



European
Commission

Rhine Alpine



Work Plan of the
European Coordinator

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This report represents the opinion of the European Coordinator and does not prejudice the official position of the European Commission.

1. Towards the Rhine-Alpine Corridor

Epitome of the Transport Challenges of the European Union

Transport is at the crossroads of the economic, social and environmental goals of Europe, an essential driver for jobs and growth. It underpins both export and competitiveness. Against this background, Europe's transport infrastructure plays a key role to completing the internal market through the removal of physical barriers and the introduction of soft measures. Furthermore, in today's interconnected world, neither scope nor vision can be exclusively limited to the European internal market, but has to incorporate the broader global context where economic gains, and likewise economic challenges, no longer stop at the border. It is, therefore, necessary to change the mental framework to understand that today's world no longer allows thinking in terms of a single mode or even country.

"*Connecting to complete*" and "*connecting to compete*" emerge as mottos for the creation of a single European transport area. Completing the transport network - in particular its core - interlinking modes and nodes, can provide a competitiveness boost and growth potential. This, however, will become reality only if all stakeholders act, and act together. In this context, three main strands emerge:

- balancing private and public interests, exploring potential areas of joint activity and collaboration, including through innovative financing schemes,
- reconciling short term and long term plans and vision, taking into account demand projections, and sustainability challenges within the larger European and global policy and economic framework, and
- above all, matching words with deeds, recognizing the need for the requisite firm political will, in the absence of which, even the best conceived project will flounder.

Transport, which has been part of one of the two founding policies present in the Treaty of Rome, holds a preeminent place in the European Union integration process. At a juncture when momentum for the European project is waning, it is the right time to deliver on political commitments, act on promises and progress with enforcement.

1.1 Characteristics of the Rhine-Alpine Corridor

In March 2014, I was given the mandate as European Coordinator for the Rhine-Alpine Corridor. Regulation (EU) 1315/2013 defines that each European Coordinator *shall, by 22 December 2014, submit to the Member States concerned a work plan analysing the development of the corridor. After it has been approved by the Member States concerned, the work plan shall be submitted for information to the European Parliament, the Council and the Commission. The work plan shall include, in particular, a description of the characteristics, cross-border sections and objective of the core network corridor.*

The Rhine-Alpine Core Network Corridor is one of the nine corridors of the core network, defined in the Trans-European Network for transport (TEN-T), based on Regulations (EU) 1315/2013 and 1316/2013. The Rhine-Alpine Corridor is mature and complex (all modes of transport). The Corridor also includes the Rhine River - one of the two major navigable arteries on the continent. The regions it encompasses, count among the most densely populated and richest in Europe.

Altogether, more than 70 million people live, work and consume in the catchment area of the Rhine-Alpine Corridor. Leading manufacturing and trading companies, production plants and distribution centres are located within. The corridor runs through the so-called "Blue banana," which includes major EU economic centres such as Brussels and Antwerp in Belgium, the Randstad region in The Netherlands, the German Rhine-Ruhr and Rhine-Neckar regions, the Basel and Zürich regions in Switzerland, and the Milan and Genoa regions in Northern Italy (cp. Figure 1). The Corridor encompasses some of world's largest ports, like: Rotterdam, Amsterdam, Antwerp and Zeebrugge, which function as entry and exit points to the corridor and stand at the crossroads for multiple modes.

Figure 1: Europe's "Blue Banana"¹



Along the Rhine-Alpine Corridor, over 1 billion tonnes of freight are transported annually, resulting in a corridor GDP of more than 2.700 billion Euros (data from 2010). With 13% of EU's population, the Corridor regions generate 19% of the EU's GDP. This corridor shows an advanced stage of the rail freight infrastructure, which makes it a "forerunner" for other corridors, while initiatives on innovations and new technologies (LNG for inland waterways for instance) pave the way into the future. The corridor also confronts important characteristic challenges, such as road congestion, noise and pollution in urban areas, the replacement of disparate safety and signalling railway systems, incomplete ERTMS deployment, upgrades of lock capacity, and vast maintenance issues of existing infrastructure.

1.2 Process towards the work-plan

Given the advanced stage of infrastructure development, the Rhine-Alpine Corridor has to be developed in a way to uphold into the future reliable and high quality freight and passenger service. Infrastructures need to be constructed, maintained and upgraded through smaller and large-scale investments within a coherent corridor vision, which takes into account the growing demand for fast and seamless movement of goods and persons.

The Rhine-Alpine Corridor runs through six Member States and Switzerland. France and Luxembourg were added to the catchment area of the Corridor in light of the relevance of inland waterways and their ports. The corridor includes four modalities and involves hundreds of stakeholders.

As part of the preparation of this work plan, in agreement with the Member States concerned, consultative Corridor *Fora* and working groups on ports, inland waterways and regions were organized in order to fine-tune a coordinated corridor approach. These activities were complemented by various visits, seminars, exchanges and bilateral meetings with national and regional authorities, private and public sector representatives, as well as civil society in the Member States concerned. The

¹ Source: www2.klett.de

collaborative approaches of all Member States as well as the valuable contributions by Switzerland have been instrumental in this endeavour.

A consortium of consultancy companies was contracted by the European Commission for the provision of technical support. The analysis presented in the Rhine-Alpine corridor study was prepared by HaCon Ingenieurgesellschaft mbH (DE) (lead partner); KombiConsult GmbH (DE); Panteia B.V. (NL); PricewaterhouseCoopers Advisory SpA–PwC (IT); Rapp Trans (CH) and Stratec (BE). Their main tasks involved: fact finding, identifying stakeholders, gathering and reviewing existing studies and materials, introducing infrastructure parameters in the TENtec system², performing a transport market study, support for the meetings of the Corridor Fora and analysis of the development of the Rhine-Alpine Corridor, which is the basis for the work plan. Another task performed by the consultants was to compile a first list of projects along the corridor, which are needed to comply with the TEN-T requirements and cope with the capacity challenges. This list – 145 EU and 35 Swiss projects – provides an indicative outline of the required investments (see link at the end of the document). The works and analyses executed by Rail Freight Corridor Rhine-Alpine (RFC1), ERTMS Corridor A and the former Priority Projects 5 (Betuweline) and 24 (Railway axis Rotterdam-Genoa) serve as a backbone.

1.3 The Corridor work-plan and beyond

This work plan aims at providing a comprehensive overview of the strengths and weakness of the corridor. It highlights the opportunities and addresses what has to be tackled, constructed, upgraded or maintained in order to remove bottlenecks and missing links, enhance cross-border sections and improve inter-modality and interoperability. The work plan seeks to identify the most important projects from the perspective of enhancing the European corridor as a whole by selecting the ones with the highest European added value. Recognizing the beneficial spill-over effects of a comprehensive and integrated approach, emphasis needs to be placed on strong commitment for project implementation.

Looking ahead and acknowledging progress achieved so far, outstanding issues remain pursuant to Article 47 of Regulation (EU) 1315/2013. Key among them are: sustainability issues, including climate change impact and greenhouse gas mitigation, the further development of the corridor economic added value, as well as the elaboration on project funding and investment. The significance of deploying ERTMS along the entire corridor is mentioned in this work-plan and will be addressed in more detail by the ERTMS dedicated European Coordinator Mr. Karel Vinck. Finally, further data analysis, especially regarding the rivers Moselle and Neckar, which have been subsequently added to the catchment of the corridor, is equally important. All these issues have to be addressed in the follow-up to this work plan.

² TENtec is the information system of the European Commission to coordinate and support the TEN-T Core Network Corridor development.

2. Characteristics of the Rhine-Alpine Core Network Corridor

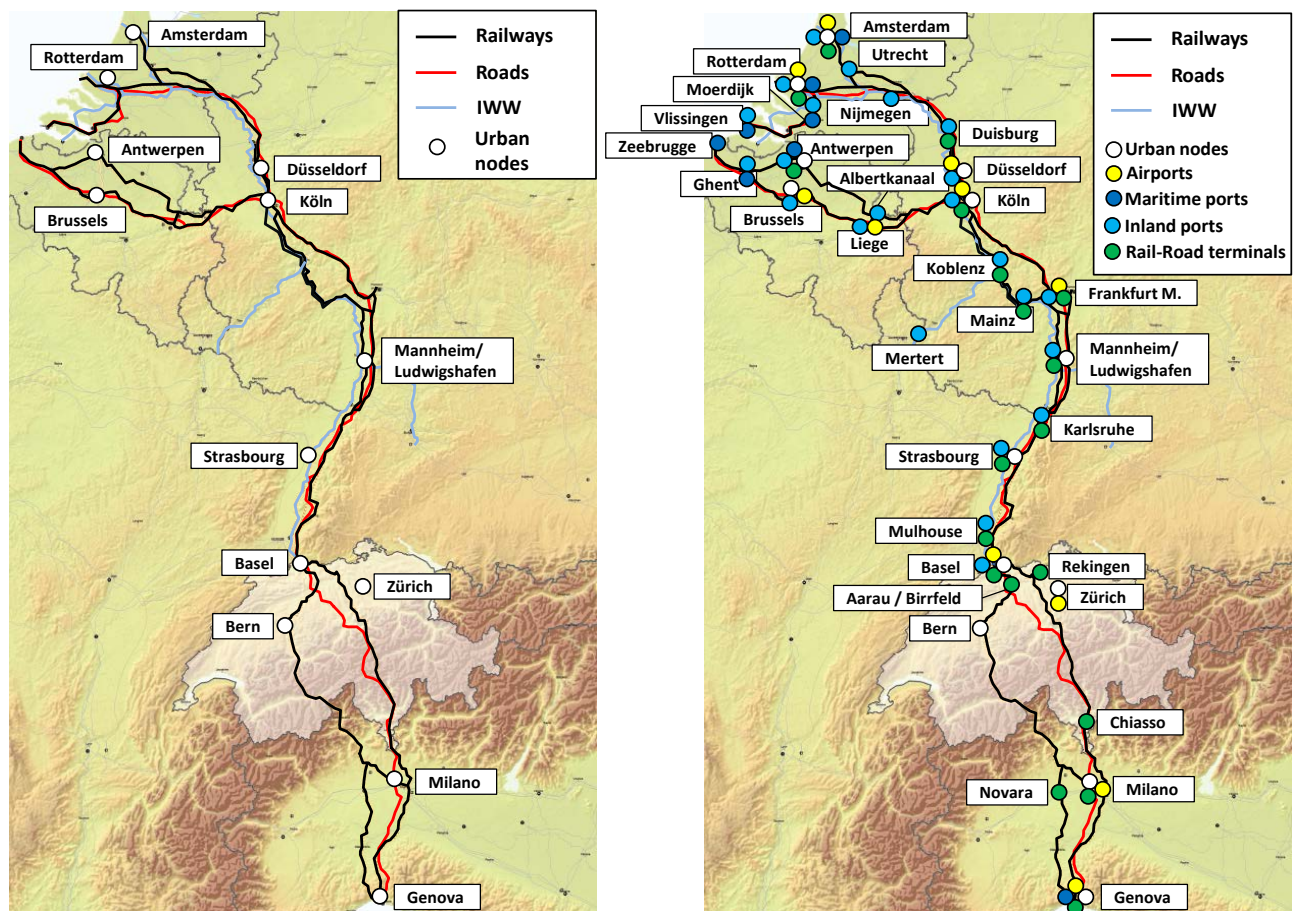
2.1 Alignment of Rhine-Alpine Corridor

The Rhine-Alpine Corridor stretches from the northern seaports in The Netherlands and Belgium to the Mediterranean basin in Genoa, through the most important and economically strongest urban regions of Europe. Countries directly involved are: The Netherlands, Belgium, Germany, Switzerland, Italy, France (Strasbourg area) and Luxembourg (Moselle) (cf. Figure 2).

The main branches of the Rhine-Alpine Corridor are:

- Genova – Milano – Lugano – Basel (480 km);
- Genova – Novara – Brig – Bern – Basel (500 km);
- Basel – Karlsruhe – Mannheim – Mainz – Koblenz – Köln (490 km);
- Köln – Düsseldorf – Duisburg – Nijmegen/Arnhem – Utrecht – Amsterdam (270 km);
- Nijmegen – Rotterdam – Vlissingen (200 km);
- Köln – Liège – Brussels – Ghent (285 km);
- Liège – Antwerp – Ghent – Zeebrugge (230 km).

Figure 2: Outline of the Rhine-Alpine Corridor³



³ Source: Regulation (EU) 1316/2013 Annex 1, Part 1 and HaCon. Left figure shows the main core urban nodes and the alignment per mode; the right figure shows all corridor nodes, including the rail-road terminals.

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

The definition of the corridor, the general alignment, urban nodes and the logistics nodes (airports, maritime ports/seaports, rail-road terminals) are based on the provisions of the TEN-T Regulations (EU) 1315/2013 and 1316/2013. The corridor alignment, set in the regulations, is supplemented by the analysis of the available TENtec data and information on Member States' infrastructure planning.

2.2 The corridor nodes

The Corridor has 13 core urban nodes, spread over the five European Member States and Switzerland involved (cf. Table 1).

Table 1: Overview of corridor nodes

Country	Urban nodes	Airports	Seaports	Inland ports	Rail-Road Terminals	Total
NL	2	2	4	6	2	16
BE	2	2	3	5	1	13
DE	3	3	-	8	8	22
FR	1	-	-	2	2	5
CH	3	2	-	1	4	10
IT	2	2	1	-	3	8
Total	13	11	8	22	20	74

The 8 **maritime ports** (among them the ports of Rotterdam, Amsterdam, Antwerp and Zeebrugge) are main exit and entry nodes of the Corridor. Ports serve as a link to the hinterland and play a crucial role in connecting road, rail and inland waterways. The connection of the maritime ports for freight transport is critical for the import of goods from outside the corridor.

The **river Rhine** is an important route for the containers and the transport of bulk commodities especially between the North Sea ports and Germany, France and Switzerland. Therefore securing the reliable navigation of the Rhine is of the utmost importance. This also applies to barge services in the inland ports along the Moselle, Main and Neckar.

International **rail** is a key feature on the corridor. For international passenger transport, connections between agglomerations in neighbouring countries are key. For rail freight, transport flows along the entire corridor play an important role in particular for intermodal transport volumes from and to the seaports and the transit via Switzerland. Against this background, Rail Freight Corridor Rhine-Alpine (RFC1) belongs to the first European rail freight corridors made operational in November 2013 as required by Regulation (EU) 913/2010.

Since all transport modes are represented on the corridor, multimodality for both passenger and freight transport plays an outstanding role. It has to be taken into consideration that the 20 rail-road terminals from Table 1 only represent its geographical location. Inland ports, rail-road platforms and airports can have more than one facility per specific location. In total, 59 multimodal platforms exist across the corridor. Duisburg

stands out in particular with nine identified multimodal platforms, five of which even deal with three modes, connecting rail, road and inland waterways infrastructure.

Among others, important **multimodal nodes** are:

- The **ports** of Antwerp and Rotterdam, which are among the world's leading seaports, particularly with regard to container trans-shipment, and along with the ports of Amsterdam, Zeebrugge, Ghent, Genoa, Vlissingen and Moerdijk are the largest multimodal nodes. These ports benefit from international maritime connections, inland waterway transport services (only in the North Sea ports), rail freight and road transport.
- For the execution of maritime and continental intermodal transport, a net of **rail-road terminals** (RRT) is located along the corridor. Beside the seaports, main locations are Duisburg, Köln, Mannheim/Ludwigshafen, Basel, Novara and Milano. Today, intermodal transports to and from Italy are mainly land connections, but with the improved connection between the Port of Genoa and the hinterland the volumes moving to Switzerland and Southern Germany are also expected to grow.
- The 11 **airports** along the Corridor have a total volume of 220 million passengers and a combined transport volume of 6.3 million tonnes per year. The airports of Amsterdam and Frankfurt are important hubs for passenger and freight transport. Other airports with considerable traffic flows on the Rhine-Alpine Corridor are Brussels (passenger), Liège (freight), Düsseldorf (passenger), Köln (freight) and Milano (passenger).

2.3 Overlapping sections

Close cooperation between the different Corridors exist as overlaps occur – altogether seven sections of the Rhine-Alpine Corridor overlap with one of the other core network corridors (cf. Table 2). On some overlapping sections only specific modes overlap; for instance between Antwerp and Aarschot, only rail has been taken into account for the Rhine-Alpine Corridor.

All Belgian inland waterways projects which could enhance the Rhine-Alpine Corridor such as the Seine Scheldt project⁴ have been taken into account in the North Sea – Mediterranean Corridor. Similarly, in the context of the Dutch core network, some sections have been assigned to two or more corridors.

Table 2: Overview of corridor overlap per section⁵

Section	Corridor	Overlapping with corridor
Amsterdam – Utrecht	Rhine-Alpine	North Sea-Baltic North Sea-Mediterranean
Utrecht – Betuwe line	Rhine-Alpine	North Sea-Baltic
Köln – Liège – Brussels	Rhine-Alpine	North Sea-Baltic
Köln – Aarschot	Rhine-Alpine	North Sea-Baltic
Antwerp – Aarschot	Rhine-Alpine	North Sea-Mediterranean North Sea-Baltic
Liège – Antwerp	Rhine-Alpine	North Sea-Baltic
Strasbourg – Karlsruhe – Mannheim – Mainz	Rhine-Alpine	Rhine-Danube

⁴ Seine Scheldt is a transnational project whose purpose is to connect and improve the connection between the Rhine, Scheldt and Maas basins with the Seine basin.

⁵ Source: HaCon based on TENtec analysis

2.4 Country specific lengths per mode

Table 3 shows the mode and country specific lengths on the Rhine-Alpine Corridor (inland waterways include the rivers Moselle and Neckar on German-Luxembourgish territory). With about 3,225km, rail is the backbone of the corridor (with the highest share in Germany). Road has 26% of the length share, inland waterway (IWW) has a share of 25% of the total network. Germany has the largest share (49%) on all modes on the Rhine-Alpine Corridor. The respective shares of total network length of Belgium, The Netherlands, Italy and Switzerland vary between 9% and 17% for all transport modes.

Table 3: Lengths per mode along the Rhine-Alpine Corridor by country

Mode	NL		BE		DE		CH		IT		Total [km]
	[km]	share of total	[km]	share of total	[km]	share of total	[km]	share of total	[km]	share of total	
Rail	435	13%	499	16%	1,322	41%	560	17%	409	13%	3,225
Road	260	15%	275	16%	708	41%	286	17%	192	11%	1,721
IWW⁶	424	27%	-	0%	1,155	72%	21	1%	-	0%	1,600
Total	1,119	17%	774	12%	3,185	49%	867	13%	601	9%	6,546

The table above demonstrates that the Rhine-Alpine Corridor encompasses all modes of transport and, given its features, can be regarded as a particular complex and mature corridor.

2.5 Compliance with TEN-T requirements

A comprehensive data analysis was performed to check the implementation of the technical parameters of the TEN-T Regulation for all sections and infrastructure nodes defined. The compliance requirements per mode are:

- **Railway** transport: ERTMS-equipped infrastructure, interoperability of national networks, full electrification, safety and multimodal nodes connected to rail;
- **Road** transport: reduction of congestion, interoperability on the network, safety, availability of clean fuels and reduction of emission;
- **Seaports**: availability of alternative fuels [including *inter alia* liquefied natural gas (LNG)], on-shore activities and intermodal connections;
- **Inland ports and inland waterways** transport: minimum of CEMT class IV, adequate capacity of transport, continuous bridge clearance, good navigability, RIS and interconnection of ports, railway lines and roads;
- **Air transport**: at least one terminal accessible to all operators, implementation of the Single European Sky, availability of clean fuels;
- **Multimodality** and intermodality on the corridor: interconnection of transport modes at the nodes, real-time information in the transport chain, communication to the users at the stations and freight transshipment.

Most infrastructure characteristics of the Rhine-Alpine Corridor are compliant with the requirements. Table 4 lists only the infrastructure characteristics which deviate the most from the TEN-T requirements; infrastructures that comply fully with the criteria are not listed. It must be considered, however, that though infrastructures are compliant, other operational restrictions such as safety and noise emission prevention limit full conformity.

⁶ Belgian inland waterways are not part of the alignment, but analysed in the corridor characteristics and in the transport market study

Table 4: Compliance with TEN-T requirements

	NL	BE	DE	FR ⁷	CH	IT	Total
Railways							
Train length ≥740m core freight lines	100%	100% ⁸	100% ⁹	-	100%	0%	87.3%
Line speed ≥100km/h core freight lines	83.0%	81.6%	100%	-	90.4%	97.8%	92.9%
ERTMS deployment	49.8%	18.4%	0.0%	-	15.5%	0.0%	12.3%
Roads							
Availability of clean fuels	100%	1 station	100%	-	41.3%	46.4%	84.3%
Inland waterways							
Minimum draught required (> 2.5m)	100%	95%	74%	90%	100%	-	82.0%
Minimum height under bridges (> 5.25m)	100%	72%	97%	100%	52%	-	97.0%

Regarding the **rail** characteristics, all sections are electrified and have a track gauge of 1,435mm. However, as Table 4 shows, a wide gap exists in ERTMS implementation, with only 12.3% of the rail sections being currently equipped. Germany and Italy can be identified as critical bottlenecks in the corridor-wide ERTMS rollout. Current interoperability constraints result from the different safety systems in use. In this context, ERTMS plays a key role in supporting rail interoperability and should be applied throughout, including in border crossings.

Rail **interoperability** is further complicated by the difference in electrification systems between participating countries, which hinders border crossings or requires dedicated locomotives or train outfits. Italy's rail sections do not allow 740m trains in operation; in Germany and Belgium, 740m trains cannot be operated during peak-hours. This impedes interoperability for 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. There is a need to develop the required levels for maximum axle load and the line speed, particularly for rail freight transport. The fulfilment of these criteria is, at 97% and 93% respectively, very high on the Rhine-Alpine Corridor with only individual sections needing upgrades. In parts of Switzerland and Italy, restrictions on the intermodal loading gauge exist.

The Corridor's extensive **road** network fulfils, to a great extent, the TEN-T requirements. The availability of clean fuels is underdeveloped in Belgium, Switzerland and Italy. In border crossing sections and around important multimodal nodes and ports, there is a substantial unmet demand for secure truck parking. In turn, this jeopardizes compliance with the applicable driving time regulations and creates a safety and security hazard by forcing trucks to park off-ramps and outside the designated areas. The night time driving ban for trucks policy in Switzerland creates a bottleneck for cross-border road transport.

For **inland waterways**, the main compliance issues identified are the draught limitations along the Rhine in Germany where only 74% of the waterways fulfil this criterion. Insufficient minimum height under the bridges is a problem mainly in Belgium and Switzerland. Insufficient lock capacity and mooring places, especially near Lobith, as a vital cross-border section between The Netherlands and Germany, emerge as critical priorities. Lock capacity is similiary an issue along the Neckar and Moselle rivers.

⁷ In the Rhine-Alpine Corridor, France is only taken into account for its Inland Waterways

⁸ Train length for the Belgian and German Core Corridor network is in general 740 meters. Restrictions due to timetabling and the operational situation influence the actual possible train length.

⁹ cf. footnote 8

3. Results of the Transport Market Study

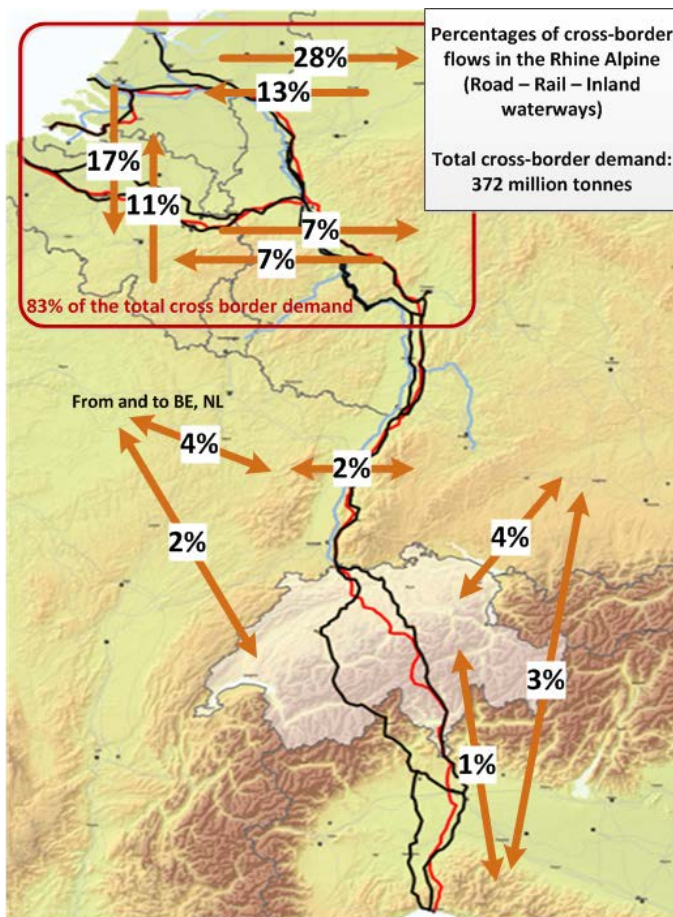
The purpose of the Transport Market Study (TMS) for the Rhine-Alpine Corridor is to analyse the current and prospective market conditions along the Corridor, with current and future utilisation levels of transport modes.

3.1 Current market characteristics

Current market characteristics¹⁰ show that for cross-border traffic within the Rhine-Alpine Corridor rail has a share of 12%, road 34%, and inland waterways 54%. The cross-border traffic volume was estimated at 372 million tonnes in 2010 (cf. Figure 3). This covers 37% of the total estimated demand in the catchment area including all traffic flows (international and domestic). Total demand is estimated slightly above 1 billion tonnes.

The main flows of the corridor are between Germany, The Netherlands and Belgium. These flows add up to 307.2 million tonnes, 83% of the total international freight activity. The highest import and export flows are between Germany and The Netherlands (103 million tonnes, representing 13% of the total corridor demand) and from The Netherlands to Germany (152 million tonnes, representing 28%). The German-Dutch bidirectional flows amount to 41% of total cross-border corridor freight demand.

Figure 3: Cross-border freight transport on the Rhine-Alpine Corridor



The main cross-border commodities are: machinery and transport equipment, fuel products (liquid and dry bulk), building material and ores. The favoured mode of transport for these commodities (hinterland transport) is inland waterways followed by road, which has been confirmed by individual port statistics.

¹⁰ based on 2010 ETIS data

Table 5: Existing international freight transport flows (2010) (in thousand tonnes)

All modes	Destination						
	Origin	France	The Netherlands	Belgium	Germany	Switzerland	Italy
France	-	2,584	3,074	2,503	1,622	717	10,500
The Netherlands	2,089	-	62,052	103,228	4,495	2,076	173,941
Belgium	3,552	39,889	-	24,868	1,288	3,032	72,629
Germany	2,322	49,468	27,698	-	8,983	6,314	94,785
Switzerland	606	1,031	462	3,668	-	1,851	7,617
Italy	554	1,040	2,621	5,249	3,047	-	12,511
Imports	9,122	94,013	95,907	139,516	19,435	13,991	371,984

International passenger transport demand

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

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

3.2 Forecast models

In order to depict the potential effect of changes on the corridor sections, the multimodal transport market study looks at transport performance of the relevant sections and its future potential. A model was employed using three runs: 2010 (basis), 2030 (baseline) and 2030 (compliance). The baseline forecast used GDP assumptions for 2030. The "compliance" to TEN-T standards scenario was defined considering a number of assumptions, such as full compliance with the TEN-T requirements, seamless interoperable railways, road tolling and LNG fuel for ships.

With regard to the baseline run, the freight demand expects a moderate growth up to 2030 with an increase of 1.7% per year for road, rail and inland waterways, resulting in a total growth of about 40% for each transport mode. Applying the policy interventions on the compliance scenario, these 2010-2030 growth rates change to 36%, 55% and 41% respectively (cf. Table 6).

Table 6: Mode performance on the Rhine-Alpine links

	Relative growth (2010-2030) <u>Without</u> TEN-T interventions	Relative growth (2010-2030) <u>With</u> TEN-T interventions
Road	40%	36%
Rail	41%	55%
IWW	39%	41%

As shown in Table 6 for the Baseline scenario (without TEN-T interventions), rail demonstrates the highest growth trend, followed by slightly lower growth for road and inland waterways. By 2030 rail is projected to grow by 55% (instead of 41% without the TEN-T interventions). This is mainly due to the expected decrease in travel costs and times that make rail a more attractive option for hinterland transport.

Table 7: Modal split for the corridor alignment

	2010	2030 Baseline	2030 Compliance
Road	28.8%	28.8%	27.4%
Rail	20.4%	20.5%	22.2%
IWW	50.8%	50.7%	50.3%

Table 7 shows that the impact of the measures on the corridor is mainly reflected on rail which is expected to increase both its share and volumes particularly by 2030. The inland waterways maintain a strong position in the corridor, while road slightly decreases its share. Therefore due attention will need to be given to measures that further strengthen inland waterways.

3.3 Conclusions of transport market study

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

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

The road network demonstrates a more evenly distributed flow, with the exception of traffic around urban nodes. Next to the network limitations causing congestion around urban nodes, the capacity of rail-road terminals could also be affected by growth.

By implementing the measures needed to comply with the TEN-T requirements, a desired modal shift from road to rail and inland waterways will occur by 2030. If the requirements are not met, the modal split will stay the same.

4. Critical issues and objectives of the Corridor

The infrastructure on the Rhine-Alpine Corridor is in general technically well advanced. With the rail, road and inland waterway systems running widely in parallel, multiple mode options for freight transport are possible. Passenger rail transport is continuous while road offers a dense network of motorways and high capacity alternative routes.

4.1 Objectives

The alignment of the Corridor, the compliance analyses and the transport market study lead to corridor specific objectives. These objectives should be fulfilled in order to use the full potential of the Rhine-Alpine Corridor by 2030. The most salient corridor-specific objectives are:

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

4.2 Critical issues

In this chapter, each objective will be discussed in terms of critical issues among the different modes. Most critical issues cannot be categorized exclusively under one objective, but serve multiple objectives.

Improving cross-border sections

Geographically, the most prominent bottlenecks along the corridor emerge at cross-border sections and around urban nodes. The railway cross-border sections, which require upgrades, are:

- Zevenaar – Oberhausen – Emmerich;
- Karlsruhe – Offenburg – Freiburg – Basel;
- Chiasso – Milano and
- Domodossola – Novara.

These projects represent the highest European added value and contain the highest priority to connect cross-border sections. Besides these large projects, smaller scale projects also emerge as critical sections. Due to operational speed limitations, the railway line Berneau – Visé – Belgium-German border also needs improvement. The railway connection Simplon/Gottard – Milan Malpensa airport (*i.e.* the connection from the airport to the Gallarate – Domodossola railway link) will contribute towards the strategic goal of creating a link between the airport terminal and Switzerland. Regarding road infrastructure, the bridge near Weil am Rhine (Highway A5, Germany) is facing capacity issues. The same holds for the road access route to the Simplon pass, at the Swiss-Italian border. For inland waterways, Lobith (NL) – the German-Dutch cross-border section of the river Rhine – lacks sufficient mooring places.

Eliminating missing links

In addition to the already existing high speed line Frankfurt – Mannheim (Riedbahn) the new line (Rhine/Main – Rhine/Neckar) will enhance the European high-speed railway network. The construction of this 85 kilometres long railway is crucial for the Rhine-Alpine Corridor. On Italian territory, the new *Terzo Valico dei Giovi* could permit a significant expansion in freight transport between Genoa and Northern Italy. Running between the regions of Liguria and Piedmont, it has a length of 53 kilometres and includes 39km of tunnels.

For roads, one missing link has been identified in The Netherlands: highway A15 needs to be extended towards the German border. A railway connection with the airport of Milan Bergamo is required.

Interoperability/Compliance with TEN-T standards

Most infrastructure characteristics are compliant with the requirements, set in the TEN-T regulation. However, serious issues remain. With only 12.3% of the rail section currently being equipped with ERTMS, investment is needed. Germany and Italy have 0% ERTMS deployment on their territorial corridor section while Belgium and Switzerland are progressing with – nevertheless - less than 20% deployment as of 2014. Karel Vinck, EU-coordinator for ERTMS, provides a comprehensive overview in his ERTMS work plan. Line speed is not compliant with the TEN-T requirements of a line speed of 100km/h at some of the tracks in Dutch harbour areas, between Berneau – Visé – German Border (BE) and near Basel, Chiasso (CH) and Como (IT). Longer trains (>740m) cannot operate on the Italian sections; in Germany and Belgium problems occur during peak hours.

Concerning inland waterways, the draught limitations between Koblenz and Karlsruhe (DE), and between Mulhouse (FR) and Basel (CH) are a serious issue. Bridge height (<5.25m) is critical between Mulhouse (FR) and Basel (CH). On the Moselle and Neckar rivers, lock capacities are insufficient. The Rhine-Scheldt connection as well as Lobith and Gorinchem (NL) suffer a lack of mooring places. For roads, compliance issues occur with clean fuels availability (Switzerland and Italy around 45% of section). Moreover, serious traffic congestion problems are recorded along many highway sections on the corridor.

Developing multimodality

Along the Rhine-Alpine Corridor 59 well-functioning bi- and tri-modal logistic platforms have been identified (cf. Table 8). Bottlenecks are identified in the available capacity and accessibility by different modes. While terminal capacity is currently described as sufficient in The Netherlands, further increases in terminal handling capacity are required, according to market needs. The Netherlands is, for example, studying on the development of a multi-modal logistic rail platform along the Betuweroute (Valburg/Nijmegen), as part of a European Rail Freight Line System along the Rhine-Alpine corridor. In Germany and Basel (Switzerland) capacity bottlenecks exist. The “Development concept 2025 for intermodal transport in Germany” identifies areas, where an increase of handling capacity is expected. In Belgium bottlenecks have been identified in Zeebrugge where investments are planned in and to the port to increase the capacity and improve the multimodal chain.

Table 8: Terminals with rail-road transshipment at core nodes

Country	Node	Number of terminals	Country	Node	Number of terminals
BE	Antwerpen	5	FR	Strasbourg	2
NL	Rotterdam	3		Mulhouse	1
	Amsterdam	3	CH	Basel	5
DE	Duisburg	9		Aarau	2
	Düsseldorf/Neuss	4		Rekingen	1
	Frankfurt	3		Chiasso	1
	Karlsruhe	2	IT	Genova	1
	Koblenz	1		Milano	4
	Köln	3		Novara	3
	Mainz	1			
	Mannheim	5	All	Total	59
	Ludwigshafen				

Multimodal trans-shipment capacity is also an important issue, particularly in Ghent, Duisburg (Rhein-Ruhr terminal), Strasbourg, Ottmarsheim, Plochingen, Milan, Novara and Genoa. In France, Strasbourg faces several bottlenecks which concern principally cross-border, interoperability and multimodality issues including a better connection and electrification of port rail lines and improvements to the stocking capacity for empty containers.

With regard to airports along the corridor, some dedicated to freight transport, such as the Liege airport, hold great potential for linking high-speed rail to achieve efficient throughput of freight. Improvements are needed for the freight hubs and smaller airports along the corridor, where rail connections will support the integration of co-modal transport chains.

Enhancing last-mile connections

Regarding road infrastructure, the last mile connections become critical in urban areas, mainly due to peak hour traffic capacity problems. The last connections in all larger core urban nodes (for instance Brussels, Düsseldorf, Frankfurt and Milan) should be improved.

The accessibility in the seaport areas and larger urban areas along the river network needs to be secured. In these areas, the last mile connections are mainly crossing densely populated areas. The inland port of Strasbourg and the seaports of Antwerp and Ghent have insufficient last-mile connections. The port of Genoa is afflicted by limited maritime accessibility for large vessels and limited rail and road accessibility. The port of Genoa faces important challenges in the physical expansion space, due to the fact that it is constrained to a strip of land near to the city and its physical layout.

Four core airports along the corridor also have an insufficient last-mile connection: Rotterdam/The Hague, Liège, Milan Bergamo and Genoa.

Tackling Externalities/Sustainability/Innovation

River Information Services (RIS) for inland waterways play a big role for achieving the sustainability goals as defined in the regulation, as do LNG or onshore power supply. The use of LNG is to be improved by reducing levels of oxide (NO_x, SO_x) and carbon dioxide emissions and enabling sufficient access to LNG. River Information Services must be implemented to increase efficiency and interoperability in local and, importantly, the cross-border sections and communication between ports. Much RIS deployment takes place in Germany, Belgium and The Netherlands, mainly on the Westerscheldt and on the Upper-Rhine. Different ITS projects have been performed, leading to intelligent truck parking, freight information services and traffic management services.

Another critical issue is the connectivity and communication between actors along the corridor in order to promote multimodality. Utilising the affiliated benefits of each mode to fulfil transport chains requires exchange and interface standards, ICT enabling high quality and reliability, as well as efficiency in trans-shipment.

To reduce, for instance, air pollution and enable sustainable and low-emission road traffic, improving the use of clean fuels is another main topic for road. Road transport is one of the main sources of greenhouse gas emissions and, in this context, clean fuel alternatives emerge as a priority. In Belgium and in Italy, (almost) no clean fuelling infrastructure is available along the Corridor.

Considering impacts on urban areas

Regarding traffic around urban nodes, challenges exist with respect to the combination of liveability and accessibility. Traffic congestion on the road is identified as a critical issue for every densely populated core node along the Corridor.

Concerning railways it should be noted that while infrastructures are compliant per design, other operational restrictions such as safety and the prevention of noise emissions limit full conformity. Rail noise is repeatedly identified as a critical issue for sections running through densely populated areas. This is mainly a problem in the middle-Rhine region in Germany, where rail and road traffic cross the populated Rhine valley. Also on the railway section between the Swiss-Italian border and Milan, noise is regarded as critical.

Due to the increased traffic flows, the necessary upgrade of the stations of Mannheim and Frankfurt has started. In Frankfurt, two additional tracks should be constructed; in Mannheim an additional platform is needed. On the Italian sections, the service quality and accessibility of the railway station need improvements.

Improving capacity and removing bottlenecks

The high level of maturity of the Rhine-Alpine Corridor results in the occurrence of capacity issues on the existing infrastructure. Travel times could be shortened and main rail hubs optimised for better accessibility and service quality. In particular, this holds for rail and road infrastructure.

The Belgian ports of Antwerp, Ghent and Zeebrugge face a number of connectivity and capacity issues. The port of Antwerp needs upgrading of sea locks, a second rail freight access and upgrades of bridges. In Ghent the capacity of the cross-border Terneuzen (NL) locks emerge as a critical need. Another main bottleneck is the connection to the rail network from the left bank of the port. For the port of Zeebrugge the major bottleneck concerns its different gauge connection to the IWW network; moreover rail investments are foreseen to improve the capacity (optimisation of the railway infrastructure inside the port and construction of new tracks) and the multimodal chain characteristics (among others marshalling yards) of this port. The port of Rotterdam has to secure sufficient capacity both for future developments in the port and connections to its hinterland. Maintaining its capacity and upgrading of the Caland bridge are – among others – critical issues in the Port of Rotterdam. Amsterdam requires an improved maritime access – given its space/territorial constraints, the port is limited in its physical expansion planning, which requires further efficiency upgrades and improvements in accessibility of the port area from the land and maritime side.

Road capacity bottlenecks are caused due to the mature state of the infrastructure whose original design cannot address today's demand levels. Congestions occur during peak hours in sections around urban centres and nodes. Because long distance transports on the road are conflicting with local use for commutes, the capacity in these areas does not suffice. Moreover, vast maintenance works needs to be done, mainly in Germany, to overcome to the backlog.

5. Recommendations and outlook by the European Coordinator

The Rhine-Alpine Corridor stands out as an epitome of a mature, complex corridor that includes all modalities and which offers widely applicable insights. Notwithstanding the present performance of the rail, ports, inland waterway, road and airport components, important challenges arise at present, as well as looking into the future. The Corridor activities of the last twelve months and studies combined provide an overview of the strengths, weaknesses and needs of the Rhine-Alpine Corridor. From this experience, the following aspects merit special attention:

Seed investments provide unique leverage

The project list (see link at the end of the document) outlines the projects necessary in order to resolve bottlenecks and reach the TEN-T objectives. Critical investments are needed to ensure economic growth and competitiveness, and to minimize the pollution. For the 145 EU and the 30 Swiss projects, a total amount of € 60 billion is required, which can be regarded as unique value for money if compared against the backdrop of the scale and outstanding performance of the Corridor: freight transport of over 1 billion tonnes and GDP contribution of more than € 2,700 billion annually.

Large projects are central to resolving cross-border bottlenecks

As it runs through regions that are among Europe's most industrialized and economically advanced, the Rhine-Alpine Corridor confronts relevant characteristic challenges. One particular challenge regards railways, where the goal still is to create a high-speed and capacity rail network for passenger and freight transport. A separation between these two traffic flows is largely beneficial in order to eliminate capacity constraints and to minimize operational conflicts, which will boost the reliability and performance of both passenger and freight railway traffic. Specifically, three cross-border railway sections merit particular attention:

- **Karlsruhe – Offenburg – Freiburg – Basel:** The infrastructure does not provide sufficient capacity and experiences long travel and transport times. Therefore, it is essential to upgrade the existing tracks (182 kilometres), as well as to construct an extra 3rd and 4th rail track and four tunnels. Project costs are € 6,000 million; project has already started, but implementation date is still unspecified.
- **Zevenaar – Emmerich – Oberhausen:** The existing line Zevenaar – Oberhausen requires upgrading (construction of a third track, including adjustments to existing bridges, level crossings and switches). Project costs are estimated € 2,012 million. Project has already started; the first stage of the project is expected to be finished in 2022.
- **Chiasso / Domodossola – Milan / Novara:** The railway tracks should be upgraded to cope with capacity, service quality and accessibility requirements, in view of the expected traffic from the Gotthard tunnel. They should also allow for a 4-meter loading gauge and 740 meter trains. Project costs for the fourth track Chiasso – Milan – Monza are € 1,412 million, but the project is planned for after 2030. At the moment, the costs and timing of Domodossola – Novara / Milan are unspecified.

These cross-border sections are crucial for the performance of the Rhine-Alpine Corridor and failure to address them adequately would jeopardize the corridor's full potential. This reaffirms the urgent need for Member States to earmark investment money and to provide an implementation planning for these projects, whose prompt construction would benefit the entire corridor.

Projects improving compliance with TEN-T requirements are a priority

Compared to other core network corridors, the Rhine-Alpine Corridor is to a large extent compliant with the requirements defined in the TEN-T guidelines. However, certain critical infrastructure characteristics still have to be upgraded:

- For **rail**, some of the tracks in Dutch harbour areas are not compliant with the TEN-T requirements of a line speed of 100km/h and an axle load of 22.5t. The

line speed issue also applies to the Belgian section Berneau – Visé – German border (Botzelaer border). For Germany and Belgium, 740m trains should be able to run the entire day, instead of only after peak hours. Moreover, the German rail network needs to be upgraded and modernised in terms of both rail bridges for capacity enhancement and electronic interlockings to stabilise and ensure capacity. The railway study performed by the Rail Freight Corridor Rhine-Alpine, where relatively small investments yield to significant rail capacity improvements, is promising.

- Since the **train control system ERTMS** allows for an increase in capacity, higher speed and improved safety, its full and prompt deployment on the Corridor is crucial. With only 12.3% of ERTMS deployment, serious investments are needed. Special attention needs to be paid to the German side of the sections Aachen – Visé and Liège – Köln, given that this section was not included in the ERTMS Corridor A and that Belgium planned to deploy ERTMS on the Belgian side (conventional lines) by 2020. Detailed ways how to accelerate ERTMS equipment along the core network corridors will be described in a separate Work Plan by the European ERTMS Coordinator Karel Vinck. In his report, the ERTMS Coordinator will present a so called Breakthrough programme, which has been established in close cooperation with the railway sector and consist of a limited number of objectives to be reached by 2016, including a review of the current European Deployment Plan and the identification of a strategy for ERTMS equipment by 2030, as laid down in Regulation (EU) 1315/2013.
- Regarding **inland waterways**, for full operational capacity, extensions of the fairway depth are needed on German sections along the Rhine. On the Neckar, lock extensions should be made to accommodate large barges with 135m length; on the Moselle river lock capacity is lacking and seriously constraints operational volume. In Switzerland, between Basel and Muttentz, the Rhine only allows a height under bridges of 5.1m (> 5.25m is required), affecting the section allocated to Germany, between Niffer (FR) and Rheinfelden (CH). In The Netherlands, the Amsterdam locks are critical, and are discussed in detail in the work plan of the North Sea – Baltic Core Network Corridor. In general, it will be necessary to improve intermodal exchanges with inland waterways in seaports and to strengthen its network.
- Concerning **roads**, many bottlenecks exist around core urban areas (peak-hour congestion). Capacity issues exist near Genoa, the Gotthard tunnel, Strasbourg, Liège and Cologne (due to restrictions for heavy goods vehicles' traffic on the A1 Rhine bridge). Intelligent transport systems (ITS) hold great potential for road infrastructure.

Innovative measures are needed

Apart from the construction, maintenance and upgrade of infrastructure, there are cross-cutting challenges (horizontal issues) which need to be incorporated along the entire corridor and will be beneficial for overall efficiency, sustainability and inter-modality. In this context, both River Information Services (RIS) and Intelligent Transport Systems hold great potential.

Sustainability measures, such as the deployment of LNG, should be encouraged through regulatory coordination at all levels. The dissemination of clean fuel alternatives has to be regarded as a critical issue along the corridor. In light of the ambitious greenhouse gas emission targets (as defined in the Clean Power for Transport Directive 2014,¹¹ among others), this can be an important factor. The forthcoming stage of the deployment plan for LNG along the river Rhine is of great importance. In the coming years, efforts need to be focused to supplying ports with sufficient fuels and to installing fuel vessels infrastructure.

¹¹ Directive 2014/94/EU on the deployment of alternative fuels infrastructure

Alternative Financial Instruments have to be explored

Sustainable, long-term infrastructure investments are required to implement the corridor. However, the investment needs of the corridor are vast and cannot be met by traditional methods only, which highlights the need to consider alternative ways of financing. The European Coordinators Prof. Kurt Bodewig (Baltic-Adriatic Corridor) and Prof. Carlo Secchi (Atlantic Corridor) have elaborated potential lines for action in order to make best use of the limited financial resources. Similarly, the € 315 billion jobs, growth and investment package, introduced by President Juncker, can offer key opportunities for the corridor.

Keep existing infrastructure in good condition

Given the maturity of the corridor, infrastructure maintenance and upgrading is as important as the construction of new sections. The uniquely high traffic volumes on this corridor make its infrastructure particularly vulnerable to disruptions and maintenance challenges are present across all modalities: among others, the highways in Germany and Belgium, the lock on the Moselle and Neckar rivers, as well as the railway sections in Italy. Also the access routes to the infrastructure belonging to the Corridor should be in good condition, in order to use its full potential. Resiliency is a key objective. The effects of climate change such as extreme weather events need to be taken into account, both in upgraded and newly-built infrastructures.

Reduce external effects of transport

The Rhine-Alpine Corridor faces unique challenges as regards noise and pollution. Noise is a particularly acute problem in Germany (Rhine-Valley) and Italy (Milan – Swiss-Italian border). The industry has already introduced anti-vibration and anti-noise measures. Under the Connecting Europe Facility, the European Commission opened up the possibility for financial support for measures which reduce rail freight noise by retrofitting existing rolling stock. Also last mile connections to final destination should be constructed in a way that reduces pollution and noise to the minimum. In this context, the effective collaboration between the industry and the Member States is crucial.

Collaboration among stakeholders is critical

Effective coordination is crucial for all European traffic flows. A project influences the performance of the entire Corridor, in every country involved, stressing the need to look beyond single projects. The Vlaams-Nederlandse Delta conference, CODE24, the Euregio Rhine-Waal, the Upper-Rhine Ports and the Verkehrsbund Rhein-Neckar, among others, demonstrate the successful collaborations along the Rhine-Alpine Core Network Corridor, with regards to the link between TEN-T development and regional benefits. The corridor implementation should take account of these alliances. They support the corridor development by providing additional perspective on specific areas of responsibilities. This new understanding is an essential condition for the completion of the TEN-T network, and in particular for the implementation of cross-border projects. Moreover cooperation exists between the Core Network Corridor and the Rail Freight Corridor Rhine-Alpine.

Fair organizational conditions are equally important

This work plan addresses, for the most part, hard infrastructure investments. However, in order to achieve the common objectives, soft measures and organizational conditions are equally important. Regarding organizational conditions, we should take the European perspective as a point of departure. In multimodal platforms (terminals), for example, a *level playing field* (discrimination-free access) is of the utmost importance in order to ensure the non-discrimination principles of the European Union.

A comprehensive approach is fundamental

The Rhine-Alpine Corridor is part of the trans-European network for transport and should be addressed in the context of that framework. Collaboration with overlapping corridors and interactions with the comprehensive network are of utmost importance in order to secure the future of Europe's transport infrastructure network. The core network corridors connect seaports by land connections. Due to the many ports in this Corridor,

interconnections are needed between the Corridor and Motorways of the Sea. The latter aims for a trans-European intermodal, maritime-based logistics chain, which will improve access to markets and bring relief to the over-stretched European road system. In this context, close coordination with Mr Brian Simpson, the European Coordinator dedicated to the Motorways of the Sea, is integral to materializing the network effects.

Strong commitment for implementation is needed

This work plan is a first comprehensive, multimodal outline for the entire corridor running from Rotterdam/Zeebrugge to Genoa. Nonetheless, in the coming years, the Rhine-Alpine corridor needs to be analysed in more detail. In 2015, two more Rhine-Alpine Corridor Forums will take place. In 2016, an update for the corridor work plan with elaborated information will be published. Meetings of the working groups will also contribute to the progress of the implementation of this corridor.

Topics that entail further in-depth analysis include sustainability issues, such as climate change impact and greenhouse gas mitigation, further development of the corridor economic added value, as well as elaboration on project funding and investment. The follow-up study will build on the current corridor study and will accompany the work plan implementation and its further evolution.

Looking ahead, the work and involvement of all stakeholders remains vital. The comprehensive information about the state of play as well as the needs and challenges of the corridor must be translated into reality. The challenges concentrate all efforts. At this crucial time in which the European project has stalled, it is essential that there be follow through on commitments, particularly in this corridor whose centrality cannot be overstated.

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Corridor website Rhine-Alpine Corridor

http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/corridors/rhine-alp_en.htm

Background information / useful links

http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/corridors/corridor-studies_en.htm

- Rhine-Alpine Corridor study
- List of projects
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