European Commission

Rhine Alpine

Fifth Work Plan of the European Coordinator

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Abbreviations

AGS	Annual Growth Strategy
A-SMGCS	Advanced-Surface Movement Guidance and Control System
ATO	Associated Terminal Operators
bn	Billion
CEF	Connecting Europe Facility
CEF2	Regulation (EU) 2021/1153 of the European Parliament and of the Council establishing the Connecting Europe Facility for the period of 2021-2027
CEMT	Conférence Européenne des Ministres des Transports
CNC	Core Network Corridor
CNG	Compressed Natural Gas
DIP	Detailed Implementation Plan (for Motorways of the Sea)
EDP	ERTMS Deployment Plan
EEAS	European External Action Service
EFSI	European Fund for Strategic Investment
EGD	European Green Deal
EGTC	European Grouping of Territorial Cooperation
EIB	European Investment Bank
EMS	European Maritime Space
ERTMS	European Rail Traffic Management System
ESPORG	European Secure Parking Organisation
ETCS	European Train Control System
EU	European Union
EUROP-E	European Ultra-Charge Roll Out Project - Electric
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GSM-R	Global System for Mobile Communications – Rail(way)
ICT	Information and Communication Technology
ILB	Issues Log Book
IM	Infrastructure Manger
ITS	Intelligent Transport System
IWW	Inland Waterway
km	Kilometre
km/h	Kilometre per hour
KPI	Key Performance Indicator
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
m	Metre
mm	Millimetre
MoS	Motorway(s) of the Sea
NUTS	Nomenclature des Unités Territoriales Statistiques (hierarchical system for dividing up the economic territory of the EU and the UK)
RFF	Recovery and Resilience Facility
RIS	River Information System
RSS	Randstad Rail Project
SSMS	Sustainable and Smart Mobility Strategy
SUMP	Sustainable Urban Mobility Plan
TEN-T	Trans-European Transport Network
TENtec	The European Commission's Information System to coordinate and support the Trans-European Transport Network Policy

Country Codes after ISO 3166:

BE	Belgium
CH	Switzerland
DE	Germany
FR	France
IT	Italy
NL	The Netherlands
UK	United Kingdom

1 Towards the Rhine-Alpine Corridor Fifth Work Plan

1.1 Introduction

Since the finalisation of the Fourth Work Plan of the Rhine-Alpine Corridor in 2020, important events have occurred, which affected our lives, transport and the economy in general. The **COVID-19 pandemic** marked this period with unprecedented border closures, movement restrictions and serious disruption of supply chains that led temporarily to a significant reduction[1] of the traffic volume. To keep freight moving freely and efficiently across the EU, the European Commission adopted the **Green Lanes initiative** in March 2020, which was then further extended in October 2020 to ensure an EU-wide multimodal connectivity. The logistic chains have not yet fully recovered.

Russia's invasion of Ukraine, which was launched on 24 February 2022, has brought disruptive effects not only in the European Union but also globally, resulting in humanitarian, food and energy crises, as well as in sharp price increases of the key commodities. European mobility of people and goods has also been affected by interrupted logistical chains, issues related to fuels supplies and drastic increase in fuel prices. In the aftermath of the unjustified Russian aggression on Ukraine, EU leaders agreed at the informal summit in Versailles to bolster European economic resilience, radically reduce our energy imports from Russia and move ahead with a serious strengthening of the European defence.

This period has also been marked by important political developments. In particular, the European Commission adopted the **European Green Deal (EGD)** in December 2019, which sets the overarching objective for the EU to become the first climate-neutral continent by 2050. For transport, it foresees a 90% reduction in emissions to be achieved in the perspective of 2050. Subsequently, the Commission proposed the **Sustainable and Smart Mobility Strategy (SSMS)** presenting concrete actions in the field of transport to contribute to the goals set in the EGD. The Strategy set tangible targets concerning the modal shift and travel by rail to be reached by 2030 and 2050, with ways to achieve those goals including recommendation to better align the Core Network Corridors with the Rail Freight Corridors.

In July 2021, the European Union adopted two important legislative documents: the new Connecting Europe Facility Regulation **(CEF 2)**[2] and the **Smart TEN-T Directive**[3]**.** The **CEF 2** describes the new financial framework of the use of the EU funds in supporting the development of the TEN-T network in line with the EGD objectives for the period of 2021-2027. The **Smart TEN-T Directive** sets out the streamlining measures aimed at reducing delays encountered in the implementation of TEN-T projects.

Lastly, the European Commission presented the **revised Regulation for the development of the trans-European transport network (new TEN-T)** on 14 December 2021. The new TEN-T Regulation aims primarily at reinforcing the contribution of the TEN-T to decarbonisation and digitalisation objectives of transport policy (please see more detailed information on this in chapter 6).

The **Fifth Work Plan of the Rhine-Alpine Corridor** includes the ramifications of the above mentioned EU legislation that have been up-to-date approved, but also

[1] To be noted that for instance, rail freight transport from the Rotterdam Port to Germany and vice-versa increased by 7% in 2021 compared to 2020, and by 3% comparing to the 2019 pre-pandemic year

[2] Regulation (EU) 2021/1153 of the European Parliament and of the Council establishing the Connecting Europe Facility for the period of 2021-2027

[3] Directive (EU) 2021/1187 on streamlining measures for advancing the realisation of the trans-European transport network) was formally adopted by the European Union (EU)

considers the evolving policy context that gave the inspiration in drafting the new TEN-T Regulation.

This document is focusing on the current and future compliance issues within the Rhine-Alpine Corridor, identifies the persisting bottlenecks, as well as presents the most important recommendations regarding projects implementation, financing and funding. It also addresses key aspects related to the deployment of alternative fuels, the development of urban nodes, the Green Deal and the Recovery and Resilience Fund, the new CEF2 Regulation, and the inclusion of the military mobility in the network development.

As the previous Work Plans, this Work Plan takes into account results of many discussions I have had with ministers, officials and stakeholders from the Corridor countries. In particular, the results of consultations in the Corridor Fora and three working groups that focused on resilience, rail capacity and progress of selected infrastructure projects have substantially contributed to this Work Plan. In addition, I was honoured to host discussions on the challenges of rail on board of the **Connecting Europe Express** train. This train travelled for 36 days across 26 countries and it visited more than 100 cities and towns. Among those were important urban nodes along the Rhine-Alpine Corridor, including Milan, Genova, Basel, Karlsruhe, Frankfurt, Amsterdam, Rotterdam, Antwerp and Brussels. All of those meetings, by creating opportunities to exchange views among a significant number of stakeholders, shed light of some new ideas. With all of those contributions and invaluable assistance of the team of consultants, I was able to draft the Fifth Work Plan.

1.2 Achievements along the Corridor

Since the last Work Plan, 61 projects with a total investment of € 8.65 billion have been finalised between January 2019 and June 2021. An important share of these projects referred to works. These finalised projects are distributed quite evenly along the Corridor. With a combined share of more than 50%, 'Road' and 'Rail' together with the 'ERTMS' clearly dominated within the group of finalised projects. In terms of road projects, the focus has been given to clean fuels and the implementation of Intelligent Transport Systems (ITS), while the removal of capacity bottlenecks represented the largest group of projects in rail transport. IWW projects concentrated on capacity improvement and further introduction of clean fuels for this transport mode. Moreover, the completed projects focused also on the improvement of transhipment nodes.

The following projects, which have the most significant impact on the Corridor, were finalised between 2019 and summer 2021 (with the total costs in brackets):

* **Ceneri Base tunnel in Switzerland** (€ 3.6 billion): the opening of the Ceneri Base tunnel aimed at increasing capacity for freight traffic and shortening travel time for passenger traffic by the removal of the physical bottlenecks between Bellinzona and Lugano.
* **Vleuten-Geldermalsen in the Netherlands** (€ 898 million): a package that includes the Second Tactical Package Project on the rail section between Vleuten-Geldermalsen and the Randstad Rail project (RSS) phase that improves the accessibility of the Utrecht region. In addition, the expansion of the track was necessary for the capacity and the reliability of the national grid.
* **Basel - Bellinzona – Chiasso in Switzerland** (€ 700 million): an upgrade to P400 in the rail section between Basel and Chiasso that aimed at increasing the market share of intermodal transport.
* **Eppenbergtunnel in Switzerland** (€ 700 million): the opening of the Eppenbergtunnel that aimed at increasing capacity for rail freight and to shortening travel time for passenger traffic.

- **Ponte di Genova San Giorgio in Italy** (€ 437 million): the new 'Ponte di Genova San Giorgio' motorway bridge in Genova as a reconstruction of the 'Ponte Morandi Bridge'.
- **Lek Canal in the Netherlands** (€ 415 million): the increase of capacity of Princess Beatrix Lock and extension of the Lek Canal on the north side of the locks to both ensure CEMT class VI navigation and extend capacity for additional mooring places.
- **Port of Antwerp in Belgium** (€ 100 million): an upgrade of the shunting yards and junctions in the Port of Antwerp, to improve rail freight yard capacity and insufficient last-mile connection to port areas.

The implementation of the projects listed above, which comprised mostly infrastructural and therefore relatively costly measures, has a significant impact on the improvement of the Corridor infrastructure and enhances its functioning.

2 Characteristics of the Rhine-Alpine Corridor

The Rhine-Alpine Corridor is the shortest of the nine core network corridors. At the same time, it runs through some of the most densely populated and economically strongest regions in Europe. Along the Corridor, 138 billion tonne-kilometres of freight are transported annually. The regions of the Corridor generate a GDP of more than € 3.1 trillion, representing 20% of the EU's total[4]. Altogether, more than 70 million people live and work in the catchment area of the Rhine-Alpine Corridor. Leading manufacturing and trading companies, production plants and distribution centres are located within the Corridor. It corresponds largely to 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 Genova regions in northern Italy.

The Rhine-Alpine Corridor includes two of Europe's largest ports: Rotterdam and Antwerp. Together, they handled 667.7 million tonnes in 2020. The other six ports of the Corridor (Ghent, Zeebrugge, Amsterdam, Moerdijk, Vlissingen and Genova) added another 282.9 million tonnes, which means that some 950 million tonnes of hinterland traffic entered or left the Corridor in 2020. The Corridor includes six of the top ten EU airports in terms of freight: Frankfurt, Amsterdam, Köln/Bonn, Liège, Brussels, and Milano Malpensa. Together, they transported 56.7 million passengers and handled 6.5 million tonnes of cargo and mail in 2020.

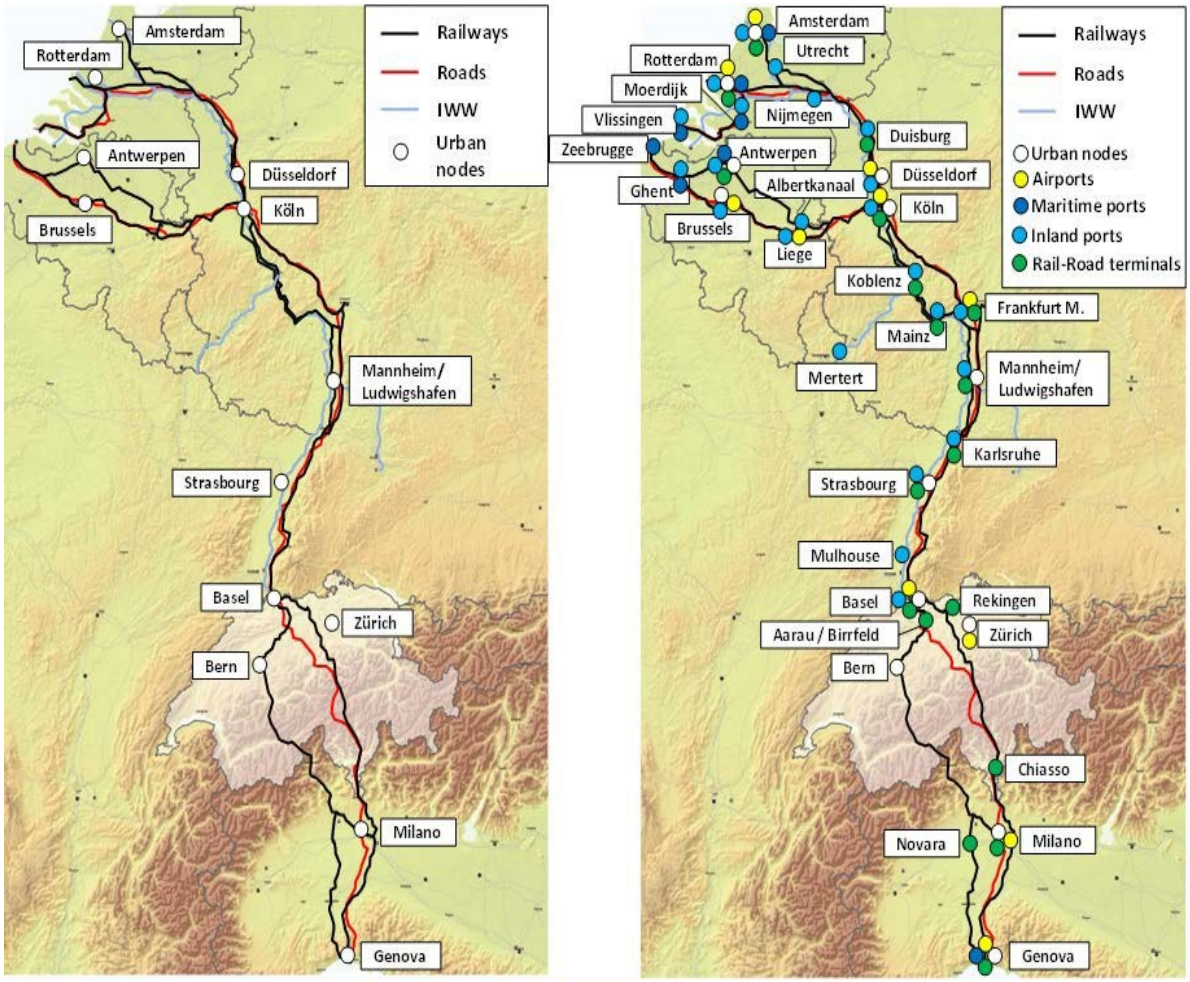
2.1 The Corridor alignment under CEF2

The Rhine-Alpine Corridor runs through five Member States and Switzerland. France has been added to the catchment area of the Corridor considering the relevance of its inland waterways and ports along the Rhine River. Moreover, the Mosel and Neckar Rivers in Germany as well as Luxembourg's inland port of Mertert are included in the Corridor. Inland waterways in Belgium are included in the North Sea-Mediterranean Corridor but are also of importance for further development of this Corridor.

The particularity of the Rhine-Alpine Corridor is the partnership with Switzerland, which provides high-quality multimodal infrastructure. Swiss representatives are members of the Corridor Forum and Swiss projects are included in the analysis of the Corridor infrastructure.

[4] 2017 Eurostat data for GDP at current market prices by NUTS 2 regions of the EU, located along the Rhine-Alpine Corridor, excluding Switzerland

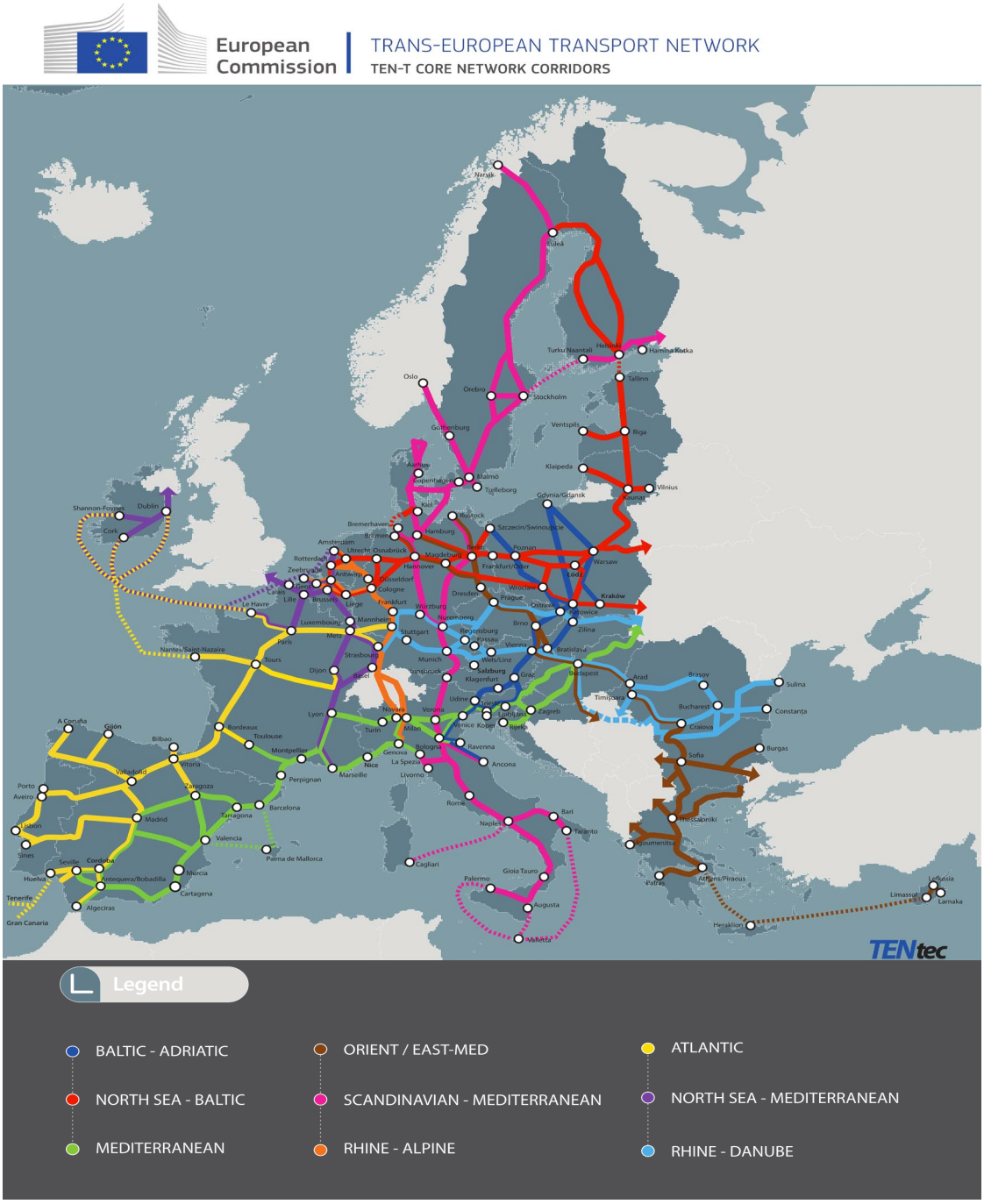
Figure 1: Alignment of the Rhine-Alpine Corridor



Source: Regulation (EU) 1316/2013 Annex 1, Part 1 / Hacon

As mentioned in the introductory part of this Work Plan, the CEF2 Regulation has been revised in 2021. The modified alignment of the core network corridors in CEF2 has only a minimal impact on the Rhine-Alpine Corridor: no new sections have been added. An existing section between Milano and Genova is now shared with the Mediterranean Corridor.

Figure 2: TEN-T core network corridors including CEF2 extensions



Source: TENtec, European Commission

2.2 Compliance with the technical infrastructure parameters of the TEN-T guidelines in 2021

The Rhine-Alpine Corridor is among the most mature TEN-T corridors with both the linear and nodal infrastructures well developed. The compliance analysis is performed based on the KPI requirements formulated within TEN-T Regulation[5]. The results of this analysis demonstrate that only a few issues have to be addressed for the Corridor to fully comply with these requirements.

Table 1 gives an overview of the analysed parameters per mode and country. For each parameter, the status of compliance regarding the Regulation targets is indicated.

Table 1: Compliance with the TEN-T requirements (2021)

	NL	BE	DE	FR	CH	IT	Total
Railways							
Train length ≥ 740 m	100%	100%[6]	100%[7]	-	100%	4%	87%
Line speed ≥100 km/h	96%	82%	100%[8]	-	90%	100%	95%
ERTMS deployment	See chapter 3.2						
Roads							
Availability of clean fuels[9]	available	available	available	-	available	available	100%
Inland waterways[10]							
Min. draught 2.5 m	100%	-	77%	100%	100%	-	85%
Min. height under bridges 5.25 m	100%	-	100%	100%	100%	-	100%

Source: TENtec /Rapp Trans

Rail compliance

The electrification of the core lines is completed. The track gauge of 1,435 mm is the established standard on the Rhine-Alpine Corridor. Freight line speed of 100 km/h is realised on 95% of the Corridor with only a few exceptions. A few sections in the Netherlands, Belgium and Germany do not allow higher speed, due to narrow curves and intersections or for operational reasons. Freight line speeds are restricted on few sections in Belgium, Switzerland and in the Netherlands on the line leading to the Port of Vlissingen, as well as in some sections around the Genova node in Italy. These sections with lower speed are not deemed problematic by the infrastructure manager because they are separate freight lines.

The general fulfilment of axle load of 22.5 tonnes and line speed requirements is very high on the Rhine-Alpine Corridor with only a few sections needing upgrade.

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5 Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU

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

7 See footnote above

8 There are some speed limit restrictions at junctions around Köln (10 km in total)

9 The TEN-T Regulation does not distinguish between different types of alternative fuels. Neither does it define the term 'availability'. Therefore, the notion 'available' does not necessarily mean that the demand for a particular type of alternative fuel is met

10 Belgian inland waterways are not part of the alignment of the Rhine-Alpine Corridor

Italy's rail sections do not enable operations of 740 metre-long trains. However, an increase in track length to accommodate such trains is planned on most sections by the first half of the 2020s. In Switzerland, 740 metre-long trains are operating on the entire core network as of the end of 2016. In Belgium, these trains cannot be operated during peak-hours. However, investments are expected to facilitate the movement of 740 metre-long trains on the Belgian part of the rail freight network in the Corridor. In Germany, 740 metre-long trains can be operated at certain times in line with the timetable. Projects exist to address this problem, however their completion is not expected before 2035. In the Netherlands, although the Dutch network is in principle suitable for running 740 metre-long trains, sidings of sufficient length are lacking on certain routes. This mainly concerns the route Rotterdam – Venlo (Brabant route) and Rotterdam/Amsterdam – Bad Bentheim (part of the North Sea-Baltic Corridor). While some terminals in the Port of Rotterdam have the infrastructure to handle 740 metre-long trains, the majority of the railway shunting and marshalling yards in this seaport do not meet the TEN-T specification for 740 metre-long trains.

Rail interoperability is further complicated by the difference in electrification systems between participating countries, which potentially hinders border crossings, requiring railway undertakings to use dedicated locomotives or train outfits. Besides technology more cross-border cooperation between operators and terminals and further digitalisation is needed..

IWW compliance

For **inland waterways**, which represent approximately 25% of the Corridor length, the main objective is to ensure reliable navigation along the Rhine River. All parameters are already compliant, except for the target draught of at least 2.5 m all year round that is not achieved on the section between Iffezheim and Duisburg in Germany. This has negative implications on an extended section of the river. While there are projects to improve the situation, they will not guarantee the compliance with the target value of 2.5 m all year round. Moreover, additional measures may be needed in the future to make waterways resilient to climate change.

On the Neckar River, the requirements concerning the waterway parameters of the TEN-T Regulation currently in force are met. Due to the increasing traffic of larger barges on the Moselle River, lock capacity is insufficient and limits the operational volume on the river. New lock chambers are needed between Koblenz and Trier in Germany to adjust to the demand.

In the Netherlands, LNG fuels are available along the rivers and canals, while truck-to-ship bunkering is available in the ports of Amsterdam and Rotterdam. Other supply chains for the LNG infrastructure establishment are currently being studied. Next to LNG, the first steps are taken to use hydrogen and battery electric sailing for vessels. River Information Service (RIS) is implemented on all Dutch waterways in the core network. Germany reports that the deployment of alternative fuels along the rivers is being studied, while the RIS is implemented on all German waterways in the core network. The EU funded project – DIWa - has been started to develop a masterplan for the further digitalisation of inland waterways with the neighbouring waterways and shipping administrations of France, Belgium, the Netherlands and Austria.

Road compliance

The Corridor's extensive road network mostly fulfils the TEN-T requirements. Almost all road sections (1,721 km) are categorised as motorways. However, road capacity bottlenecks are common. Serious traffic congestion problems occur along many highway sections, in particular around urban nodes. They are often due to intense mixed transit and local traffic during peak hours. As some of the road infrastructure is worn, significant maintenance work must be performed despite capacity limitations

that contribute to heavy traffic at several sections of the Rhine-Alpine Corridor to ensure the performance of our Corridor.

In the east of the Netherlands, the connection between the A15 motorway linking Arnhem and the German border is still not completed. It is expected to be finished before 2026, which would make the TEN-T road network fully compliant.

The availability of clean fuels along the road sections is in good progress. Further development depends on various factors, such as number of vehicles suited for alternative fuel propulsion and prices for the alternative fuels. Alternative fuels (CNG, LPG and LNG) infrastructure and electric charging stations are widely available in all the Rhine-Alpine Corridor countries, although the coverage of stations along the Corridor differs from section to section. Most of these stations are located near urban nodes. The capacity for fuel and charging stations has been improved and is expected to be improved even further until 2030. Further investments are necessary to diversify the alternatives to enhance decarbonisation, especially for heavy duty transport.

Ports compliance

For the eight seaports of the Corridor located in Antwerp, Ghent, Zeebrugge, Amsterdam, Moerdijk, Rotterdam, Vlissingen and Genova, no current compliance issues were identified. Nevertheless, there is a huge problem with congestion for barges in ports such as Rotterdam and Antwerp with long waiting times (many days) for barge operators at the terminals in the ports.

All ports are connected to the rail network through intermodal facilities. The connection of seaports for mass freight transport (sea, inland waterways, and rail) is critical for several reasons. From a European perspective, it guarantees freight traffic to and from the economic regions along the Corridor. It also improves the sustainability of transport by lowering the road share and subsequently reducing environmental impacts and road congestion. Lastly, it guarantees the competitiveness of seaports.

Currently, the availability of clean fuels in the seaports of the Corridor is difficult to assess due to the lack of information from a centralised database. The ports of Rotterdam, Amsterdam, Antwerp (bunkering operations for inland vessels) and Zeebrugge report the availability of LNG. Projects are scheduled for 2025 to establish access to cleaner fuels in multiple ports.

Airport compliance

Airport infrastructure on the Rhine-Alpine Corridor is well established and it provides reliable long-distance connections. These infrastructure conditions lead to an intensive competition between all relevant transport modes along the Corridor for both passenger and freight transport.

Along the Rhine-Alpine Corridor, 13 airports are considered, out of which seven fall under the obligation of art. 41.3 of the TEN-T Regulation to be connected by rail by 2050. The airports of Amsterdam, Brussels, Frankfurt, Düsseldorf, Köln-Bonn, Zürich[11] Malpensa (Milan) and Linate (Milan) are the EU's main airport hubs for passenger transport, and all of them except for the Linate Airport have direct rail connections. The Linate Airport will have an underground metro line, which will be interconnected to the railway network. The works are foreseen to be finalised by the end of 2022. The remaining airports do not have a rail connection (please see Table 2 for details).

[11] Please note that the Zurich Airport is not falling under the obligation of art. 41.3 of the TEN-T Regulation to be connected by rail, as it is located outside of the EU

Table 2: Airport infrastructure on the Rhine-Alpine Corridor

Airport	Connection with rail (Yes/No)
Rotterdam Airport	No
Amsterdam Airport*	Yes
Brussels National*	Yes
Liége Airport	No (with exemption)
Düsseldorf Airport*	Yes
Köln-Bonn Airport*	Yes
Frankfurt/Main Airport*	Yes
Zürich Airport	Yes
Basel EuroAirport	No
Linate (Milan) Airport*	No
Malpensa (Milan) Airport*	Yes
Orio al Serio (Bergamo) Airport[12]	No (with exemption)
Genova-Sestri Airport[12]	No

* *Airports marked with a star (*) fall under the obligation of art. 41.3 of the TEN-T Regulation, which requires them to have a railway connection by 2050.*

Source: TENtec/Rapp Trans

At the moment, clean fuels are not available at the Corridor airports and their compliance perspective by 2030 is rather limited. Though IATA commits to the development of alternative jet fuels, neither dedicated roadmap, central feasibility study nor specific information for the horizon 2030 are available. The development will be primarily cost driven, based on the intra-sectoral high pressure on kerosene price competition today.

Rail-road terminals compliance

TEN-T regulation explicitly requires rail-road terminals (RRT) to be open for all operators and to be capable for the transhipment of intermodal transport units, while the rail access electrification and handling of 740 metre-long freight trains are prioritised. Table 3 shows the current compliance of the rail-road terminals with the TEN-T requirements along the Rhine-Alpine Corridor.

Table 3: Rail-road terminals - Compliance with TEN-T requirements in 2021

Rail-road Terminals requirements	Target 2021
Capability of intermodal transhipment	50%
Electrified train accessibility*	17%
740m train terminal accessibility*	41%

* These are not direct requirements according to the current TEN-T Regulation referring to terminals. However, the requirements set for the rail network make it necessary also for terminals to comply with those provisions along the Rhine-Alpine Corridor.

Source: KombiConsult analysis, November 2021

[12] Railway connections to airports in Bergamo and Genova are planned and works are scheduled to be finalised in 2030.

In 2020, the Rhine-Alpine Core Network Corridor included 70 intermodal terminals. The 'Interbulk Duisburg Terminal' is excluded from further analysis, as it is not in operations anymore. Out of the 70 terminals along the Corridor, 32 sites have been classified as 'rail-road terminals' in the strict sense.

There are still no reports that any of the 70 terminals have not granted non-discriminatory access. Hence, all terminals are complying with this criterion.

In 2020, 35 terminals, which amount to half of the Corridor terminals, were capable of handling all types of intermodal loading units. Total compliance share for this KPI is, therefore, 50%. At the same time, 33 terminals were capable of handling containers only. This might be still a high number in view of the envisaged compliance until 2030. However, since many terminals are located along the Rhine River, they specialise in handling of containers that are transported from and to the hinterland of the seaports. The Novara Eurogateway CIM terminal can only handle containers and swap-bodies[13]. The Novara RoLa terminal is a dedicated Rolling Highway[14] terminal.

In 29 out of the 70 terminals, it was identified that the access was electrified, while the other 41 terminals still do not provide for such feature and require additional shunting by diesel locomotives, which leads to additional dwelling times.

All existing terminals are connected to 1,435 mm railway tracks. The only challenges concern the partial limitations of the corresponding rail lines, the accessibility for 740 metre-long trains 'in one piece', and the electrified locomotives.

2.3 Evolution of the KPIs over time and per Member State

The Rhine-Alpine Corridor has already been one of the most mature corridors with a well-developed infrastructure since 2014.

However, to achieve full compliance with the TEN-T standards and to allow for seamless connectivity throughout Europe by 2030, some critical issues have to be addressed. They include rail capacity bottlenecks, restrictions to run 740 metre-long trains across the Corridor, operational barriers in cross-border rail services, road congestion, noise and pollution in urban areas, insufficient availability of alternative fuels infrastructure, incomplete ERTMS deployment, fairway depth on the Rhine River, insufficient lock capacity and a variety of maintenance issues of existing infrastructure. Progress has been made in all of these areas. In terms of the TEN-T Regulation, some improvements have been made in inland waterways minimum draught parameter in France and Germany.

The following chapters present an analysis of the current situation, highlighting the evolution over time per Member State.

2.3.1 Belgium

Belgium is the starting and ending point of three Core Network Corridors, the North Sea–Baltic Corridor, the North Sea–Mediterranean Corridor and the Rhine–Alpine Corridor. The TEN-T network in Belgium is largely compliant with the requirements set in the TEN-T Regulation and the remaining issues are being solved.

All the Belgian road sections (share of 15% of the total road network in the Rhine-Alpine Corridor) are categorised as motorways and meet the TENT-T requirements. However, serious traffic congestion problems occur along many highway sections, around urban nodes. A project is ongoing to optimise the Brussels Ring Road to

[13] Swap body: Loading unit used for road and rail transport. The size of this loading unit is standardised and it cannot be stacked

[14] Rolling Highway: Complete trucks are loaded onto trains at special terminals; the drivers travel in an accompanying passenger coach.

improve its traffic flow and safety. A similar project is ongoing in Antwerp, with the upgrade of Ring of Antwerp and building of Oosterweel connection. Concerning alternative fuel infrastructure, while different projects have been completed and others are ongoing[15], the deployment of alternative fuels for all transport modes still needs a boost. Regarding smart mobility, Belgium is investing in realisation and rollout of a range of innovative technological traffic solutions through public-private cooperation and co-creation through for example the Mobilidata programme.

The Belgian railway network complies with the TEN-T requirements except for the ERTMS and the speed parameters for freight trains. The ERTMS implementation is ongoing on the entire core network in Belgium and will be finished in 2025. For some sections, the line speed criterion is not compliant due to a safety concern (lines running through a city or the Port of Antwerp). The rest of the sections will be compliant once the ERTMS deployment is completed. It should also be noted that in Belgium, 740 metre-long trains cannot be operated during peak-hours. However, investments are foreseen or ongoing to facilitate the movement of 740 metre-long trains on the Belgian part of the rail freight network in the Corridor, notably in the framework of the Recovery and Resilience Plan. Concerning the rail congestion, the Port of Antwerp needs a second rail freight access. Currently, all trains starting from the Port of Antwerp to European destinations go through a single railway line that will soon reach its saturation point. Studies and preliminary works are ongoing.

For the three Belgian seaports of the Corridor, located in Antwerp, Ghent, and Zeebrugge, there is no current compliance issue identified. The Deurgangdock in Antwerp is fully developed and the Port of Antwerp is launching studies and works to implement a new tidal dock on the left bank of the Scheldt River. All ports are also investing in alternative fuels, as well as exploring their broader role as energy hubs.

The international airport of Brussels has direct rail connections.

The Belgian inland waterways are included in the North Sea-Mediterranean Corridor and are not part of the Rhine-Alpine Corridor, but are of importance for the further development of the corridor.

2.3.2 The Netherlands

With its large international network and extensive hinterland infrastructure, the Netherlands occupies a strategically important position in Europe. Just like Belgium, it is the starting and ending point of three CNC's, the North Sea-Baltic Corridor, the North Sea-Mediterranean Corridor and the Rhine-Alpine Corridor. The TEN-T network in the Netherlands is largely compliant, exceeding TEN-T standards for the most part, while remaining issues are being resolved.

The Corridor road network in the Netherlands already fulfilled the TEN-T requirements in 2014, except for one missing link, the extension of the A15 motorway between Arnhem and the German border, which is expected to be completed before 2026. Several infrastructure projects have been recently completed or are underway to address congestion on existing motorways that already fulfil the TEN-T requirements.

In recent years, increased attention has been paid to smart mobility and the rollout of alternative fuels. The share of passenger cars on the road using electric propulsion in the Netherlands is among the highest in the EU, in particular for battery electric vehicles. Zero emission zones for city logistics will give a boost to zero emission vans and trucks. However, the supply of charging infrastructure needs to keep pace with

[15] These projects include, inter alia: **Benefic** – a project focusing on transport innovation and on the deployment of alternative fuels (Electric Vehicles, Compressed Natural Gas, Hydrogen and Onshore Power Supply) for different modes; **Zero emission at berth for maritime & inland shipping** - a project from the Port of Antwerp; or **H2Benelux** - a project aiming to accelerate market development of hydrogen as a fuel in road transport

this development. A lot of attention is being paid to safe and secure truck parking, with various ongoing projects for the realisation of truck parking locations along the entire Corridor.

The Netherlands has a high density of navigable inland waterways. Almost its entire inland waterway network in the Corridor meets the TEN-T requirements, apart from one short section: the Wilhelmina Canal. The first part of the Wilhelmina Canal has already been widened to CEMT class IV in 2019 and currently, works are ongoing to widen the second part by 2025.

The Dutch railway network already complies with most of the TEN-T requirements, except for the line speed parameters. The projects completed in the past period are mainly of an operational nature or have led to capacity expansions but have had no impact on the KPI compliance rate of the rail network. Running of the 740m long trains is a priority: several projects have been extensively prepared and financing is being sought. Concerning the implementation of ERTMS, the Rhine-Alpine Corridor sections in the Netherland are predominantly compliant. Adjusting of rolling stock is still necessary to fully take advantage of ERTMS.

The provision of alternative fuels in seaports has also increased in recent years. Only Terneuzen does not offer yet alternative fuels, although plans of implementation are underway. Also alternative fuels are also not available yet in the Dutch inland ports, and some inland ports are not yet directly accessible by rail.

All rail-road terminals in the Netherlands located on the Corridor already fulfilled all TEN-T standards.

2.3.3 Germany

Germany has by far the largest share on the transport infrastructure network on the Rhine-Alpine Corridor. It has the longest rail, road and inland waterway network, as well as the largest number of inland ports and rail-road terminals.

Due to its central geographical location in Europe and the strong economic and trade interconnection with the neighbouring countries, the infrastructure in Germany has always been of high quality and capacity. This is also reflected in the compliance rates on the TEN-T indicators.

With respect to the evolution of these compliance rates for rail, road and inland waterways between 2014 and 2020, no quantitative progress can be observed. This is due to the fact that the infrastructure was either largely compliant with the requirements of the TEN-T regulation in 2014 or compliance gaps are subject to ongoing/planned projects. In exceptional cases, projects are not foreseen yet or will not close the compliance gaps completely.

For airports and inland ports, the compliance situation is even clearer. All German airports of the Corridor were already connected to rail in 2014, so no compliance progress was possible for this criterion. The same also applies to the rail and waterway connection of the Germany inland ports. However, the availability of alternative fuels for all modes of transports should be improved. This is being accelerated across the EU through the revision of the Alternative Fuels Infrastructure Directive (2014/94/EU).

Regarding the market-driven indicators for rail-road terminals, the compliance rates of the German RRTs are comparably high against other countries. Yet, the accessibility to electric traction and the possibility to run 740 metre-long trains needs to be improved further.

2.3.4 Switzerland

Switzerland has a share of around 15% of the rail and road network in the Rhine-Alpine Corridor and its infrastructure includes crossings through the Alps that are characterised by challenging topographical and weather conditions. It has only a minor

share of the inland waterway section, but Basel at the upper end of the inland waterway is an important trimodal gateway hub for freight transport with three inland ports and numerous trimodal and rail-road terminals.

Due to its strategic location at the Alpine Mountains range and the strong economic interrelations with the countries in the northern and southern part of the Rhine-Alpine Corridor, Switzerland has always been a transit country for the north-south (and vice versa) freight and passenger traffic. The transport infrastructure has always been of high quality and capacity. This is also reflected in the high compliance rates of the TEN-T indicators (KPIs).

Although the transport infrastructure was already largely compliant with the requirements of the TEN-T Regulation in 2014, further improvements have been made to the railway infrastructure between 2014 and 2020.

With the opening of the Gotthard base tunnel in 2016 (length of 57 km) and the Monte Ceneri base tunnel in December 2020 (length of 15.4 km), the capacity, line speed, efficiency (especially of freight trains) and the redundancy on the rail route Basel-Chiasso could have been increased substantially. In order to foster the shift of transalpine freight transports from road to rail further, the route from Basel-Bellinzona - Chiasso has been expanded into a 4-metre high corridor on behalf of the federal government by 2020. This will allow the transport of semi-trailers with a corner height of 4 metres.

2.3.5 France

France was added to the catchment area of the Corridor considering the relevance of its inland waterways and ports along the Rhine River.

The Port of Strasbourg is the second largest inland port in France. A recent project allows the handling of 740 metre-long trains. Other projects are ongoing to increase the capacity, improve multimodal access and the supply of clean energy.

Other smaller French ports are located on the Rhine River: Lauterbourg (north of Strasbourg) and Huningue/Ottmarsheim (near Mulhouse). Those ports have projects ongoing to increase capacity and to improve the access.

2.3.6 Italy

Italy is the southern entry/exit point of the Rhine-Alpine Corridor, which crosses its north-western part from Domodossola and Chiasso, both on the Italian-Swiss border, down to Genova - its strategic seaport.

In terms of the rail network, the KPIs such as electrification, track gauge and axle load are reaching full compliance.

The minimum required line speed of 100 km/h for freight lines is achieved on more than 95% of the network, with non-compliance concentrated in some sections of the Genova node (Genova Sampierdarena – Genova P. Principe and Genova Voltri – Genova Sampierdarena). The use of these sections by freight trains will be reduced by the opening of the Giovi Pass (planned in 2024/2025), which will allow a rerouting of a significant share of freight trains to other sections of the Genova Node. A train length of 740 metre is only allowed on 4% of the Italian network, with a limited number of already compliant sections located in northern Italy.

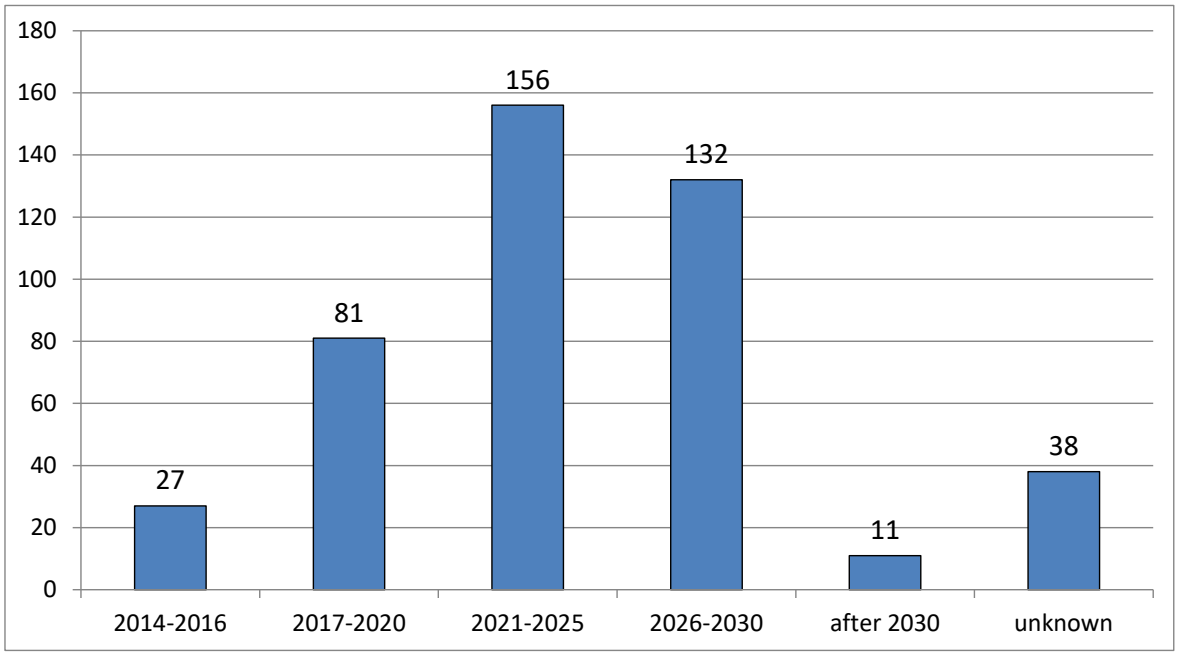
To ensure compliance with the TEN-T requirements, ongoing works on the new high speed railway link Terzo Valico dei Giovi foresee the achievement of all the railway KPIs. The Italian road network is fully compliant with the TEN-T standards, both concerning the presence of highways and the availability of clean fuels.

Both the airports and maritime ports belonging to the Italian section of the Rhine-Alpine Corridor are also compliant with the TEN-T standards.

3 Inventory of what still needs to be realised by 2030

In the framework of the Rhine-Alpine Corridor study, a list of projects has been developed. The final indicative list of October 2021 consists of 445 Rhine-Alpine related projects, an increase by 127 projects since 2017. Of these, 116 have been completed in the period between the adoption of the TEN-T Regulation and the end of June 2021. The vast majority of projects, i.e. 396, is expected to be completed by 2030.

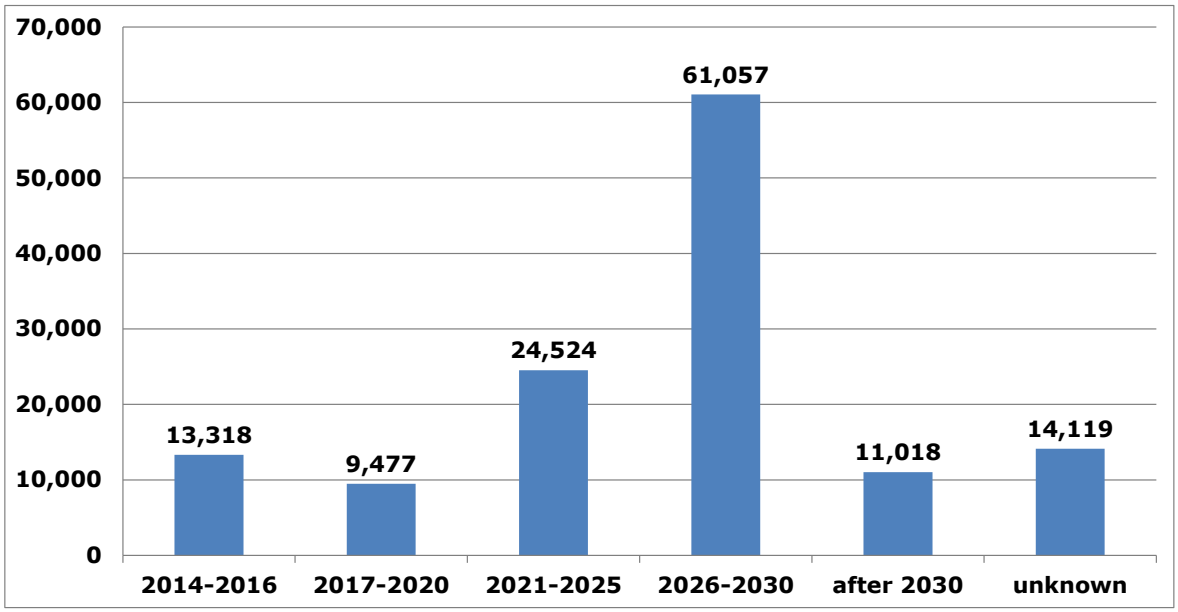
Figure 3: Number of projects by completion cluster



Source: KombiConsult analysis based on status 10/2021 Project List

Information on the costs is available for 383 projects (86% of total number). These envisaged project costs sum up to a total of about € 134 bn with by far the highest value dedicated to measures foreseen to be finalised in the timeframe between 2026 and 2030. By the end of 2030, the target date of the TEN-T Regulation, the costs of all projects to be finalised then sum up to a total of € 108.4 bn.

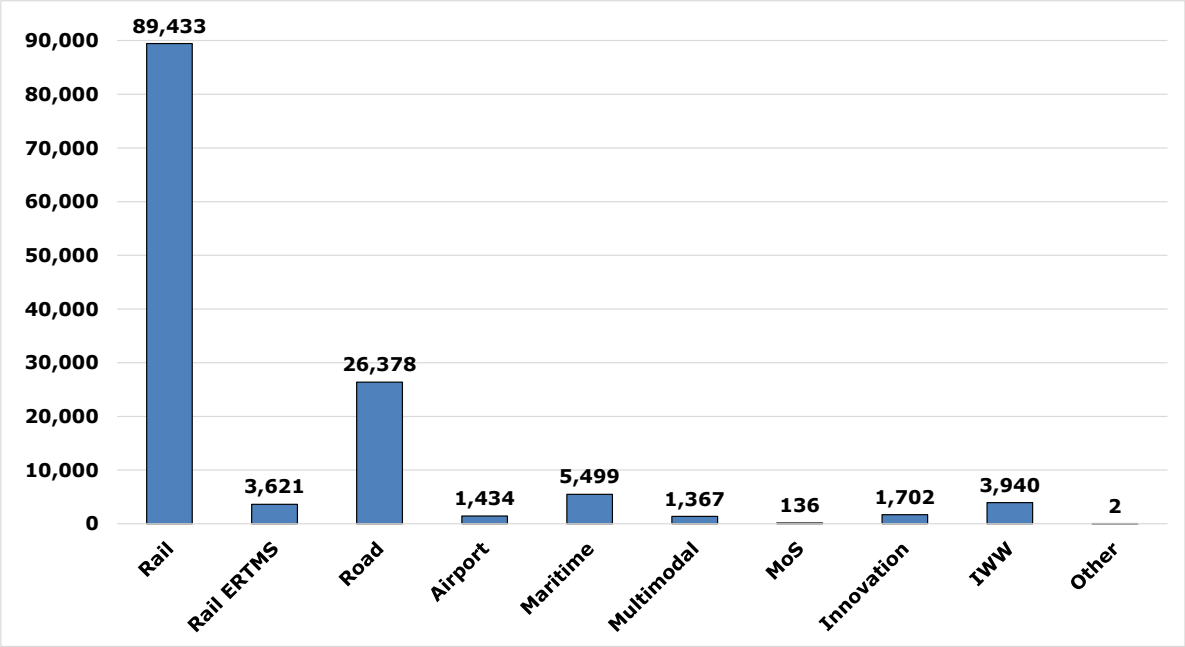
Figure 4: Total cost (in € million) of projects by completion time cluster



Source: KombiConsult analysis based on status 10/2021 Project List

The planned investment per project category (as indicated in Figure 5) shows that rail has by far the highest needs for infrastructural upgrades.

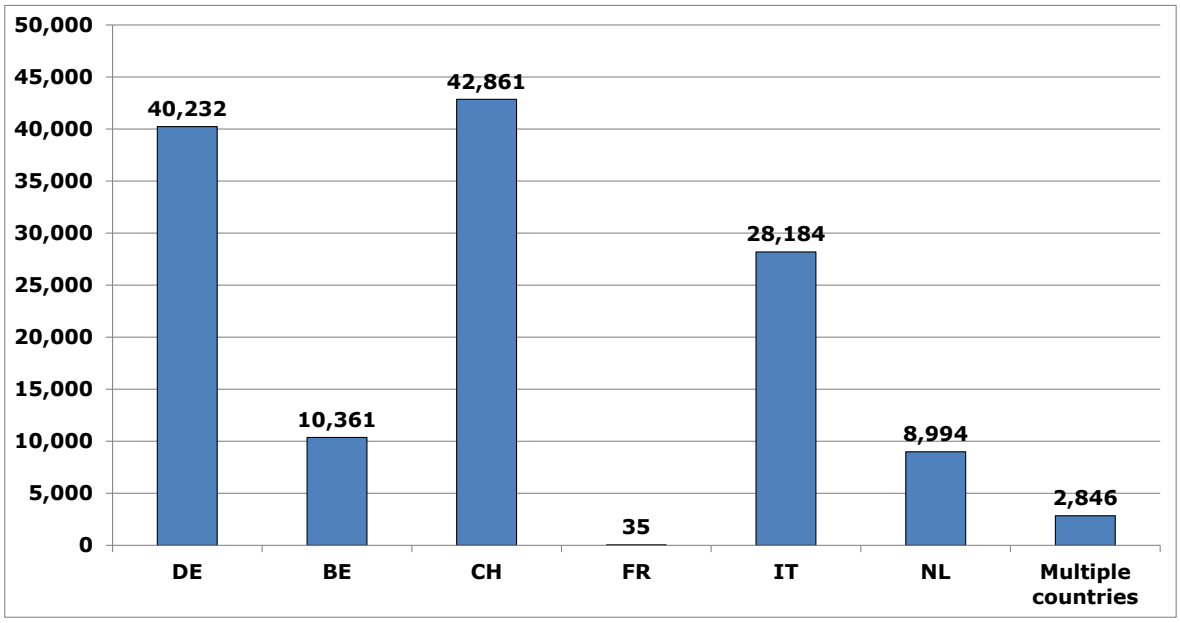
Figure 5: Investments per category in € billion



Source: KombiConsult analysis based on status 10/2021 Project List

Looking at the investments per country (Figure 6), Switzerland and Germany have the largest share with more than € 40 billion each. For Germany, this corresponds to the largest number of projects (147). For Switzerland, this can be explained with a high share of 'costly' projects under the New Rail Link across the Alps programme.

Figure 6: Investments per country in € million



Source: KombiConsult analysis based on status 10/2021 Project List

As an outcome of the analysis of the current 'comments' column in the October 2021 Project List, it was reported that no project shows difficulties, which may jeopardise the completion of the Corridor by 2030.

However, the analysis in chapter 2.2 has shown that not all KPI requirements will be fulfilled by ongoing or planned projects until 2030. Therefore, the consultants proposed a list of additional measures designed to complete the Corridor. According to the identified compliance gaps, most of these additional measures refer either to the TEN-T parameters 'Clean fuels' for both airport and inland waterways or upgrading of tracks to accommodate heavy trains for higher speed in the rail category. Besides that, there are also a few measures necessary for eliminating bridge height limitations at the Rhine River. Next to the requirements of the TEN-T Regulation, the list also includes market driven measures, mainly intended to improve competitiveness of intermodal transport. These measures refer to standards of rail-road terminals.

In order to meet the Corridor objectives, 54 additional measures were identified in the gap analysis for the Rhine-Alpine Corridor, which could be considered by the respective Member States. These measures include:

- 26 measures aim at the improvements in rail-road terminals
- 17 measures relate to clean fuels at airports and IWW
- 8 measures relate to upgrading of rail tracks for heavier and faster trains
- 3 measures relate to infrastructures upgrades at the Rhine River.

3.1 Rail and rail-road terminals

Figure 7 below illustrates the expected compliance of the rail network in the Rhine-Alpine Corridor in 2030 by There are some potential capacity bottlenecks, where infrastructure projects will not be implemented by 2030 (e.g. on the section Karlsruhe – Basel). To remedy the situation in the short to medium perspectives, the following measures will be undertaken by Germany in coordination with Switzerland:

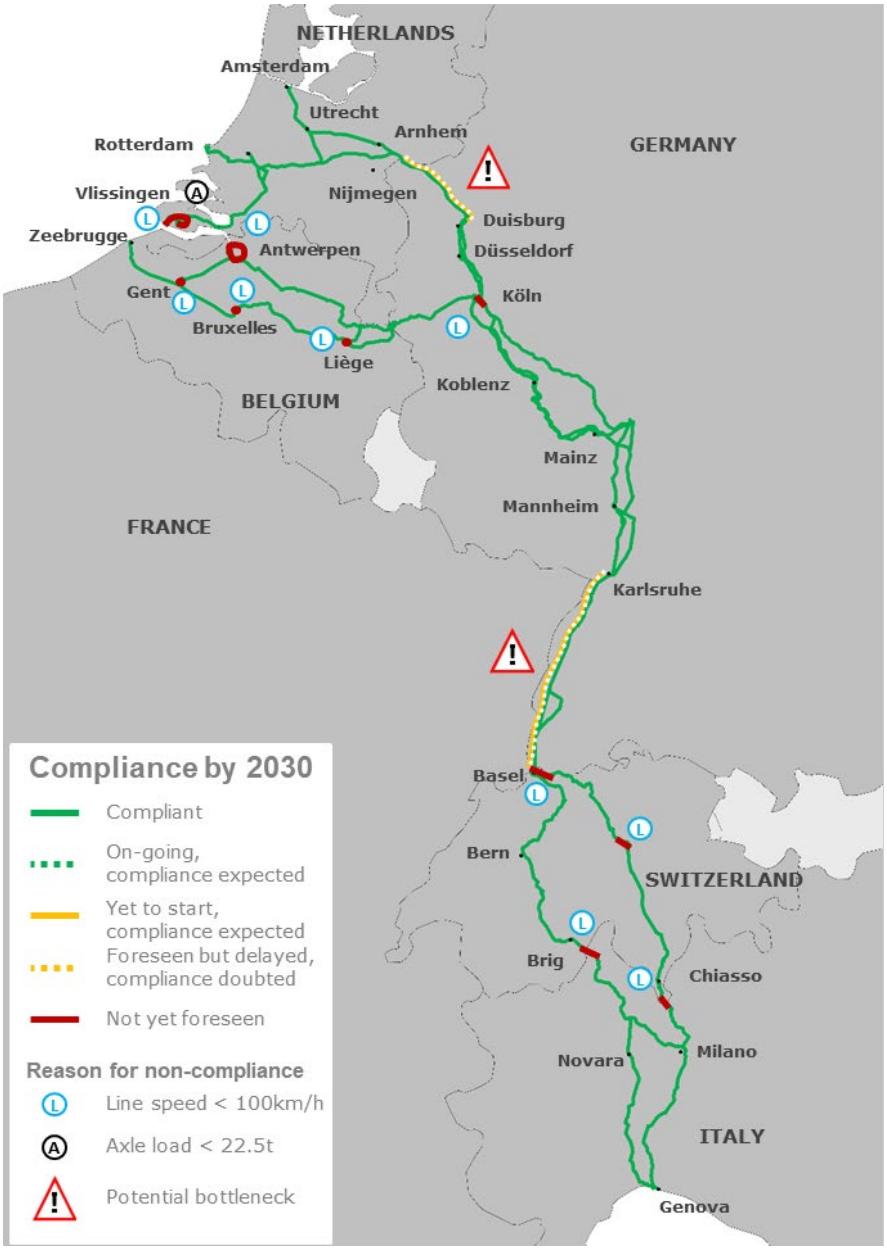
a. the development of certain infrastructures additional infrastructure measures in Offenburg;

b. a shift of the location where the change of locomotive drivers takes place to a location outside Offenburg;

c. the harmonisation of velocities between Offenburg and Freiburg.

These initiatives are currently in planning phase and are intended to be finalised in 2025.

Figure 7: Rail compliance by 2030



Source: Rapp Trans

The most important challenge is to continue upgrading the Corridor sections, most of which cannot cope with the existing and future needs for capacity. These are mostly adjacent to borders: Zevenaar (NL) – Oberhausen (DE); Karlsruhe (DE) – Basel (CH);

Chiasso (CH) – Milano (IT)[16]. However, they also concern hinterland connections from ports such as Zeebrugge – Ghent in Belgium. Between Zevenaar and Oberhausen the first improvement projects have started.

Other necessary measures for rail include upgrading passing tracks for 740 metre-long trains, reduction of noise and upgrade of terminals to increase their handling capacity. The latter is crucial to ensure competitive and seamless transport chains for intermodal services.

For rail-road terminals, besides the already implemented or planned projects, additional measures would still be needed at 26 RRTs to achieve compliance until 2030 with estimated costs of about € 33.3 million.

A close cooperation with the respective Rail Freight Corridor (RFC) brings overall benefits to the Rhine-Alpine Corridor. Together, the two governance structures are in the unique position to identify the most critical rail projects and indicate the need for their efficient implementation along the Corridor. For example, the latest update of the RFC Implementation Plan (December 2021) identifies current and potential capacity bottlenecks for rail freight on a number of sections that need attention.

3.2 3.2 European Rail Traffic Management System (ERTMS)

This chapter presents the analysis of the ERTMS deployment and the compliance with the ERTMS European Deployment Plan in the Rhine-Alpine Corridor.

3.2.1 The ERTMS deployment 2023 and 2030

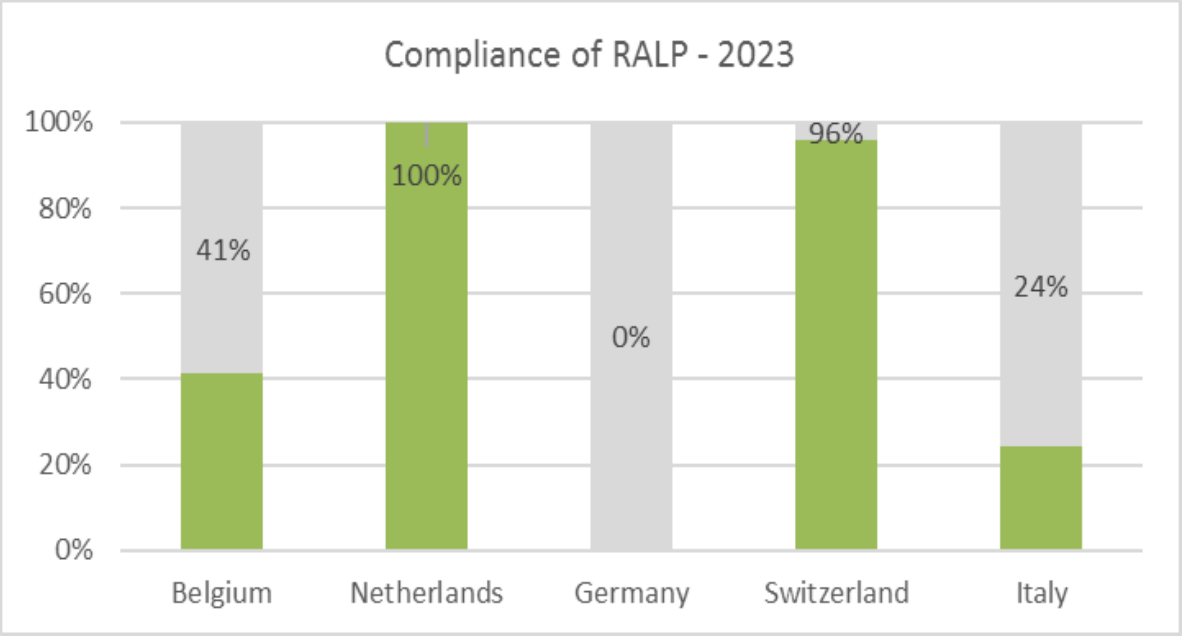
The total length of the rail part of the Rhine-Alpine Corridor is 3,460 km and, as indicated in chapter 2, this length has not been affected by the modifications introduces in the CEF 2 Regulation. The ERTMS European Deployment Plan (EDP) foresees that 1,640 km and 2,270 km of these lines should be operational by 2021 and 2023 respectively. Currently, the European Train Control System[17] (ETCS) is in operation on 29% of Rhine-Alpine Corridor, while GSM-R is used on 99% of the Corridor railway lines. According to the ERTMS EDP, ETCS is planned to be put in operation on 66% of the Corridor's railway lines by 2023 (the highest share of planned ETCS deployment of all the CNCs). In September 2021, 44% of the Rhine-Alpine Corridor's length planned in the EDP by 2023 was equipped with the ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the ERTMS EDP deadlines in this Corridor by 2023.

Figure 8 and Figure 9 show the current state of play of the ETCS deployment by Member States on the Rhine-Alpine Corridor as percentage of the 2023 and 2030 targets.

[16] In the revision of the TEN-T Regulation, Italy proposed to add a new extended section from Chiasso-Bivio Rosales, which will fulfil the speed criterion

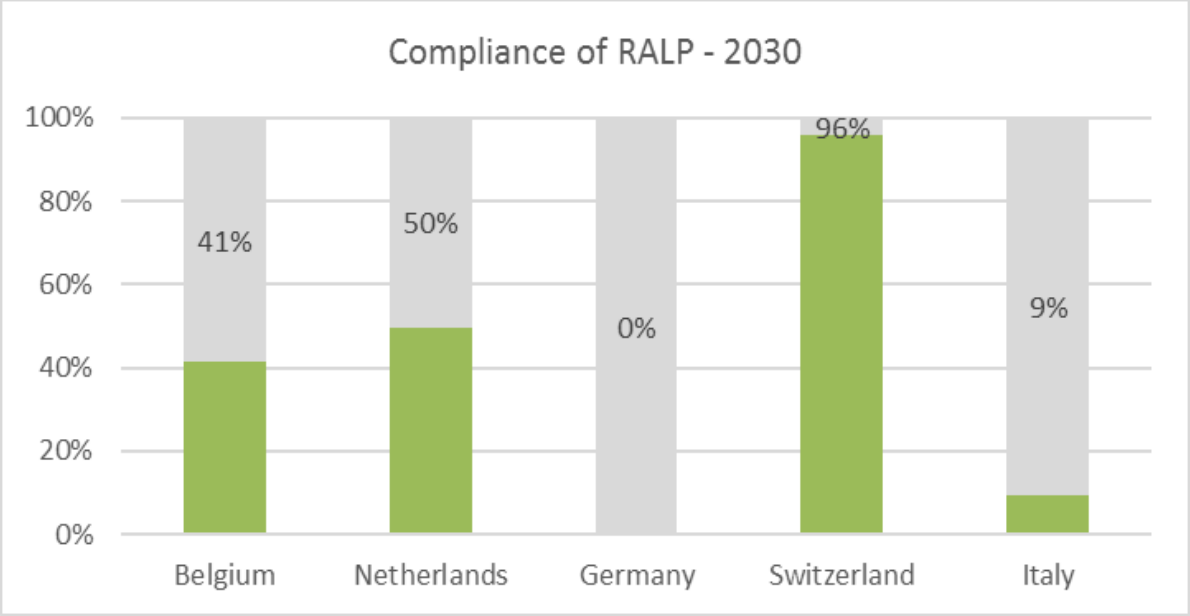
[17] The European Train Control System (ETCS) is the signalling and control component of the European Rail Traffic Management System (ERTMS)

Figure 8: Current status ETCS deployment in the Rhine-Alpine Corridor by Member States as percentage of the 2023 targets



Source: DMT

Figure 9: Current status ETCS deployment in the Rhine-Alpine Corridor by Member States as percentage of the 2030 targets



Source: DMT

The following bottlenecks regarding the 2030 compliance have been identified:

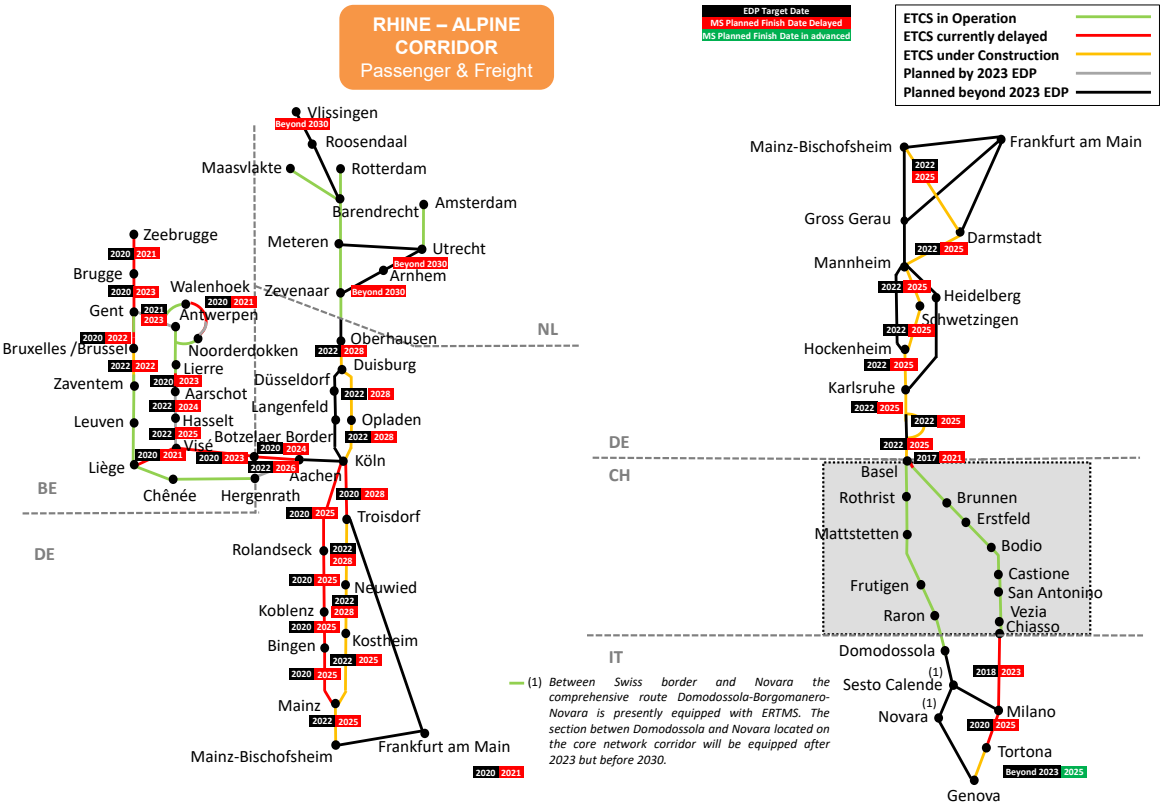
- In the Netherlands, according to the Dutch plan both Roosendaal – Vlissingen and Utrecht – Zevenaar lines will be deployed beyond 2030. Remaining sections are planned by 2030.
- The German plan does not indicate specific deadlines for some Rhine-Alpine Corridor lines planned in the ERTMS EDP beyond 2023 (e.g. Frankfurt, Mannheim and Karlsruhe). German authorities envisage a full network equipped with ETCS

by 2040, but there is no confirmation if the Rhine-Alpine Corridor will be equipped by 2030.

3.2.2 The compliance with the ERTMS European Deployment Plan

The following scheme shows the state of play and deadlines for the ERTMS deployment in the Rhine-Alpine Corridor, considering the dates of the ERTMS EDP:

Figure 10: State of play and deadlines for the ERTMS deployment in the Rhine-Alpine Corridor as per EDP



Source: DMT

The lines currently in operation **in the Netherlands** had already been commissioned when the ERTMS EDP was published in 2017. All remaining Dutch sections are planned by 2030 both in the ERTMS EDP and in the Dutch plan, except for Roosendaal – Vlissingen and Utrecht – Zevenaar lines.

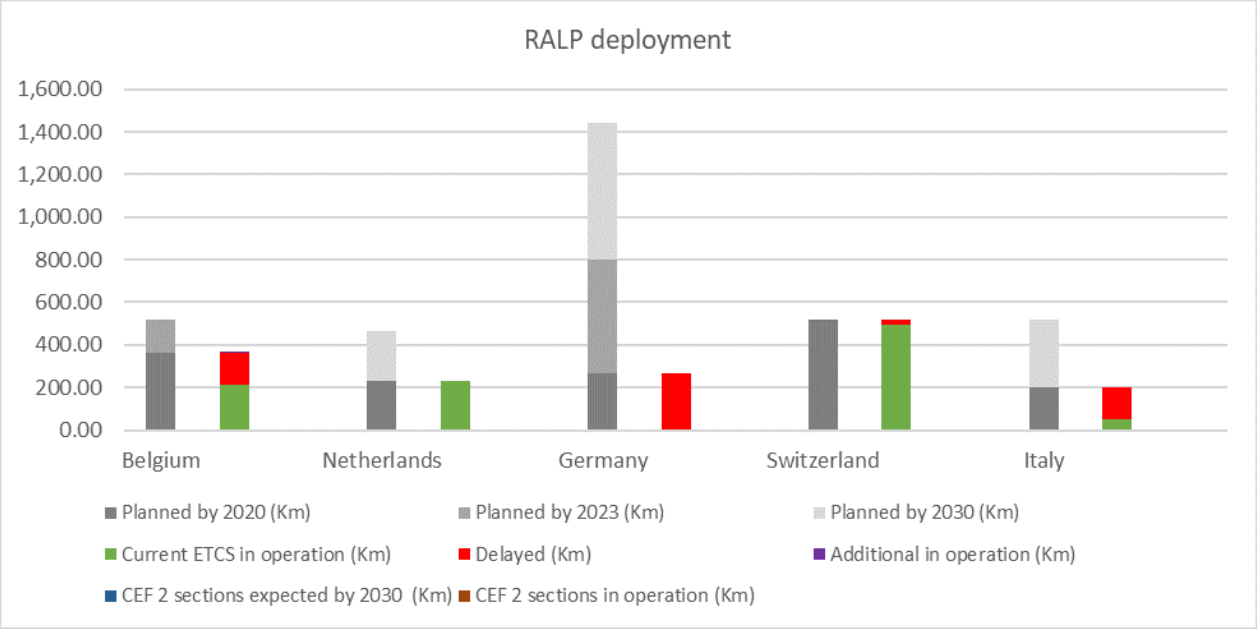
Although **Germany** had some sections planned to be in operation according to the ERTMS EDP by 2021, all German sections planned in the ERTMS EDP by 2023 will be delayed, and their commissioning is expected between 2024 and 2028 according to the German plan. Regarding German sections planned in the EDP beyond 2023, although the entire German network is planned to be equipped by 2040, there are no specific deadlines for some Rhine-Alpine Corridor sections in the German plan.

In Belgium, many of the sections have been delayed. However, the Belgian authorities plan to equip the entire Belgian rail network with the ERTMS by 2025.

In Switzerland, the ERTMS deployment is almost finalised, and all its rail sections will achieve the status of ETCS without restrictions by 2022.

In Italy, all sections in the Corridor are planned by Italian authorities to be equipped with the ERTMS by 2030.

Figure 11: The ERTMS deployment in the Rhine-Alpine Corridor



Source: DMT

3.3 IWW and inland ports including RIS Deployment Plan

The expected compliance of the inland waterways network in 2030 is illustrated in Figure 12. Projects addressing lock capacity and length, as well as the optimisation of fairway to enable greater laden draught are included in the Corridor's project list, aiming at enhancing the navigation conditions and increasing the reliability of navigation. Nevertheless, these works will not ensure full compliance with the TEN-T requirements for draught, along the whole Corridor by 2030.

The only compliance issue identified for the IWW network is the target draught of min. 2.50 m all year round, which is not achieved on the section between Iffezheim and Duisburg in Germany. While there are projects to improve transport conditions on the Rhine River, they will not guarantee the compliance with the target draught of 2.5 m all year round by 2030.

In the Netherlands, various projects are taking place to further improve existing infrastructure, e.g. infrastructure upgrades are currently ongoing along the Dutch waterways including the Waal River, IJmuiden lock, Volkerak lock, Kreekrak lock and the extension of mooring place capacity along the Corridor. Additionally, a series of climate change adaptation measurements in order to prepare for periods of low water is being prepared in the Netherlands. The drought package is composed of a set of interventions meant to improve the existing cross-border waterway connections in terms of robustness, sustainability and climate adaptation. It consists of measures such as increasing the capacity of locks e.g. at Grave and Weurt, so that they ensure good navigability, i.e. that the water depth criteria are met throughout the year, including periods of drought and low water.

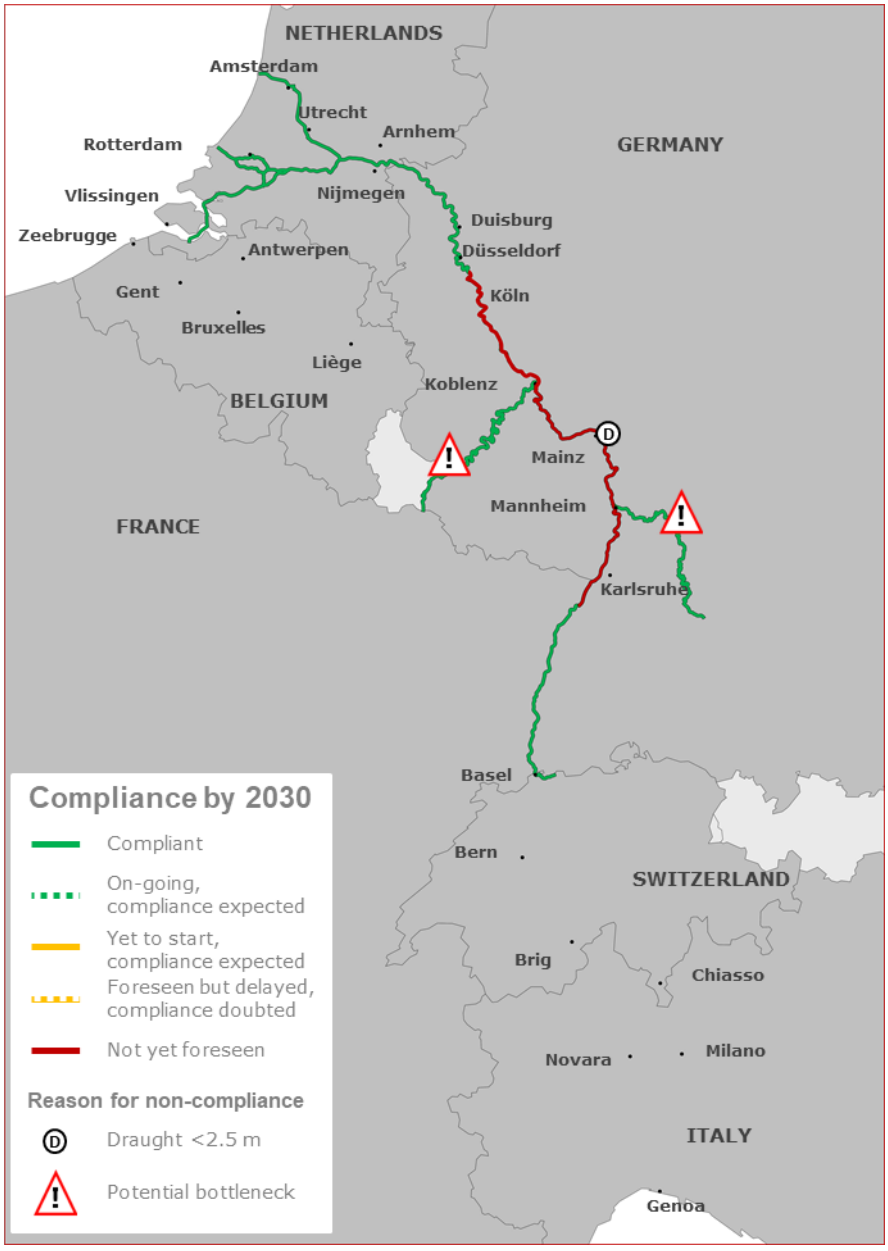
Congestion of barges in ports like Rotterdam and Antwerp is a huge issue with long waiting times (many days) for barge operators at the terminals in the ports.

In the Netherlands, LNG fuels are available along the rivers and canals, while truck-to-ship bunkering is available in the Ports of Amsterdam and Rotterdam. Further supply chains for the LNG establishment are currently under study. The River Information Service is implemented on all waterways in the core network.

Germany reports the implementation of alternative fuels along the rivers and upgrade of locks for increased capacity and optimisations of the fairway to enable greater laden

draught. The River Information Service is implemented on all German waterways in the core network. The EU funded project – DIWa - has been started to develop a masterplan for the further digitalisation of inland waterways with the neighbouring waterways and shipping administrations of France, Belgium, the Netherlands and Austria.

Figure 12: IWW compliance by 2030



Source: Rapp Trans

3.4 Road transport

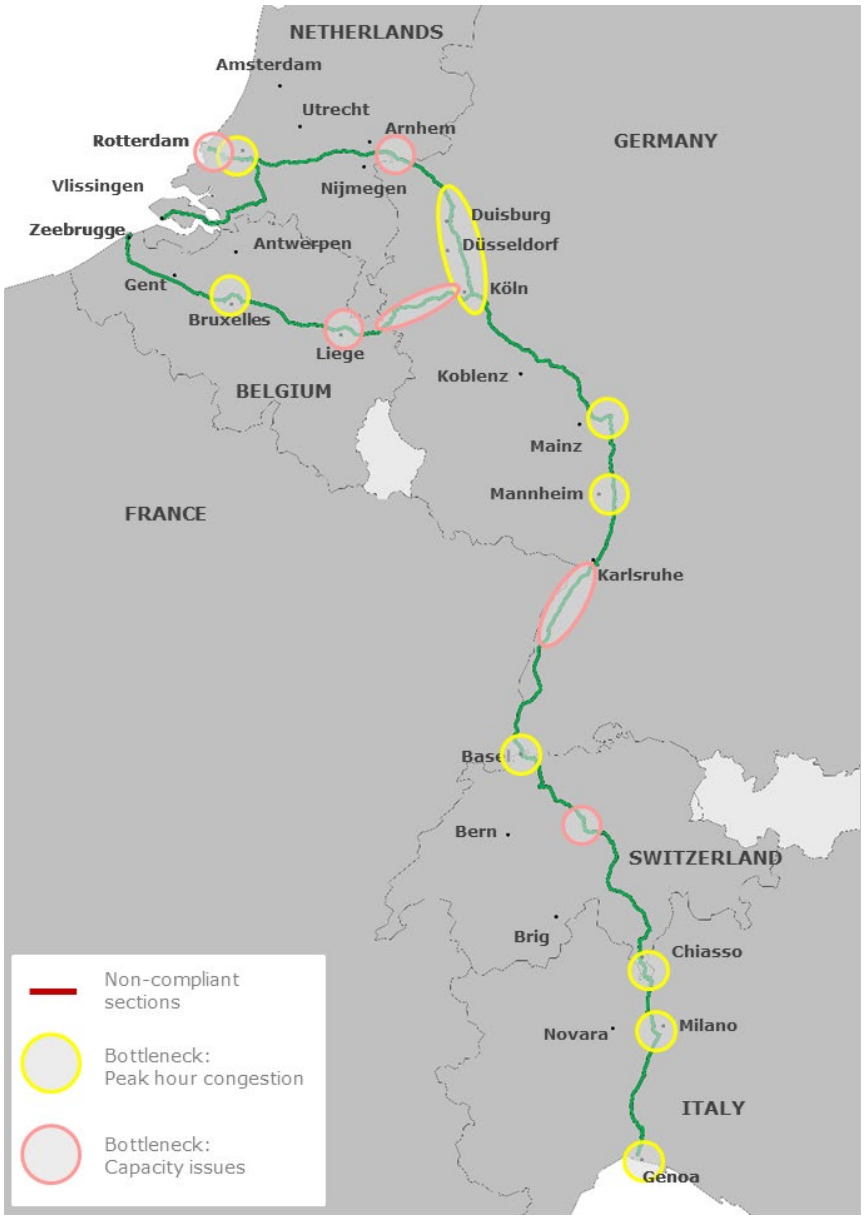
As mentioned in chapter 2.2, the road network on the Rhine—Alpine Corridor almost fulfils the standards of a motorway or an expressway. Thus, the road network is expected to be fully compliant with the TEN-T Regulation in 2030. The envisaged measures aim mostly at the modernisation of the network or at capacity issues. Modernisation measures concern outdated and deteriorating road sections, bridges, or parking areas.

Additionally, there are some issues on the road network, especially around urban nodes, due to high use and insufficient capacity for road traffic, where

countermeasures are planned (extension of lanes, removing missing links, optimisation of road sections or crossings, etc.). The most prominent projects concerning road infrastructure include the optimisation of the road rings of Brussels and Antwerp in Belgium, the extension of A15 motorway south of Arnhem with an additional lane on both sides, or the bypass of Genova by a new orbital motorway.

The compliance map of Figure 13 highlights these bottlenecks in capacity and sections, where peak-hour congestion is expected on the motorway network in 2030.

Figure 13: Road compliance in 2030



Source: Rapp Trans

An important group of projects are those aimed at providing infrastructure for clean fuels and deploying Intelligent Transport Systems (ITS).

The availability of clean fuels along the road sections is already at a high level and progressing well. Further development depends on various factors such as number of operative vehicles suited for alternative propulsion and prices of the alternative fuels. Alternative fuels (CNG, LPG and LNG) and electric charging stations are widely available in all of the Rhine-Alpine Corridor countries, although the density of stations along the Corridor differs from section to section and country to country. Most of the

stations are located near urban nodes. The capacity of fuel and charging stations continues to be extended and it is expected to be improved even further until 2030.

The TEN-T Regulation requires the development of rest areas on motorways approximately every 100 km in line with the needs of society, of the market and of the environment, in order to provide appropriate parking space for commercial road users with an appropriate level of safety and security. However, the TEN-T Regulation does not define appropriate levels of safety and security. In 2019, the EU adopted a new parking standard, but the number of certified sites (bronze, silver, gold) is still relatively low. The Rhine-Alpine Corridor has shown progress in the implementation of safe and secure truck parking, especially in Flanders/Belgium, the Netherlands and Italy.

3.5 Airports

Airports in Milano Linate, Bergamo, Genova, Liège and Rotterdam do not have connections to the rail network. However, only Milano Linate is under the relevant TEN-T obligation. A project to connect the airport by the subway (Metro Line 4) is being implemented and is expected to be completed in 2022.

In Genova, a project of automated monorail train is currently undergoing the necessary approval steps, while works are expected to start in 2022 and end by 2025. In Liège, the Carex project concerning the implementation of a new rail link to the future cargo terminal at the airport is planned. There are also plans to establish a rail connection to Bergamo airport. Moreover, for Amsterdam Schiphol, it is foreseen to improve the already existing rail connection by an additional connection to the public light rail system in the future.

More attention should be given to clean fuels availability in the future, as they are currently not available at Rhine-Alpine Corridor airports.

3.6 Maritime Ports on the Rhine-Alpine Corridor

Seaports, which are the main access points to the Rhine-Alpine Corridor, face a number of capacity and connectivity issues, for which relevant projects are being implemented or planned. They concern both hinterland connections and maritime access.

The Port of Antwerp needs a second rail freight access (preliminary studies ongoing) and upgrades of bridges. It also has to secure its capacity through a new tidal dock on the left bank. There is also an active cooperation in the northern part of the Corridor, including on the improvement of port hinterland connections and capacity to the German Ruhr region, for example in the framework of a tri-national working group, following up on the 3RX study. In Ghent, the capacity of the cross-border Terneuzen (NL) locks emerges as a critical issue, but works are to be completed by 2023. For the Port of Zeebrugge, the major bottleneck concerns its different gauge connection to the inland waterway network but measures to improve the situation are being analysed. Moreover, rail investments are foreseen to improve the capacity and the multimodal chain characteristics. The infrastructure upgrade for 740 metre-long trains is also necessary for the Belgian seaports. Relevant projects are ongoing.

The Port of Rotterdam has to secure sufficient capacity both for future developments in the port and in terms of connections to its hinterland. The newly commissioned Theemswegtracé has increased capacity of the harbour rail line. However, upgrading of the Caland Bridge and the Suurhoff Bridge remain critical issues to ensure the port's sufficient capacity.

The seaports in Amsterdam and Genova require an improved maritime access – given their space/territorial constraints. These ports are limited in their physical expansion planning, which requires further efficiency upgrades and improvements in accessibility of the port areas from the land and maritime side. In the Port of Genova, a re-configuration of the maritime access to the Sampierdarena Port Basin is planned. On

the railway-side, significant investments for improving the accessibility to the ports of Genova are planned.

Currently, the availability of clean fuels is difficult to assess due to lack of information from a centralised database. The ports in Rotterdam, Amsterdam, Antwerp (bunkering operations for inland vessels) and Zeebrugge report availability of LNG. Projects to establish access to cleaner fuels in multiple ports are scheduled for 2025.

The potential of Motorways of the Sea (MoS) is not fully used by the Corridor's large seaports, with only 9% of their traffic accounting for trans-shipment. Closer collaboration with the MoS is needed.

3.7 Overview of major persisting bottlenecks and missing links

This chapter summarises the persisting bottlenecks and missing links in the Rhine-Alpine Corridor.

3.7.1 Persisting bottlenecks and missing links

Regarding **rail,** there are no missing links but remaining main capacity bottlenecks on the sections Karlsruhe - Basel (DE) and Oberhausen (DE) – Zevenaar (NL).

Important projects, which will be realised after 2030 are:

- **in Germany,** the construction of new and upgrade of the existing rail lines between Karlsruhe and Basel (section Offenburg – Hügelheim). This is planned to be realised until 2035.
- **in the Netherlands**, the upgrade to the Brabantroute to support the Betuweroute in case of lack of capacity on the Betuweroute. The realisation period is unknown .
- **in Italy**, the upgrade to four tracks on the railway line on the part of the section between Chiasso and Milano and an additional rail track on the Vignale - Oleggio - Arona line. These capacity extensions will be realised after 2030.
- **in Belgium**, a second rail access to the Port of Antwerp. This project is currently planned to be realised by 2031.
- **in Switzerland**, the new Axen tunnel between Arth-Goldau and Flüelen to increase capacity (freight traffic) and to shorten travel time (passenger traffic) and a new tunnel section on the Lötschberg-Tunnel to increase capacity especially for rail freight transport.

These projects will further increase the capacity and reliability of rail freight along the Corridor, and reduce travel times in both rail passenger and freight transport. They will also improve the redundancy in case of line interruptions. Other projects include further upgrading and modernisation of existing rail connections and noise reduction measures in several countries along the Corridor.

Regarding IWW, in Germany there are remaining bottlenecks on the Rhine River, especially concerning the draught in the section between Iffezheim and Koblenz and lock capacity on the Mosel River. Improvement projects include the upgrade of locks for increased capacity and reliability and the optimisations of the fairway to enable greater laden draught in Germany. In addition, in the Netherlands there are projects for enhancing capacity of the existing locks. Regarding **road,** remaining capacity bottlenecks are to be found in all the Corridor countries, especially around urban nodes where long-distance road traffic overlaps with regional and local road traffic. Bottlenecks caused mainly by peak hour congestion are to be found especially in metropolitan areas (Rotterdam, Brussels, Milano, Köln/Düsseldorf, etc.) and bigger cities (Genova, Basel, Mannheim, etc.). Further capacity bottlenecks, which are not only caused by peak hours, are to be found in Germany, Switzerland, the Netherlands and Belgium.

In Italy (Milano area), there are plans to modernise the A50 – Milan West Ring Road (fully belonging to the TEN-T core network). The A50 bypass is about 31 km long, of which 26 km section from the interconnection with the A4 Turin-Milan motorway to the junction with the A1 motorway will be upgraded to four lanes. There are also plans for an upgrade the Sesto San Giovanni junction, between A4 motorway and SS36 freeway. This will reduce congestion on the A50 and the A4 motorway from Bergamo and from Torino to Milano. It can also be expected that further regional and local traffic management measures will be implemented to minimise the negative impacts of remaining capacity bottlenecks. The time horizon for realisation of the improvement projects is not known yet.

In the Netherlands, for the motorway connection to the Maasvlakte (A15 Maasvlakte – Barendrecht), there is a comprehensive exploration for a road- and rail connection within the construction of the new Suurhoff Bridge. This would reduce existing capacity bottlenecks. For the motorway A15 section Ridderkerk – Gorinchem, one of the long-term solutions to reduce bottlenecks is a capacity increase. Other solutions look at less infrastructure demanding options, such as smart mobility. The A67 motorway connecting Antwerp and the Ruhr-Area is a part of the SmartWays programme. For the section between Eindhoven and Venlo, the plan is to widen the road and perhaps to introduce smart mobility measures, mostly concerning tire pressure. The time horizon for realisation of the improvement projects is not known yet.

Airport infrastructure in the Rhine-Alpine Corridor is well established and it provides reliable long-distance connections. As pointed out in an earlier section, only the airport at Milano Linate is missing the railway connection, however it is planned that it will be connected by metro line by the end of 2022. Clean fuels are not available at the Corridor airports.

The airports of Bergamo and Liège are exempted from the obligation to have rail connections; nevertheless, in both cases such connections are planned (please see also information in chapter 3.5). The Liège airport is the main Belgian freight airport and claims a significant growth potential over the coming decade. The plans foresee an implementation of a new rail link to the future cargo terminal at Liège airport (Carex Project). The action supports an early implementation of advanced surface movement guidance and control systems (A-SMGCS) at the airport. These systems are essential in improving capacity in low visibility operations and safety under all weather conditions.

The capacity of railway line connecting the Schiphol airport to Amsterdam is not sufficient. Therefore, there are plans to connect the Schiphol airport with light rail transit to Amsterdam. The time horizon for realisation of the improvement projects is not known yet.

The prospective compliance of alternative fuel availability in the airports by 2030 is rather limited.

Maritime ports, which are the main access points to the Rhine - Alpine Corridor, face a number of capacity and connectivity issues, for which relevant projects are being implemented or planned. They concern both hinterland connections and maritime access.

The Port of Antwerp needs a second rail freight access and upgrades of bridges (see also rail-related information provided in chapter 3.6). The major bottleneck in the Port of Zeebrugge concerns its different gauge connection to the inland waterway network, but measures to improve the situation are being analysed. Moreover, rail investments are foreseen to improve the capacity and the multimodal chain characteristics. The infrastructure upgrade for 740 metre-long trains is also necessary for the Belgian seaports.

The Port of Rotterdam has to secure sufficient capacity both for future developments in the port and connections to its hinterland. A study for the removal of a railway

bottleneck to Maasvlakte II is ongoing. Maintaining its capacity and upgrading of the Caland Bridge and the Suurhoff Bridge are critical issues.

Key challenges that the **rail-road terminals** in the Corridor still face include the historically grown access to the rail infrastructure (single sided, non-electrified, annex to shunting yard or port railway line) and the partial limitations of the corresponding rail lines, the accessibility for 740 metre-long trains 'in one piece' and the electrified locomotives.

In general, the handling tracks' lengths at terminals range between 150 m (ATO Antwerp - Associated Terminal Operators) and 1,420 m (Mannheim-Mühlauhafen). Two terminals allow 740 metre-long trains to enter in 'one piece'. Another seven terminals have a maximum train length of 700 m. Others do not have plans to meet the full-length requirement by the end of 2030. This requires a very delicate handling as terminals belong to private investors, who sometimes are not convinced of the need to meet such standards. The arguments used by terminal managers include, inter alia, the following ones:

(i) the need to achieve the maximum permitted train weight rather than the train length in cases of terminals that handle an exceptionally heavy cargo;

(ii) the shunting yards allow splitting of trains and handling its sections; or

(iii) the corresponding rail network does not allow longer trains either.

Equipping the remaining terminals in infrastructure allowing 740 meter-long trains to enter in one piece would be an optimal solution leading to improved intermodality along the Corridor. However, taking into account the variety of characteristics related to the terminals, certain flexibility needs to be retained in this regard. In particular, it should offer the private companies, which are responsible for investments in the infrastructure of the terminals, the ability to decide on the best set of measures to be implemented to improve the intermodal functions of their terminals in the most economical and efficient way. Due attention should in this context be paid to ensuring interoperability in the Corridor as concerns running of the 740 metre-long trains.

As capacity bottlenecks were identified for a variety of terminals in different federal states/terminal areas in the previous study, several projects were postponed due to the impact of the COVID-19 crisis. Nevertheless, increased terminal handling capacity is still required, according to expected mid- and long-term market needs.

In this context, in the Netherlands, there are plans to realise a rail-road terminal between Nijmegen and Arnhem to replace long distance road transport on the Corridor by rail transport.

3.7.2 Overview of administrative and operational bottlenecks

There are still operational barriers in the rail transport stemming from the historically founded interoperability issues in the national rail networks. These issues occur in particular at cross-border sections, where voltage, signalling and safety systems change. Operational bottlenecks are currently identified and assessed in the EU project called *The Technical Support for the Interoperability Issues Log Book (ILB)*[18]. In cooperation with the Infrastructure Managers (IMs) involved, this study aims to define mitigation measures to overcome the existing operational barriers. The deployment of ERTMS will only partly solve these problems. Furthermore, language requirements pose an additional barrier. As a result, the continuity of traffic is jeopardised, requiring railway companies to use dedicated locomotives or train outfits. This leads to longer travel time and higher transport costs. Rail noise remains a significant negative externality. It requires a European, harmonised solution, while avoiding unilateral

[18] Project is still ongoing, results should be available in summer 2022

actions, which would hamper the functioning of the internal market. The lack of a one-stop shop (ticketing) and internationally coordinated timetables constitutes yet another operational bottleneck.

4 The deployment plans of MoS, alternative fuels and development of urban nodes

4.1 Deployment plan of MoS

Maritime transport plays a key role for the European economy, transporting about 75% of its external trade and approximately 31% of its internal trade. Specifically, short sea shipping (SSS) makes up the majority (up to 60%) of the total maritime transport of goods to and from the main EU ports. With its large network of maritime ports on the TEN-T, the European maritime sector forms an important part of the intra-European transport system. The Motorways of the Sea (MoS) programme is a key instrument in this setting, working towards the ultimate vision of a European Maritime Space (EMS) that is **Sustainable, Seamless, Smart and Resilient**.

In the Detailed Implementation Plan (DIP) for MoS, the aim is to provide a sound analysis of priority investment needs to achieve the EMS, centred on four thematic pillars:

1. **Sustainable**: Emphasising the reduction of GHG emissions and pollution of air, noise and water
2. **Seamless**: enhancing the connectivity with the rest of the TEN-T (the CNCs in particular), other transport modes, peripheral and outermost regions, islands and European neighbourhood countries
3. **Smart**: aligning maritime transport with the European digital agenda
4. **Resilient**: ensuring the EMS is capable of facing exogenous shocks

Maritime ports and their hinterland connections play a key role to achieve these goals. The port infrastructure and the hinterland connections must facilitate the transfer of the European economies to non-fossil fuels, providing appropriate handling and alternative fuels terminals, storage, and hinterland infrastructure. These cross-border multimodal nodes serve not only as transport hubs, but also as gateways for trade, industrial clusters and energy hubs, for example with regard to the deployment of off-shore wind installations.

Given that the future demand of new fuels is not yet known, investment plans need to be flexible and react quickly with regard to a developing demand and supply.

Due to its relatively high-energy efficiency, maritime transport can also play an important role in reducing the climate impact of transport. Especially on long coastal routes, maritime transport should be considered as a serious alternative to road transport. Such coastal services with a reduced carbon footprint should be developed in cooperation with shippers and forwarders.

Ports and port communities are also natural digital hubs, exchanging data with seaborne and land-based transport from all parties involved in the transport chain. Simplifying procedures, harmonised data flows and a common approach to deploy interoperable ICT systems will further facilitate the use of maritime transport.

Finally, the resilience of maritime transport chains requires the cooperation of ship operators, ports, and forwarders. Exogenous shocks such as extreme weather events may lead to a temporary breakdown of ports or parts of the hinterland transport chains. To address such possible shocks, alternative shipping routes should be identified for relevant transport flows. Such alternative shipping routes may involve stakeholders along the TEN-T core network corridors with core and comprehensive network ports.

4.2 Plans for the deployment of alternative fuels infrastructure

The European climate law requires the Union to reduce its net greenhouse gas emission by at least 55% in 2030. Such emission reduction will require a significant contribution from transport. There is now considerable momentum as regards the market uptake of zero- and low-emission vehicles in the EU. However, in order to facilitate transition to a mass market and develop a truly common EU transport market ensuring connectivity and a seamless user experience along the European transport network for low- and zero-emission vehicles, vessels and aircraft are needed. The TEN-T network has to provide the backbone of this endeavour.

The Commission report on the implementation of the Directive 2014/94/EU on the deployment of alternative fuels infrastructure provides a comprehensive assessment of the state of play of alternative fuels infrastructure rollout in the EU[19]. It shows that market maturity varies considerably, depending on the mode of transport. Although some Member States have raised their ambition, the EU still lacks a comprehensive and complete network coverage of easy-to-use alternative fuels infrastructure for all modes of transport. The European Court of Auditors has also stressed the significant differences between Member States in deploying charging infrastructure[20].

The Commission is proposing a new **Regulation on the deployment of alternative fuels infrastructure and repealing Directive 2014/94/EU**. Being part of the Fit for 55 Package of 14 July 2021, the proposal seeks to provide for a dense, widespread network of publicly accessible alternative fuels infrastructure in the EU.

The proposal for a new Regulation sets binding requirements for rollout of an infrastructure with a sufficient amount of minimum recharging and refuelling capacity to ensure full cross-border connectivity of light and heavy-duty vehicles throughout the EU. Distance-based targets for fast-recharging infrastructure along the TEN-T network complement national fleet-based targets for recharging of light-duty electric vehicles. A combined approach of distance-based targets along the TEN-T network with targets for overnight recharging infrastructure for trucks in safe and secure parking places and targets at urban nodes should further support the electrification of heavy-duty vehicles.

Distance-based targets for deployment of hydrogen refuelling stations, including for each urban node, will also ensure necessary minimum refuelling infrastructure for light- and heavy-duty fuel cell hydrogen vehicles.

Following the provisions of the proposal for a **Regulation on alternative fuels infrastructure**, shore-side electricity supply should be provided in maritime and inland waterway ports. In addition, an appropriate number of refuelling points for LNG should be put in place at maritime ports and on road network of the TEN-T core and comprehensive network. Finally, stationary aircraft at airports and commercial transport operation should be able to make use of external electricity supply while parked at gates or at outfield positions at TEN-T airports.

The proposal for the revised **Regulation on the development of the TEN-T network** provides cross-references to the Regulation on the deployment of alternative fuels infrastructure per transport mode and additionally, it addresses aspects of private recharging and refuelling infrastructure in certain cases such as freight terminals. Private recharging infrastructure is also likely to be addressed in the upcoming proposal for the revision of the Energy Efficiency of Buildings Directive.

[19] COM(2021) 103 final
[20] Special Report 05/2021: Infrastructure for charging electric vehicles: more charging stations but uneven deployment makes travel across the EU complicated

4.3 The development of urban nodes by 2030

Urban nodes represent crucial points of origin and destination of transport flows on the Corridors. Therefore, the effectiveness of the core network corridors is impacted by the effectiveness of the first and last miles of the journeys in those urban nodes and it is important to ensure sufficient multimodal connections. Urban nodes can also contain bottlenecks and missing links on the corridors; conversely, they can be impacted by the negative aspects of traffic on the corridors in terms of pollution, noise and safety.

In that perspective, urban nodes should receive sufficient attention in the work of the Corridors, as well as in the TEN-T Regulation. Moreover, it might be relevant to set up a Working Group on Urban Nodes within the Corridor Forum and to organise its meetings on a regular basis.

Given this context, the proposal for the revised TEN-T network defines more clearly the role of the urban nodes within the network and their constituting elements, as well as it sets additional requirements that the Member States should ensure in this regard. Those additional requirements include the development of Sustainable Urban Mobility Plans (SUMPs), the use of sustainable urban mobility indicators, as well as the development of multimodal passenger hubs and freight terminals. In addition, the proposal extends the list of recognised urban nodes from the previously limited list of 88 'network defining urban nodes' to all cities of at least 100,000 inhabitants and, for NUTS2 regions without such a large city, the capital of those regions. Depending on the final version that the Council and the European Parliament will adopt, the number of urban nodes per corridor would significantly increase.

5 Funding and Financing tools

5.1 Update on the Corridor's funding needs

This chapter reflects on the economic and financial aspects of the projects included in the Rhine-Alpine Project List and, more specifically, it provides information on the projects' cost, maturity and financial viability.

The Rhine-Alpine Project List accounts for 302 ongoing and planned projects, amounting to a total of € 116.7 bn[21]. The modal split in terms of necessary funding is presented in Table 4 below:

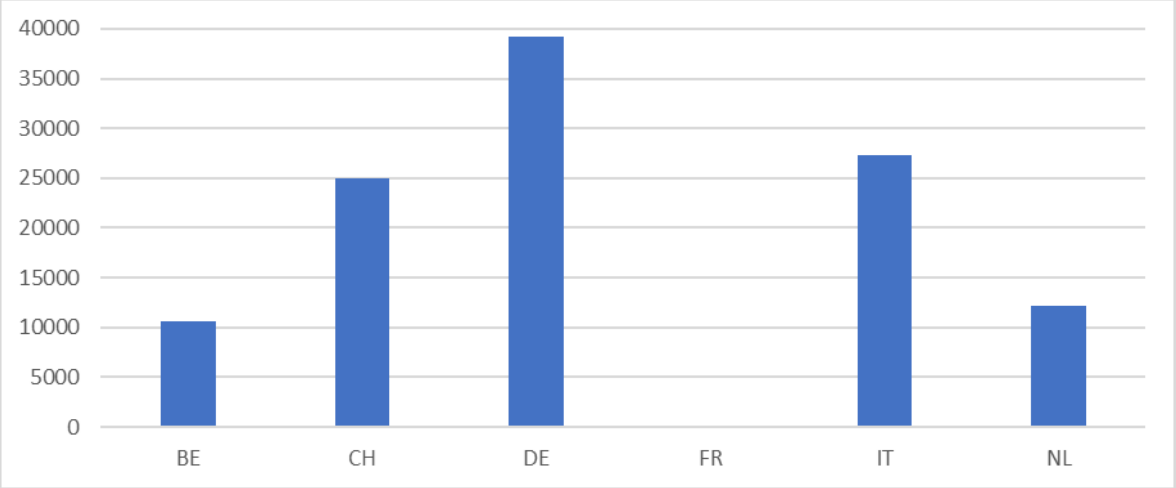
Table 4: Necessary funding in the Corridor by transport category[22]

Transport mode	Necessary funding in € billion
Airports	3.7
Innovation	1.6
IWW	4.7
Maritime	6.4
Multimodal	1.1
Rail	71.2
Rail ERTMS	3.4
Road	24.5

Source: PwC

The total amount is divided among the Member States as shown in Figure 14 below.

Figure 14: Funding per Member State



Source: PwC

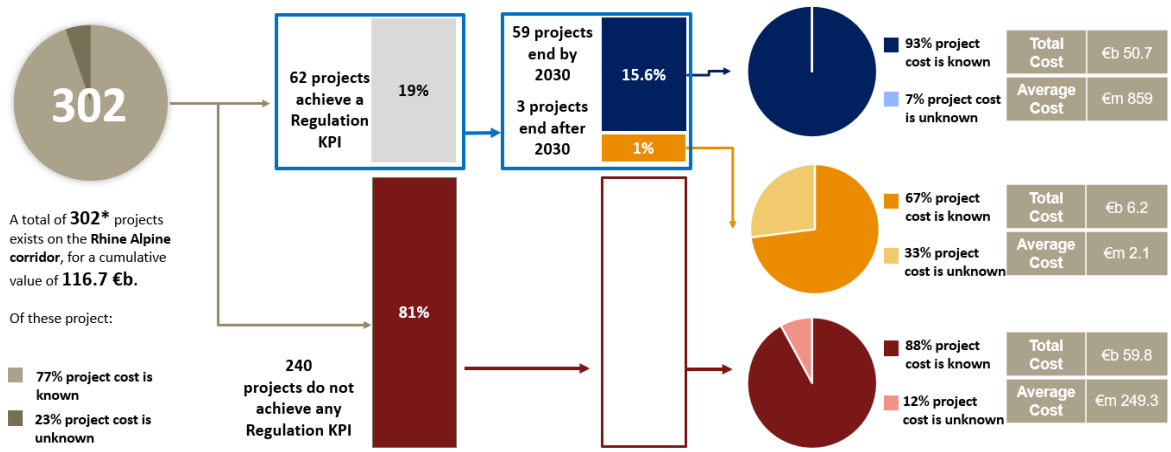
The maturity status of the Rhine-Alpine projects is graphically summarised in Figure 15 below. This assessment took into account the number of active projects and

[21] For the purpose of this financial analysis, only projects ending after the 31st of December 2021 have been considered. The figures for France are very low (11 projects for a total of € 108.8 million) and, therefore, they do not appear in the graph. NB: not all of the projects included in the Rhine-Alpine Corridor Project List have been endorsed by the countries concerned

[22] The financial analysis presented in Table 4 and Figure 14 is based on the Project List for the Rhine-Alpine Corridor mentioned in the footnote above. No financial obligation for the countries concerned derives from this analysis

clustered them through different metrics, such as projects contribution to at least one of the TEN-T Regulation's KPI, their timing and the availability of an official cost figure. As depicted in Figure 15 below, the vast majority (77%) of the projects have information on cost and this high share is further reflected through the three subcategories.

Figure 15: Financial analysis



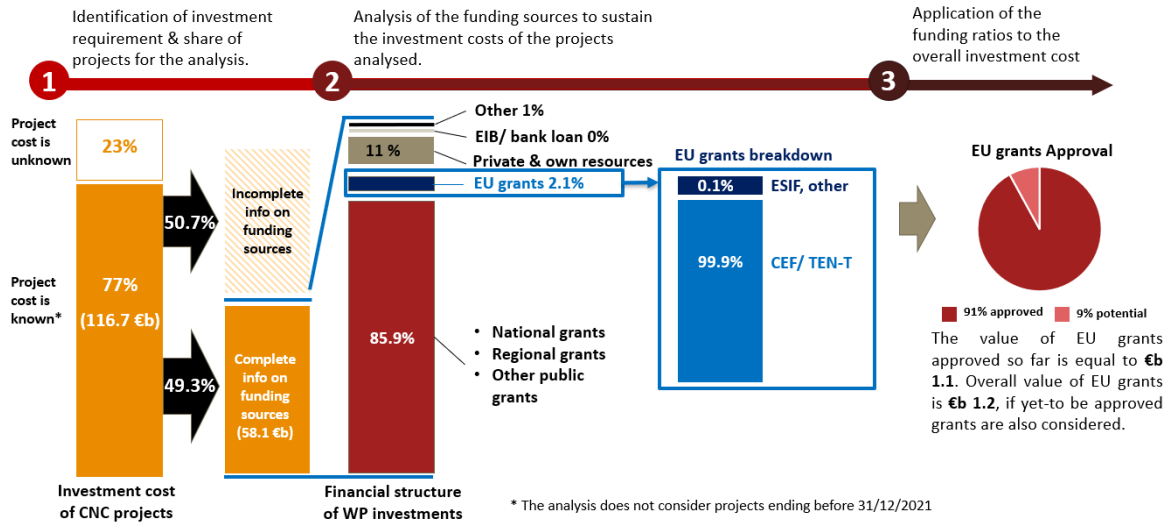
* The analysis does not consider projects ending before 31/12/2021

* Excludes completed projects

Source: PwC

Figure 16 below presents information on the **funding sources** of projects to be still implemented along the Rhine-Alpine Corridor. It shows that complete and full information on cost sources are available for roughly 50% of the Corridor projects, which total around € 58.1 bn. Out of this amount, € 1.2 bn (2.3%) come from the CEF grants. Almost all (91% or € 1.1 bn) of the EU funding has already been approved. The remaining share is still listed as 'potential', i.e. yet to be applied and confirmed by grant or loan agreements.

Figure 16: Funding sources analysis



Source: PwC

As concerns **financial sustainability** of Rhine-Alpine transport infrastructure projects, the analysis shows that almost 20% of the projects are potentially financially sustainable, i.e. able to generate returns from the market to cover the operating costs and possibly a share of the capital expenditure. More specifically:

- 13.3% of the projects, at a total value of € 15.7 bn, are financially sustainable. Projects fall in this group following either a direct assessment of the project promoter or a subsequent analysis of the consultant.
- 5.6% of the projects, at a total value of € 6.5 bn, present a good potential for financial sustainability. Projects included in this category, are considered appropriate based on consultant's assessment.
- 80.1% of the project list, totalling € 94.4 bn, has a low to non-existent potential for financial sustainability. This was based either on a direct assessment of the project promoter or on a subsequent analysis of the consultants.

Financially sustainable projects are relevant because they can be developed with less or no impact on public finances and supported with softer support measures (i.e. soft loans, blending instruments, de-risk instruments, etc.) The more infrastructure is developed through projects generating returns from the market, the less the amount of grants and national public finance is needed to complete the TEN-T network. Projects in the transport sector – and in some sub-sectors in particular i.e., rail, inland waterway, etc. – usually face difficulties being fully financially sustainable. Various factors, among which the presence of financing gaps can, indeed, prevent the project promoter from meeting the desired returns. In this case, projects are potentially financially sustainable, but require some financial aid.

5.2 The Green Deal and the Recovery and Resilience Fund

The Recovery and Resilience Facility (RRF) Regulation has made € 672.5 bn in loans and grants available to support both reforms and investments undertaken by Member States in the framework of national recovery and resilience plans. The aim is to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient, and better prepared for the challenges and opportunities of the green and digital transitions.

The Annual Growth Strategy for 2021 (AGS) and the Commission RRF guidelines have identified the development of sustainable, smart and safe transport as a priority for the European recovery and mentioned the deployment of alternative fuel infrastructure among the seven European flagship initiatives that national recovery plans are invited to contribute to.

In this framework and considering the national plans already submitted, the Commission expects Member States to dedicate significant parts of the RRF funding to transport, placing it among the top sectors of the economy to benefit from investments under NextGenerationEU.

While the RRF will finance a large variety of projects, priority will be given to those contributing to the decarbonisation of the transport system in the framework of the European Green Deal. Investments in the rail sector, in particular on the TEN-T network, will therefore have a prominent place. Other priorities will include sustainable urban mobility solutions (including collective transport and active mobility), inland navigation and the electrification of road fleets. In addition, digitalisation of the European transport system will be accelerated by RRF support to investments in ERTMS, ITS or RIS.

5.3 The CEF 2021-2027 Regulation (CEF2)

The CEF 2021-2027 Regulation (CEF2) entered into force on 14 July 2021, applying retroactively from 1 January 2021. The total **budget** for the CEF transport is € 25.8 bn [23] and is divided between the following three envelopes:

- General envelope: € 12.8 bn
- Cohesion envelope: € 11.3 bn
- Military mobility envelope: € 1.7 bn

The **main priorities** of CEF2 are:

- Completion of the network: supporting the completion of the TEN-T, with particular priority to cross-border sections and missing links of the core network corridors (60% of general envelope and 85% of cohesion envelope).
- Modernisation of the existing infrastructure: tackling much more decisively the challenge of decarbonisation and digitalisation of the transport sector and supporting the transition to smart, sustainable, inclusive, safe, and secure mobility (40% of general envelope and 15% of the cohesion envelope).
- In line with the Action Plan on Military Mobility, for the first time, supporting the critical development of civilian-military dual-use transport infrastructure.

CEF2 will contribute at least 60% of its funding to the climate objectives (compared to 30% of the overall target of the MFF).

Building on the previous CEF blending facility, a dedicated **Alternative Fuels Infrastructure Facility (AFIF)** has been set up. It takes the form of a rolling call for proposals, including five cut-off dates until end of 2023. With a budget of EUR 1.58 billion (out of which around 20% come from the cohesion envelope with higher co-funding rates), it funds alternative fuels infrastructure for renewable and low carbon fuels by combining the CEF grants with financing from finance institutions to achieve a higher impact of the investment. The European Investment Bank (EIB) and other national promotional banks are implementing partners facilitating the combined operations.

The **blending** of CEF2 grants with other financial sources will be allowed. This might be implemented either through blending calls (CEF grants in combination with non-EU financial instruments e.g., commercial banks or national promotion banks) or through blending operations (blend CEF grants with InvestEU).

CEF2 will allow the implementation of **synergies** between CEF transport, energy, and digital sectors. It will be applied either as 'synergetic elements' (it will be possible for each sector to accept as eligible cost ancillary elements pertaining to another sector) or through joint work programmes, jointly financed from each sector involved with the possibility to apply the highest co-funding rate of the sectors concerned and 10% top-up.

The Commission adopted the first multiannual work programme 2021-2027 on 5 August 2021. This specifies the funding objectives and budget for the years 2021-2023.

[23] All amounts are in 2021 prices

5.4 The inclusion of Military Mobility in the network development plans

As of 2021, military mobility is taken into account in the Corridor work plans. The efforts addressing military mobility are based on 2018 EU Action Plan on Military Mobility, which aims to improve military mobility in three key areas of action: transport infrastructure, regulatory and procedural issues, and other cross-cutting topics.

Concerning transport infrastructure, the Council of the EU approved the Military Requirements for Military Mobility within and beyond the EU in 2019. These Military Requirements identify the geographical scope for military mobility, as well as define transport infrastructure standards necessary for the military. The gap analysis performed by the Commission services and the EEAS in 2019 emphasises the synergies between TEN-T and military mobility: 93% of the military transport network is also part of TEN-T; and military transport infrastructure standards are mostly compatible with civilian transport infrastructure needs.

Owing to these synergies between civilian and military transport needs, actions aiming to complete TEN-T corridors can also improve military mobility. The EU's new long-term budget now includes a dedicated € 1.7 bn military mobility envelope as part of the CEF 2 to co-fund such dual-use transport infrastructure projects. The first CEF2 call for proposals to improve dual-use transport infrastructure was launched on 16 September 2021. In order to be eligible, projects have to be on both the TEN-T and the military transport network. They also need to address dual-use transport infrastructure requirements identified in Commission Implementing Regulation (EU) 2021/1328[24].

[24] Commission Implementing Regulation (EU) 2021/1328 of 10 August 2021 specifying the infrastructure requirements applicable to certain categories of dual-use infrastructure actions pursuant to Reg. (EU) 2021/1153 of the European Parliament and of the Council, C/2021/5859, OJ L 288, 11.8.2021, p. 37

6 Recommendations and outlook by the European Coordinator

Slightly less than a decade away from the 2030 deadline and in the aftermath of an unprecedented global crisis, it is time to reflect on what has been achieved, and most importantly, look ahead to what remains to be done to complete the Rhine-Alpine Corridor. In this final chapter, I am putting forward my personal vision and recommendations on how to put the Corridor on the path to becoming a green, smart, safe, resilient, competitive and sustainable multimodal transport Corridor.

6.1 Progress made and its operational influence on efficiency

The fifth Work Plan for the Rhine-Alpine Corridor has been based on the updated project list, which now contains 445 projects and measures related to the Corridor. This compares to 175 projects accounted for in 2014, when we started our journey towards achieving a modern, safe, sustainable, efficient and competitive transport Corridor. Of the 445 projects, 76 are located on 'cross-border' sections, 81 on 'last-mile' sections and 104 are classified as 'pre-identified CEF section or project'. In total, 151 projects are exclusively located on the Rhine-Alpine Corridor, while 294 projects are shared with one or more corridors, thereof 157 with the North Sea-Baltic Corridor and 146 with the North Sea-Mediterranean Corridor[25]. This very high number of overlapping projects shows the strong interconnection of the nine core network corridors.

Since the first Work Plan, 116 projects have been completed accounting for a total investment of € 23 bn. With 35 implemented measures, which amounted to € 19 bn, the rail and ERTMS constituted the largest group of completed projects by both volume and value. Road projects were the second largest group of projects that have been finalised. In total, 27 projects aiming at the improvement of road infrastructure have been completed since the entry into force of the TEN-T Regulation in 2013 and they totalled € 2.2 bn. Within the same period, 16 inland waterways projects have been completed, followed by 13 measures focussing on enhanced multimodality.

From my perspective, this is a very good progress since the adoption of the TEN-T Regulation in December 2013. Although the Rhine-Alpine Corridor has already a relatively high compliance regarding the relevant KPIs, the infrastructure for all modes of transport has been improved and partly expanded to provide even more efficient, safer, smarter and sustainable services.

6.2 Remaining critical issues

Compared to other core network corridors, the Rhine-Alpine Corridor is largely compliant with the requirements defined in the TEN-T guidelines. However, certain critical infrastructure characteristics need to continue to be upgraded.

- **Rail capacity** is already stretched to maximum at certain sections. In order to accommodate heavy mixed passenger/freight traffic, Member States must speed up implementation of major rail infrastructure projects at cross-border sections between Germany and Netherlands and Switzerland on the one hand and between Italy and Switzerland on the other hand. Similarly, extensions of capacity of hinterland connections to the Port of Zeebrugge and Port of Genova remain a priority.
- To further increase the attractiveness and competitiveness of rail for international freight services, it is indispensable to allow for **740m trains** to

[25] Explanation: the projects mentioned can belong either to both corridors or only to one of the overlapping corridors

run the entire day on the whole Corridor. Current diverging situation in Member States creates a serious obstacle to seamless international freight traffic flows. A study, performed by Rail Freight Corridor Rhine-Alpine demonstrated that with limited financial resources serious gains in capacity (of up to 15%) could be achieved.

- Finally, as regards rail, there are still **operational barriers** stemming from the historically founded interoperability issues in the national rail networks. These issues occur in particular on cross-border sections, where voltage, signalling and safety systems change. The deployment of ERTMS will only partly solve these problems. Furthermore, language requirements pose an extra barrier. As a result, the continuity of traffic is jeopardised, requiring railway companies to use dedicated locomotives or train outfits. This leads to longer travel time and higher transport costs. **Rail noise** remains an important negative externality. It requires a European, harmonised solution, while avoiding unilateral actions, which would hamper the functioning of the internal market.
- Regarding **inland waterways**, enhancement of the fairway depth on German sections of the Rhine is needed to improve the navigation conditions. Even if it is understood that a major section of the river will not be compliant with the 2.5m draught requirement, projects addressing this problem should continue to be treated with priority. On the Mosel River on the section between Koblenz and Trier, lock capacity and operational volume should be improved.
- To make rail and IWW more competitive the **robustness** of the Corridor should be guaranteed for reliable operations, including in terminals. Diversion routes and alternative routes cannot be ignored in this respect.
- Concerning **roads**, many bottlenecks exist around core urban areas, mainly during peak-hours. Intelligent Transport Systems hold great potential for road infrastructure. High level of bridge and tunnel safety must be ensured through upgrades and rehabilitation.
- **Multimodality** plays a crucial role for the Corridor and its further development. Besides pure rail-road terminals, tri-modal terminals connecting inland waterways, rail and road, as well as bi-modal barge-road terminals, support the multimodal functioning of the Corridor. To improve multimodality, there is a need to invest in longer transhipment tracks and in infrastructure for handling faster and more containers of barges within the seaports. Furthermore, electrification of terminals should be pursued in order to reduce local pollution.
- **Seaports** face a number of capacity and connectivity issues, which need to be resolved, both when it comes to hinterland connections (Antwerp, Zeebrugge, Rotterdam, Amsterdam, Genova), maritime access (Amsterdam, Genova) and barge congestion.

6.3 Future challenges and what still needs to be done

The Rhine-Alpine Corridor has a **challenging amount of ongoing and expected projects** (302), and some € 116.7 bn is necessary to complete the Corridor by 2030. Similarly to its predecessor, CEF2 will continue to support the development of the TEN-T networks, especially the modernisation of the existing infrastructure, reinforcing the decarbonisation and digitalisation of the transport sector, and also the desired transition to smart, sustainable, inclusive, safe and secure mobility (40% of general envelope and 15% of the cohesion envelope). However, the lion's share of the investments will have to be financed from national, regional budgets or other public sources.

The European plans for the **deployment of alternative fuels** are ambitious and as mentioned in chapter 4, the TEN-T network has to provide the backbone. Our Corridor

has its particular role to play in this context, as we should strive to become a leader not only in deployment of alternative fuels, but more broadly, in greening of the core network corridors. One of the measures to achieve this is to create a dense and widespread network of publicly accessible alternative fuels infrastructure along the Rhine-Alpine Corridor to make sure that our network is future proof, allowing countries and regions to reap the benefits of the green transition. We already have very promising examples in the countries belonging to our Corridor. Notably, there are 23 completed projects on alternative fuels infrastructure and vehicles deployment for LNG, electric charging points, hydrogen refuelling stations, such as 'EUROP-E: European Ultra-Charge Roll out Project', 'BioLNG EuroNet', 'EV CHARGING ITALY', 'CRE8: Creating the station of the future', 'AMBRA-Electrify Europe' and 'RH2INE' just to name a few of them. Additionally, 21 projects are ongoing and expected to start before 2030. Bottom-up initiatives like the Roadmap towards a carbon neutral Rhine-Alpine Corridor of the EGTC Rhine-Alpine are also very useful in this respect. This shows the commitment to the deployment of alternatives fuels.

Climate change poses a critical threat to the Corridor infrastructure, requiring adaptive measures to minimise the losses and disruptions caused by extreme weather conditions. The climate along the Corridor is characterised by a temperate continental climate in the north and a hot Mediterranean climate in the south. The critical climate-related topics and their effects have mostly been known for years and some of them are relevant for the Rhine-Alpine Corridor. These include in particular:

- rail buckling, limited IWW navigability and road degradation due to droughts in inland areas during summer,
- more river flooding,
- more precipitation at sea areas, and
- stronger winds and lightning throughout the Corridor.

All modes of transport are affected by one or several of these issues.

It is then of utmost importance to maximise the effort on projects that help mitigating climate change and reduce carbon dioxide emissions, such as by favouring rail and inland waterway transport over road, while increasing resilience of the two modes. For international rail passenger transport, for instance, a consistent international network of connections should be developed to reduce the number of continental flights.

6.4 How will our actions contribute to the Green Deal?

The transport sector currently accounts for around 25% of total greenhouse gas emissions in the EU. Against this background, the European Green Deal calls for a significant part of the 75% of inland freight currently transported by road to be shifted to rail and inland waterways. The EU's Sustainable and Smart Mobility Strategy reaffirms these modal shift targets: rail freight is expected to increase by 50% by 2030 and double by 2050, while inland waterways and short sea shipping are expected to increase by 25% by 2030 and 50% by 2050.

The TEN-T policy and the core network corridors will play a key role in achieving the targets set for transport in both the EGD and SSMS. To ensure that transport duly contributes to reaching the European ambitions to become climate neutral continent by 2050, the European Commission adopted a legislative proposal for a revised Regulation for the development of the trans-European transport network (TEN-T) on 14 December 2021. The new TEN-T proposal is the result of a comprehensive evaluation of the existing legal framework, extensive Member States and stakeholder consultation and an in-depth assessment of the impacts of the changes proposed. In particular, the revised Regulation ensures that the appropriate infrastructure basis to alleviate congestion and reducing GHG emissions is provided. To that end, the proposal includes firm incentives to shift transport demand towards more sustainable modes of transport. The aim is two-fold:

a) to increase the number of passengers travelling by rail through the development of a competitive and seamless high speed rail network throughout Europe; and

b) to shift a substantial amount of freight onto rail, inland waterways, and short sea shipping.

In the revised TEN-T Regulation, the overall objective remains unchanged, as we need to gradually complete a competitive and interoperable TEN-T network at highest standards within given deadlines, i.e. by 2030 for the core network, by 2040 for the extended core network, and by 2050 for the comprehensive network. In particular, the revised TEN-T Regulation introduces a number of **new or reinforced infrastructure requirements**, which promote the development of infrastructure of sustainable forms of transport.

With regard to **rail transport,** the proposal introduces a new requirement to enable the P400 loading gauge on the entire network and foresees the extension of existing core network requirements to the entire comprehensive network (22.5 tons axle load, 740 m train length) or to the extended core network (100 km/h line speed). In addition, a minimum line speed of 160 km/h is proposed for passenger lines of the core and the extended core network and the installation of ERTMS on the entire network by 2040, while decommissioning existing national class B systems is made mandatory.

In terms of **waterborne transport**, the revised TEN-T Regulation defines a 'good navigation status through minimum requirements (2.5 m navigable channel depth and 5.25 m height under bridges) that shall be complemented by specific requirements per river-basin.

Short sea shipping shall be promoted in a wider perspective by integrating all components of the maritime dimension into a new concept called European Maritime Space.

In the field of **road transport**, the focus is on improving the quality of roads to increase road safety and to augment the number of rest areas and safe and secure parking spaces along the TEN-T network.

Finally, the proposal for a revised TEN-T Regulation foresees an increase in the number of **multimodal freight terminals** along the TEN-T in order to promote multimodality as well as the inclusion of all EU **urban nodes** of at least 100,000 inhabitants into the network, thereby also ensuring that each NUTS-2 region is represented by an urban node. For the latter, the requirement to implement a Sustainable Urban Mobility Plan (SUMP) and the development of transhipment facilities (multimodal freight terminals and passenger hubs) is imposed.

In order to achieve the targets and to fulfil the objectives of the EGD and the SSMS an intermediary **deadline of 2040** is proposed to be introduced for the new standards on the core network and for advancing the existing standards to the comprehensive network, notably the deployment of ERTMS.

The integration of the nine Core Network Corridors with the eleven Rail Freight Corridors in a common set of '**European Transport Corridors**' constitutes a major element of the revised TEN-T proposal. The Rhine-Alpine Corridor is proposed to be combined with the North Sea - Mediterranean Corridor to form one major transport artery in Europe, now called the North Sea - Alpine Corridor. Importantly, the geographical alignment of these new corridors has been defined in the revised TEN-T Regulation and thus, the existing alignment of corridors in the CEF 2 Regulation will be repealed. While striving for maximum stability of the existing TEN-T network, this merger brings certain changes such as the identification of an extended core network, which has been fully integrated into the corridors.

Similarly, the current Corridor governance system shall be further reinforced. Based on **European Coordinators'** work plans, which shall be elaborated every four years, the Commission will be able to adopt an implementing act for each work plan, setting

clear milestones to be implemented by the respective Member States. The elaboration of the work plans shall be complemented by annual status reports. Last but not least, the role of European Coordinators as observers in dedicated entities for the implementation of cross-border projects shall be institutionalised.

The proposal is now being negotiated with the European Parliament and the Council for a possible entry into force of the revised TEN-T Regulation in the course of 2023. Once adopted, this new Regulation will shape the work along the TEN-T networks and within the European Transport Corridors.

In this context, it can be stated that **multimodal transport and the so-called synchro-modality already play a very important role on the Rhine-Alpine Corridor**. The interconnections of the seaports with their hinterland and the transalpine freight flows constitute the paramount examples in this regards. In particular, the northern seaports prove perfectly how all transport modes can complement each other providing efficient transport options by rail and inland waterways. Transport volumes are handled via a dense network of intermodal terminals.

In order to reach the goals of the Green Deal, **transport infrastructure** in the Corridor, in particular for rail, has to be further expanded to increase its capacity resulting from growing traffic both along the transport routes and in transhipment terminals to improve multimodality. We also need to continue with improvements of terminals to increase their handling capacity. Numerous dedicated projects are already on the list, but infrastructure expansion is time-consuming and has sometimes also physical limits. Therefore, a mix of additional measures is necessary.

Firstly, we have to utilise the infrastructure available in a more efficient way. **Digitalisation** providing reliable information e.g., on delays and estimated time of arrival is one important instrument for the future. This will also support modal shift through an increased attractiveness of rail, IWW and intermodal transport. In particular, we need to embrace fully the opportunity that the digitalisation and innovation offer to increase efficiency of the rail transport in the Corridor.

In this context, a rapid **deployment of ERTMS** should be given a particular attention, as it is a step towards automatic and continuous train operation. The Rhine-Alpine Corridor is among the frontrunners when it comes to rollout of the ERTMS, yet the ETCS is deployed only on 29% of railway lines in the Corridor. This shows a room for improvement and we must try harder to implement ERTMS by the deadlines foreseen in the TEN-T Regulation.

Secondly, we need to focus on removing barriers to **interoperability in rail transport**. A high share of rail freight in the Rhine-Alpine Corridor is travelling long distances and crossing borders. Despite adoption of four railway legislative packages, both operational and technical barriers such as diverse voltage, signalling and safety systems still exist – and they all manifest themselves at the cross-border sections. Therefore, we need to step up the efforts to eliminate these barriers.

Also from a passenger perspective, each transport mode operates almost in isolation. **Planning and buying tickets for multimodal journeys,** especially in cross-border traffic, remains cumbersome, and this should change. To get to the next level, we need greater coordination and interaction between different transport operators, including data-sharing.

Of course, an important pillar is making our Corridor more **sustainable and green** to contribute to the decarbonisation of transport in line with the EU ambitions to make our continent climate neutral by 2050. We have already made significant steps forward, but the Corridor has to explore further the opportunities in fleet modernisation, electrification, technology innovation in sustainable fuel, deployment of charging facilities and uptake of hydrogen fuel technology, just to name the key areas.

Thirdly, the transport infrastructure in the Rhine-Alpine Corridor needs to **increase its resilience**, especially in rail freight segment, by dealing adequately and effectively with the repairs and maintenance, as well as accidents or incidents.

To this end, the proposed integration of the TEN-T Corridors and the Rail Freight Corridors into 'European Transport Corridors' will support this goal and will enable to focus joint efforts on 'quick wins' like train length, loading gauge and improved operational rules. It will also allow the TEN-T network to better deal with temporary closures caused by accidents, extreme weather events or maintenance works.

Finally, Russia's unprovoked aggression on neighbouring Ukraine has changed geopolitical and economic reality for the European Union, especially in the context of the energy and defence sectors. As part of the joint EU response to the Russia's invasion of Ukraine, on 8 March 2022, the European Commission proposed an outline of a plan to make Europe independent from Russian fossil fuels well before 2030, starting with gas.

Although the Rhine-Alpine Corridor is located relatively far from the EU border with Ukraine, we need to look at the **short- and long-term consequences of the unprovoked Russia's invasion of Ukraine on the transport system of our Corridor**. In particular, our ports should play a prominent role in Re-Powering Europe, e.g. by facilitating imports and storage of fuels delivered from alternative to Russia's origins. This is crucial to ensure resilience of the logistic chains and uninterrupted supply of fuels for both transport sector and beyond.

Final remarks

This Fifth Work Plan has been prepared since September 2021 and it was finalised in June 2022. The period since the completion of the fourth Work Plan has been marked by the Brexit, the SARS-CoV-2 pandemic and the Russian invasion on Ukraine, the latter two having serious consequences on our lives, transport sector and economy in general.

The strategic context has also evolved substantially within this period, as presented in the introduction of this Work Plan, including the preparation by the Commission of the proposal for the revised TEN-T Regulation, which - once adopted - will support the way forward towards a green, more sustainable, smart and resilient Rhine-Alpine Corridor. This Work Plan will therefore be the last one adopted under the current TEN-T Regulation.

My last word goes to the joint collaboration efforts for the successful completion and greening of the Corridor. The Corridor concept is based on the cooperation among all stakeholders: countries, regions, cities, infrastructure managers, transport operators, shippers, etc. The multi-level governance is critical to ensuring the harmonious development of the Corridor. In the context of the Rhine-Alpine Corridor, a particular attention should be given to three actors, whose commitment has been instrumental: the Central Commission for the Navigation on the Rhine, the Rail Freight Corridor 'Rhine-Alpine' and the Interregional Alliance for the Rhine-Alpine Corridor (EGTC Rhine-Alpine). Cooperation and participation of all these stakeholders needs to be enhanced and supported to ensure their due contribution to the development of the Corridor.

I strongly believe that only by working closely together can we reach our common goals of making the Corridor truly green, smart, efficient and resilient.

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