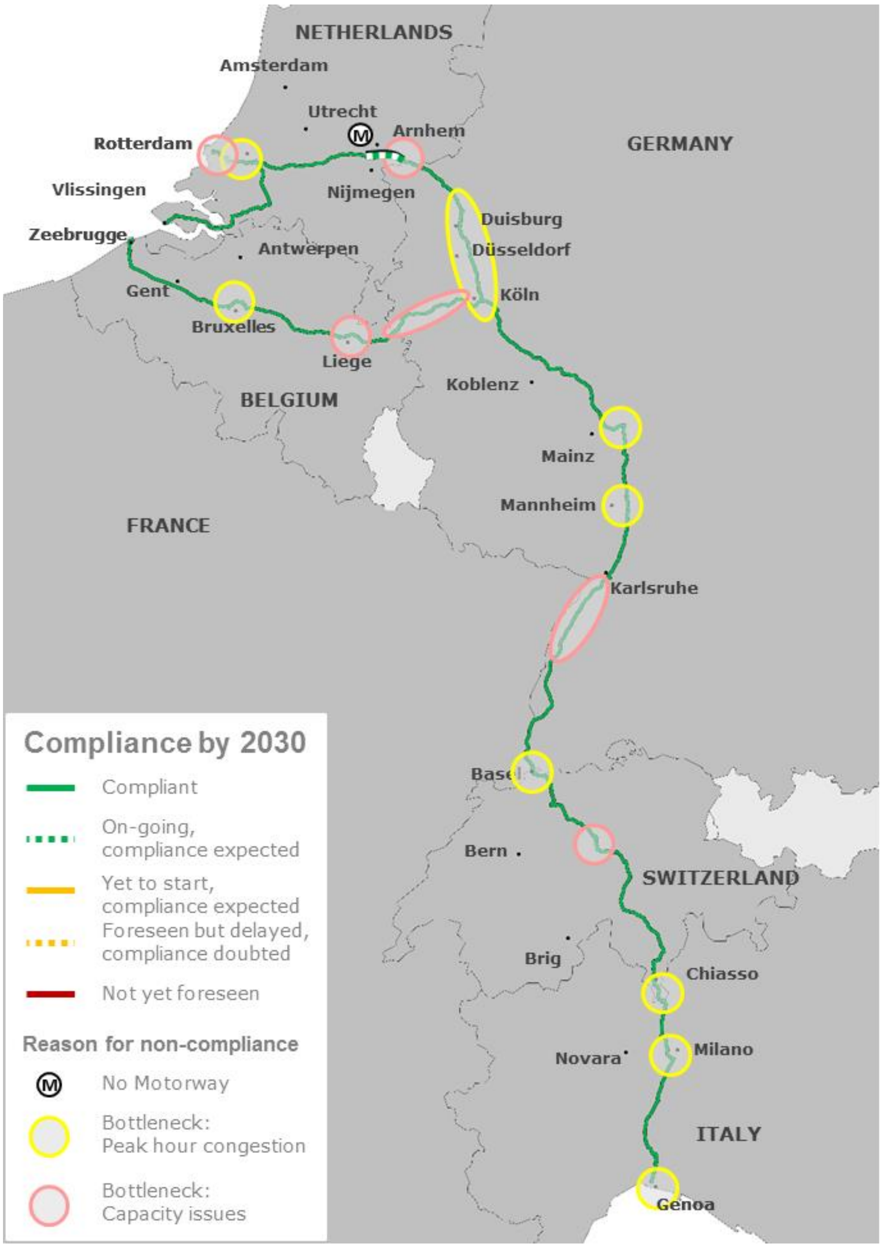


Figure 5: Aperçu de la conformité du mode routier en 2030



Obstacles administratifs et opérationnels

En plus des obstacles physiques et techniques, des obstacles administratifs et opérationnels entravent également le fonctionnement et le développement du corridor Rhin-Alpes. Ensemble, ils ont un impact important sur l'attractivité des voies et modes de transport et influencent ainsi la demande en transport et la répartition modale.

Il convient de noter que cette analyse présente le statut en 2017 et qu'il n'est pas possible de prédire avec précision les futures décisions politiques qui pourraient avoir une incidence sur les contraintes administratives et opérationnelles identifiées. Ces dernières consistent principalement en de différentes caractéristiques physiques de l'infrastructure aux frontières, comme par exemple les systèmes électriques du réseau ferroviaire, mais aussi en des enjeux administratifs qui contraignent la continuité des flux le long du Corridor. Une analyse détaillée est présentée au chapitre 3.5.

Nœuds urbains

Un nœud urbain est défini comme une « zone urbaine où les infrastructures de transport du réseau transeuropéen de transport, tels que les ports, y compris leurs terminaux de voyageurs, les aéroports, les gares ferroviaires, les plateformes logistiques et les terminaux de fret se trouvant à l'intérieur et autour de l'agglomération urbaine, sont connectées avec d'autres parties de ces infrastructures et avec les infrastructures de trafic régional et local ». Les nœuds urbains sont en outre définis comme points de départ (premier kilomètre), destination finale (dernier kilomètre) et/ou points de correspondance à l'intérieur ou entre différents modes de transport pour le fret et les passagers sur le RTE-T.

Un contrôle de la conformité du RTE-T à l'intérieur des nœuds urbains a été effectué. En général, les résultats de l'analyse montrent une légère différence en termes de conformité entre les différents pays européens impliqués dans le corridor Rhin-Alpes. Les nœuds néerlandais, belges, suisses et allemands sont presque entièrement conformes tandis que les nœuds français et italiens présentent encore des contraintes. En particulier, les nœuds urbains tels que Strasbourg, Milan, Gênes, Bruxelles et Cologne sont caractérisés par deux paramètres non-conformes par nœud. D'autre part, la partie du corridor entre Amsterdam et Rotterdam est totalement conforme, tandis qu'Anvers, Düsseldorf, Bâle et Mannheim ne présentent qu'un seul paramètre non conforme par nœud. Une analyse détaillée est présentée au chapitre 3.6.

Innovation

Les projets innovants se réfèrent aux mesures prises dans les États membres qui impliquent l'utilisation de nouvelles technologies améliorant le système de transport. Une définition spécifique de « l'innovation » a été utilisée pour identifier et classer les projets associés pour les neuf corridors du réseau central.

Dans ce corridor, 288 projets ont été évalués sur leur contribution à l'innovation. 71 projets, soit 25%, ont été identifiés comme innovants selon la définition appliquée. La part des projets innovants dans le corridor Rhin-Alpes est relativement élevée par rapport à la moyenne de 23,5% pour les neuf corridors du réseau central. Le total des investissements pour ces 71 projets s'élève à 4,6 milliards EUR. Ce montant démontre que l'innovation est peu coûteuse par rapport aux projets d'infrastructure. L'analyse détaillée est présentée au chapitre 3.7.1.

Incidences sur l'environnement

En ce qui concerne la quantification des émissions, le scénario 2016 de référence de l'UE est appliqué. Le trafic de fret devrait passer de 129 milliards de tkm aujourd'hui à 156 milliards de tkm d'ici à 2030 (route, rail et voie navigable intérieure). Le secteur le plus dynamique dans le scénario de référence est le rail (croissance de 1,8% par an). Le trafic de passagers (routier, ferroviaire et aérien) devrait passer de 165 milliards de pkm aujourd'hui à 190 milliards de pkm d'ici 2030. Ici, le secteur le plus dynamique est celui de l'aviation (croissance annuelle de 1,8%).

D'après l'analyse réalisée pour la période 2015-2050, les émissions du mode routier diminueront alors que sa fréquentation en nombre de passagers et de tonnes de fret augmentera. Par rapport à 2015, les émissions du rail seront constantes en 2030 mais augmenteront légèrement en 2050. Pour le transport par voie navigable, les émissions augmenteront légèrement jusqu'en 2050. L'aviation est un secteur où le nombre de passagers augmentera constamment entre 2015 et 2050 (+76%). Dans la même période, les émissions n'augmenteront que légèrement.

Les émissions totales en 2015 pour la route, le rail, la navigation intérieure et l'aérien sur le Corridor sont de 18,9 millions de tonnes d'équivalent CO_2. Sur la base des volumes de trafic prévus et de l'augmentation de l'efficacité énergétique, des émissions de 16,9 millions de tonnes d'équivalent CO_2 en 2030 et de 16,6 millions de tonnes en 2050 sont prévues pour le scénario de référence. Une analyse détaillée est présentée au chapitre 3.7.2.

Analyse globale des investissements sur corridor Rhin-Alpes

Les coûts d'investissement globaux de tous les projets de la liste dressée pour le corridor Rhin-Alpes s'élèvent à un total de 100,3 milliards d'euros. Pour 53% des projets, des informations complètes sur le financement sont disponibles. Ils sont donc éligibles à cette analyse. Le montant correspondant (41,1 milliards EUR) est divisé par source de financement.

Les sources de financement des projets qui contiennent des informations complètes sur leur financement sont identifiées comme suit :

- Dotation de l'Etat membre/publique : 39.3 milliards d'EUR, ou 95.6% du total ;
- Dotations de l'UE (CEF, ESIF) : 0.7 milliards d'EUR, ou 1.7% du total ;
- Ressources privées/propres : 1.1 milliards d'EUR, ou 2.7% du total.

La répartition des sources de financement à l'intérieur des subventions de l'UE montre la situation suivante :

- CEF/ RTE-T : 0.7 milliards d'EUR, ou 99.8% du total ;
- ESIF: 0 EUR ;
- Autres: 0.02 milliards d'EUR, ou 0.2% du total.

L'analyse aboutit à la conclusion suivante : si le même ratio de financement de l'UE (1,7% pour les subventions de l'UE) était appliqué au montant total de l'investissement du corridor, on pourrait s'attendre à ce que 1,7 milliard d'EUR soit nécessaire. Une analyse détaillée est présentée au chapitre 3.8.

Résumé des actions déjà accomplies

Depuis le premier Plan de travail publié en mai 2015, de grands progrès ont déjà été réalisés sur l'ensemble du corridor Rhin-Alpes et pour tous les modes de transport. Au total, 16 projets d'infrastructure et d'importantes études ont été achevés et mis en œuvre. La somme totale de l'investissement lié à ces mesures s'élève à 13 milliards d'euros. Des projets importants et représentatifs sont mis en évidence et décrits dans le Plan de travail du corridor. Ceux-ci sont :

- Le **tunnel de base du Saint-Gothard** qui traverse les Alpes suisses ;
- Le nouvel **Hub intermodal Rhin-Ruhr** à Duisbourg ;
- La nouvelle autoroute belge **A11** qui lie Bruges à Knokke-Heist en Flandre Occidentale ;
- La mise à niveau de la **liaison ferroviaire Maasvlakte 2** au port de Rotterdam ; l'amélioration de **l'accès ferroviaire à l'aéroport de Milan Malpensa** ;
- Le démarrage des travaux sur **la ligne ferroviaire Zevenaar - Emmerich – Oberhausen.**

Estimation de l'impact socio-économique du Corridor sur l'emploi et la croissance

Une analyse de l'impact du développement du corridor sur la croissance et l'emploi a été réalisée en appliquant une méthodologie multiplicative basée sur les résultats de l'étude « Coût de non-achèvement du RTE-T [24].

Les projets pour lesquels des estimations de coûts sont disponibles et dont la mise en œuvre est prévue pour la période allant de 2016 à 2030 ont été pris en compte. Ils représentent un investissement de 96,6 milliards d'euros. La mise en œuvre de ces projets sur le Corridor entraînera une augmentation du PIB sur la période de 2016 à 2030 de 743 milliard d'euros au total. D'autres effets positifs sont également attendus après l'année 2030.

Les investissements stimuleront également l'emploi. Les effets directs, indirects et induits sur l'emploi de ces projets s'élèveront à environ 2,14 millions d'années de travail supplémentaires créées entre 2016 et 2030. On peut s'attendre à ce qu'après 2030 d'autres années de travail soient créées par les projets. Une analyse détaillée est présentée au chapitre 8.

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[24] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Etude pour le compte de la Commission Européenne, DG MOVE, Carlsruhe, Allemagne.

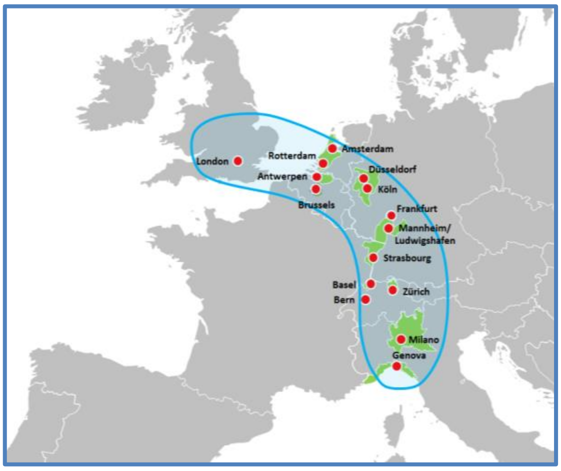
ANNEX III– Executive Summary (German)

Der Rhein-Alpen Korridor

Der Rhein-Alpen Kernnetzkorridor ist einer der neun Korridore des im transeuropäischen Transportnetz (TEN-T) und in den EU Verordnungen 1315/2013 und 1316/2013 definierten Kernnetzes.

Die vom Korridor umfassten Regionen weisen eine hohe Bevölkerungsdichte auf und zählen zu den wirtschaftlich stärksten in ganz Europa. Insgesamt leben und arbeiten mehr als 70 Millionen Einwohner im Einzugsbereich des Korridors. Führende Herstellungs- und Industriebetriebe, sowie Produktionsanlagen und Logistikzentren sind hier beheimatet. Der Rhein-Alpen Korridor verläuft durch die sogenannte "Blaue Banane", welche die europäischen Wirtschaftszentren erfasst. Dazu zählen beispielsweise Brüssel und Antwerpen in Belgien, die Randstad-Region in den Niederlanden, die Rhein-Ruhr und Rhein-Neckar Gebiete auf deutscher Seite, Basel und Zürich in der Schweiz sowie Mailand und Genua in Italien.

Abbildung 1: Die "Blaue Banane" Europas



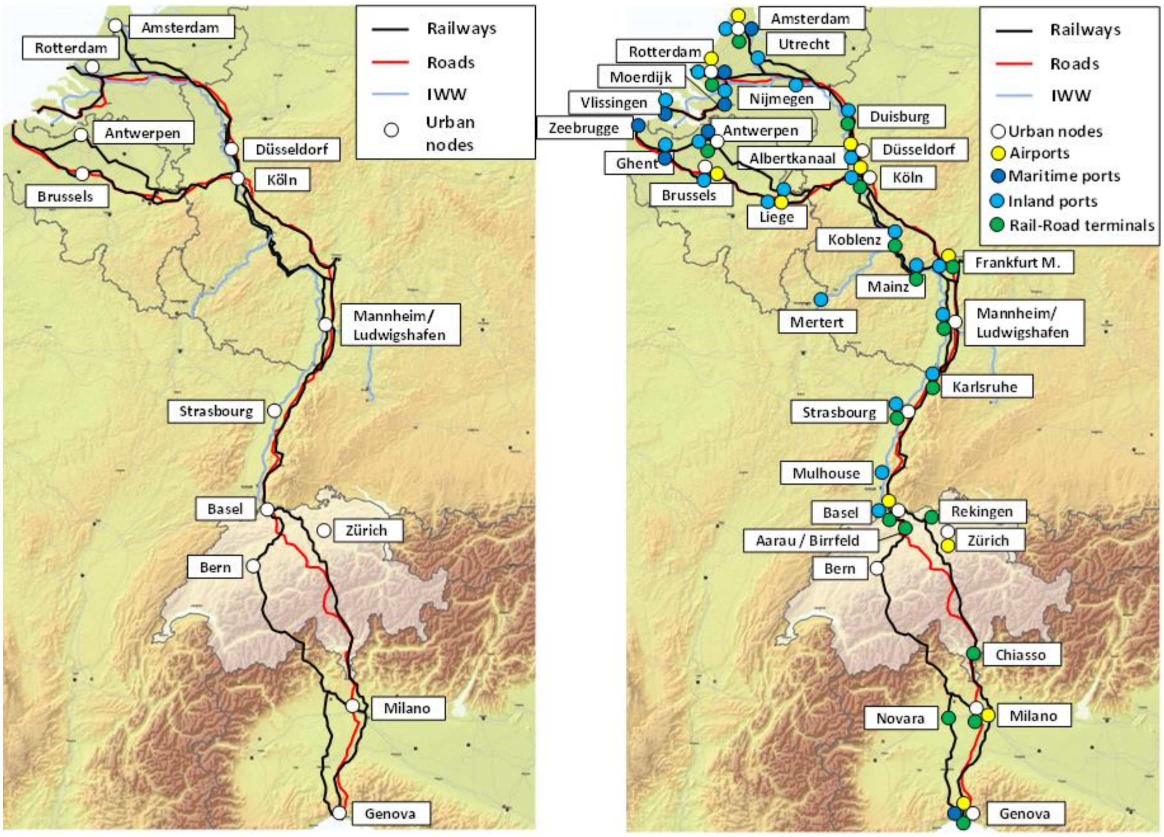
Der Rhein-Alpen Korridor verläuft durch fünf Mitgliedsstaaten und die Schweiz. Frankreich wurde vor dem Hintergrund der Bedeutung der Wasserstraßen und der dazugehörigen Häfen entlang des Rheins in das Einzugsgebietes des Korridors mit aufgenommen.

In Absprache mit den Mitgliedsstaaten und dem Korridorforum wurden sowohl die Mosel und der Neckar auf deutscher Seite, die französischen Rheinhäfen Straßburg und Mülhausen, als auch der luxemburgische Inlandhafen Mertert an der Mosel für weitere Analysen berücksichtigt. Belgische Wasserstraßen sind nicht Teil des Rhein-Alpen Korridors, sind aber nichtsdestotrotz bedeutend für die Planung und weitere Entwicklung des Korridors. Daten über belgische Wasserstraßen wurden daher für die Transportmarktanalyse berücksichtigt.

Die Hauptrouten des Rhein-Alpen Korridors sind:

- Genua – Mailand – Lugano – Basel;
- Genua – Novara – Brig – Bern – Basel;
- Basel – Karlsruhe – Mannheim – Mainz – Koblenz – Köln;
- Köln – Düsseldorf – Duisburg – Nimwegen/Arnheim – Utrecht – Amsterdam;
- Nimwegen – Rotterdam – Vlissingen;
- Köln – Lüttich – Brüssel – Gent;
- Lüttich – Antwerpen – Gent – Zeebrügge.

Abbildung 2: Der Verlauf des Rhein-Alpen Korridors



Quelle: Verordnung 1316/2013 Anhang 1, Teil 1 / HaCon

Erfüllung der technischen Infrastrukturanforderungen

Die TEN-T Verordnung 1315/2013 gibt für jeden Transportmodus und die dazugehörige Infrastruktur bestimmte technische Anforderungen vor. Um sich einen aktuellen Überblick verschaffen zu können, ob der Rhein-Alpen Korridor diese vorgegebenen Anforderungen erfüllt, wurden die technischen Parameter des Korridors für alle Sektionen und Infrastrukturknoten analysiert.

Diese Analysen haben gezeigt dass die Infrastruktur des Rhein-Alpen Korridors größtenteils die TEN-T Anforderungen erfüllt. Nichtsdestotrotz gibt es immer noch einige Problemstellen. So ist für den Schienentransport insbesondere die flächendeckende Verwendung von ERTMS eine große Herausforderung. 740m lange Güterzüge können nur mit Einschränkungen in Italien eingesetzt werden; in Deutschland und Belgien greifen Fahrplaneinschränkungen. In den Niederlanden müssen einige, wenn auch kurze, Sektionen auf eine zulässige Achslast von 22.5t aufgewertet werden. Die geforderte Geschwindigkeit von 100km/h für Güterzüge ist grundsätzlich überall möglich – die wenigen Ausnahmen haben größtenteils betriebsbedingte Gründe. Von den analysierten 65 multimodalen Terminals besitzen nur elf Umschlaggleise von mindestens 740m Länge. Das Wasserstraßennetzwerk ist flächendeckend zulässig für die CEMT IV Klasse. Einige Abschnitte des Rheins, insbesondere zwischen Koblenz und Iffezheim, sind jedoch bei extremer Trockenheit und Niedrigwasser gänzlich nicht befahrbar. Die Erreichbarkeit der schweizerischen Häfen wird durch zu niedrige Brücken eingeschränkt. Eine hohe Dringlichkeit haben auch die Kapazitätsengpässe von Schleusen und Ankerplätzen. Dies betrifft vor allem die Gegend um Lobith, welches von zentraler Bedeutung für den grenzüberschreitenden Verkehr zwischen den Niederlanden und Deutschland ist. Die Schleusenkapazität ist auch entlang der Mosel und des Neckars eingeschränkt. Das

Hauptproblem für Flughäfen ist die fehlende Anbindung an das Schienennetz. Betroffen sind die Flughäfen in Basel, Mailand-Linate, Genua und Rotterdam.

Der heutige und zukünftige Verkehrsfluss auf dem Korridor

Im Zuge der ersten Studie 2014 wurde eine Transportmarktanalyse durchgeführt. Der Rhein-Alpen Korridor stellt eine der meistbefahrenen Frachtrouten in Europa dar. Verbindungen mit besonders hohem Aufkommen (307,2 Millionen Tonnen, 83% des korridorweiten Gesamtfrachtaufkommens) existieren zwischen Deutschland, den Niederlanden und Belgien. Die Hauptgütergruppen für den grenzüberschreitenden Verkehr sind: Maschinerie und Transportausrüstung, Brennstoffprodukte (Flüssig- und Schüttgut), Baustoffe und Erze. Für den Transport dieser Gütergruppen (Hinterlandtransport) werden am häufigsten die Binnenwasserstraßen genutzt, gefolgt von der Straße.

Im Rahmen der Analyse der aktuellen Personenverkehrsnachfrage, gemessen in der Anzahl von Fahrten, wurden drei große bidirektionale Verkehrsflüsse ermittelt: Zwischen Belgien und den Niederlanden, zwischen Deutschland und der Schweiz und zwischen Deutschland und den Niederlanden. Diese Verkehrsflüsse stellen jeweils 25%, 23% und 19% des Gesamtverkehrsaufkommens da. Für den internationalen Personenverkehr auf dem Korridor ist die Straße der bevorzugte Transportmodus. Der Flugverkehr repräsentiert mit 4.1% nur einen kleinen Teil der Gesamtnachfrage. Hier sind die Hauptverkehrsflüsse zwischen Deutschland und der Schweiz, zwischen den Niederlanden und der Schweiz sowie zwischen Deutschland und Italien.

Eine Analyse über zukünftige Verkehrsaufkommen wurde auf Basis von verschiedenen nationalen Prognosen durchgeführt. Diese haben sowohl den hohen Stellenwert des Seetransports aufgezeigt (insbesondere für Belgien, die Niederlande und Italien), als auch die Dominanz der Straße in Deutschland, Italien und den Niederlanden, sowie ein erwartetes Wachsum des Schienentransports in der Schweiz, Deutschland und den Niederlanden. Darüber hinaus wurden die Effekte der Maßnahmen des Work Plan auf den Modal Split ermittelt. Die Transportmarktstudie hat die Transportleistung von bestimmten Sektionen untersucht, um dort die mögliche Auswirkung von Änderungen auf den Korridor darstellen zu können. Zu diesem Zweck wurde ein Analysemodell in drei verschiedenen Durchläufen verwendet: 2010 (base), 2030 (baseline) und 2030 (compliance). Die "baseline"-Prognose basiert auf GDP Schätzungen für 2030. Das "compliance" Szenario geht davon aus, dass das gesamte Netz die oben erwähnten TEN-T Anforderungen erfüllt, sowie von einem nahtlosen und kompatiblen Schienenverkehr, kompatible Mautsysteme und LNG-Treibstoff für Schiffe.

Mithilfe des Simulationsmodells wurde für das baseline Szenario ein moderates Wachstum von 1.7% pro Jahr für alle Transportmodi bis 2030 ermittelt, also ein Zuwachs von insgesamt 40% für jeden Modus. Unter Berücksichtigung der TEN-T Verordnungen (dem compliance Szenario) betragen die Wachstumsraten stattdessen 36% für Straße, 55% für Schiene und 41% für Binnenwasserstraße.

Bezüglich des Modal Split weist die Schiene mit insgesamt 55% den höchsten Wachstumstrend auf. Ohne die TEN-T Richtlinien betrüge das Wachstum nur 41%. Für Straße und Binnenwasserstraße wurde ein etwas niedrigerer Anstieg ermittelt. Dies lässt sich hauptsächlich mit den zukünftig niedrigeren Reisekosten und -zeiten erklären, was die Eisenbahn zu einer attraktiveren Option für den Hinterlandtransport macht.

Plan zur Entfernung physischer und technischer Enpässe

Eins der Hauptziele der aktualisierten Korridorstudie war es, jene Projekte zu identifizieren und zu beschreiben, welche notwendig für die Komplettierung des Korridores sind. Die finale Projektliste basiert ursprünglich auf der Projektliste der Korridorstudie von 2014. Diese Liste wurde aktualisiert und mit Informationen aus den

2015 CEF Projekten, ausgewählten CEF 2016 Anträgen, nationalen Transportplänen, dem operationellen Transportprogramm (OPT) sowie den Implementierungsplänen der Rail Freight Corridor ergänzt. Durch diesen ganzen Prozess hindruch gewährleisteten mehrere Konsolidierungsrunden mit Mitgliedsstaaten und Interessensvertretern des Korridorforums eine harmonisierte und koordinierte Projektliste.

Die finale Projektliste aus 2017 besteht aus 318 Projekten; sie beinhaltet auch Projekte, die bereits fertiggestellt sind aber noch nicht vor dem Inkrafttreten der Verordnung 1315/2013 abgeschlossen waren. Im Vergleich zum Work Plan 2014 bedeutet das einen Anstieg von 42 Projekten; verglichen mit dem Work Plan 2016 ist es sogar ein Zuwachs von 101 Projekten. Dies lässt sich zum Einen dadurch erklären, dass Mitgliedsstaaten oder andere Interessenvertreter Projekte hinzugefügt haben, zum Anderen durch die optimierte Vorgehensweise bei der Handhabung von überlappenden Projekten.

Technische Kompatibilität

Die Rhein-Alpen Korridorstudie ermittelt Problemstellen und Hindernisse, welche einer vollständigen Kompatibilität mit der TEN-T Verordnung 1315/2013 im Weg stehen. Der Plan zur Beseitigung physischer und technischer Enpässe berücksichtigt den Beitrag von den identifizierten Projekten für die Entwicklung des Korridors. Darauf aufbauend ist es möglich, eine qualifizierte Prognose für die technische Kompatibilität des Korridors für das Jahr 2030 abzugeben. Die Ergebnisse dieser Prognose sind in den folgenden drei Abbildungen je nach Transportmodus dargestellt.

Abbildung 3: Kompatibilitätsübersicht Schiene 2030

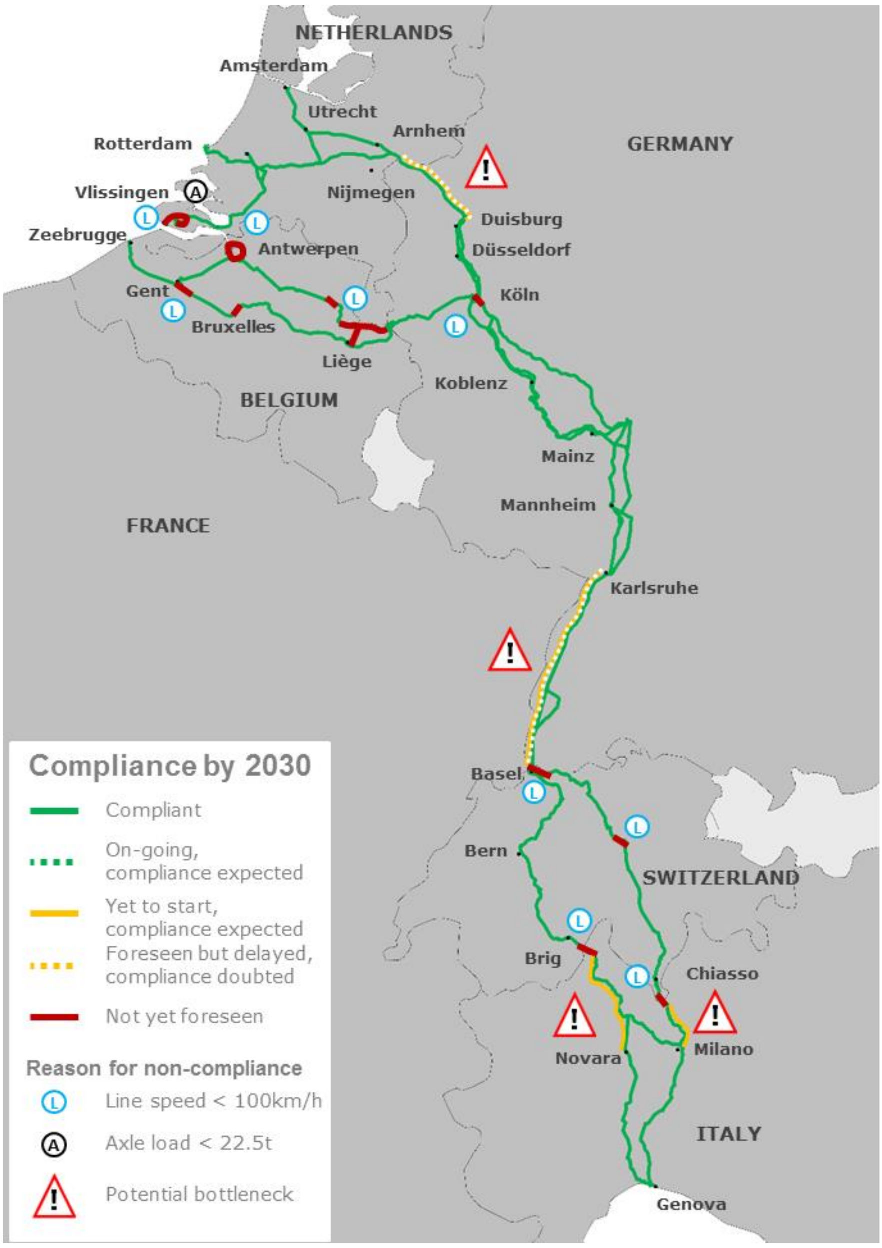


Abbildung 4: Kompatibilitätsübersicht Binnenwasserstraße 2030

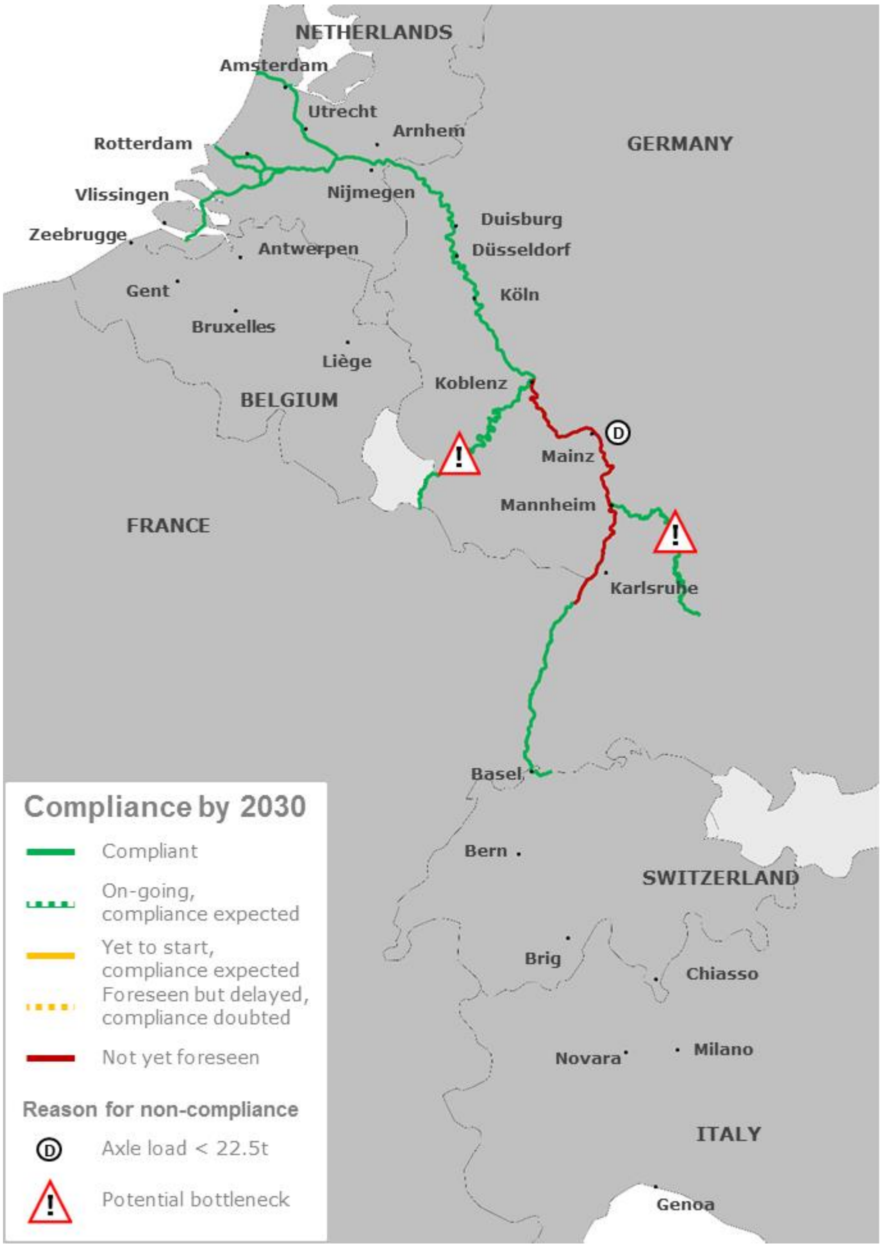
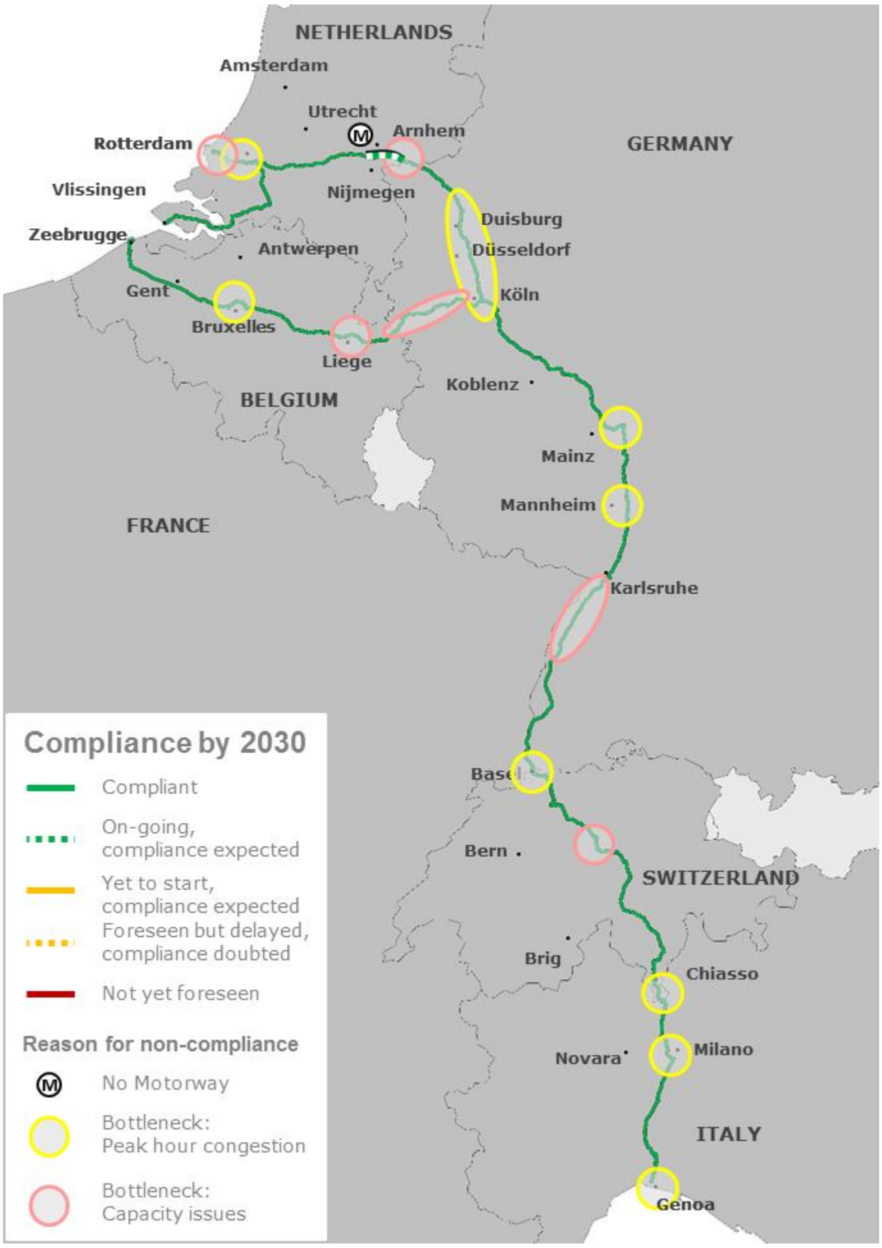


Abbildung 5: Kompatibilitätsübersicht Straße 2030



Administrative und operative Hindernisse

Zusätzlich zu den oben genannten physischen und technischen Engpässen behindern auch administrative und operative Problemstellen den Betrieb und die zukünftige Entwicklung des Rhein-Alpen Korridors. Sie haben einen starken Einfluss auf die Attraktivität von Transportrouten und -modi und somit auch auf die Nachfrage und den Modal Share.

Es ist jedoch zu beachten, dass diese Analyse den Status von 2017 repräsentiert und dass es nicht möglich ist, zukünftige Richtlinienänderungen, welche unter Umständen die ermittelten administrativen und operativen Hindernisse beeinflussen, genau vorherzusagen. Diese Hindernisse betreffen meistens Unterschiede in der Infrastrukturbereitstellung an Grenzen, starke Probleme mit der Infrastruktur selbst, wie beispielsweise unterschiedliche Oberleitungsspannung oder administrative Engpässe, die einen reibungslosen Transportfluss entlang des Korridors verhindern. Eine detaillierte Analyse findet sich in Kapitel 3.5 wieder.

Städtische Knoten

Städtische Knoten sind definiert als ein „städtischer Bereich wo die Transportinfrastruktur des transeuropäischen Transportnetzwerks, beispielsweise Häfen einschließlich Passagierterminals, Flughäfen, Bahnhöfen, Logistikplattformen und Frachtterminals, die in oder um ein städtisches Areal gelegen sind, mit anderen Teilen dieser Infrastruktur sowie mit dem regionalen und örtlichen Verkehr verbunden ist[25]. Städtische Knoten sind weiter spezifiziert als Startpunkt (erste Meile), Endpunkt (letzte Meile) und/oder Übergabepunkte in oder zwischen verschiedenen Modi für den Passagier- oder Gütertransport des TEN-T Netzes.

Es wurde eine Kompatabilitätsprüfung der Kernnetzkorridorlinien in den städtischen Knoten durchgeführt. Allgemein wurde eine leichte Diskrepanz in der Kompatibilität der Korridorlinien zwischen verschiedenen Europäischen Ländern des Rhein-Alpen Korridors festgestellt. Niederländische, belgische, schweizerische und deutsche Knoten sind fast gänzlich kompatibel, während französische und italienische Knoten einige Problemstellen und Engpässe aufzeigen. Insbesondere Knoten wie Straßburg, Mailand, Genua, Brüssel und Köln erfüllen jeweils zwei Parameter nicht. Knoten wie Amsterdam und Rotterdam hingegen sind mit jedem Parameter kompatibel. Antwerpen, Düsseldorf, Basel und Mannheim weisen lediglich eine Unkonformität per Knoten auf. Eine detaillierte Analyse ist in Kapitel 3.6 zu finden.

Innovation

Als innovative Projekte werden mitgliedsstaatenübergreifende Maßnahmen beschrieben, welche neue Technologien beinhalten, die in irgendeiner Weise Teile des aktuellen Transportsystems verbessern. Eine genaue Definition von „Innovation" wurde benutzt um für alle Kernnetzkorridore Innovationsprojekte zu identifizieren und zu klassifizieren.

Für den Einsatz von Innovation wurden 288 Projekte nach ihrem Beitrag zu Innovation verglichen. 71 Projekte (25%) wurden anhand der verwendeten Definition als innovativ klassifiziert. Der Anteil von Innovationsprojekten des Rhein-Alpen Korridors ist vergleichsweise hoch verglichen zu dem korridorweiten Durchschnitt von 23,5%. Die Gesamtinvestitionssumme für diese 71 Projekte beläuft sich auf 4,6 Milliarden Euro. Diese Summe zeigt auf dass Innovation deutlich weniger kostenintensiv ist als die Infrastrukturprojekte. Die detaillierte Analyse wird in Kapitel 3.7.1. aufgeführt.

Umweltbelastung

Für die Emissionsquantifizierung wurde das EU Referenzszenario 2016 genutzt. Der Güterverkehr (Straße, Schiene, Binnenwasserstraße) soll zunehmen – von 129 Milliarden tkm heute bis zu 156 Milliarden tkm 2030. Der am Schnellsten wachsende Sektor in dem Referenzszenario ist die Schiene mit 1.8% pro Jahr. Passagiertransport (Straße, Schiene und Flugverkehr) soll laut Prognose von 165 Milliarden pkm heute auf 190 Milliarden pkm 2030 ansteigen. Hier ist der stärkste Zuwachs für den Flugverkehr zu verzeichnen (1.8% pro Jahr).

Die Analyse, welche für den Zeitraum 2015-2050 durchgeführt wurde, prognostiziert eine Abnahme der Immissionen auf der Straße, während sich in der selben Zeit die Anzahl von Reisenden und das Frachtvolumen erhöht. Im Vergleich zu 2015 bleiben die Immissionen der Schiene konstant bis 2030, nimmt 2050 jedoch leicht ab. Für die Binnenschifffahrt nimmt die Immission bis 2050 leicht zu. Die Passagieranzahl für Luftverkehr steigt zwischen 2015 und 2050 konstant (+76%), während die Immissionen nur leicht zunehmen.

Die Gesamtimmissionen 2015 für Straße, Schienen, Binnenwasserstraße und Luftverkehr betragen 18,9 Millionen Tonnen CO_2-Äquivalent. Anhand des

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[25] TEN-T Verordnung 1315/2013

prognostizierten Verkehrsaufkommens und der höheren Energieeffizienz werden für das Referenzszenario 16,9 Millionen Tonnen CO_2-Äquivalent in 2030 und 16,6 Millionen Tonnen CO_2-Äquivalent für 2050 vorhergesagt. Eine detailliertere Analyse findet sich in Kapitel 3.7.2.

Gesamtinvestitionsanalyse für den Rhein-Alpen Korridor

Die Gesamtinvestitionen für alle Projekte der Rhein-Alpen Projektliste belaufen sich auf 100,3 Milliarden Euro. Für 53% der Projekte liegen vollständige Finanzinformationen[26] vor und sind daher für diese Analyse geeignet. Die dazugehörigen Investitionen (41,1 Milliarden Euro) werden nach den Finanzierungsquellen, die die Projektkosten tragen, aufgeteilt.

Die Finanzierungsquellen der Projekte, für die vollständige Finanzinformationen vorliegen, können wie folgt aufgeteilt werden:

- MS/öffentliche Zuschüsse: 39,3 Milliarden Euro (95,6%);
- EU Förderung (CEF, ESIF): 0,7 Milliarden Euro (1,7%);
- Private/eigene Förderung: 1,1 Milliarden Euro (2,7%).

Die EU Förderung kann weiter aufgeteilt werden:

- CEF/ TEN-T: 0,7 Milliarden Euro (99,8%);
- ESIF: 0 Euro;
- Other: 0,02 Milliarden Euro (0,2%).

Die Investitionsanalyse führt zu der Schlussfolgerung, dass, wenn die selbe EU Förderungsrate (z.B. die oben ermittelten 1,7% EU Förderung) auf das korridorweite Gesamtinvestitionsvolumen angewendet würde, über die nächsten Jahre 1,7 Milliarden Euro oder CEF Förderung notwendig ist. Eine detailliert Analyse ist in Kapitel 3.8 zu finden.

Zusammenfassung bereits verwirklichter Maßnahmen

Seit der Veröffentlichung des ersten Work Plan im Mai 2015 wurde bereits erheblicher Fortschritt im ganzen Rhein-Alpen Korridor und allen Transportmodi gemacht. Insgesamt 16 Infrastrukturprojekte und wichtige Maßnahmen wurden fertiggestellt und umgesetzt. Das Gesamtinvestitionsvolumen dieser Maßnahmen beläuft sich auf 13 Milliarden Euro. Wichtige und repräsentative Projekte sind im Work Plan des Korridors hervorgehoben und beschrieben. Diese sind:

- Der durch die schweizer Alpen verlaufende **Gotthard Basistunnel**;
- Der neue **intermodale Rhine-Ruhr hub** in Duisburg;
- Die neue belgische **A11 Autobahn**, die Brügge und Knokke-Heist in Westflandern verbindet;
- Der Ausbau der **Maasvlakte 2 Schienenanbindung** zum Hafen von Rotterdam;
- Die verbesserte **Schienenerreichbarkeit des Mailand Malpensa Flughafen**;
- erste Spatenstich der Schienenstrecke zwischen **Zevenaar – Emmerich - Oberhausen.**

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[26] Vollständige Finanzinformation bedeutet dass alle Projektkosten eine Finanzierungsquelle haben. Für ein Projekt mit 10 Millionen Kosten sind beispielsweise 8 Millionen durch den Staat und 2 Millionen durch EU Förderung abgedeckt.

Abschätzung des sozioökonomischen Effekts des Korridors auf Arbeitsplätze und Wachstum

Eine Analyse über die Auswirkung der Korridorentwicklung auf Arbeitsplätze und Wachstum wurde mithilfe einer Multiplikatormethode durchgeführt. Letztere basiert auf den Erkenntnissen der Studie „Kosten der Nichtvollendung von TEN-T[27]“.

Es wurden diejenigen Projekte berücksichtigt, für welche eine Kostenabschätzung möglich ist und die im Zeitraum zwischen 2016 und 2030 realisiert werden sollen. Zusammen belaufen sich diese Projekte auf eine Investitionssumme von 96,6 Milliarden Euro. Die Fertigstellung dieser Projekte wird zu einem Anstieg des BIP von insgesamt 743 Milliarden Euro führen. Auch nach 2030 wird es weitere Vorteile geben.

Die Investitionen werden auch eine höhere Beschäftigungsrate stimulieren. Die direkten, indirekten und herbeigeführten Beschäftigungseffekte dieser Projekte belaufen sich auf rund 2,14 Millionen zusätzlicher Arbeitsjahre, die über den Zeitraum zwischen 2016 und 2030 generiert werden. Auch nach 2030 kann ein zusätzlicher Anstieg von Arbeitsjahren erwartet werden, welcher durch die Realisierung der Projekte generiert wird. Eine detaillierte Analyse befindet sich in Kapitel 8.

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[27] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): “Cost of non-completion of the TEN-T”. Studie im Auftrag der Europäischen Kommission DG Move, Karlsruhe, Deutschland.

ANNEX IV – Executive Summary (Italian)

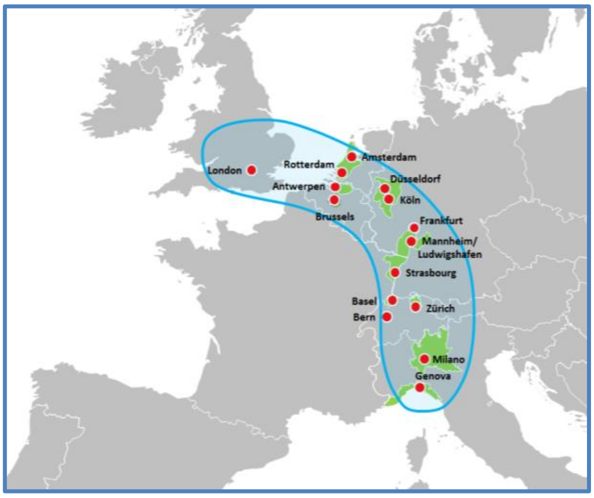
Corridoio Reno Alpi

Il Corridoio Reno-Alpi è uno dei nove corridoi Core previsti dalla Rete Transeuropea dei Trasporti TEN-T[28] definita nei Regolamenti Europei 1315/2013 e 1316/2013.

Esso attraversa alcune tra le regioni più densamente popolate e sviluppate d’Europa. Complessivamente, oltre 70 milioni di persone vivono e lavorano nel bacino di attrazione del Corridoio. Molte grandi aziende manifatturiere e del commercio, come anche i relativi impianti di produzione e centri di distribuzione sono dislocati lungo il percorso del Corridoio.

Il Corridoio attraversa la cosiddetta "Banana Blu", che comprende importanti centri economici dell'UE come Bruxelles e Anversa in Belgio, la regione di Randstad nei Paesi Bassi, le regioni tedesche della Renania-Ruhr e del Reno-Neckar, le regioni di Basilea e Zurigo in Svizzera e le città di Milano e Genova nel Nord Italia (vedi Figura 1).

Figura 1 : “Banana Blue” europea



Il Corridoio Reno-Alpi attraversa cinque Stati membri oltre alla Svizzera. Anche la Francia è stata inclusa in considerazione dell'importanza per il Corridoio delle sue vie navigabili interne e dei porti lungo il fiume Reno.

In accordo con gli Stati membri e sulla base delle discussione emerse nei forum del Corridoio, i fiumi Mosella e Neckar in Germania, nonché i porti francesi interni sul Reno (Strasburgo e Mulhouse) e Mertert sulla Mosella a Lussemburgo sono stati integrati per ulteriori analisi. Le vie navigabili interne belghe non sono state incluse direttamente nel Corridoio, tuttavia viene riconosciuta la loro importanza strategica e rilevanza per l’ulteriore sviluppo del Corridoio; coerentemente le informazioni su queste vie navigabili sono state considerate nelle analisi per lo studio di mercato dei trasporti.

Le principali ramificazioni del Corridoio Reno-Alpino sono:

- Genova - Milano - Lugano - Basilea;
- Genova - Novara - Brig - Berna - Basilea;
- Basilea - Karlsruhe - Mannheim - Magonza - Coblenza - Colonia;
- Colonia - Dusseldorf - Duisburg - Nimega / Arnhem - Utrecht - Amsterdam;

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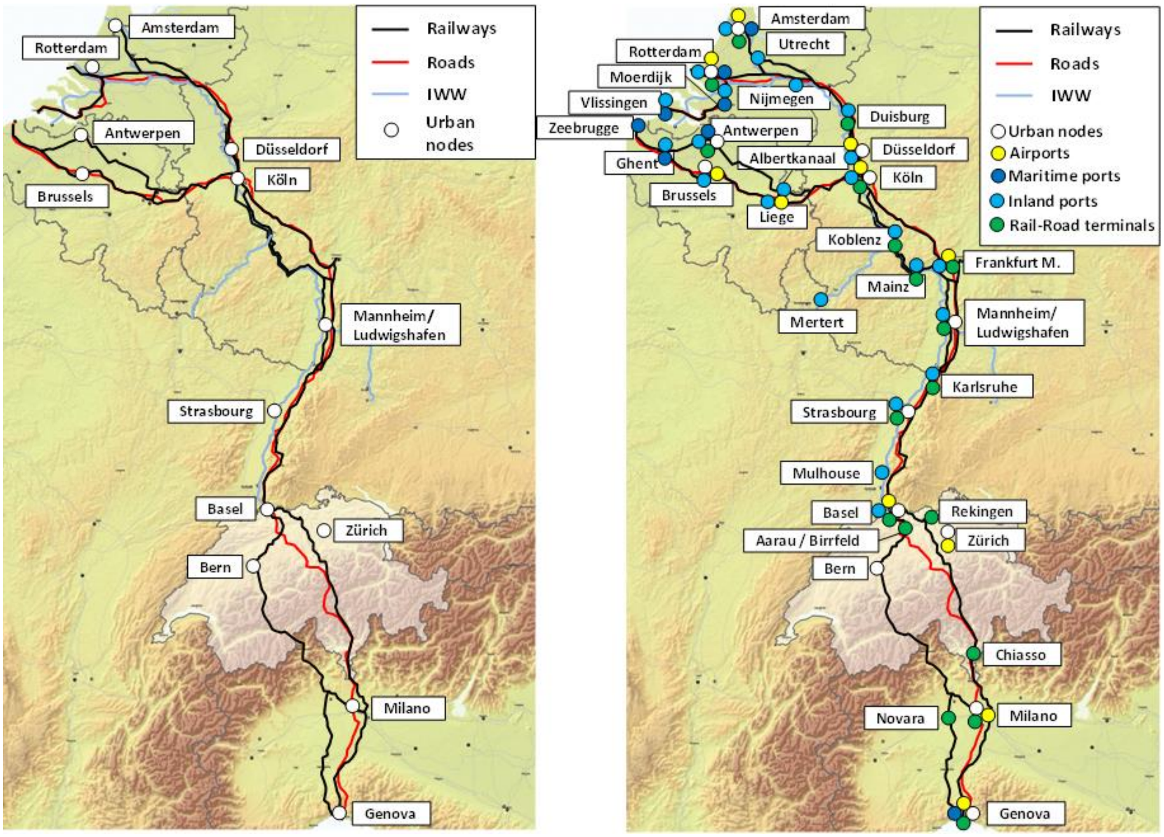
[28] Trans-European Network for Transport

- Nijmegen - Rotterdam - Vlissingen;
- Colonia - Liegi - Bruxelles - Gand;
- Liegi - Anversa - Gand – Zeebrugge.

Figura 2: Rappresentazione grafica del Corridoio Reno-Alpi



Fonte: Regolamento 1316/2013 Annex 1, Part 1 / HaCon

Conformità del Corridoio con i requisiti infrastrutturali

Il Regolamento TEN-T 1315/2013 definisce i requisiti minimi per l'infrastruttura di trasporto con riferimento a ciascuna modalità oltre a definire le tipologie di connessioni necessarie. Con lo scopo di sviluppare un quadro aggiornato sulla conformità del Corridoio Reno-Alpi ai requisiti definiti dal Regolamento TEN-T, sono stati analizzati i parametri tecnici del Corridoio per tutte le sezioni e i nodi dell'infrastruttura.

Le analisi hanno dimostrato che la maggior parte delle caratteristiche infrastrutturali del Corridoio Reno-Alpi sono conformi ai requisiti TEN-T. Tuttavia, ci sono delle problematiche da affrontare.

Ad esempio, una delle sfide principali per la rete ferroviaria è l’implementazione del sistema ERTMS. Si rileva poi che i treni merci con una lunghezza superiore ai 740 m non possono essere operati senza restrizioni in Italia, mentre sono presenti dei limiti sull’orario in Germania e Belgio. In Olanda, alcuni brevi tratti di ferrovia necessitano di interventi per consentire il carico massimo per asse di 22,5 tonnellate. La rete consente nella quasi sua totalità una velocità per i treni merce di 100 km / h, esistono tuttavia alcune eccezioni dovute a questioni operative. Con riferimento ai servizi multimodali, attualmente solo 11 dei 65 terminali intermodali identificati sono dotati di fasci di binari per gestire la composizione e scomposizione di treni di almeno 740 m di lunghezza. La rete di vie per la navigazione interna risulta essere conforme nella sua totalità ai requisiti definiti dalla classe CEMT IV. Tuttavia, alcune delle sezioni del Reno possono risultare non navigabili in alcuni periodi di eccezionale siccità. Ciò vale in particolare per la sezione tedesca tra Coblenza e Iffezheim. Si riporta inoltre che l'insufficiente altezza sul livello dell'acqua della campata di alcuni ponti limita l'accessibilità ai porti svizzeri. Criticità sono state rilevate anche in riferimento all'insufficiente portata delle chiuse e alla scarsità di ormeggi, in particolare vicino a Lobith, una vitale sezione transfrontaliera tra Olanda e Germania. L'insufficiente portata delle chiuse è un problema anche lungo i fiumi Neckar e Mosella. In fine, con riferimento gli aeroporti situati lungo il Corridoio, i principali problemi di conformità sono la mancanza di collegamenti ferroviari per Basilea, Milano Linate, Genova e Rotterdam.

I flussi di traffico sul Corridoio oggi e in futuro

Lo studio di mercato per i trasporti, realizzato nell'ambito del primo studio nel 2014, ha confermato l'importanza del Corridoio Reno-Alpino come rotta per le merci tra le più trafficate in Europa. Si osservano forti flussi di merci tra Germania, Paesi Bassi e Belgio che ammontano ad un totale di 307,2 milioni di tonnellate, pari all'83% del totale delle attività di trasporto internazionale del Corridoio. Le principali tipologie merceologiche scambiate lungo il Corridoio sono: macchinari e attrezzature per il trasporto, combustibili, materiali da costruzione e minerali. La modalità di trasporto più utilizzata per queste merci (trasporto di superfice) sono le vie di navigazione interne seguite dalla strada.

La domanda attuale di trasporto passeggeri, espressa in numero di viaggi, si divide in tre principali flussi di traffico bidirezionale: tra il Belgio e i Paesi Bassi, tra Germania e Svizzera e tra Germania e Paesi Bassi: queste rappresentano rispettivamente il 25%, il 23% e il 19% del traffico complessivo del Corridoio. Il trasporto stradale è predominante per i flussi di passeggeri internazionali nel Corridoio, mentre il trasporto aereo rappresenta solo una piccola parte (4,1%) della domanda totale di traffico passeggeri. Con riferimento a questi ultimi, i flussi principali sono osservati tra Germania e Svizzera, Paesi Bassi e Svizzera, nonché Germania e Italia.

L'analisi dei futuri flussi di trasporto ha sottolineato la rilevanza del trasporto marittimo (soprattutto per Belgio, Paesi Bassi e Italia), e l'assoluta predominanza del trasporto stradale in Germania, Italia e Paesi Bassi, oltre ad una crescita prevista per il trasporto ferroviario in Svizzera, Germania e Paesi Bassi.

Con l'obiettivo di stimare i possibili effetti degli interventi sul Corridoio, lo studio di mercato dei trasporti ha analizzato la performance delle diverse sezioni del Corridoio. Il modello di stima è stato sviluppato a partire dall'anno base 2010 e con riferimento a due scenari distinti: 2030 (senza intervento) e 2030 (con intervento). Lo scenario "senza intervento" è stato sviluppato sulla base di ipotesi predeterminate sull'andamento del PIL fino al 2030. Lo scenario "con intervento" considera una serie di ipotesi aggiuntive, come lo sviluppo del Corridoio piena conformità ai requisiti infrastrutturali TEN-T, ferrovie interoperabili, sistemi di pedaggio interoperabili e disponibilità di carburanti GNL per le navi.

Nel caso dello scenario "sena intervento", la domanda di merci dovrebbe prevedere una crescita moderata fino al 2030 con un aumento dell'1,7% all'anno per tutti i modi di trasporto (stradale, ferroviario e fluviale), con una crescita totale di circa il 40% per ciascuna modalità di trasporto. Nel caso dello scenario "con intervento", grazie all'effetto degli interventi strategici, i tassi di crescita per il periodo 2010-2030 si dovrebbero attestare al 36% per strada, al 55% per ferrovia e al 41% per via fluviale. Per quanto riguarda la ripartizione modale, la ferrovia presenta il più alto trend di crescita, con una conseguente crescita leggermente più contenuta per trasporto su strada e per vie navigabili interne. Entro il 2030, la ferrovia dovrebbe aumentare del 55% (anziché del 41% in assenza degli interventi TEN-T). Ciò è principalmente spiegabile con la prevista diminuzione dei costi e dei tempi di viaggio che renderanno la ferrovia un'opzione più attraente per il trasporto di superficie.

Piano per l'eliminazione delle barriere fisiche e tecniche

Uno degli obiettivi principali dell'aggiornamento dello Studio era identificare e descrivere tutti i progetti necessari per il completamento del Corridoio. La versione finale della lista di progetti considera i progetti originariamente inclusi nella lista di progetti dello Studio del 2014 (se ancora rilevanti) oltre ai progetti CEF 2015, ai progetti selezionati tra le proposte per CEF 2016, eventuali nuove informazioni rilevabili nei piani nazionali di trasporto, i programmi operativi sui trasporti (OPT) ei piani di attuazione del Corridoio merci ferroviario. Durante l'intero processo, diversi incontri di consolidamento con gli Stati membri e le parti interessate del forum del Corridoio hanno permesso l'affinamento della lista di progetti.

La lista progetti finali del 2017 comprende 318 progetti trai quali progetti per i quali i lavori erano stati avviati prima dell'entrata in vigore del Regolamento 1315/2013. Con riferimento al Work Plan 2014, la lista progetti ha visto un incremento di 42 progetti, mentre rispetto al Work Plan del 2016 la lista è aumentata di 101 progetti. Questa crescita è dovuta principalmente a progetti che sono stati aggiunti dagli Stati membri o da altre parti interessate, ma anche grazie al miglioramento dell'approccio utilizzato per gestire quei progetti che insistono su più corridoi contemporaneamente.

Conformità tecnica

Lo Studio del Corridoio Reno-Alpi ha identificato le principali criticità che ostacolano il funzionamento di questo importante collegamento di trasporto europeo in linea con le disposizioni del Regolamento 1315/2013. Il piano per la rimozione degli ostacoli fisici e tecnici definisce alcune ipotesi sulla conformità del Corridoio con i parametri del Regolamento 1315/2013 entro il 2030, sulla base del contributo previsto dei progetti pianificati. I risultati sono illustrati nella Figura 3 per il settore ferroviario, nella Figura 4 per le vie interne di navigazione, nella Figura 5 per il trasporto stradale.

Figura 3: Conformità della rete ferroviaria al 2030

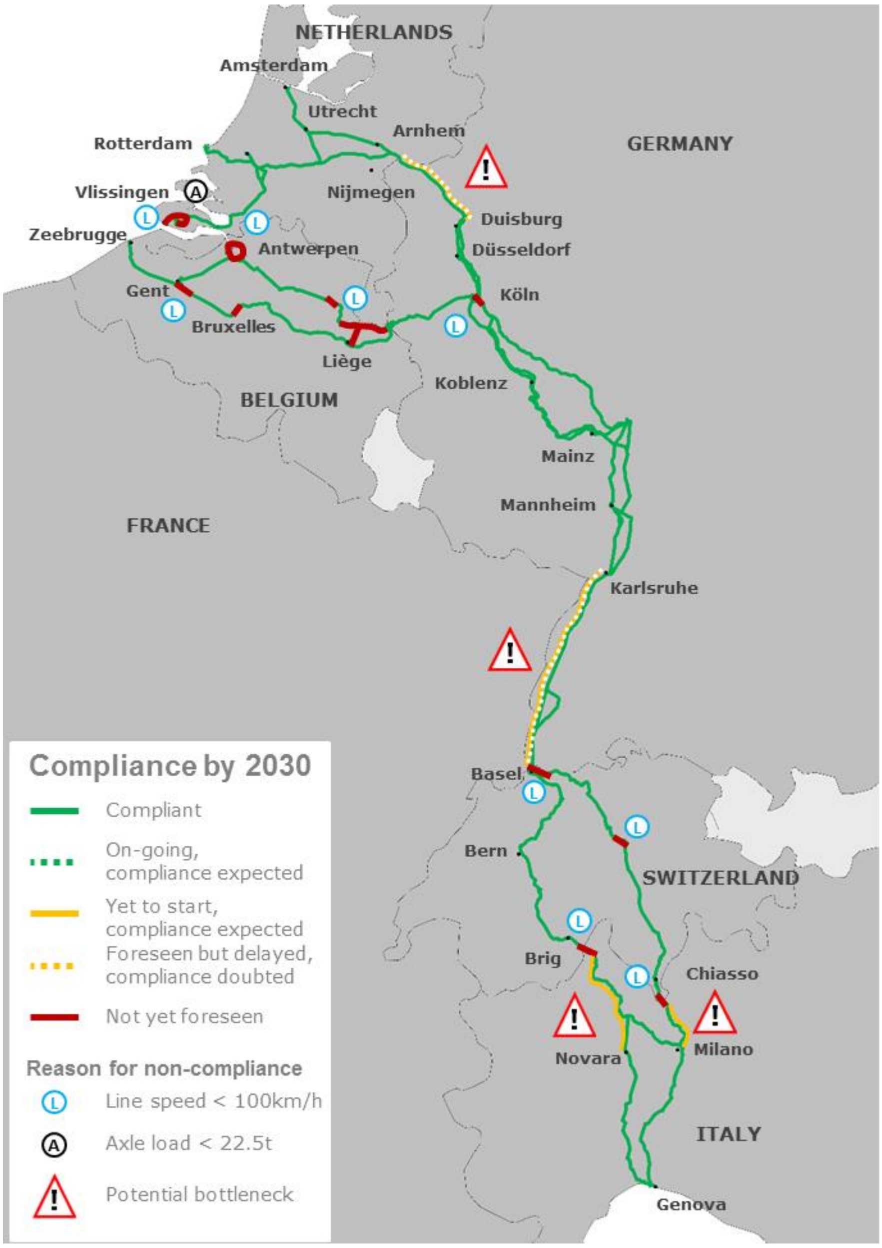


Figura 4: Conformità delle vie interne di navigazione al 2030

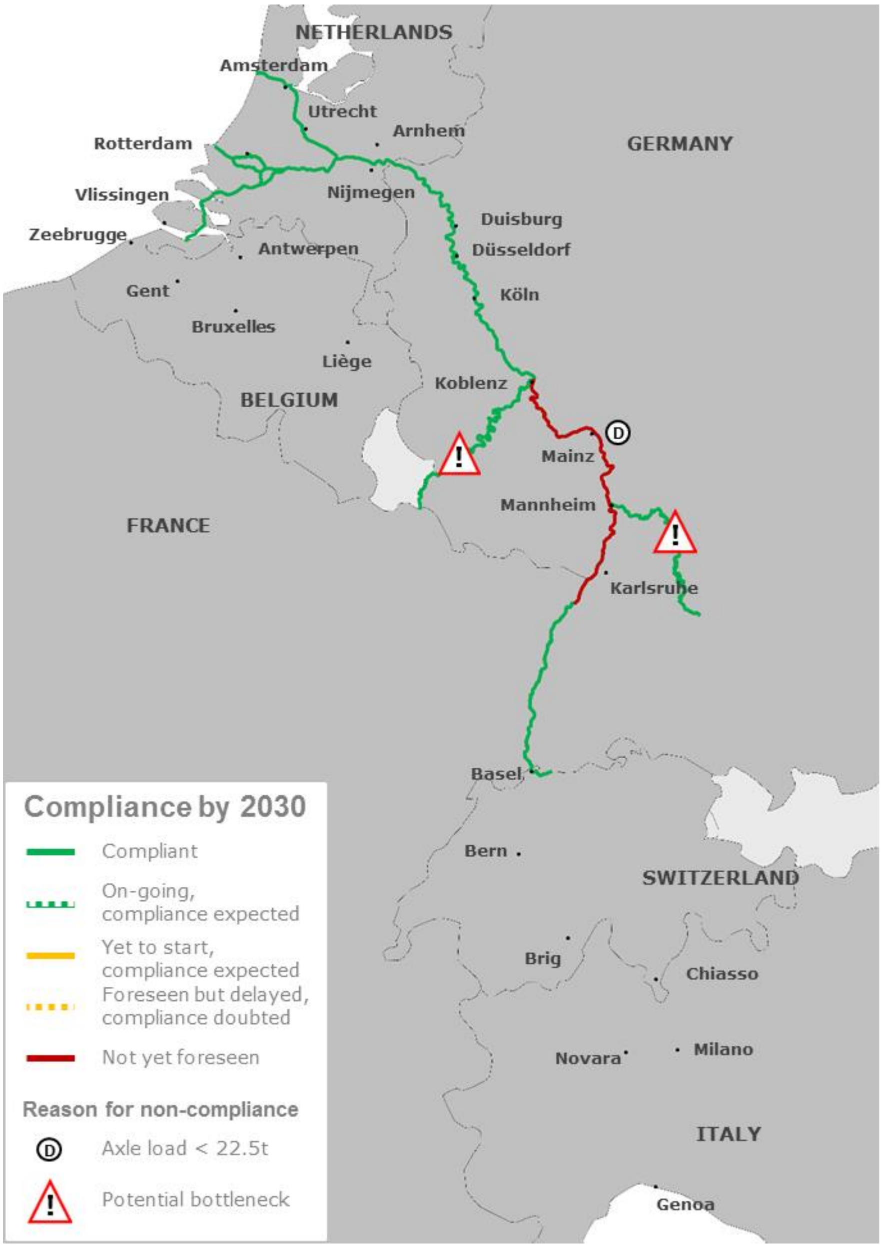
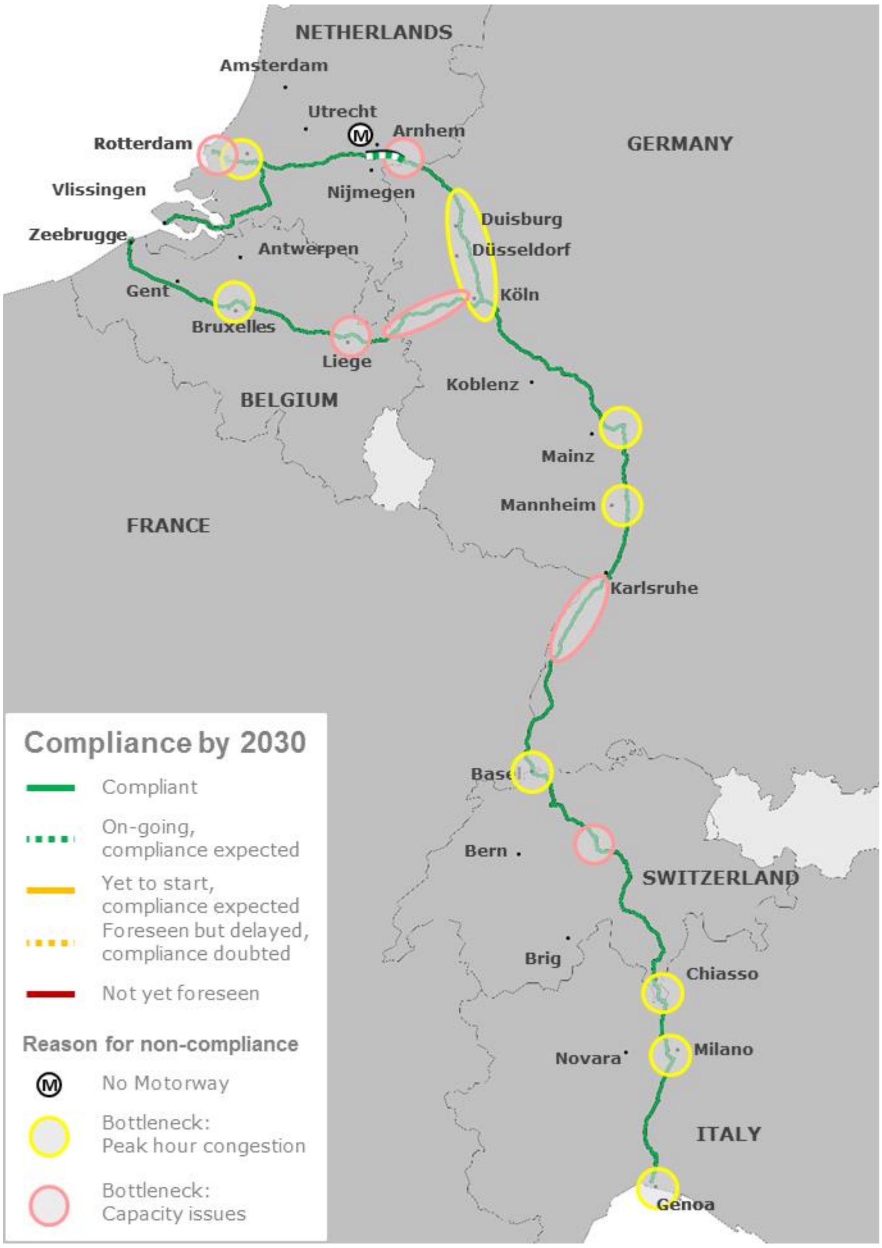


Figure 5: Conformità della rete stradale al 2030



Barriere di tipo amministrativo e operativo

Oltre ai colli di bottiglia fisici e tecnici, anche barriere di tipo amministrativo e operativo possono ostacolare il funzionamento e l'ulteriore sviluppo del Corridoio Reno-Alpi. Entrambe incidono in maniera rilevante sull'efficienza delle rotte e delle modalità di trasporto, influenzando quindi la domanda di trasporto e la quota modale.

Va notato che questa analisi rappresenta lo stato al 2017, e che non è possibile prevedere in modo accurato i futuri cambiamenti delle politiche che potrebbero rimuovere le barriere amministrative e operative che sono state identificate. Le barriere identificate riguardano principalmente differenti specificazioni infrastrutturali alle frontiere, gravi insufficienze nelle infrastrutture -come ad esempio differenze di voltaggio nelle tratte ferroviarie, che rendono impossibile la continuità delle line- o questioni amministrative che impediscano flussi continui lungo il Corridoio. Un'analisi dettagliata è presentata nel capitolo 3.5.

Nodi urbani

Il nodo urbano viene definito come "un'area urbana dove l'infrastruttura di trasporto della rete transeuropea dei trasporti, come ad esempio porti, inclusi terminali passeggeri, aeroporti, stazioni ferroviarie, piattaforme logistiche e terminali merci, sia interni che circostanti all'area urbana, è collegata con altre parti di tale infrastruttura e con l'infrastruttura per il traffico locale e regionale[29]". I nodi urbani sono inoltre riconducibili ai punti di origine (primo miglio), destinazione finale (ultimo miglio) e / o punti di interscambio all'interno o tra diverse modalità di trasporto per merci e passeggeri sulla rete TEN-T.

L’analisi delle sezioni del Corridoio ricadenti nei nodi urbani degli Stati attraversati dal Corridoio ha fatto emergere diverse situazioni di lieve discrepanza in termini di conformità ai requisiti del Regolamento. Molti dei nodi olandesi, belgi, svizzeri e tedeschi sono risultati essere quasi completamente conformi mentre le città francesi e italiane mostrano alcuni difformità. In particolare, Strasburgo, Milano, Genova, Bruxelles e Colonia sono caratterizzati da due parametri non conformi per nodo. Le sezioni passanti per Amsterdam e Rotterdam sono totalmente conformi mentre Anversa, Düsseldorf, Basilea e Mannheim presentano solo un parametro non conforme per nodo. Un'analisi dettagliata è presentata nel capitolo 3.6.

Innovazione

I progetti innovativi fanno riferimento a misure di varia natura che prevedano l'uso di nuove tecnologie atte a migliorare l'attuale sistema di trasporto. Una specifica e comune definizione di "innovazione" è stata utilizzata per l’identificare e classificare dei progetti innovativi lungo i nove Corridoi della rete principale.

Dei 288 progetti che sono stati valutati sulla base del loro contributo all'innovazione, 71, o il 25%, sono stati classificati come innovativi in coerenza con la definizione adottata. La quota dei progetti innovativi per il Corridoio Reno-Alpi è relativamente elevata rispetto alla media del 23,5% che considera tutti i nove corridoi della rete centrale. Gli investimenti complessivi per la realizzazione dei 71 progetti innovativi ammontano a 4,6 miliardi di euro, a dimostrazione del fatto che interventi di tipo innovativo tendono ad essere meno costosi rispetto a progetti infrastrutturali di tipo “classico”. L'analisi dettagliata è presentata nel capitolo 3.7.1.

Impatto ambientale

La quantificazione delle emissioni è stata realizzata con riferimento allo scenario di riferimento UE 2016. Si prevede che il traffico merci aumenterà dagli attuali 129 miliardi di tkm a 156 miliardi di tkm entro il 2030 (strade, ferrovie e vie navigabili interne). Il settore in più rapida crescita nello scenario di riferimento è il settore ferroviario (1,8% annuo). Si prevede che il traffico di passeggeri (strada, ferrovia e aviazione) aumenti da 165 miliardi di pkm a 190 miliardi di pkm entro il 2030. Nel caso in esame il settore in più rapida crescita è invece l'aviazione (1,8% annuo).

Secondo l'analisi condotta per il periodo 2015-2050, le emissioni riconducibili al trasporto stradale diminuiranno, nonostante un contemporaneo aumento del numero di passeggeri e tonnellate di merci. Rispetto al 2015, le emissioni ferroviarie rimarranno costanti nel 2030, ma aumenterebbero leggermente nel 2050. Per quanto riguarda il trasporto per vie navigabili interne, è stato calcolato un leggero aumento delle emissioni da qui al 2050. L'aviazione è un settore in cui il numero di passeggeri aumenterà costantemente tra il 2015 e 2050 (+ 76%). Nello stesso periodo, le emissioni aumenteranno solo leggermente.

Le emissioni totali nel 2015 di strade, ferrovie, trasporto per vie navigabili interne e aviazione sul Corridoio sono pari a 18,9 milioni di tonnellate di CO2. In base ai volumi

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[29] Regolamento TEN-T 1315/2013

di traffico previsti e all'aumento dell'efficienza energetica, sono previste emissioni di CO2 pari a 16,9 milioni di tonnellate nel 2030 e 16,6 milioni di tonnellate nel 2050. Un'analisi dettagliata è presentata nel capitolo 3.7.2.

Analisi generale degli investimenti del Corridoio Reno-Alpi

I costi di investimento complessivi di tutti i progetti del Corridoio Reno-Alpi ammontano a un totale di 100,3 miliardi di Euro. Per il 53% dei progetti sono disponibili informazioni finanziarie complete, che li rendono quindi idonei a questa analisi. L'importo corrispondente (41,1 miliardi di EUR) è suddiviso nelle fonti finanziarie a copertura del costo dei progetti analizzati. Le fonti di finanziamento dei progetti sono suddivise come segue:

- Stati membri / fondi pubblici: 39,3 miliardi di EUR, pari al 95,6% del totale;
- Fondi UE (CEF, ESIF): 0,7 miliardi di EUR, pari al 1,7% del totale;
- Risorse private: 1,1 miliardi di euro, pari al 2,7% del totale.

La ripartizione dei finanziamenti mediante fondi UE è la seguente:

- CEF / TEN-T: 0,7 miliardi di EUR, pari al 99,8% del totale;
- ESIF: 0 EUR;
- Altro: 0,02 miliardi di EUR, ovvero lo 0,2% del totale.

L'analisi suggerisce che se si applicasse lo stesso coefficiente di finanziamento UE (ossia l'1,7% di cui sopra per i fondi UE) all'intero costo degli investimenti per il Corridoio, nei prossimi anni sarebbe necessario stanziare 1,7 miliardi di Euro di fondi UE al fine di completare tutti i progetti presenti nella lista. Un'analisi dettagliata è presentata nel capitolo 3.8.

Riepilogo dei progetti completati

Dal il primo Work Plan, pubblicato a maggio 2015, sono già stati fatti grandi progressi in tutto il Corridoio Reno-Alpi e in tutti i modi di trasporto. In totale, sono stati completati e implementati 16 progetti infrastrutturali e importanti studi, per una spesa complessiva pari a circa 13 miliardi di Euro. Trai progetti più importanti e rappresentativi:

- la galleria di base del Gottardo che attraversa le Alpi svizzere;
- il nuovo hub intermodale Reno-Ruhr a Duisburg;
- la nuova autostrada belga A11 che collega Bruges e Knokke-Heist nelle Fiandre occidentali;
- l'adeguamento del collegamento ferroviario di Maasvlakte 2 nel porto di Rotterdam;
- la migliore accessibilità ferroviaria all'aeroporto di Milano Malpensa;
- l'innovativa linea ferroviaria tra Zevenaar - Emmerich - Oberhausen.

Stima dell'impatto socio-economico del Corridoio in termini occupazionali e crescita economica

Le stime sulla crescita e sullo sviluppo occupazionale del Corridoio sono state realizzate con un modello sviluppato a partire dai risultati dello studio "*Cost of non-completion of the TEN-T*[30]".

I progetti per i quali sono disponibili stime dei costi e che sono programmati per essere implementati nel periodo compreso tra il 2016 e il 2030 comportano un investimento di 96,6 miliardi di Euro. La realizzazione di questi progetti sul Corridoio determinerà un aumento del PIL nel periodo 2016-2030 di 743 miliardi di EUR in totale, con ulteriori benefici anche dopo il 2030.

Gli investimenti stimoleranno anche ulteriore occupazione: tra gli effetti diretti e indiretti dello sviluppo dei progetti legati al Corridoio c'è infatti la creazione di circa 2,14 milioni di occupati-anno nel periodo compreso tra il 2016 e il 2030. Inoltre è ragionevole ipotizzare che, anche dopo il 2030, i progetti continueranno a garantire un numero rilevante di occupati-anno. Un'analisi dettagliata è presentata nel capitolo 8.

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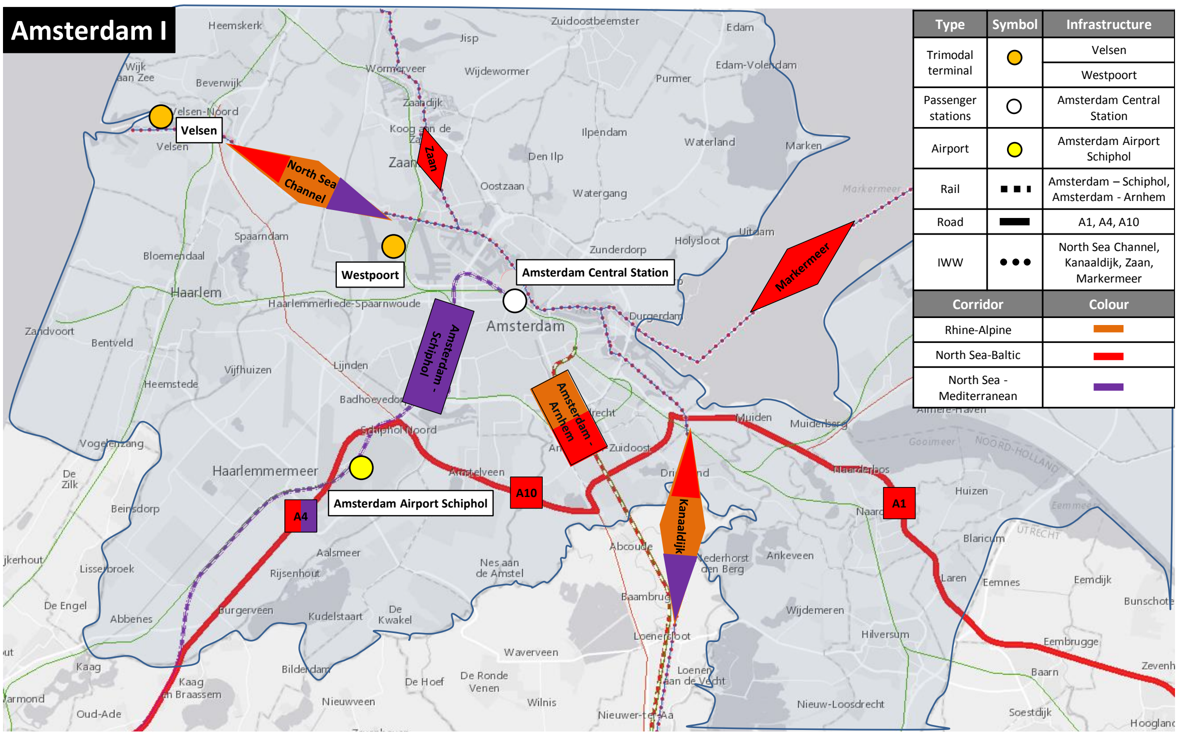
[30] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Studio realizzato per la European Commission DG MOVE, Karlsruhe, Germany.

ANNEX V– Urban node analysis

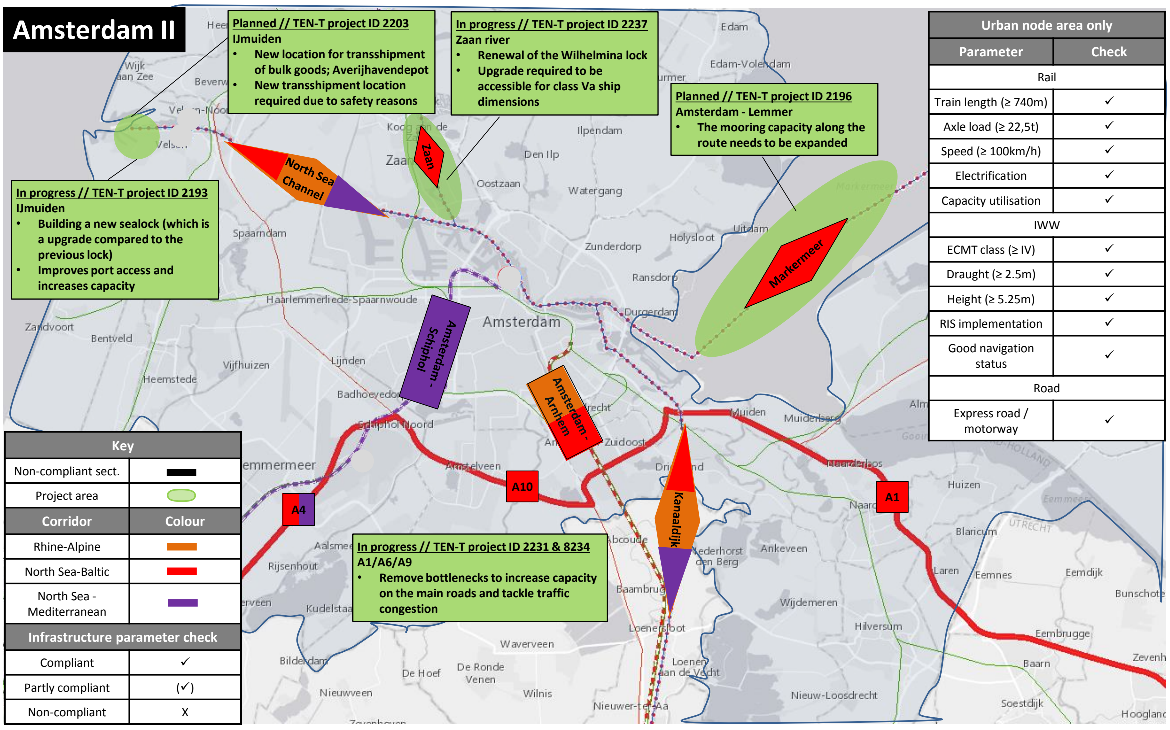
Amsterdam (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Trimodal terminal	●	Velsen
		Westpoort
Passenger stations	○	Amsterdam Central Station
Airport	●	Amsterdam Airport Schiphol
Rail	■ ■ ■	Amsterdam – Schiphol, Amsterdam - Arnhem
Road	▬	A1, A4, A10
IWW	● ● ●	North Sea Channel, Kanaaldijk, Zaan, Markermeer

Corridor	Colour
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪

Amsterdam (Layer II – Analysis of corridor lines)



Planned // TEN-T project ID 2203
IJmuiden
- **New location for transshipment of bulk goods; Averijhavendepot**
- **New transshipment location required due to safety reasons**

In progress // TEN-T project ID 2237
Zaan river
- **Renewal of the Wilhelmina lock**
- **Upgrade required to be accessible for class Va ship dimensions**

Planned // TEN-T project ID 2196
Amsterdam - Lemmer
- **The mooring capacity along the route needs to be expanded**

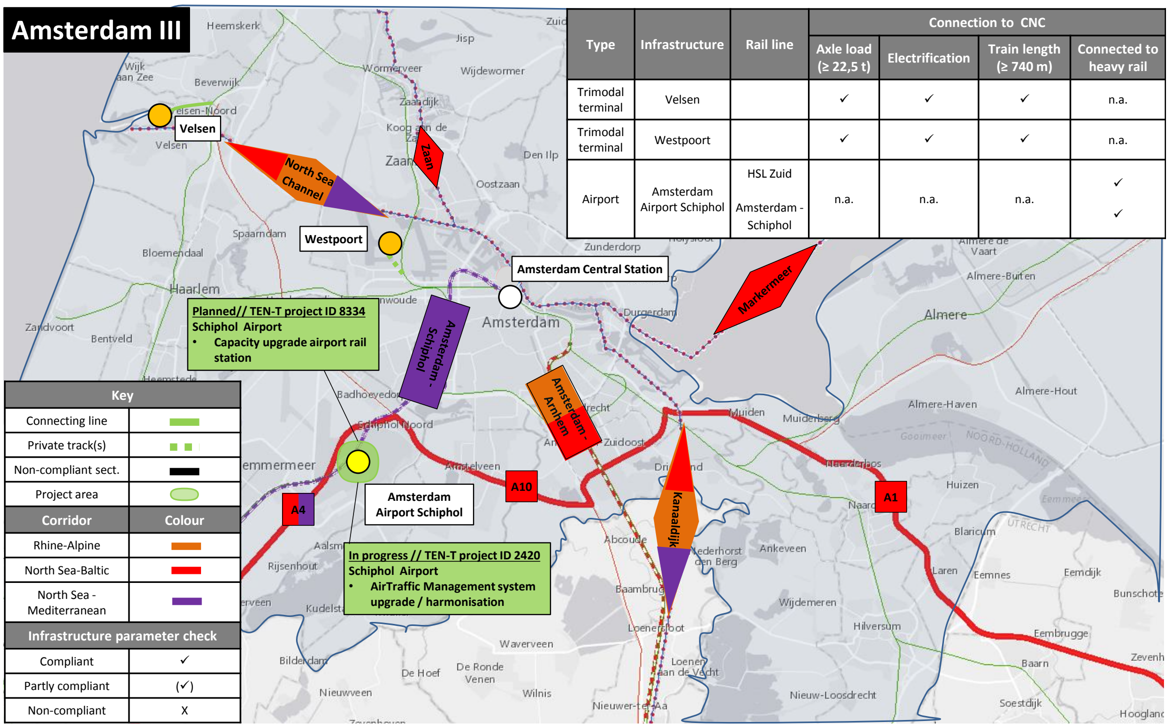
In progress // TEN-T project ID 2193
IJmuiden
- **Building a new sealock (which is a upgrade compared to the previous lock)**
- **Improves port access and increases capacity**

In progress // TEN-T project ID 2231 & 8234
A1/A6/A9
- **Remove bottlenecks to increase capacity on the main roads and tackle traffic congestion**

Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	✓
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	✓
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Amsterdam (Layer III – Analysis of last-mile connections)



Amsterdam III

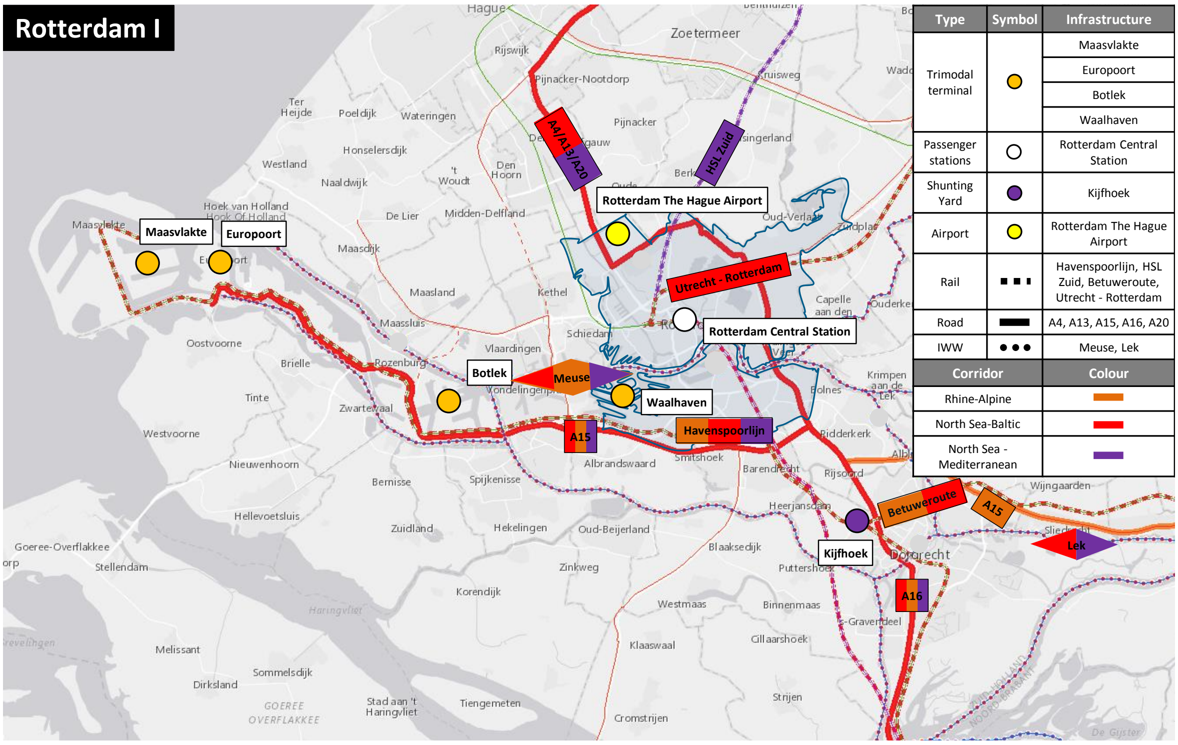
Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Trimodal terminal	Velsen		✓	✓	✓	n.a.
Trimodal terminal	Westpoort		✓	✓	✓	n.a.
Airport	Amsterdam Airport Schiphol	HSL Zuid Amsterdam - Schiphol	n.a.	n.a.	n.a.	✓ ✓

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	■
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Planned// TEN-T project ID 8334
Schiphol Airport
- **Capacity upgrade airport rail station**

In progress // TEN-T project ID 2420
Schiphol Airport
- **AirTraffic Management system upgrade / harmonisation**

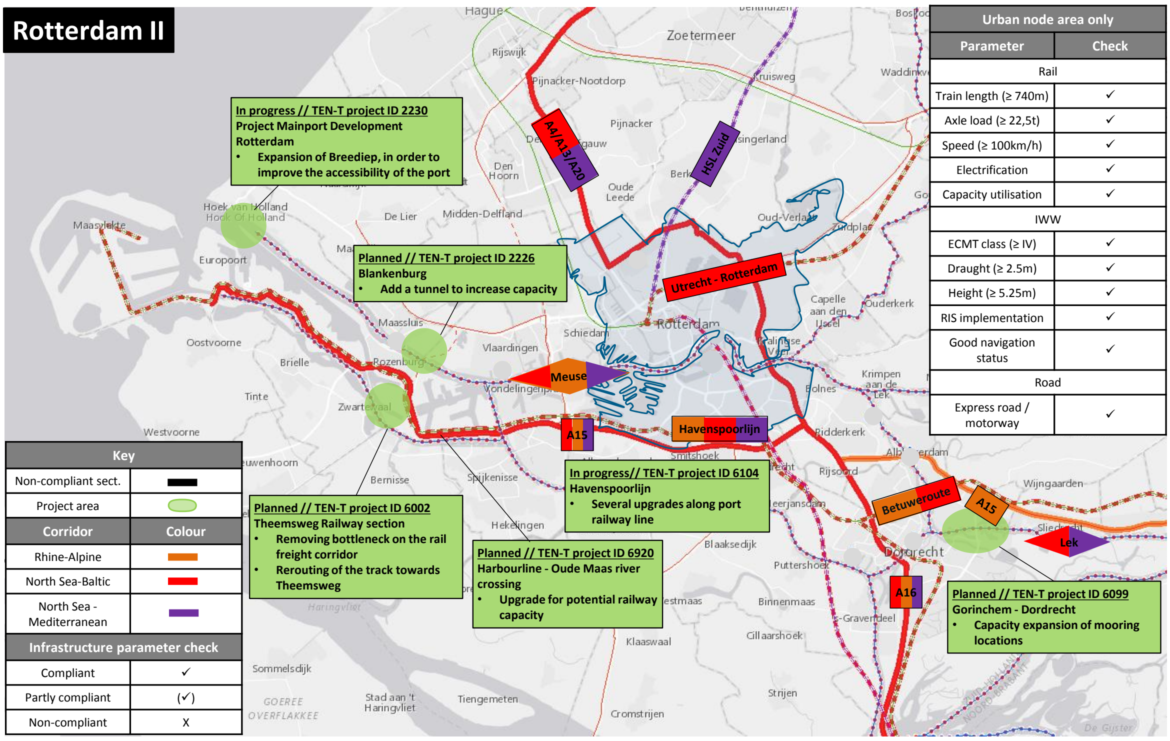
Rotterdam (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Trimodal terminal	●	Maasvlakte Europoort Botlek Waalhaven
Passenger stations	○	Rotterdam Central Station
Shunting Yard	●	Kijfhoek
Airport	●	Rotterdam The Hague Airport
Rail	▪ ▪ ▪	Havenspoorlijn, HSL Zuid, Betuweroute, Utrecht - Rotterdam
Road	▬	A4, A13, A15, A16, A20
IWW	● ● ●	Meuse, Lek

Corridor	Colour
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪

Rotterdam (Layer II – Analysis of corridor lines)



In progress // TEN-T project ID 2230
Project Mainport Development Rotterdam
- **Expansion of Breediep, in order to improve the accessibility of the port**

Planned // TEN-T project ID 2226
Blankenburg
- **Add a tunnel to increase capacity**

Planned // TEN-T project ID 6002
Theemsweg Railway section
- **Removing bottleneck on the rail freight corridor**
- **Rerouting of the track towards Theemsweg**

Planned // TEN-T project ID 6920
Harbourline - Oude Maas river crossing
- **Upgrade for potential railway capacity**

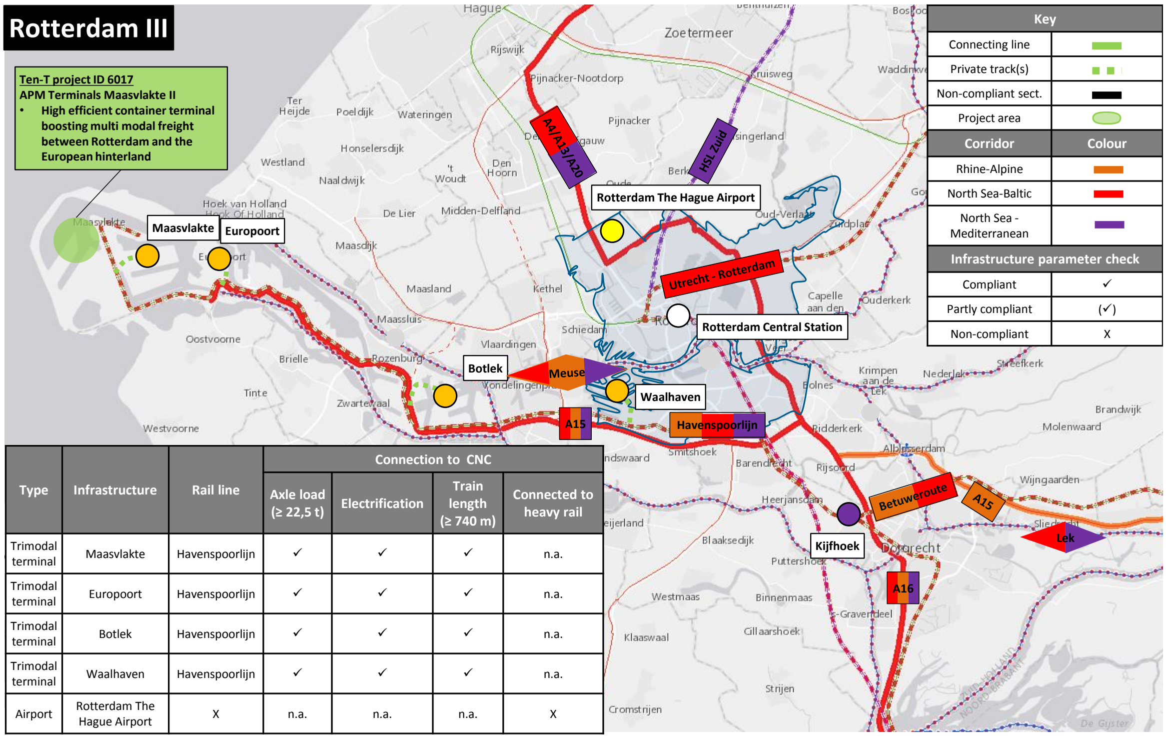
In progress// TEN-T project ID 6104
Havenspoorlijn
- **Several upgrades along port railway line**

Planned // TEN-T project ID 6099
Gorinchem - Dordrecht
- **Capacity expansion of mooring locations**

Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	✓
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	✓
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Rotterdam (Layer III – Analysis of last-mile connections)

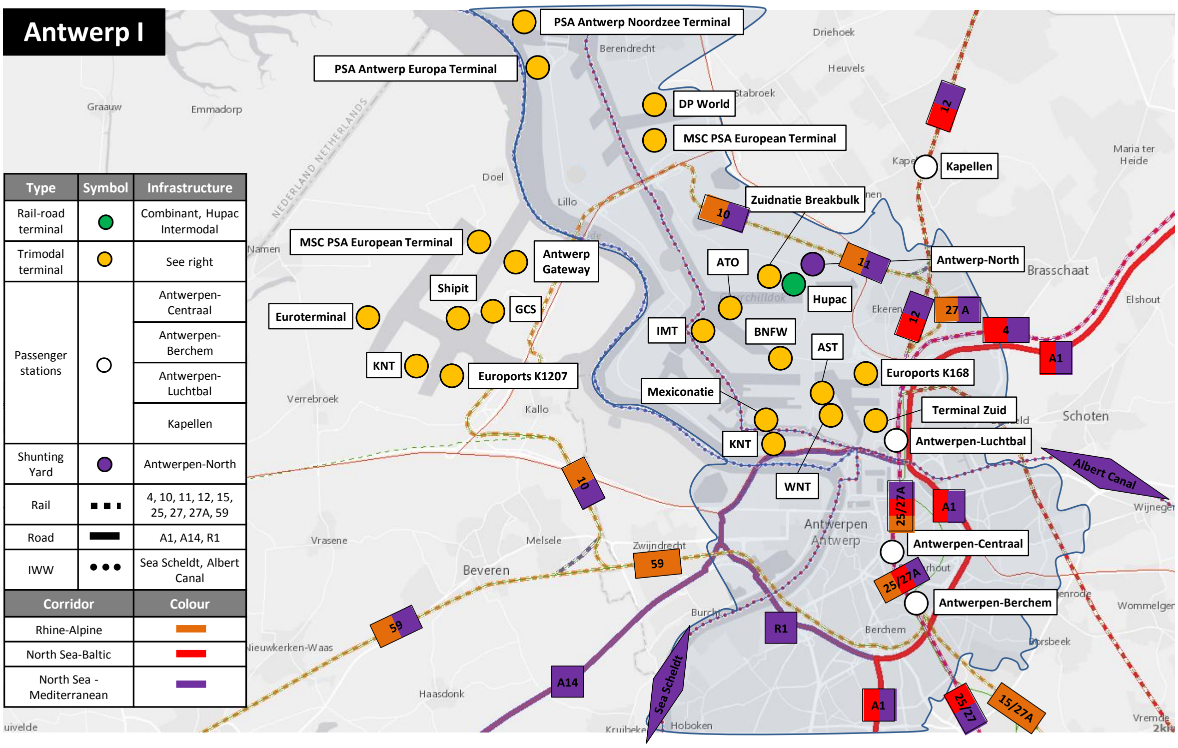


Ten-T project ID 6017
APM Terminals Maasvlakte II
- **High efficient container terminal boosting multi modal freight between Rotterdam and the European hinterland**

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	■
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Trimodal terminal	Maasvlakte	Havenspoorlijn	✓	✓	✓	n.a.
Trimodal terminal	Europoort	Havenspoorlijn	✓	✓	✓	n.a.
Trimodal terminal	Botlek	Havenspoorlijn	✓	✓	✓	n.a.
Trimodal terminal	Waalhaven	Havenspoorlijn	✓	✓	✓	n.a.
Airport	Rotterdam The Hague Airport	X	n.a.	n.a.	n.a.	X

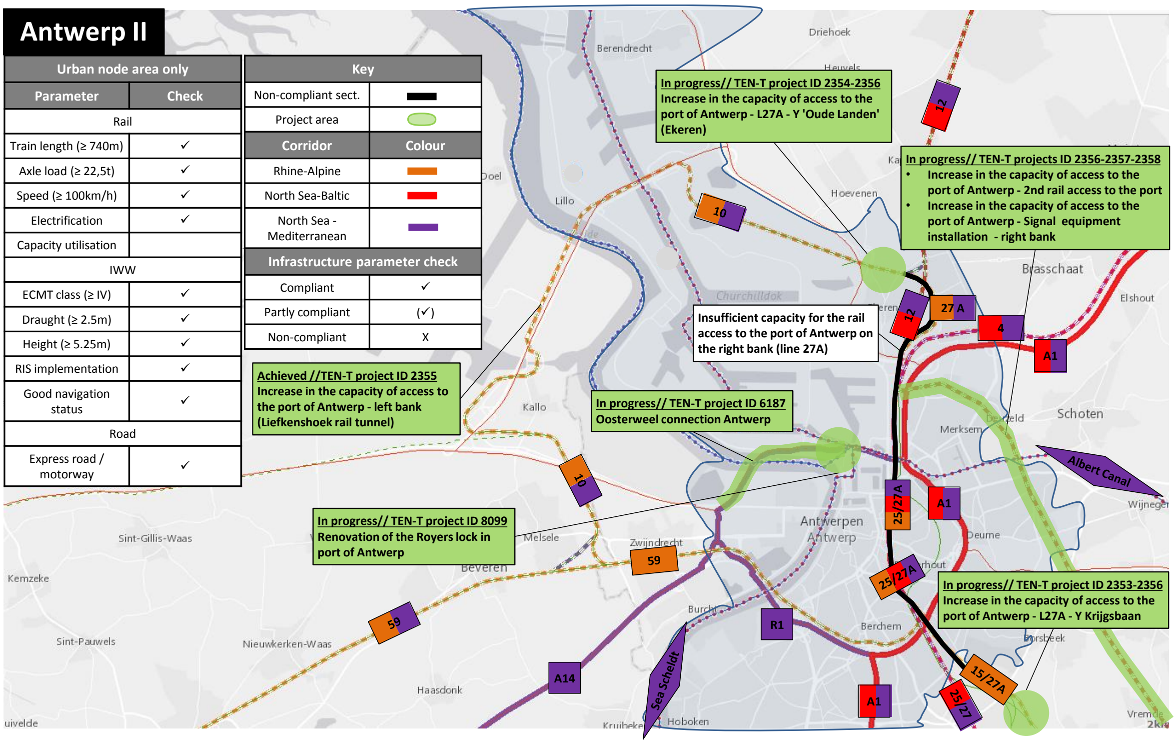
Antwerp (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Rail-road terminal	●	Combinant, Hupac Intermodal
Trimodal terminal	●	See right
Passenger stations	○	Antwerpen-Centraal
		Antwerpen-Berchem
		Antwerpen-Luchtbal
		Kapellen
Shunting Yard	●	Antwerpen-North
Rail	■ ■ ▪	4, 10, 11, 12, 15, 25, 27, 27A, 59
Road	▬	A1, A14, R1
IWW	● ● ●	Sea Scheldt, Albert Canal

Corridor	Colour
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪

Antwerp (Layer II – Analysis of corridor lines)



Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	✓
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Achieved //TEN-T project ID 2355
Increase in the capacity of access to the port of Antwerp - left bank (Liefkenshoek rail tunnel)

In progress// TEN-T project ID 8099
Renovation of the Royers lock in port of Antwerp

In progress// TEN-T project ID 2354-2356
Increase in the capacity of access to the port of Antwerp - L27A - Y 'Oude Landen' (Ekeren)

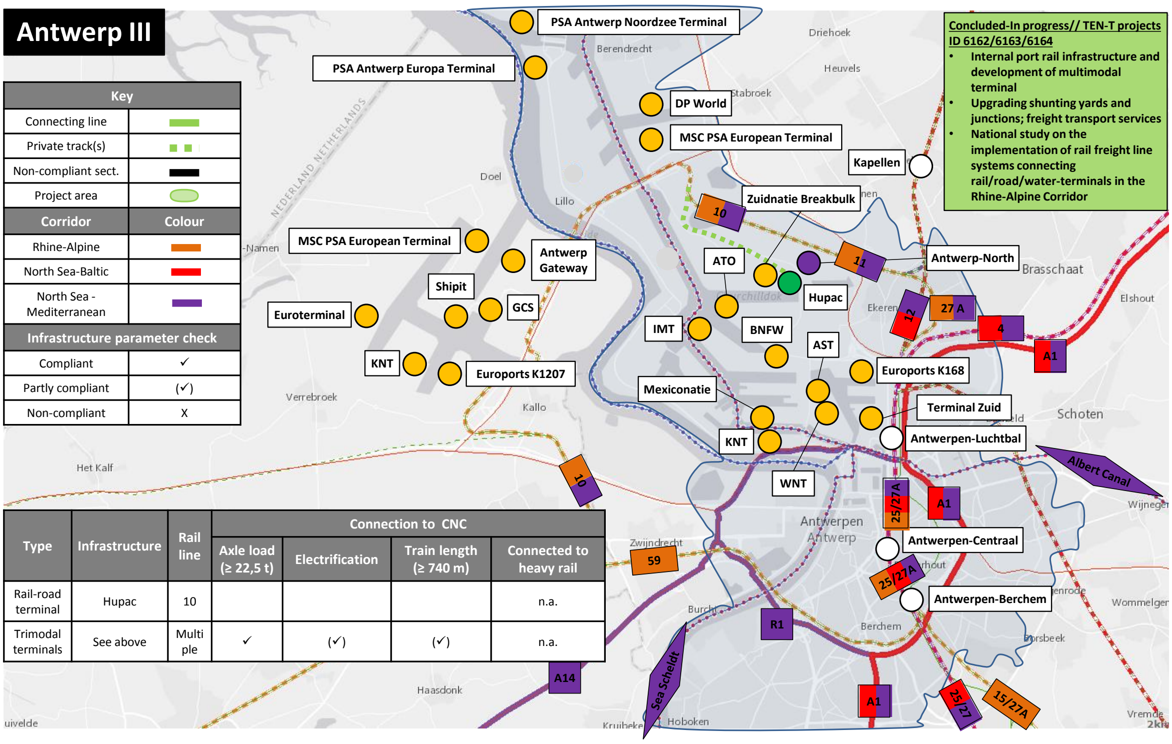
In progress// TEN-T projects ID 2356-2357-2358
- **Increase in the capacity of access to the port of Antwerp - 2nd rail access to the port**
- **Increase in the capacity of access to the port of Antwerp - Signal equipment installation - right bank**

Insufficient capacity for the rail access to the port of Antwerp on the right bank (line 27A)

In progress// TEN-T project ID 6187
Oosterweel connection Antwerp

In progress// TEN-T project ID 2353-2356
Increase in the capacity of access to the port of Antwerp - L27A - Y Krijgsbaan

Antwerp (Layer III – Analysis of last-mile connections)



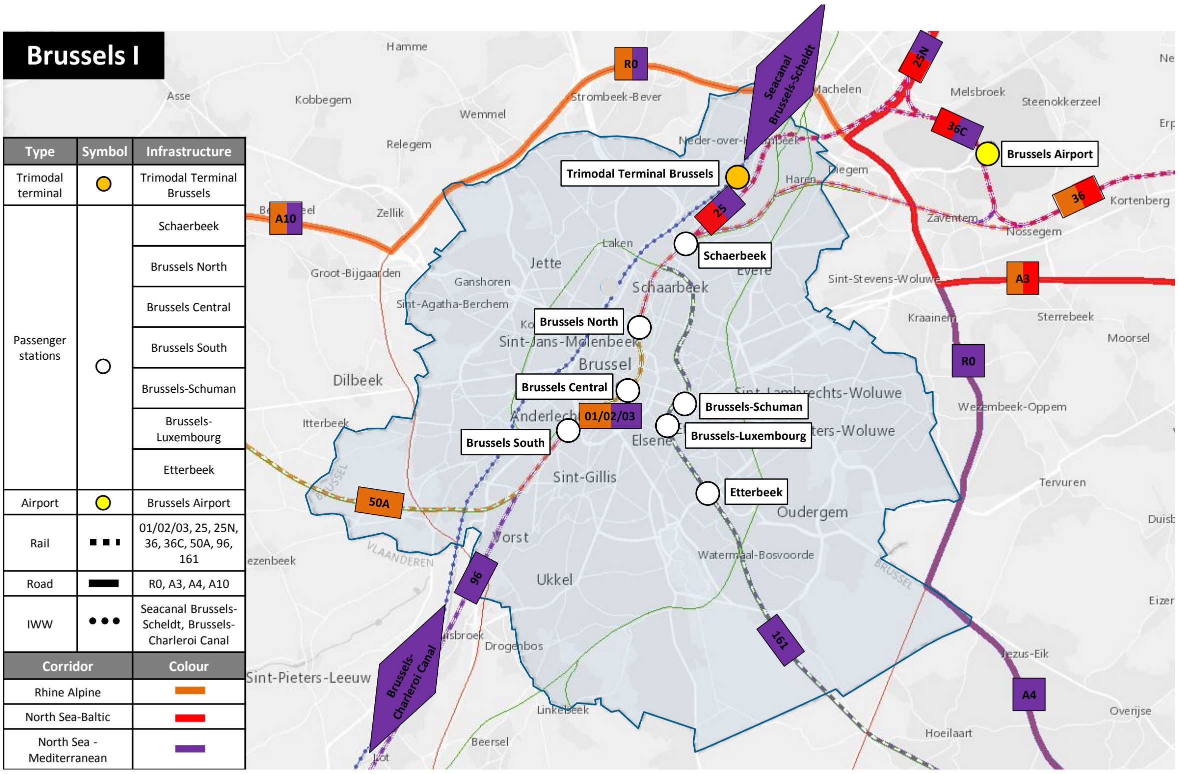
Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	■
Project area	●
Corridor	**Colour**
Rhine-Alpine	■
North Sea-Baltic	🟥
North Sea - Mediterranean	■
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Concluded-In progress// TEN-T projects ID 6162/6163/6164

- **Internal port rail infrastructure and development of multimodal terminal**
- **Upgrading shunting yards and junctions; freight transport services**
- **National study on the implementation of rail freight line systems connecting rail/road/water-terminals in the Rhine-Alpine Corridor**

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Rail-road terminal	Hupac	10				n.a.
Trimodal terminals	See above	Multiple	✓	(✓)	(✓)	n.a.

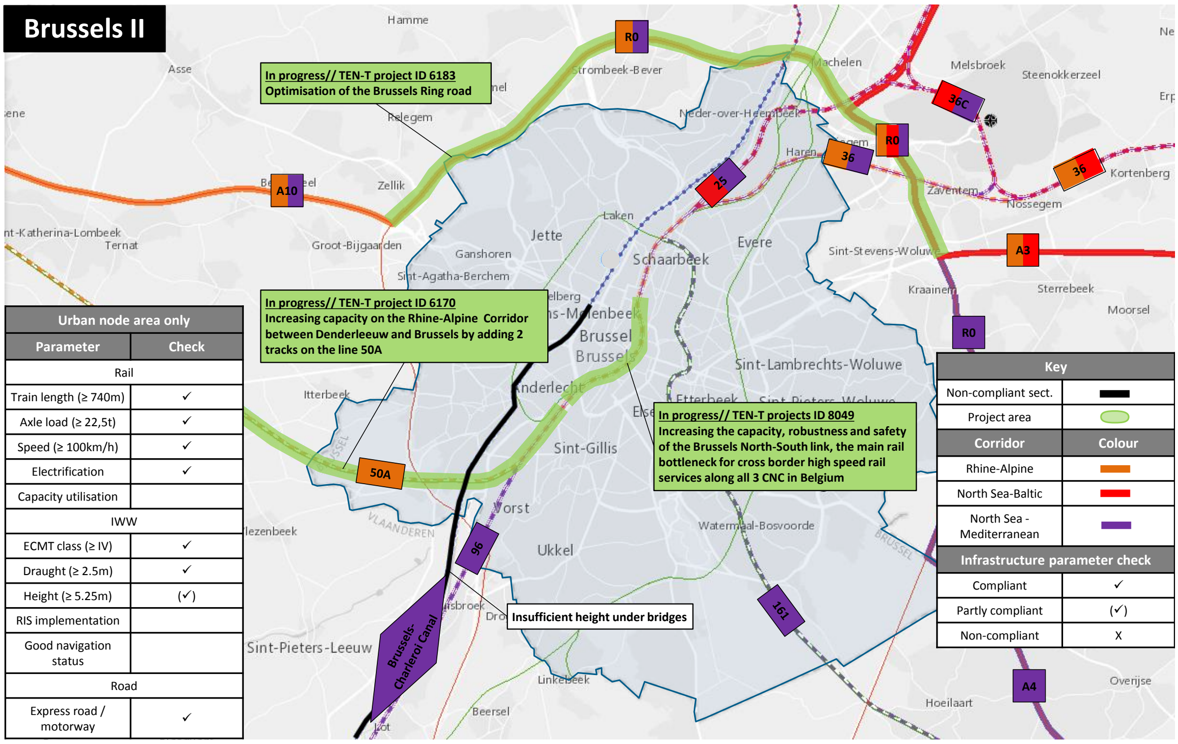
Brussels (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Trimodal terminal	●	Trimodal Terminal Brussels
Passenger stations	○	Schaerbeek
		Brussels North
		Brussels Central
		Brussels South
		Brussels-Schuman
		Brussels-Luxembourg
		Etterbeek
Airport	●	Brussels Airport
Rail	■ ■ ■	01/02/03, 25, 25N, 36, 36C, 50A, 96, 161
Road	▬	R0, A3, A4, A10
IWW	● ● ●	Seacanal Brussels-Scheldt, Brussels-Charleroi Canal

Corridor	Colour
Rhine Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪

Brussels (Layer II – Analysis of corridor lines)



In progress// TEN-T project ID 6183
Optimisation of the Brussels Ring road

In progress// TEN-T project ID 6170
Increasing capacity on the Rhine-Alpine Corridor between Denderleeuw and Brussels by adding 2 tracks on the line 50A

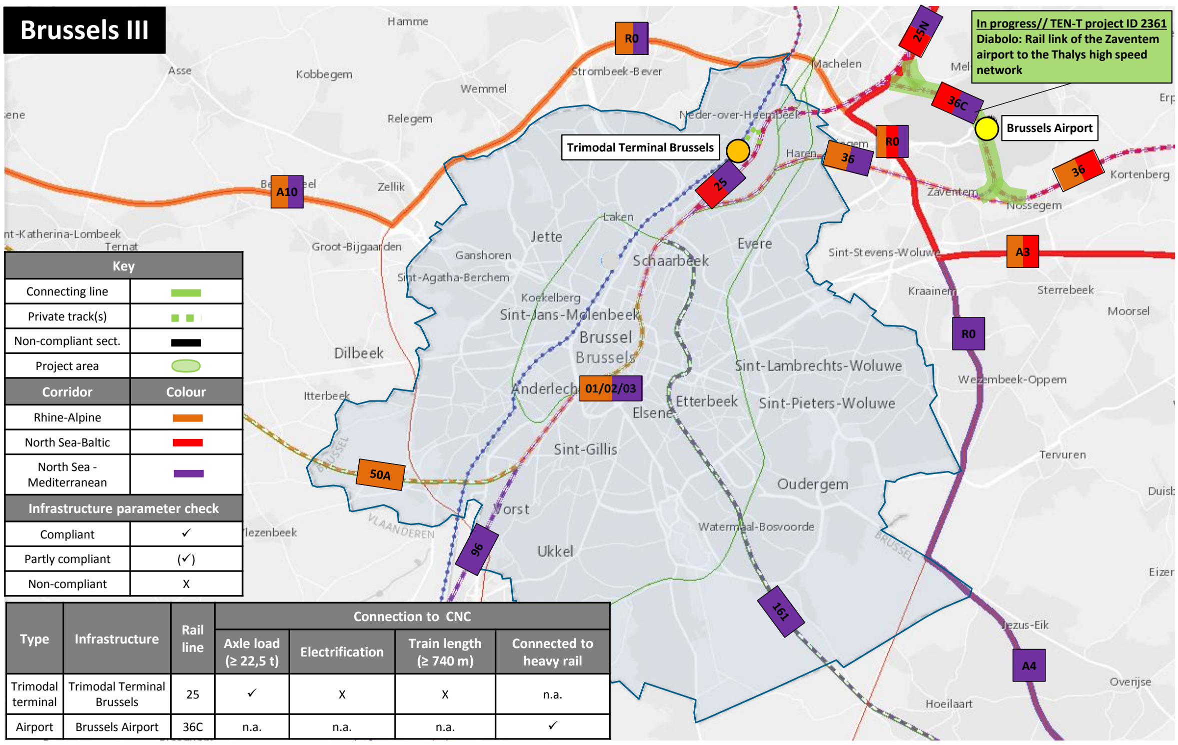
In progress// TEN-T projects ID 8049
Increasing the capacity, robustness and safety of the Brussels North-South link, the main rail bottleneck for cross border high speed rail services along all 3 CNC in Belgium

Insufficient height under bridges

Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	(✓)
RIS implementation	
Good navigation status	
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Brussels (Layer III – Analysis of last-mile connections)

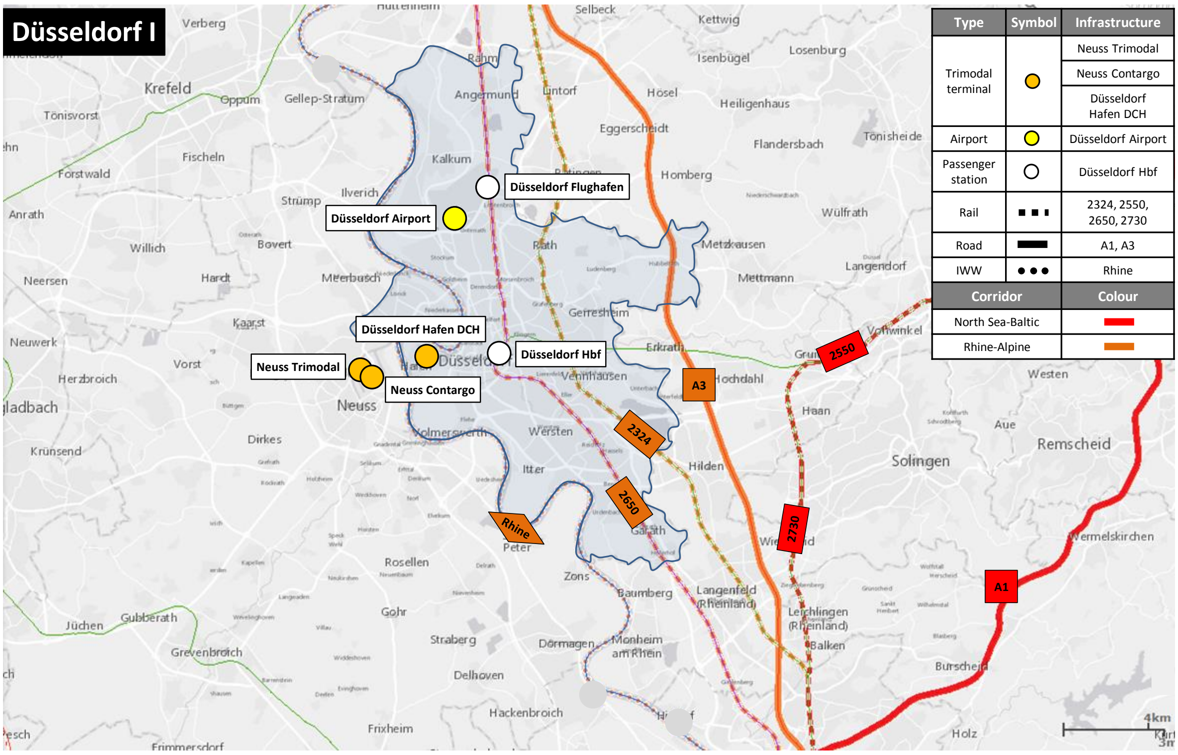


In progress// TEN-T project ID 2361
Diabolo: Rail link of the Zaventem airport to the Thalys high speed network

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
North Sea-Baltic	🟥
North Sea - Mediterranean	🟪
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Trimodal terminal	Trimodal Terminal Brussels	25	✓	X	X	n.a.
Airport	Brussels Airport	36C	n.a.	n.a.	n.a.	✓

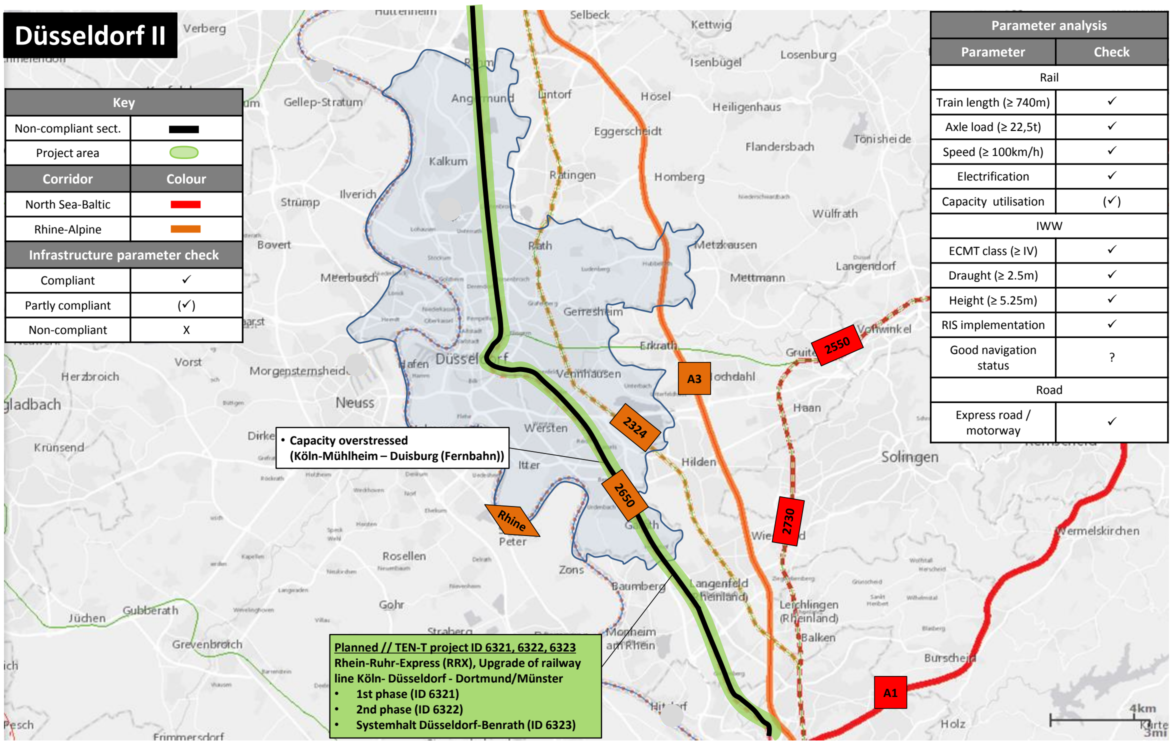
Düsseldorf (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Trimodal terminal	●	Neuss Trimodal
		Neuss Contargo
		Düsseldorf Hafen DCH
Airport	●	Düsseldorf Airport
Passenger station	○	Düsseldorf Hbf
Rail	▪ ▪ ▪	2324, 2550, 2650, 2730
Road	▬	A1, A3
IWW	● ● ●	Rhine

Corridor	Colour
North Sea-Baltic	🟥
Rhine-Alpine	🟧

Düsseldorf (Layer II – Analysis of corridor lines)



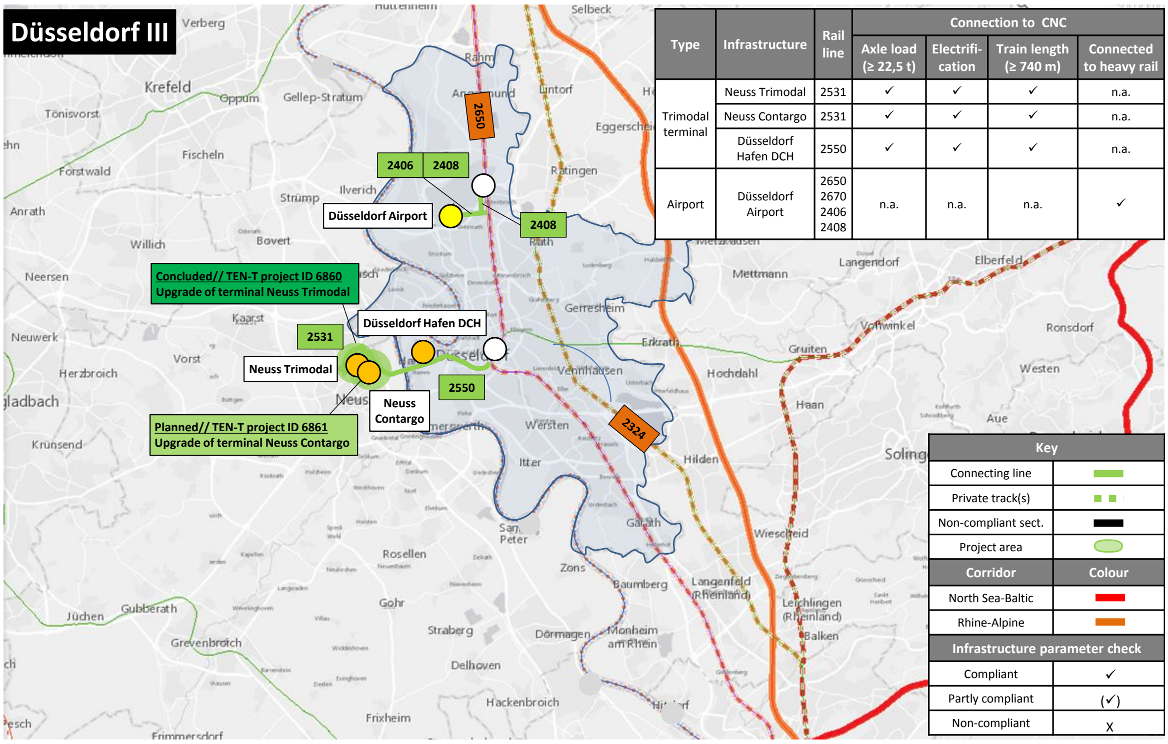
Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
North Sea-Baltic	🟥
Rhine-Alpine	🟧
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Parameter analysis	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	(✓)
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	?
Road	
Express road / motorway	✓

- Capacity overstressed (Köln-Mühlheim – Duisburg (Fernbahn))

Planned // TEN-T project ID 6321, 6322, 6323
Rhein-Ruhr-Express (RRX), Upgrade of railway line Köln- Düsseldorf - Dortmund/Münster
- **1st phase (ID 6321)**
- **2nd phase (ID 6322)**
- **Systemhalt Düsseldorf-Benrath (ID 6323)**

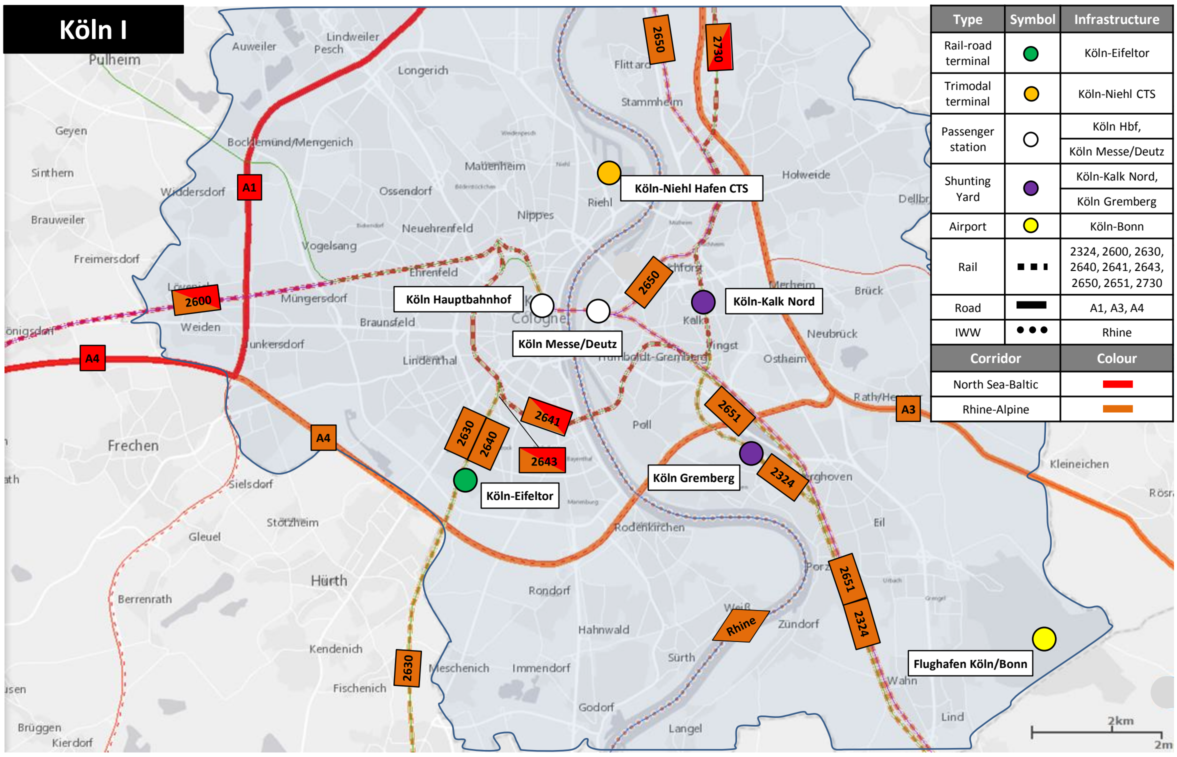
Düsseldorf (Layer III – Analysis of last-mile connections)



Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Trimodal terminal	Neuss Trimodal	2531	✓	✓	✓	n.a.
	Neuss Contargo	2531	✓	✓	✓	n.a.
	Düsseldorf Hafen DCH	2550	✓	✓	✓	n.a.
Airport	Düsseldorf Airport	2650 2670 2406 2408	n.a.	n.a.	n.a.	✓

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
North Sea-Baltic	🟥
Rhine-Alpine	🟧
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

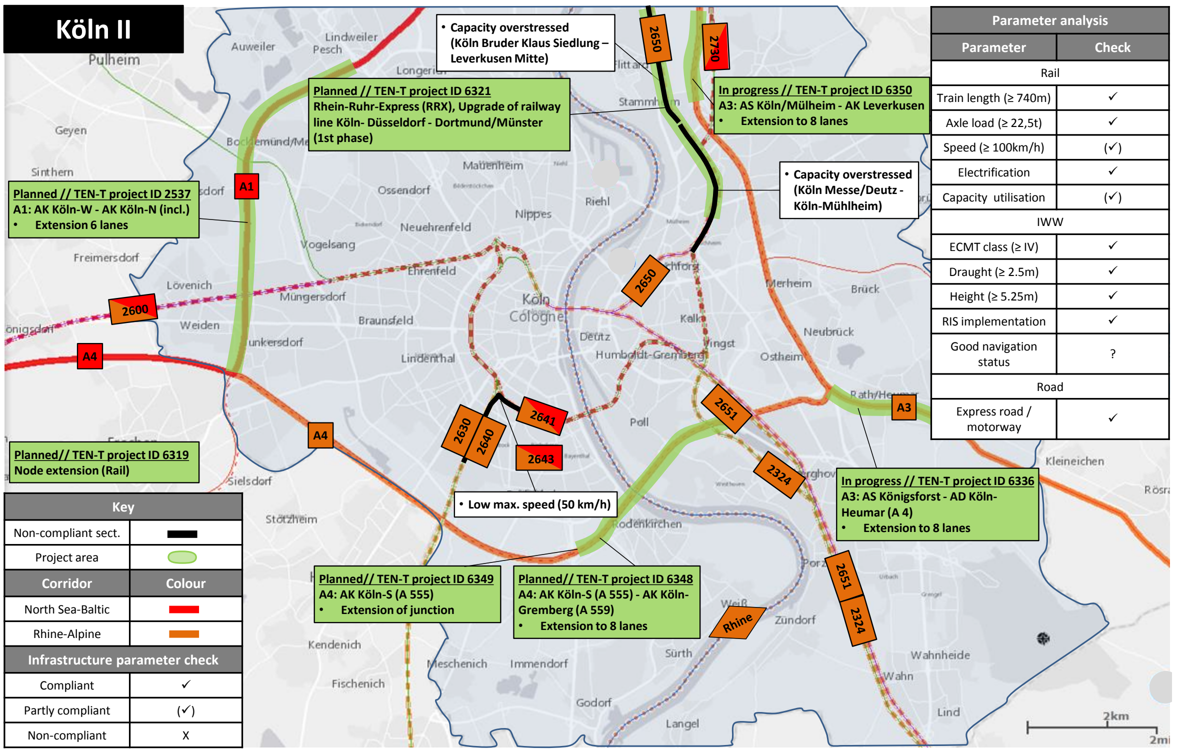
Köln (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Rail-road terminal	●	Köln-Eifeltor
Trimodal terminal	●	Köln-Niehl CTS
Passenger station	○	Köln Hbf, Köln Messe/Deutz
Shunting Yard	●	Köln-Kalk Nord, Köln Gremberg
Airport	●	Köln-Bonn
Rail	■ ■ ■	2324, 2600, 2630, 2640, 2641, 2643, 2650, 2651, 2730
Road	▬	A1, A3, A4
IWW	● ● ●	Rhine

Corridor	Colour
North Sea-Baltic	🟥
Rhine-Alpine	🟧

Köln (Layer II – Analysis of corridor lines)



- Capacity overstressed (Köln Bruder Klaus Siedlung – Leverkusen Mitte)

Planned // TEN-T project ID 6321
Rhein-Ruhr-Express (RRX), Upgrade of railway line Köln- Düsseldorf - Dortmund/Münster (1st phase)

In progress // TEN-T project ID 6350
A3: AS Köln/Mülheim - AK Leverkusen
- **Extension to 8 lanes**

Planned // TEN-T project ID 2537
A1: AK Köln-W - AK Köln-N (incl.)
- **Extension 6 lanes**

- Capacity overstressed (Köln Messe/Deutz - Köln-Mühlheim)

Planned// TEN-T project ID 6319
Node extension (Rail)

- Low max. speed (50 km/h)

In progress // TEN-T project ID 6336
A3: AS Königsforst - AD Köln-Heumar (A 4)
- **Extension to 8 lanes**

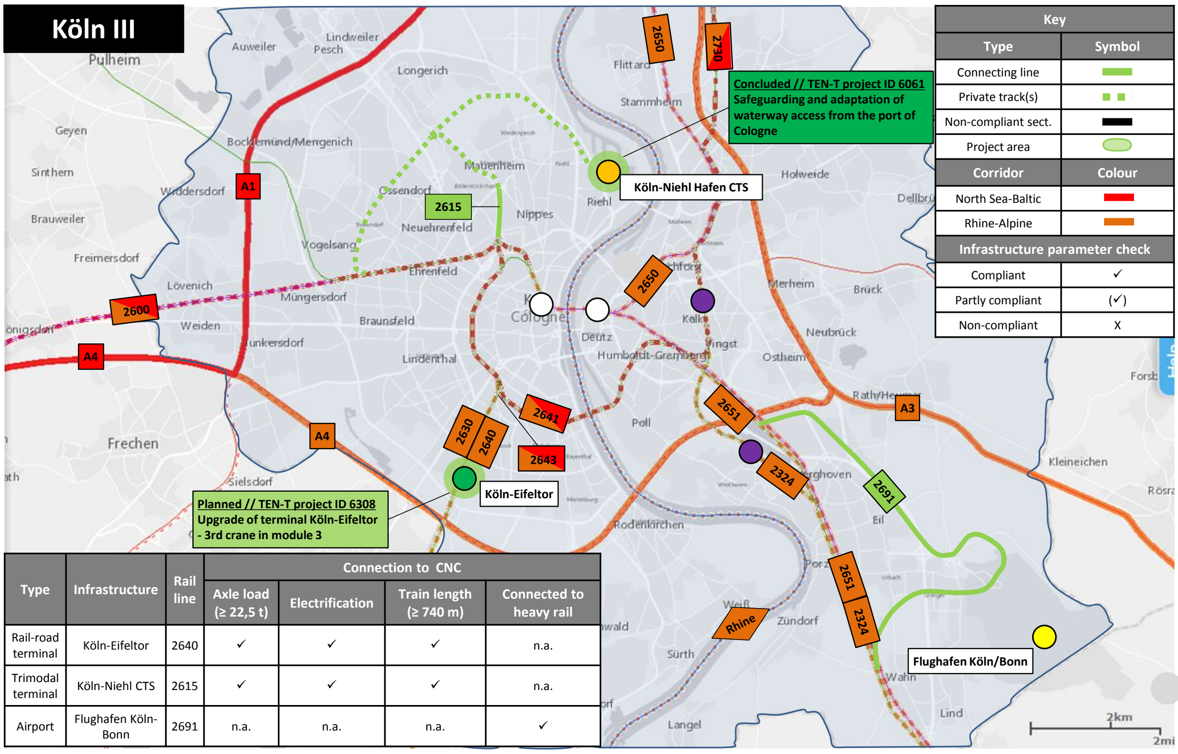
Planned// TEN-T project ID 6349
A4: AK Köln-S (A 555)
- **Extension of junction**

Planned// TEN-T project ID 6348
A4: AK Köln-S (A 555) - AK Köln-Gremberg (A 559)
- **Extension to 8 lanes**

Parameter analysis	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	(✓)
Electrification	✓
Capacity utilisation	(✓)
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	?
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
North Sea-Baltic	🟥
Rhine-Alpine	🟧
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Köln (Layer III – Analysis of last-mile connections)



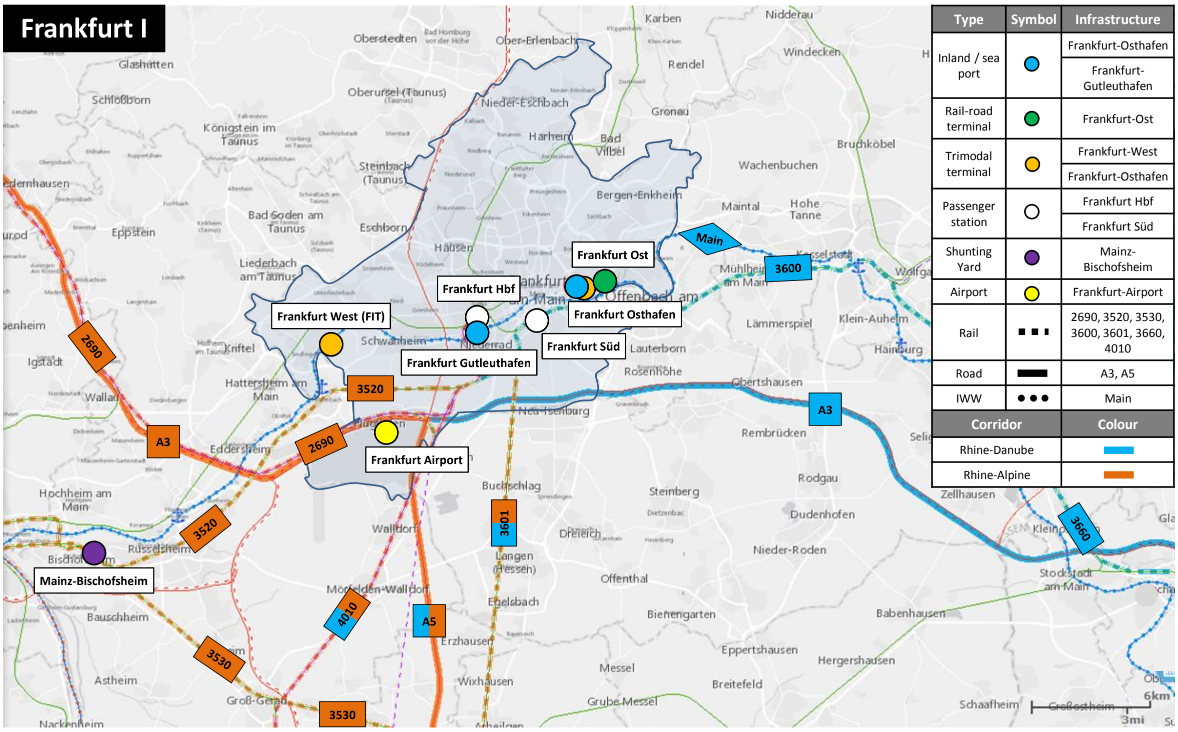
Concluded // TEN-T project ID 6061
Safeguarding and adaptation of waterway access from the port of Cologne

Planned // TEN-T project ID 6308
Upgrade of terminal Köln-Eifeltor
- 3rd crane in module 3

Key	
Type	**Symbol**
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	■
Project area	●
Corridor	**Colour**
North Sea-Baltic	🟥
Rhine-Alpine	🟧
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Rail-road terminal	Köln-Eifeltor	2640	✓	✓	✓	n.a.
Trimodal terminal	Köln-Niehl CTS	2615	✓	✓	✓	n.a.
Airport	Flughafen Köln-Bonn	2691	n.a.	n.a.	n.a.	✓

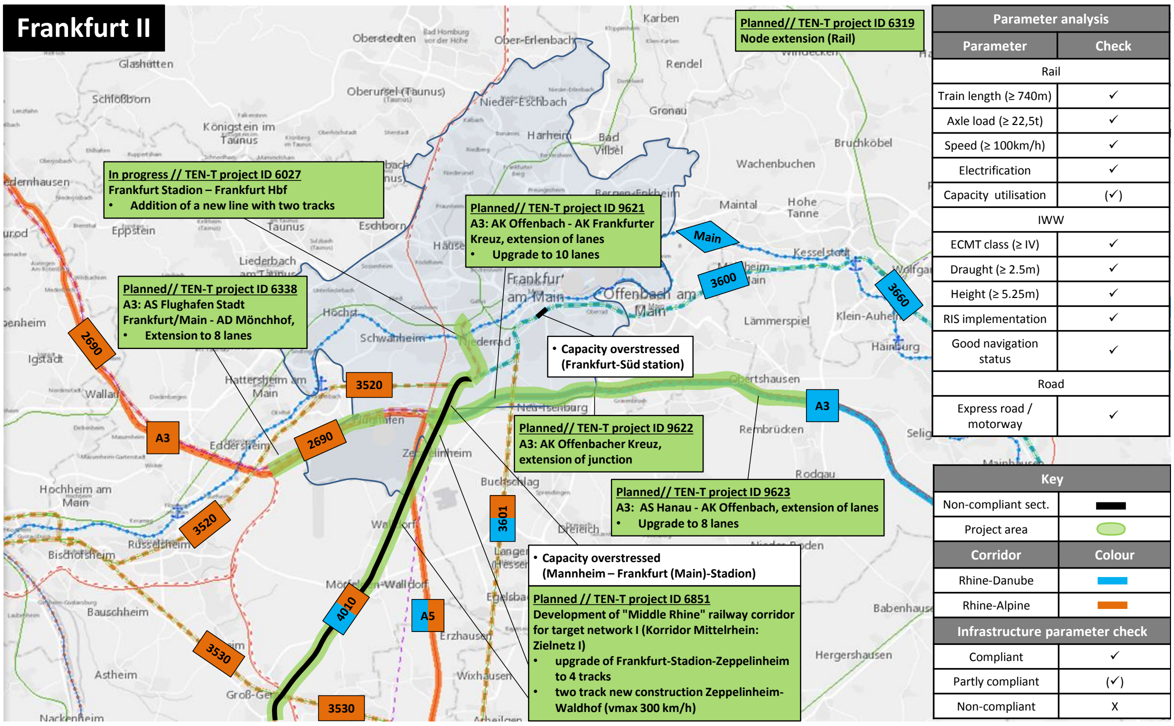
Frankfurt/M. (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Inland / sea port	●	Frankfurt-Osthafen
		Frankfurt-Gutleuthafen
Rail-road terminal	●	Frankfurt-Ost
Trimodal terminal	●	Frankfurt-West
		Frankfurt-Osthafen
Passenger station	○	Frankfurt Hbf
		Frankfurt Süd
Shunting Yard	●	Mainz-Bischofsheim
Airport	●	Frankfurt-Airport
Rail	■ ■ ■	2690, 3520, 3530, 3600, 3601, 3660, 4010
Road	▬	A3, A5
IWW	● ● ●	Main

Corridor	Colour
Rhine-Danube	▬
Rhine-Alpine	▬

Frankfurt/M (Layer II – Analysis of corridor lines)



Planned// TEN-T project ID 6319
Node extension (Rail)

In progress // TEN-T project ID 6027
Frankfurt Stadion – Frankfurt Hbf
- Addition of a new line with two tracks

Planned// TEN-T project ID 9621
A3: AK Offenbach - AK Frankfurter Kreuz, extension of lanes
- Upgrade to 10 lanes

Planned// TEN-T project ID 6338
A3: AS Flughafen Stadt Frankfurt/Main - AD Mönchhof,
- Extension to 8 lanes

- Capacity overstressed (Frankfurt-Süd station)

Planned// TEN-T project ID 9622
A3: AK Offenbacher Kreuz, extension of junction

Planned// TEN-T project ID 9623
A3: AS Hanau - AK Offenbach, extension of lanes
- Upgrade to 8 lanes

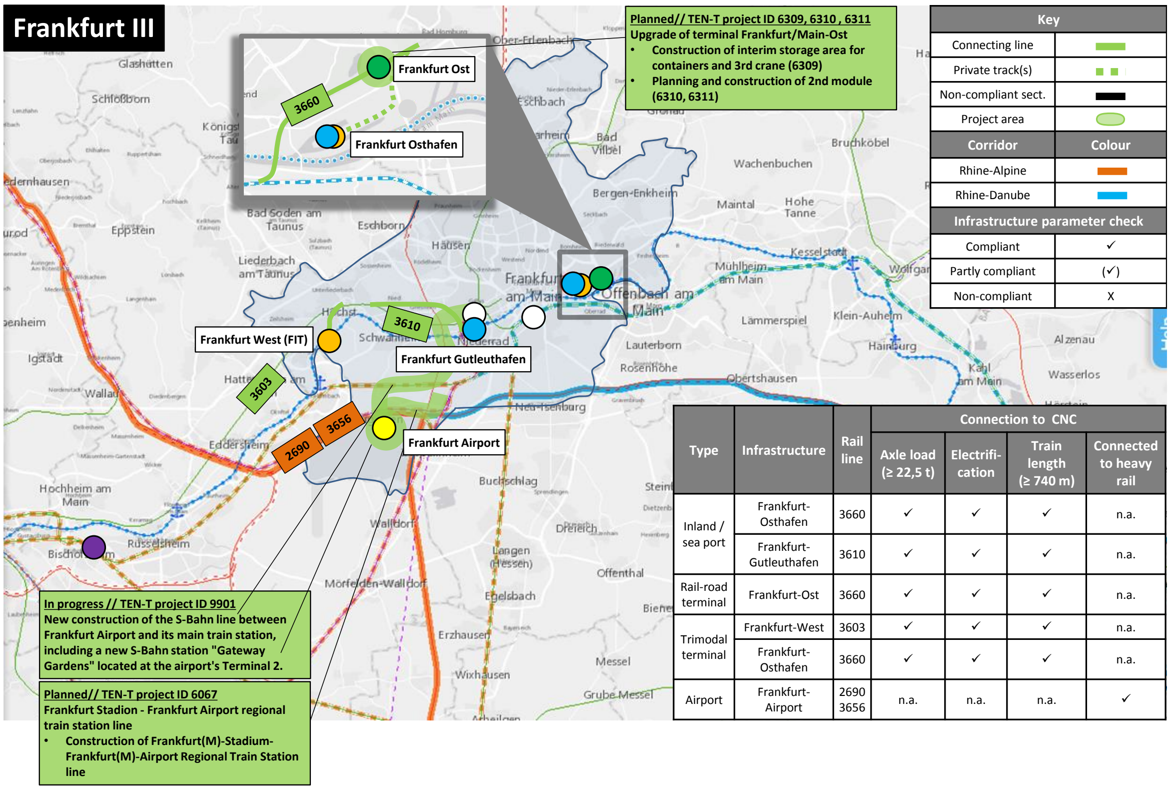
- Capacity overstressed (Mannheim – Frankfurt (Main)-Stadion)

Planned // TEN-T project ID 6851
Development of "Middle Rhine" railway corridor for target network I (Korridor Mittelrhein: Zielnetz I)
- upgrade of Frankfurt-Stadion-Zeppelinheim to 4 tracks
- two track new construction Zeppelinheim-Waldhof (vmax 300 km/h)

Parameter analysis	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	(✓)
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	✓
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Danube	▬
Rhine-Alpine	▬
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Frankfurt/M. (Layer III – Analysis of last-mile connections)



Planned// TEN-T project ID 6309, 6310 , 6311
Upgrade of terminal Frankfurt/Main-Ost

- **Construction of interim storage area for containers and 3rd crane (6309)**
- **Planning and construction of 2nd module (6310, 6311)**

In progress // TEN-T project ID 9901
New construction of the S-Bahn line between Frankfurt Airport and its main train station, including a new S-Bahn station "Gateway Gardens" located at the airport's Terminal 2.

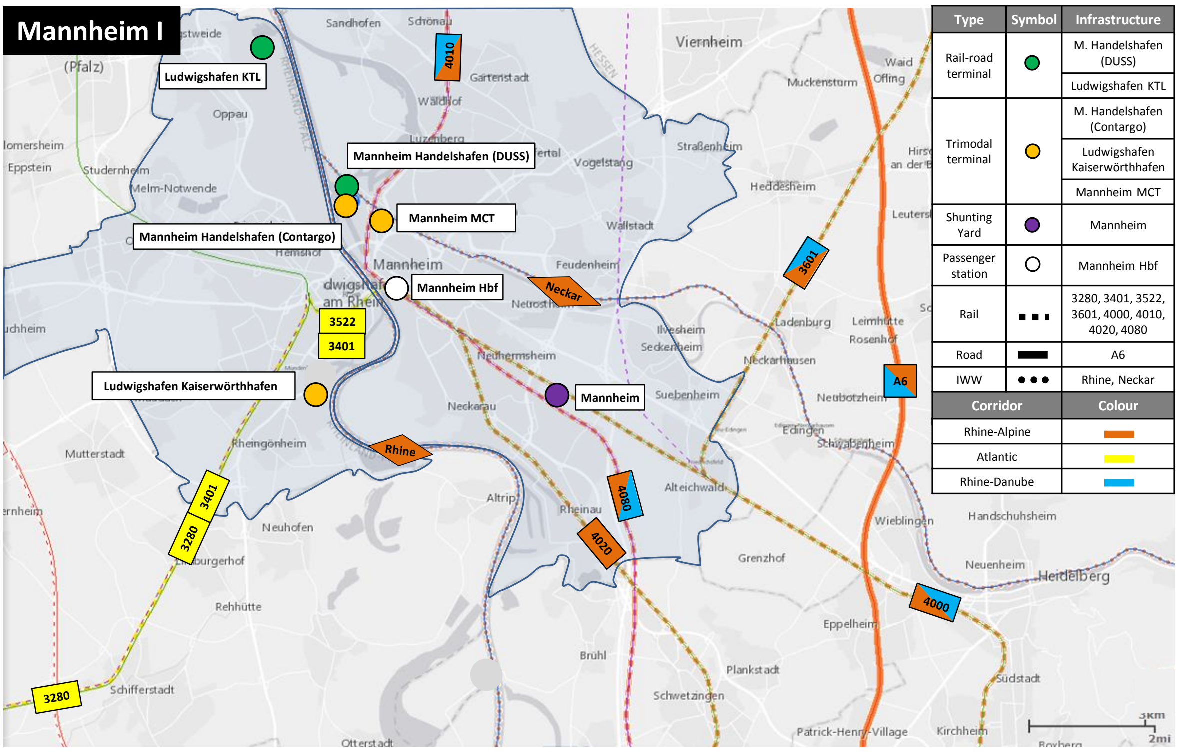
Planned// TEN-T project ID 6067
Frankfurt Stadion - Frankfurt Airport regional train station line

- **Construction of Frankfurt(M)-Stadium-Frankfurt(M)-Airport Regional Train Station line**

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
Rhine-Danube	🟦
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrifi-cation	Train length (≥ 740 m)	Connected to heavy rail
Inland / sea port	Frankfurt-Osthafen	3660	✓	✓	✓	n.a.
	Frankfurt-Gutleuthafen	3610	✓	✓	✓	n.a.
Rail-road terminal	Frankfurt-Ost	3660	✓	✓	✓	n.a.
Trimodal terminal	Frankfurt-West	3603	✓	✓	✓	n.a.
	Frankfurt-Osthafen	3660	✓	✓	✓	n.a.
Airport	Frankfurt-Airport	2690 3656	n.a.	n.a.	n.a.	✓

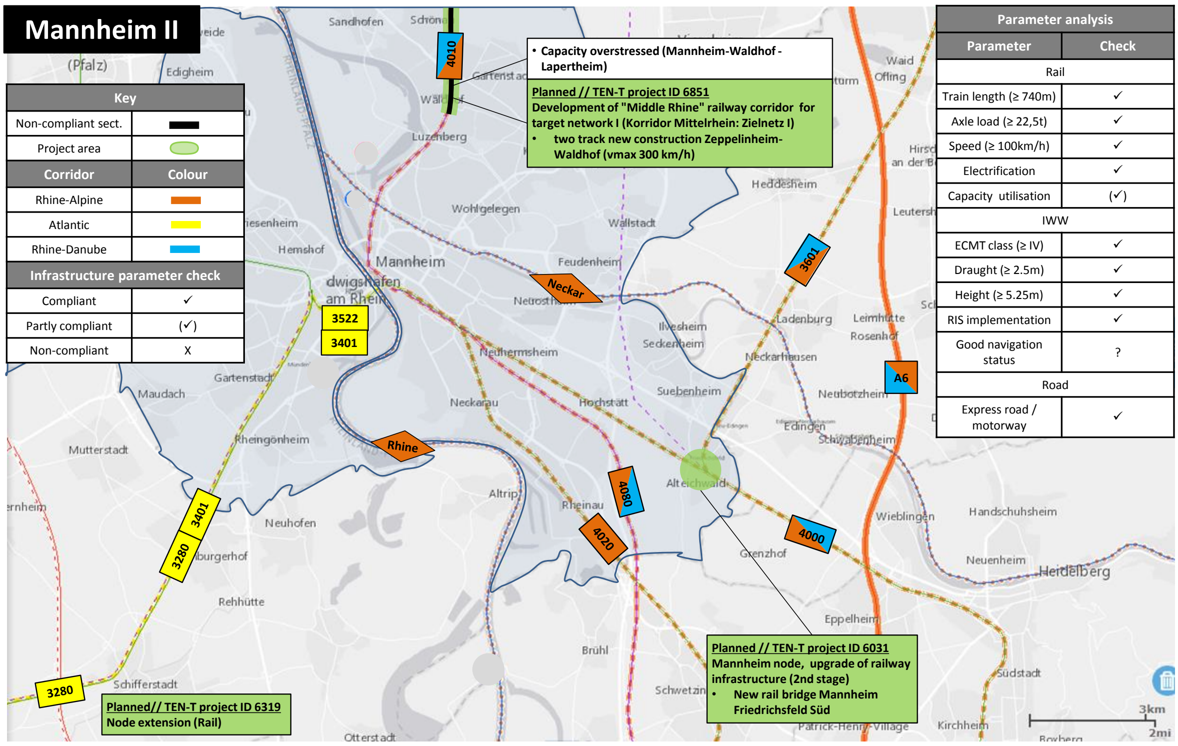
Mannheim (Layer I – Overview on urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Rail-road terminal	●	M. Handelshafen (DUSS)
		Ludwigshafen KTL
Trimodal terminal	●	M. Handelshafen (Contargo)
		Ludwigshafen Kaiserwörthhafen
		Mannheim MCT
Shunting Yard	●	Mannheim
Passenger station	○	Mannheim Hbf
Rail	■ ■ ▪	3280, 3401, 3522, 3601, 4000, 4010, 4020, 4080
Road	▬	A6
IWW	● ● ●	Rhine, Neckar

Corridor	Colour
Rhine-Alpine	🟧
Atlantic	🟨
Rhine-Danube	🟦

Mannheim (Layer II – Analysis of corridor lines)



Key	
Non-compliant sect.	▬
Project area	🟩

Corridor	Colour
Rhine-Alpine	🟧
Atlantic	🟨
Rhine-Danube	🟦

Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

- Capacity overstressed (Mannheim-Waldhof - Lapertheim)

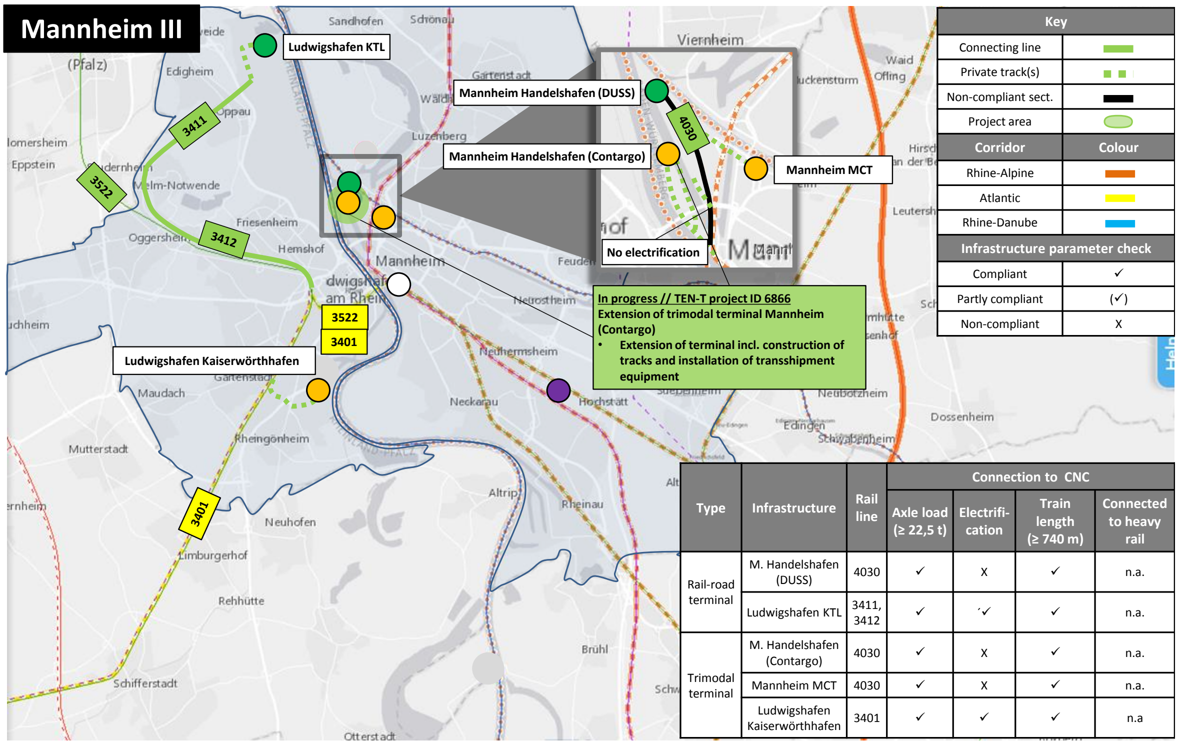
Planned // TEN-T project ID 6851
Development of "Middle Rhine" railway corridor for target network I (Korridor Mittelrhein: Zielnetz I)
- **two track new construction Zeppelinheim-Waldhof (vmax 300 km/h)**

Planned // TEN-T project ID 6031
Mannheim node, upgrade of railway infrastructure (2nd stage)
- **New rail bridge Mannheim Friedrichsfeld Süd**

Planned// TEN-T project ID 6319
Node extension (Rail)

Parameter analysis	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	(✓)
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	✓
RIS implementation	✓
Good navigation status	?
Road	
Express road / motorway	✓

Mannheim (Layer III – Analysis of last-mile connections)

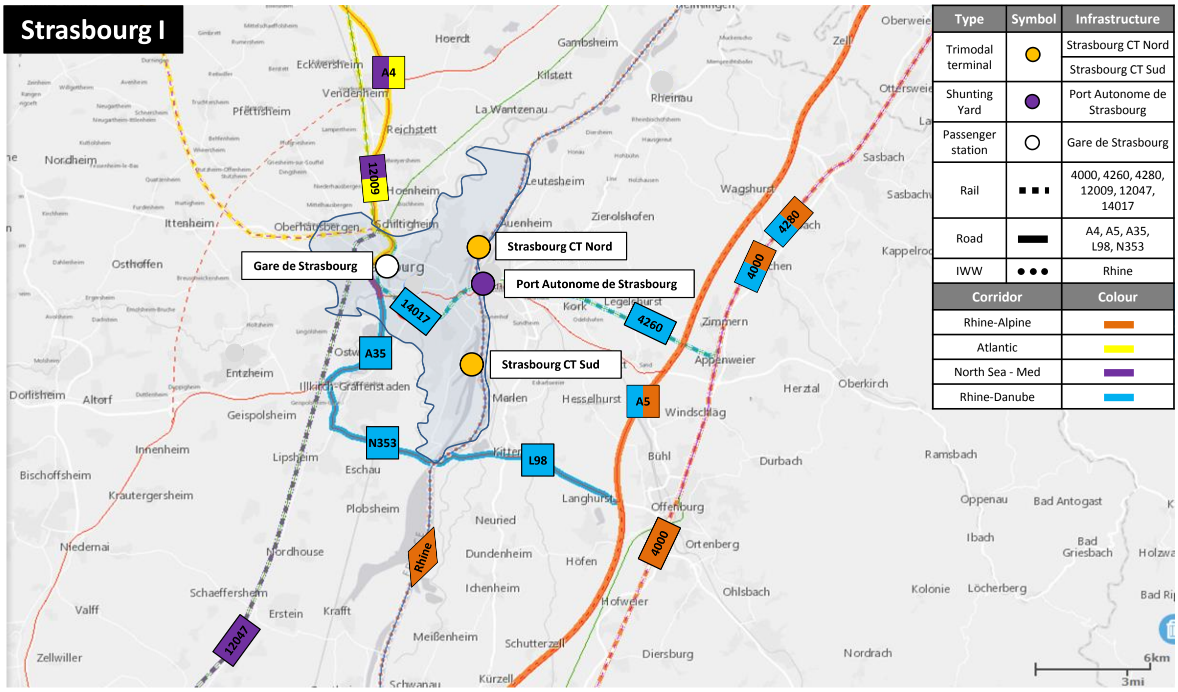


In progress // TEN-T project ID 6866
Extension of trimodal terminal Mannheim (Contargo)
- **Extension of terminal incl. construction of tracks and installation of transshipment equipment**

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
Atlantic	🟨
Rhine-Danube	🟦
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrifi-cation	Train length (≥ 740 m)	Connected to heavy rail
Rail-road terminal	M. Handelshafen (DUSS)	4030	✓	X	✓	n.a.
	Ludwigshafen KTL	3411, 3412	✓	´✓	✓	n.a.
Trimodal terminal	M. Handelshafen (Contargo)	4030	✓	X	✓	n.a.
	Mannheim MCT	4030	✓	X	✓	n.a.
	Ludwigshafen Kaiserwörthhafen	3401	✓	✓	✓	n.a

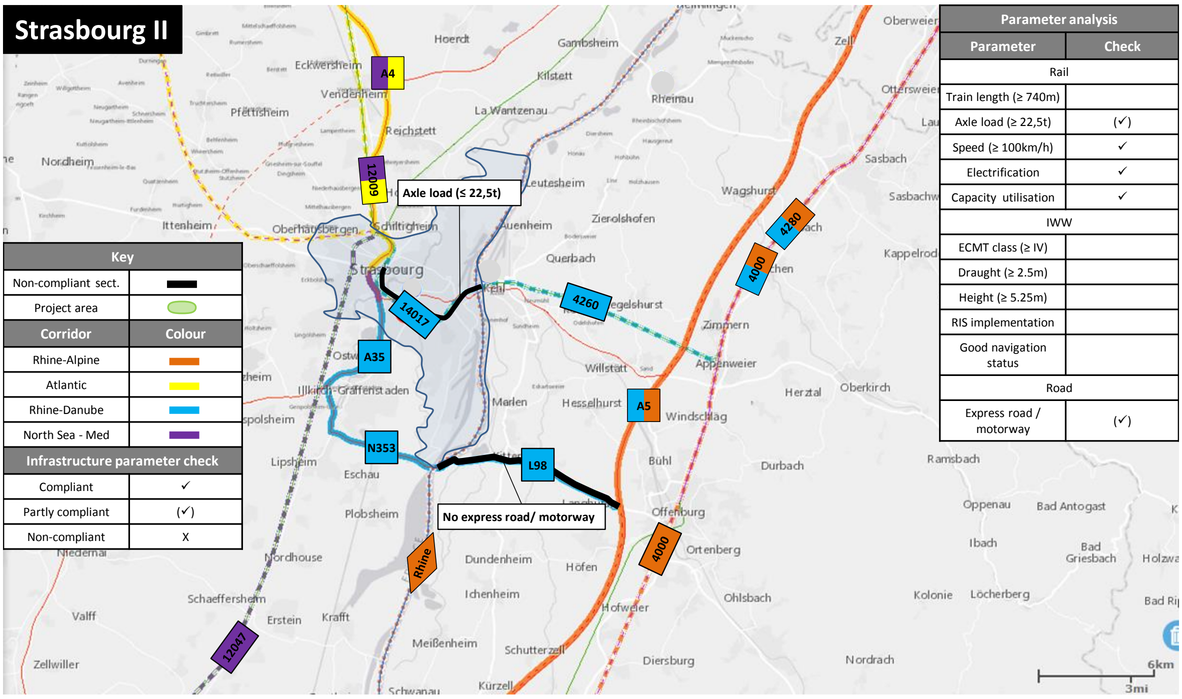
Strasbourg (Layer I – Overview on the urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Trimodal terminal	●	Strasbourg CT Nord
		Strasbourg CT Sud
Shunting Yard	●	Port Autonome de Strasbourg
Passenger station	○	Gare de Strasbourg
Rail	■ ■ ▪	4000, 4260, 4280, 12009, 12047, 14017
Road	▬	A4, A5, A35, L98, N353
IWW	● ● ●	Rhine

Corridor	Colour
Rhine-Alpine	▬
Atlantic	▬
North Sea - Med	▬
Rhine-Danube	▬

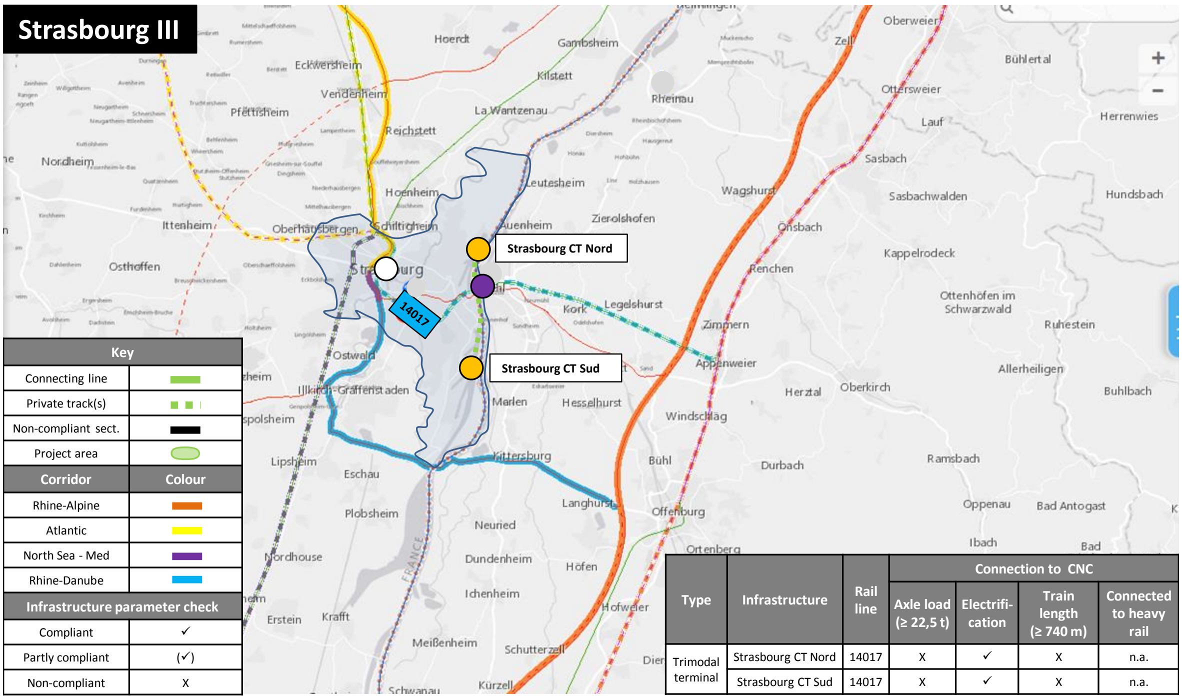
Strasbourg (Layer II – Analysis of corridor lines)



Key	
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	▬
Atlantic	▬
Rhine-Danube	▬
North Sea - Med	▬
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Parameter analysis	
Parameter	**Check**
Rail	
Train length (≥ 740m)	
Axle load (≥ 22,5t)	(✓)
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	✓
IWW	
ECMT class (≥ IV)	
Draught (≥ 2.5m)	
Height (≥ 5.25m)	
RIS implementation	
Good navigation status	
Road	
Express road / motorway	(✓)

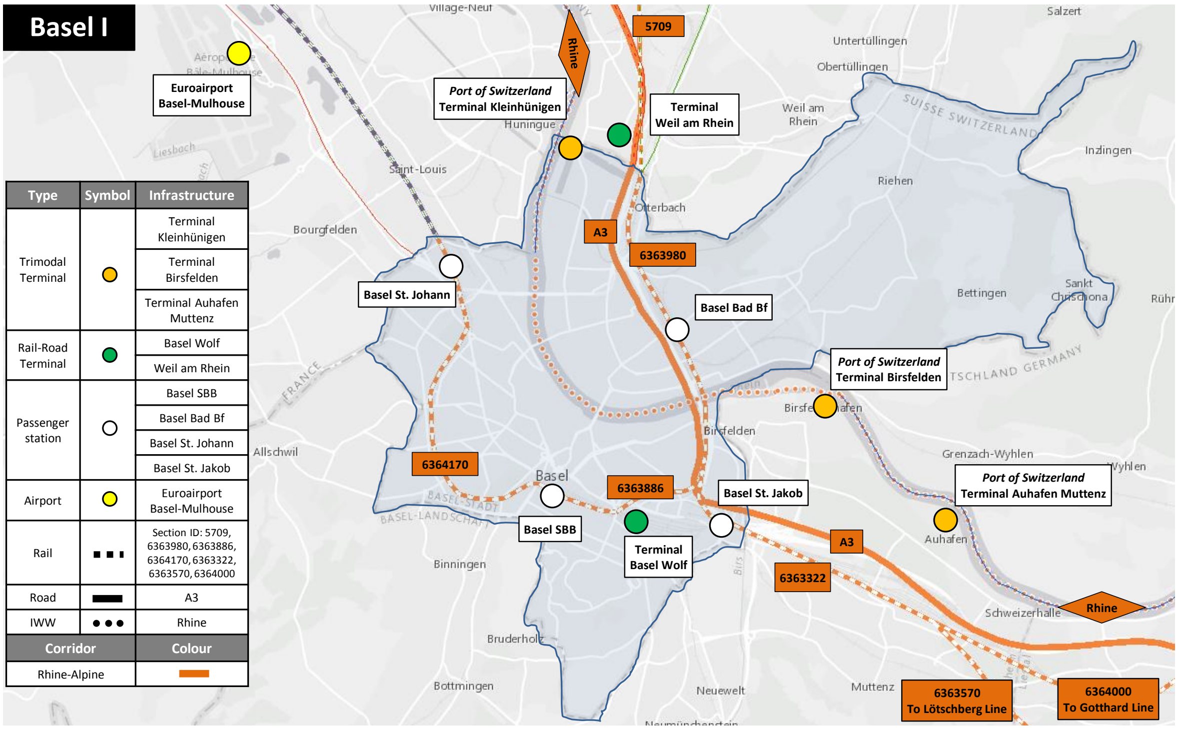
Strasbourg (Layer III – Analysis of last-mile connections)



Key	
Connecting line	▬
Private track(s)	▪ ▪
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
Atlantic	🟨
North Sea - Med	🟪
Rhine-Danube	🟦
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrifi-cation	Train length (≥ 740 m)	Connected to heavy rail
Trimodal terminal	Strasbourg CT Nord	14017	X	✓	X	n.a.
	Strasbourg CT Sud	14017	X	✓	X	n.a.

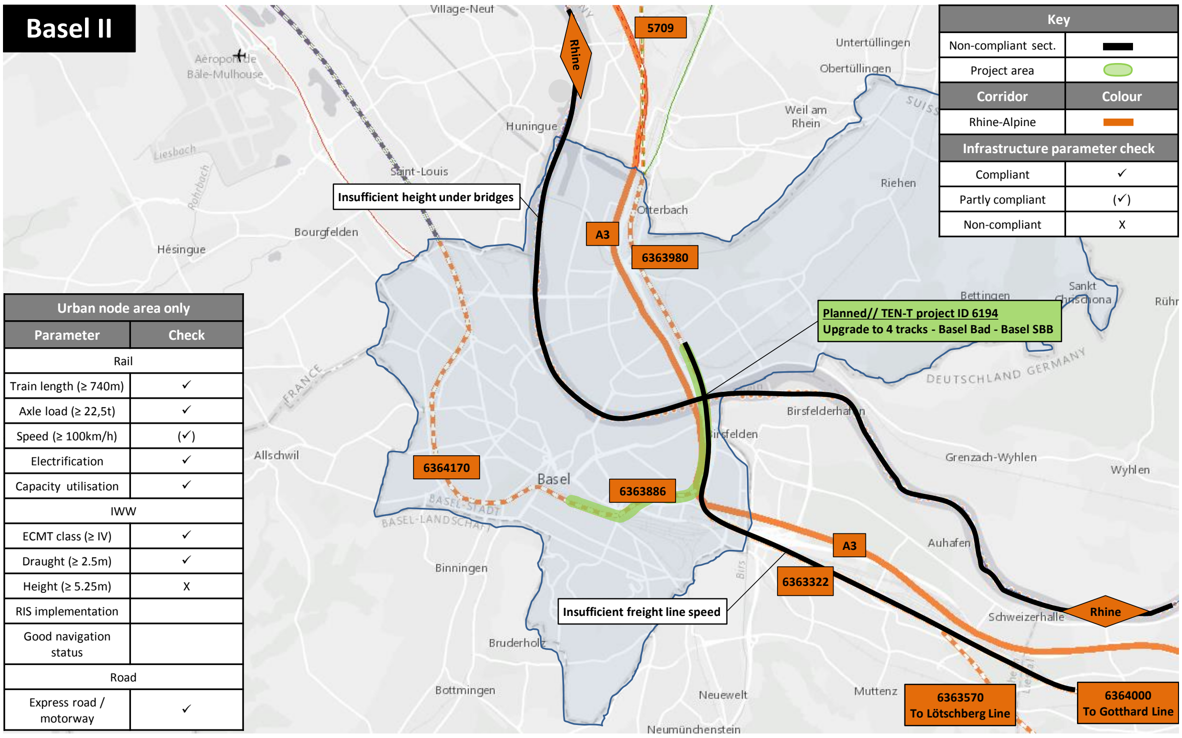
Basel (Layer I – Overview on the urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Trimodal Terminal	●	Terminal Kleinhünigen
		Terminal Birsfelden
		Terminal Auhafen Muttenz
Rail-Road Terminal	●	Basel Wolf
		Weil am Rhein
Passenger station	○	Basel SBB
		Basel Bad Bf
		Basel St. Johann
		Basel St. Jakob
Airport	●	Euroairport Basel-Mulhouse
Rail	■ ■ ▪	Section ID: 5709, 6363980, 6363886, 6364170, 6363322, 6363570, 6364000
Road	▬	A3
IWW	● ● ●	Rhine

Corridor	Colour
Rhine-Alpine	▬

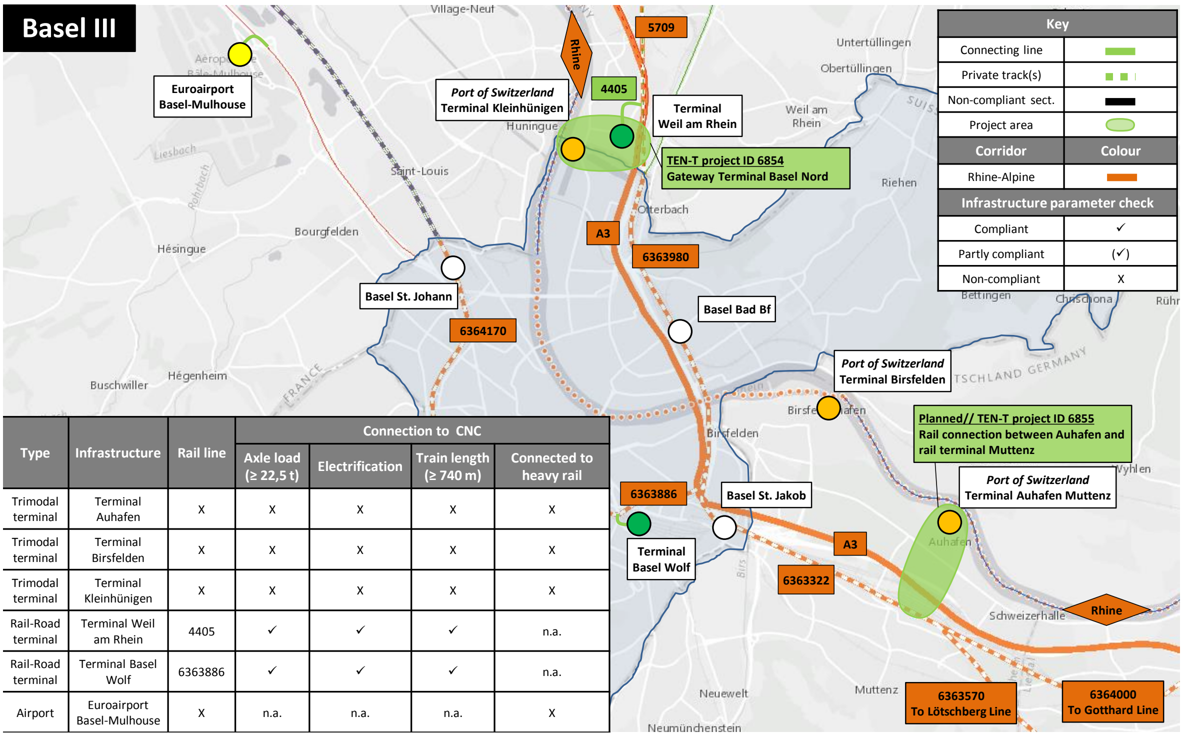
Basel (Layer II – Analysis of corridor lines)



Key	
Non-compliant sect.	▬
Project area	🟩
Corridor	**Colour**
Rhine-Alpine	▬
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

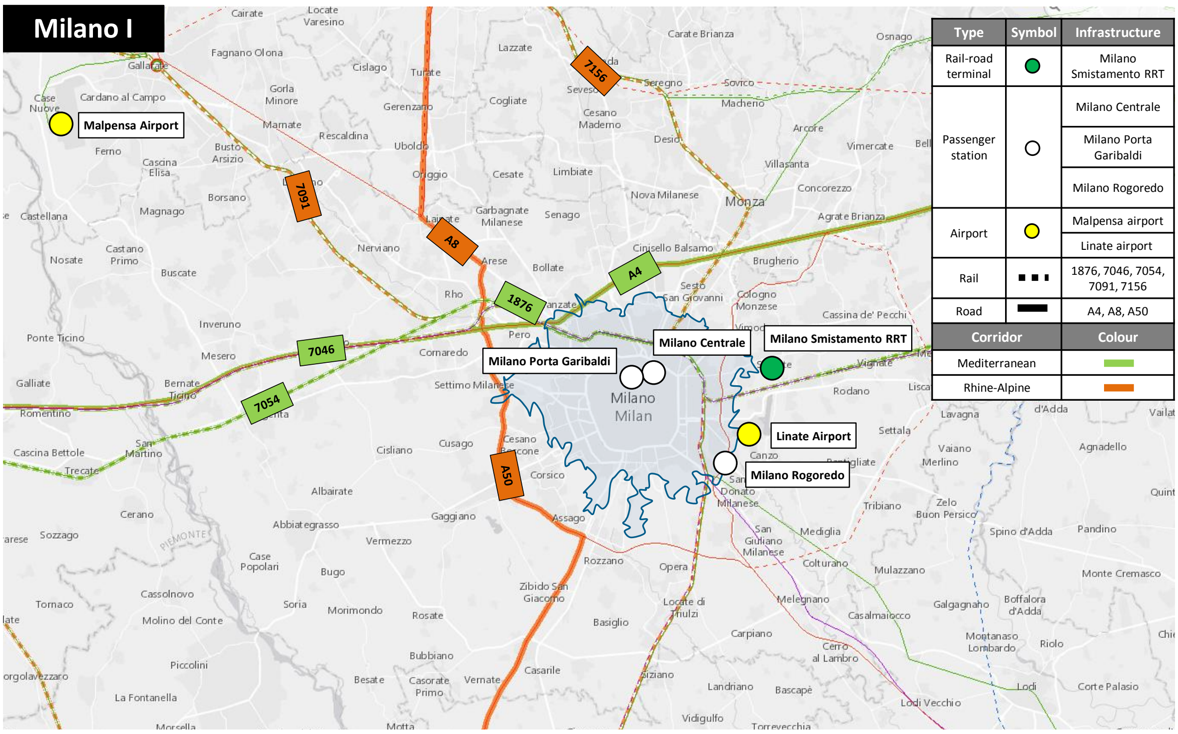
Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	✓
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	(✓)
Electrification	✓
Capacity utilisation	✓
IWW	
ECMT class (≥ IV)	✓
Draught (≥ 2.5m)	✓
Height (≥ 5.25m)	X
RIS implementation	
Good navigation status	
Road	
Express road / motorway	✓

Basel (Layer III – Analysis of last-mile connections)



Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Trimodal terminal	Terminal Auhafen	X	X	X	X	X
Trimodal terminal	Terminal Birsfelden	X	X	X	X	X
Trimodal terminal	Terminal Kleinhünigen	X	X	X	X	X
Rail-Road terminal	Terminal Weil am Rhein	4405	✓	✓	✓	n.a.
Rail-Road terminal	Terminal Basel Wolf	6363886	✓	✓	✓	n.a.
Airport	Euroairport Basel-Mulhouse	X	n.a.	n.a.	n.a.	X

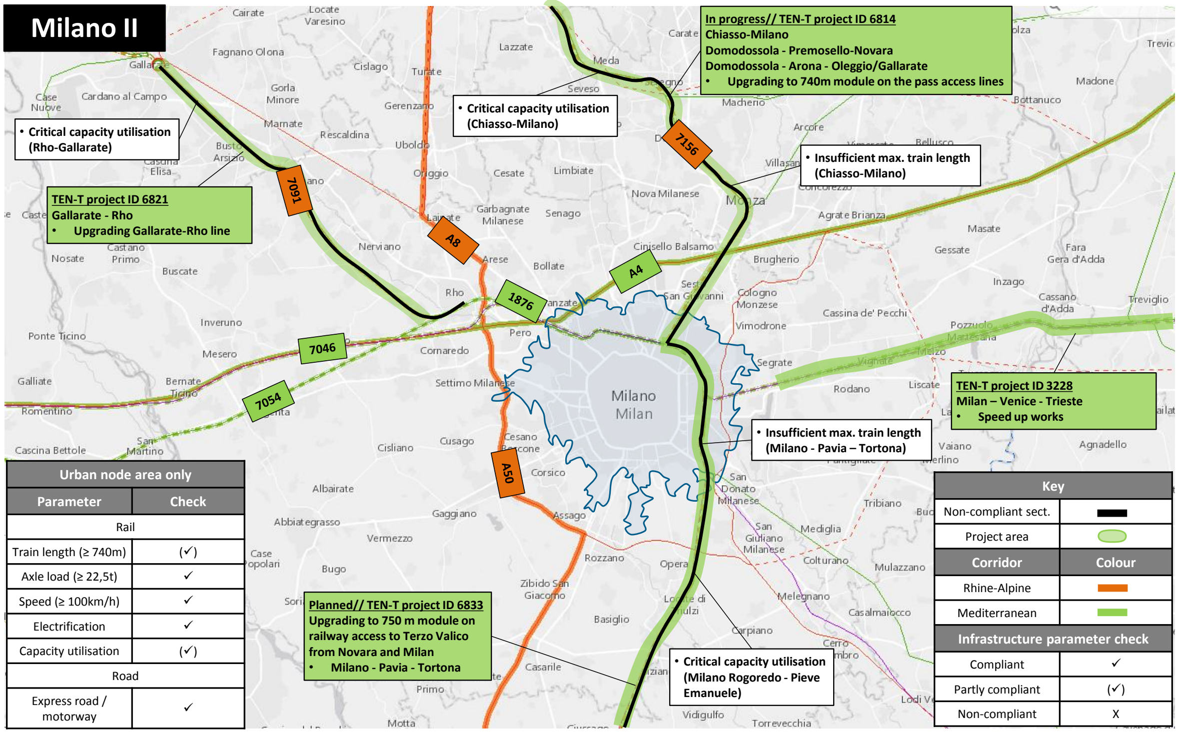
Milano (Layer I – Overview on the urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Rail-road terminal	●	Milano Smistamento RRT
Passenger station	○	Milano Centrale
		Milano Porta Garibaldi
		Milano Rogoredo
Airport	●	Malpensa airport
		Linate airport
Rail	■ ■ ■	1876, 7046, 7054, 7091, 7156
Road	▬	A4, A8, A50

Corridor	Colour
Mediterranean	🟩
Rhine-Alpine	🟧

Milano (Layer II – Analysis of corridor lines)



<u>In progress// TEN-T project ID 6814</u>
Chiasso-Milano
Domodossola - Premosello-Novara
Domodossola - Arona - Oleggio/Gallarate
- **Upgrading to 740m module on the pass access lines**

- **Critical capacity utilisation (Chiasso-Milano)**

- **Critical capacity utilisation (Rho-Gallarate)**

- **Insufficient max. train length (Chiasso-Milano)**

<u>TEN-T project ID 6821</u>
Gallarate - Rho
- **Upgrading Gallarate-Rho line**

<u>TEN-T project ID 3228</u>
Milan – Venice - Trieste
- **Speed up works**

- **Insufficient max. train length (Milano - Pavia – Tortona)**

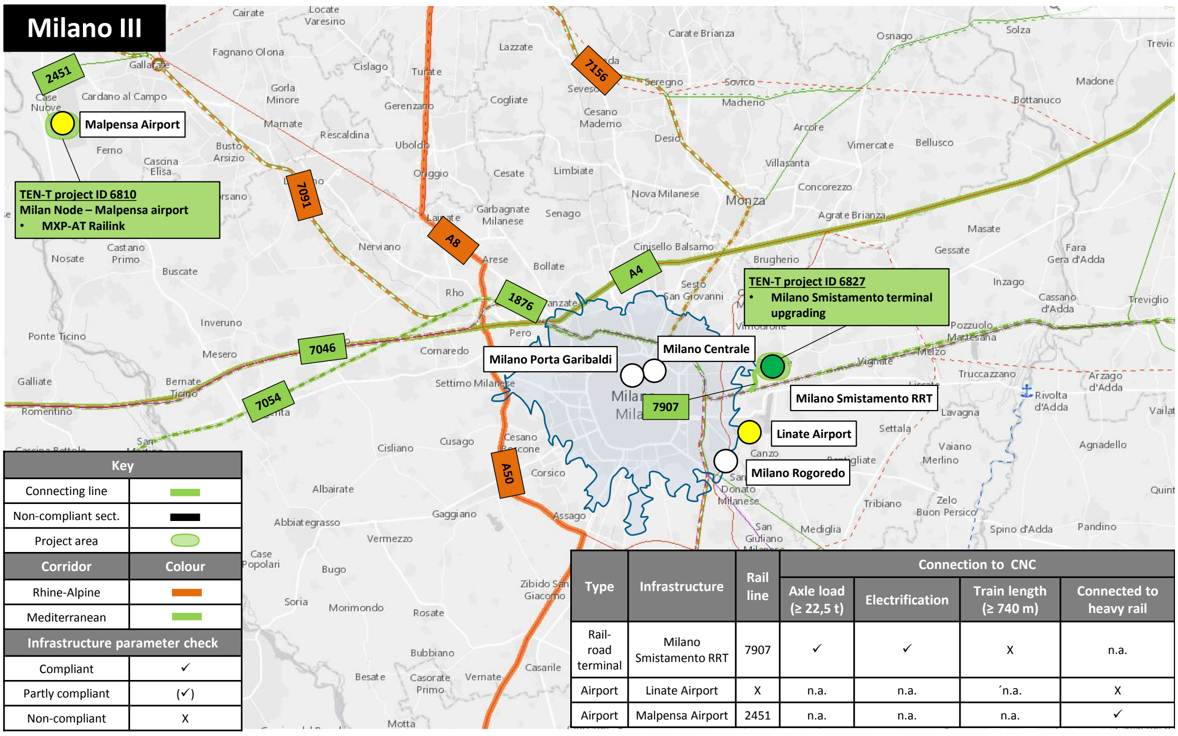
<u>Planned// TEN-T project ID 6833</u>
Upgrading to 750 m module on railway access to Terzo Valico from Novara and Milan
- **Milano - Pavia - Tortona**

- **Critical capacity utilisation (Milano Rogoredo - Pieve Emanuele)**

Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	(✓)
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	(✓)
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
Mediterranean	🟩
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

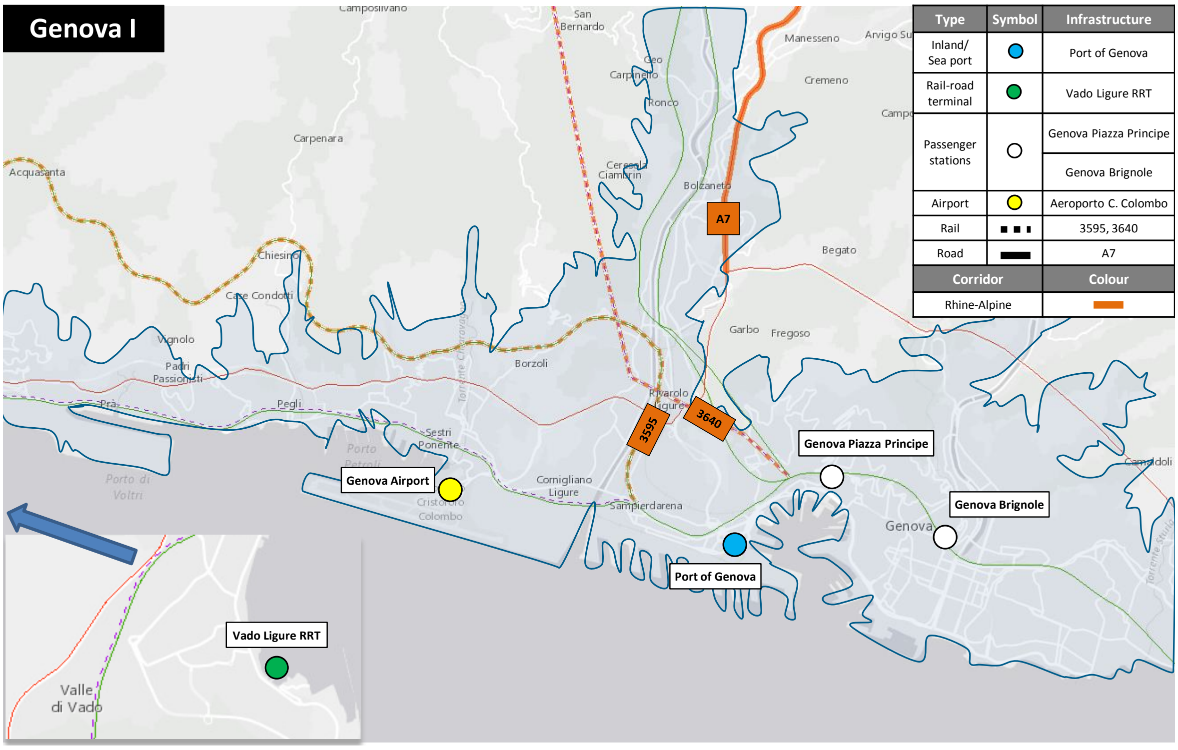
Milano (Layer III – Analysis of last-mile connections)



Key	
Connecting line	🟩
Non-compliant sect.	⬛
Project area	🟢
Corridor	**Colour**
Rhine-Alpine	🟧
Mediterranean	🟩
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Rail-road terminal	Milano Smistamento RRT	7907	✓	✓	X	n.a.
Airport	Linate Airport	X	n.a.	n.a.	´n.a.	X
Airport	Malpensa Airport	2451	n.a.	n.a.	n.a.	✓

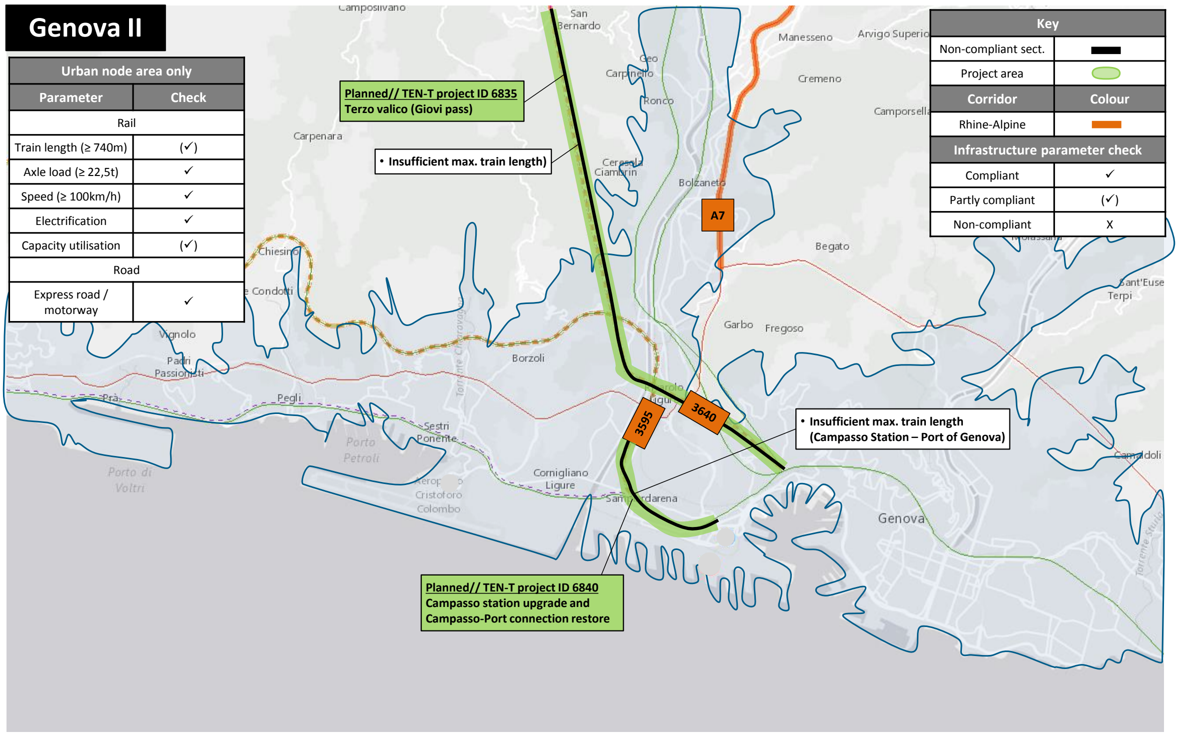
Genova (Layer I – Overview on the urban node including entire corridor infrastructure)



Type	Symbol	Infrastructure
Inland/ Sea port	●	Port of Genova
Rail-road terminal	●	Vado Ligure RRT
Passenger stations	○	Genova Piazza Principe Genova Brignole
Airport	●	Aeroporto C. Colombo
Rail	■ ■ ■	3595, 3640
Road	▬	A7

Corridor	Colour
Rhine-Alpine	▬

Genova (Layer II – Analysis of corridor lines)



Planned// TEN-T project ID 6835
Terzo valico (Giovi pass)

- **Insufficient max. train length)**

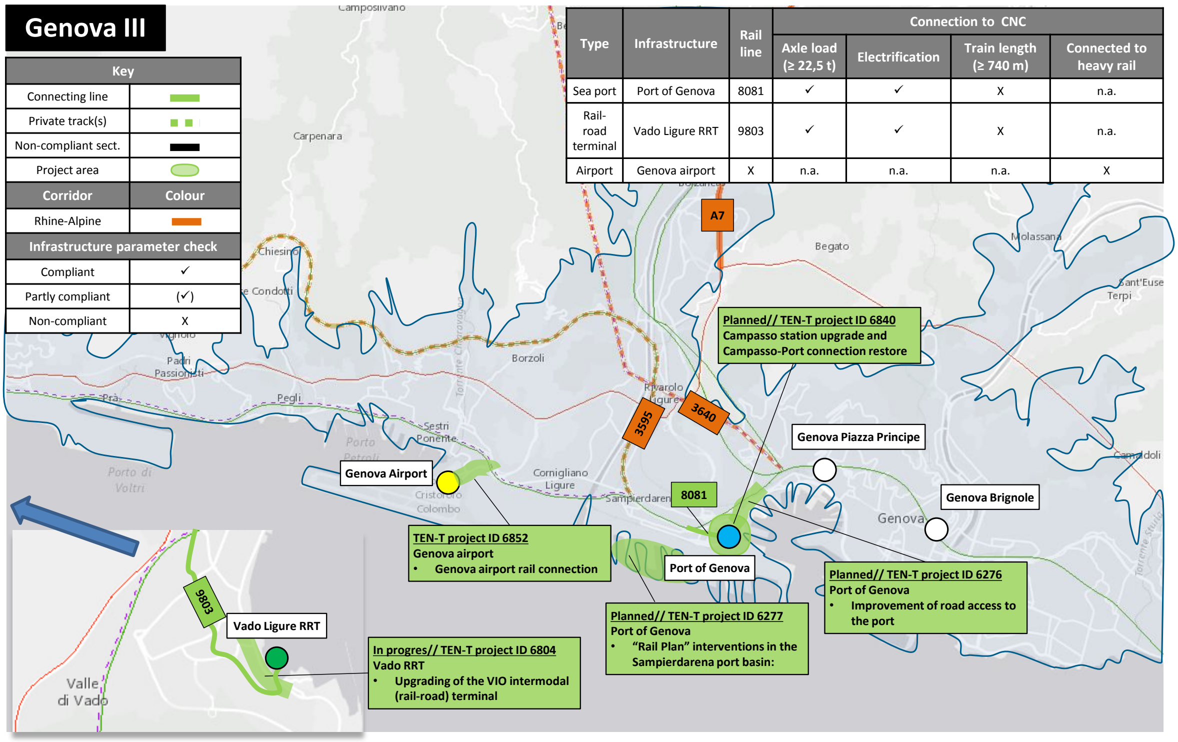
- **Insufficient max. train length (Campasso Station – Port of Genova)**

Planned// TEN-T project ID 6840
Campasso station upgrade and Campasso-Port connection restore

Urban node area only	
Parameter	**Check**
Rail	
Train length (≥ 740m)	(✓)
Axle load (≥ 22,5t)	✓
Speed (≥ 100km/h)	✓
Electrification	✓
Capacity utilisation	(✓)
Road	
Express road / motorway	✓

Key	
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	▬
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Genova (Layer III – Analysis of last-mile connections)



Genova III

Key	
Connecting line	🟩
Private track(s)	▪ ▪
Non-compliant sect.	▬
Project area	⬭
Corridor	**Colour**
Rhine-Alpine	🟧
Infrastructure parameter check	
Compliant	✓
Partly compliant	(✓)
Non-compliant	X

Type	Infrastructure	Rail line	Connection to CNC			
			Axle load (≥ 22,5 t)	Electrification	Train length (≥ 740 m)	Connected to heavy rail
Sea port	Port of Genova	8081	✓	✓	X	n.a.
Rail-road terminal	Vado Ligure RRT	9803	✓	✓	X	n.a.
Airport	Genova airport	X	n.a.	n.a.	n.a.	X

Planned// TEN-T project ID 6840
Campasso station upgrade and Campasso-Port connection restore

TEN-T project ID 6852
Genova airport
- **Genova airport rail connection**

Planned// TEN-T project ID 6277
Port of Genova
- **"Rail Plan" interventions in the Sampierdarena port basin:**

Planned// TEN-T project ID 6276
Port of Genova
- **Improvement of road access to the port**

In progres// TEN-T project ID 6804
Vado RRT
- **Upgrading of the VIO intermodal (rail-road) terminal**