



# Study on Rhine - Danube TEN-T Core Network Corridor

*2<sup>nd</sup> Phase*

*Final Report*

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## Information on the current version

This document is the deliverable D8 "Draft Final Report", containing the task 4 items set forth in the tender specifications, summarising the conclusions and key aspects from the tasks 2 and 3, and providing the technical input to the Work Plan Update of the Coordinator.

The conclusions and key aspects in assessing the corridor development are based on the

- updated project list that has been submitted to the Commission by 28<sup>th</sup> March 2017,
- the Final report on the project list, submitted on 6<sup>th</sup> June 2017,
- the Final report on the elements of the Work Plan, submitted on 6<sup>th</sup> June 2017 and
- the Final report on the wider elements of the Work Plan, revised and submitted on 30<sup>th</sup> June 2017.

All these Final reports were approved by the EC.

The first draft version of this deliverable is submitted to the European Commission by 8/11/2017.

The updated Final Report of this deliverable is submitted to the European Commission by 25/01/2018.

## Disclaimer

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## Abbreviations

bn	billion
CBA	Cost/Benefit Analysis
CEMT class	Classification of Inland Waterways
CNC	Core Network Corridor
CNG	Compressed Natural Gas
DG MOVE	European Commission – Directorate General for Mobility and Transport
EC	European Commission
EIA	Environmental Impact Assessment
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
EUR	Euro
GDP	Gross Domestic Product
IM	Infrastructure Manager
IU	Infrastructure User
IWW	Inland waterway
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
mio	million
MoS	Motorway(s) of the Sea
MS	Member States of the European Union
MTMS	Multimodal Transport Market Study
n.a.	not available / not applicable
NGO	Non-governmental organization
RDC	Rhine Danube (Corridor)
PAX	Passengers
p.a.	per annum / annual
RA	Regional Authority
RFC	Rail Freight Corridor
tbd	to be defined
TEN-T	Trans-European Transport Network
F	Freight
WP	Work Package/Work Plan

### Country Codes after ISO 3166:

AT	Austria
BG	Bulgaria
CZ	Czech Republic
DE	Germany
FR	France
HR	Croatia
HU	Hungary
RO	Romania
SK	Slovakia
BA	Bosnia and Herzegovina
RS	Serbia
UA	Ukraine



## Executive Summary of the Study

The **Rhine-Danube Corridor** is described as:

“the main east-west link between continental European countries connecting France and Germany, Austria, the Czech Republic, Slovakia, Hungary, Croatia, Romania and Bulgaria all along the Main and Danube rivers to the Black Sea by improving (high speed) rail and inland waterway interconnections. It includes sections of the former Priority Projects 7, 17, 18 and 22. Rail parts in the Czech Republic and Slovakia are also covered by the Rail Freight Corridor 9.”<sup>1</sup>

The Member States Bulgaria and Croatia are only included as regards of Inland Waterways. This concerns ports and inland waterways of the Danube and Sava Rivers. Also non-EU neighbouring countries are included in the analysis of the core waterway network<sup>2</sup>. In detail the sections below are included in the analysis:

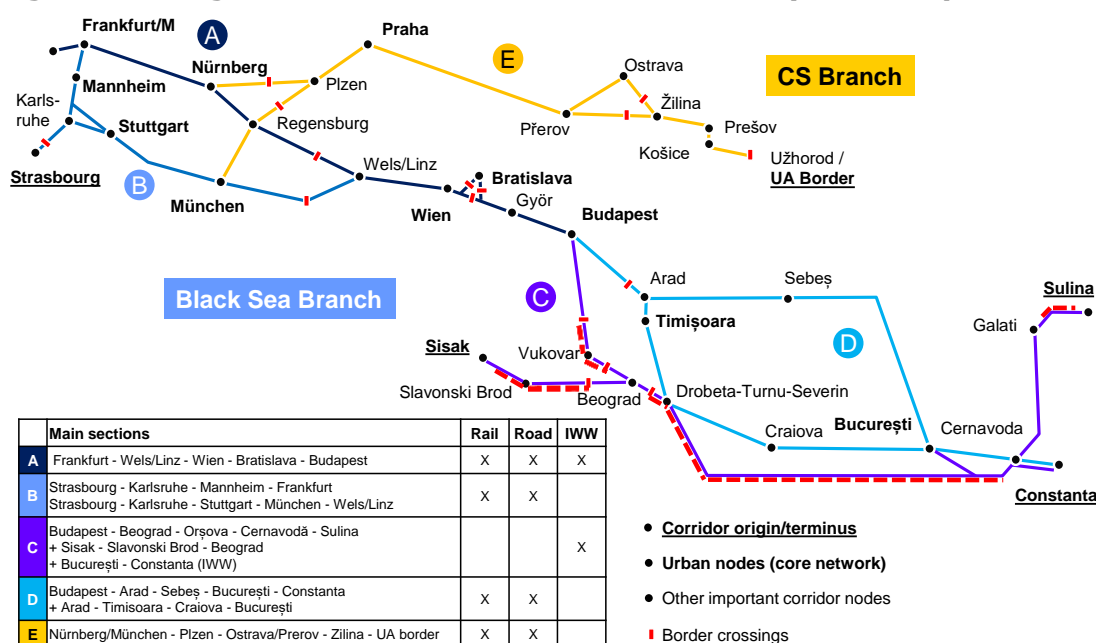
Serbia: related to inland waterways (Danube, Sava) and two ports (Beograd, Novi Sad);

Bosnia and Herzegovina: related to inland waterways (Sava);

Ukraine: related to inland waterways (Danube).

Figure 1 shows the full alignment of the Rhine-Danube Corridor split in five main sections. In total, the Corridor consists of 5,715 km rail network, 4,488 km roads and 3,656 rkm inland waterways that cross nine EU-Member States and four non-EU Member States. There are 18 inland ports and 1 seaport. 11 airports form part of the Corridor. The Corridor counts 16 trimodal freight terminals and 27 terminals dedicated to rail and road only. 13 urban nodes are part of the Rhine-Danube CNC.

**Figure 1: Alignment of the Rhine-Danube Corridor (all modes)**



Source: HaCon, status 09/2017

<sup>1</sup> See Annex 1 of the CEF regulation 1316/2013. Document of the European Commission (Directorate-General for Mobility and Transport) The core Network Corridors- Trans European transport Network 2013

<sup>2</sup> The cooperation with third countries is described in Article 8 of the TEN-T Guidelines. Projects of common interest in order to connect the TEN-T network with networks of neighbouring countries may be supported, including financially by the Union.

## Traffic demand and forecast

Over 94 million people lived in the catchment area of the Rhine-Danube Corridor in 2014, slightly less than in the years before. The population is centred on the urban nodes. The GDP is estimated for 2014 at 2,009 bn EUR and has grown by 9% between 2010 and 2014. It has been higher in the western part of the Corridor. According to national forecasts the difference in GDP between western and eastern Corridor countries will remain until 2030.

In 2010 road was the most used mode for cross-border passenger and freight transport. 83% of the total passenger trips are covered by road, 13% by rail and 4% by air. For the individual modes the bidirectional traffic flow between Austria and Germany is the most important, except for rail. For rail the most important flow is between Austria and Hungary.

International freight transport demand is concentrated on the western part of the Corridor. Transport between the areas of Austria, Germany, Czech Republic and Slovakia accounts for 82% percent of the total Corridor transport. In the period 2010-2013 the modal share of road traffic stabilised. Road transport volume (58%) is twice as big as for rail (28%) and four times as big as for inland waterways (14%).

Forecasts indicate that road transport will remain to be dominant in the future market. This is the case for international and national traffic, passenger and freight transport. Passengers are forecasted to have more individual wealth, more car ownership and in a limited number of countries face deteriorating public transport. In the baseline freight scenarios a continued trend is generally assumed, which is beneficial for road as no modal shift has taken place in the past years.

This leads to the conclusion that there is a need to strengthen rail and inland waterway transport through the improvement of the related infrastructures, in order to shift future transport volumes. International traffic, import, exports and transit is expected to grow in all forecasts. The traffic in the eastern part of the Corridor will grow at a higher rate. However, Austria, Czech Republic, Germany and France (Strasbourg) are expected to maintain a high transport demand by 2030.

## Compliance with the technical infrastructure requirements

Regulation 1315/2013 sets out the transport infrastructure requirements for each of the transport modes and the connected infrastructure components. The comprehensive set of core parameters analysed during the first Corridor study was reduced to a limited set of Key Performance Indicators (KPI), which aim at measuring the progress of all nine Core Network Corridors in a comparable way. Corridor specific characteristics have been added in order to present a more complete picture of the Corridors' development.

**Table 1: Supply side Key Performance Indicators 2013 to 2016**

Mode	KPI	Baseline value 2013	Status 2015	Status 2016
Rail network	Electrification	91%	91%	91%
	Track gauge 1435mm	100%	100%	100%
	ERTMS implementation	7% <sup>5</sup>	7% <sup>5</sup>	7% <sup>5</sup>
	Line speed >=100km/h	95%	95%	95%
	Axle load >=22.5t	75% <sup>6</sup>	75% <sup>6</sup>	75% <sup>6</sup>
	Train length (740m)	47%	47%	47%
Inland waterway network <sup>1</sup>	CEMT requirements for class IV IWW	85%	85%	85%
	Permissible Draught (min 2.5m)	77%	77%	77%
	Permissible Height under bridges (min. 5.25m)	86% (5)	89% (4) <sup>4</sup>	89% (4) <sup>4</sup>

Mode	KPI	Baseline value 2013	Status 2015	Status 2016
	RIS implementation (minimum requirements set out by the RIS directive are met)	100%	100%	100%
	Targeted depth according to waterway manager reached <sup>2</sup>	45%	42%	40%
Road network	Express road/ motorway	77%	77%	78%
	Availability of clean fuels	available	available	available
Airport	Connection to rail <sup>3</sup>	67%	67%	67%
	Availability of at least one terminal open to all operators in a non-discriminatory way and application of transparent, relevant and fair charges	100%	100%	100%
	Capacity to make clean fuels available to airplanes <sup>2</sup>	available	available	available
	Availability of clean fuels (ground services)	67%	67%	67%
Seaport	Connection to rail	100%	100%	100%
	Connection to IWW CEMT IV	100%	100%	100%
	Availability of clean fuels	0%	0%	0%
	Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%	100%	100%
	Facilities for ship generated waste	100%	100%	100%
Inland ports	Class IV waterway connection	100%	100%	100%
	Connection to rail	89%	89%	89%
	Availability of clean fuels	0%	6%	6%
	Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%	100%	100%
Rail Road Terminals (RRT)	Capability for Intermodal (unitised) transshipment	44%	44%	44%
	740m train terminal accessibility	2%	2%	5%
	Electrified train terminal accessibility	16%	16%	21%
	Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%	100%	100%

<sup>1</sup> Member States only

<sup>2</sup> Corridor specific indicator

<sup>3</sup> considers only airports, which are to be connected to rail by 2050

<sup>4</sup> The recalculation of the High Navigable Water Level in Hungary revealed its decrease and lead to a higher bridge clearance of the Margit-híd in Budapest in compliance with Regulation 1315/2013.

<sup>5</sup> Includes level 1, 2 and 3 ERTMS implementation

<sup>6</sup> Compliance figures modified due to new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017

In summary, the infrastructure of the Rhine-Danube Corridor already started from a high level of compliance with Regulation 1315/2013 in 2013.

## Rail

91% of the rail lines are electrified and gaps only relate to some sections in Germany (München-Mühldorf-Salzburg), the cross-border sections between Germany and the Czech Republic and in the Czech Republic. The entire rail infrastructure of the Corridor provides for standard gauge (1,435 mm). An operating speed of at least 100 km/h is enabled at more than 90% of the rail lines. Line sections with insufficient operating speeds are located on the "CS branch" and on the eastern part on the "Black Sea branch" (Romania; Hungary: local speed drops in Budapest node). Lowest compliance rates for rail relate to axle load, train length and ERTMS. 75% of the rail network allows for 22.5 tonnes axle load; this value incorporates new information on Romanian infrastructure provided by CFR-SA in July/August 2017. Line sections not fulfilling the

requested standards are mostly located in Hungary and Romania. If speed limitations are accepted, the required axle load may be reached in Hungary. A maximum train length of 740m is permitted at 47% of the rail infrastructure. Sections which only provide for shorter trains are located on the "CS branch", in Austria and in Romania. Operational ERTMS are exceptional at the Rhine-Danube Corridor and are restricted to some line sections in Austria and Hungary.

### **Inland Waterways**

85% of the inland waterway network, including Serbia, is classified as a class IV waterway or higher, only the Sava River is assigned to a lower class. A draught of 2.50m is permissible at 77% of the inland waterways. Shortfalls relate not only to the above mentioned sections of the Sava but also to the Upper Main and the Danube between Straubing and Vilshofen (1.6m at 94% of days per year). Four bridges offered a clearance below 5.25m, 89% of the sections length does comply with the requirement. Two of the bridges, the Alte Mainbrücke Würzburg and the Rail Bridge Bogen can represent a particular challenge for the navigation of ships. River Information Services are available along the entire Corridor (100%) but to a different extent and quality. International and national data exchange is not always ensured. The specific indicator showing the percentage of section kilometres on which the targeted fairway depth was met, reveals the particular challenges of the Rhine-Danube Corridor. Achievement of targeted depths varies dynamically as it depends not only on the waterway infrastructure conditions but also on the hydrologic circumstances. Above all at free flowing river sections, they are challenging to be met. In 2013 the targets were met at 45% of the inland waterways sections length, in 2014 at 58%, in 2015 at 42% and in 2016 at 40%.

### **Ports**

The majority of the Corridor core ports comply with the requirements set by Regulation 1315/2013. Only two ports, Vidin (BG) and Cernavodă (RO), do not meet the minimum depth and therefore require dredging activities. All core ports<sup>3</sup> have a road connection but of varying quality in terms of number of lanes and capacities. The situation is similar in view of railway connection, as only two ports, Komarom (HU) and Cernavodă (RO), have no fully functional rail connection to the hinterland and the rest of the network. The level of intermodal facilities in ports is varying and, generally, declines further downstream, with a noticeable need for additional provision of such facilities in determined ports. There are five ports with reported incompliances in terms of lacking intermodal facilities: Komarom (HU), Slavonski Brod (HR), Drobeta Turnu Severin (RO), Calafat (RO) and Cernavodă (RO). Based on the latest update of the project list (March 2017), ports of Slavonski Brod (HR) and Drobeta Turnu Severin (RO) plan significant modernization including the infrastructure and related facilities which will facilitate intermodality in these ports. Plans for alternative clean fuel facilities have been reported by the ports of Constanța, Bratislava and Enns. The Port of Ruse constructed a LNG terminal with fuelling facilities for future LNG vessels, completed in 2015. As regards the shore-side (external) supply of electricity to vessels in ports, most of the ports reported the existence of shore-side electricity supply facilities for vessels, except for the ports of Wien (AT) and Galați (RO).

### **Intermodal terminals**

For intermodal terminals, the 2014 study considered different criteria, but the situation two years ago was not pretty much different from the KPI analysed for 2015/16 so that the same values were included: The newly built terminal in Žilina, which was completed end of 2015, is the only of the present 43 terminals of the

<sup>3</sup> Rhine ports are tackled in the study on Rhine-Alpine Corridor, while the Czech ports are tackled in the Orient-East Med Corridor study.

Rhine-Danube Corridor, which fully complies with all three KPI. Only 44% are able to handle all three types of loading units. While the focus on single types of loading units might be explained by the past/current market orientation, the electrified rail access which is fulfilled by only 21% of the sites and the limited length of the handling tracks where only two sites fulfil the Regulation target, create a real burden for an efficient supply of intermodal transport services. The largest challenge for the present sites is their historically grown access to the rail infrastructure (single sided, non-electrified, annex to shunting yard or port railway line) and the limitation of the (wagon) train length by either the reception/departure siding or the transshipment track(s). Only Budapest BILK and Žilina are proving transshipment tracks of  $\geq 740\text{m}$  length, while four sites are covering the present industry standard of 700m. With respect to the criterion "non-discriminatory access" one can state that all terminals are basically fulfilling this requirement since at least no court decisions are known where a terminal was judged to discriminate its users.

### **Road**

About 78% of the total length of roads is classified as motorways (express ways) and 22% are conventional roads. The majority of conventional roads are still in the eastern part of the corridor, in Slovakia and in Romania. The majority of the projects in the project list relate to upgrade (57%) and 28% to new construction of road infrastructure. The availability of alternative clean fuels along the road corridor is given; possibilities for compressed natural gas (CNG) and liquefied petroleum gas (LPG) are available in all Member States at different levels. A good coverage of LPG supply stations already exists. For CNG supply along the corridor route a limited coverage exists. Electric charging stations show a slightly different picture, they are available to a larger extent in Southern Germany, Austria and Slovakia; supply stations in the Czech Republic, Hungary and Romania are not available. Funding of innovative projects through CEF is an important enabler in the development of infrastructure for clean fuels (12 projects) and for ITS and other telematics applications (15 projects) on the entire corridor.

With regard to the other core parameters such as the availability of safe parking and resting areas the requirement of rest areas on motorways shall be approximately every 100km in line with the need of the society and the market. The average number of secure parking areas in the Member States for the commercial traffic in 2016 was between 1 and 4 parking areas per 100km and is improving, which is also supported by a number of projects in the project pipeline.

### **Airports**

There are in total 11 airports along the Rhine-Danube Corridor, which can be assigned to Core network nodes. There are dedicated main airports, defined in the part 2 of Annex II of Regulation 1315/2013 that shall be connected with the trans-European rail network by 2050 wherever possible with a high-speed rail network connection: Frankfurt, München, Stuttgart, Praha, Wien and Budapest. Airports assigned to the core network, which do not fall under the obligation of Regulation 1315/2013, Article 41(3) and accordingly they do not have to be connected to the TEN-T rail and road network by 2050 are the remaining airports of the list, namely: Nürnberg, Ostrava, Bratislava, București and Timișoara.

The airports of Frankfurt, Stuttgart, München, and Wien dispose of a rail connection; București and Ostrava have now also a rail connection. Nürnberg, Praha, Bratislava, Budapest and Timișoara do not dispose of a rail connection. Thus, the Airport of Praha (Václav Havel International) and Budapest Airport (Ferenc Liszt International) are to be connected to rail by 2050. Relevant studies are under preparation. Frankfurt, Stuttgart, München and Wien started to make provisions for the use of alternative clean fuels for ground services. Charging stations for e-cars are under implementation.

All airports dispose of cargo terminals, which are open to all operators in a non-discriminatory way.

### **Actions already accomplished**

Since the adoption of the TEN-T Regulation by the end of 2013 values of Key Performance Indicators (KPI) changed only slightly. Nevertheless, Member States have implemented and prepared a number of measures in order to provide an operational trans-European transport network in line with the provisions of Regulation 1315/2013 by 2030.

86 projects in the corridor with an investment volume of 5.27 bn EUR were completed in the period 2014 - 2016, being about 15% of the total number of projects, which were collected in the updating process of the project list (563 projects).

### **Rail**

All recently concluded rail projects are located in Austria and in the Czech Republic. Two Austrian projects refer to the new Wien central rail station and its connection to regional and long-haul rail traffic. Another four projects allocated to Austria deal with upgrades of stations and short sections of the "Westbahn" (Salzburg-Wien). These actions do not remedy non-compliant infrastructure as the requirements of the Regulation have already been fulfilled before. However, they adjust the configuration of rail stations to the demands of high-speed traffic; in this context, they enhance rail capacity and allow for higher speed of passenger trains. Similar to Austria, also the finalised Czech rail projects show a clear affinity to line upgrades and modernisation of important nodes or station areas (e.g. Plzeň, Praha, Ústí nad Orlicí, Přerov). All these projects achieve and/or improve KPIs, mostly on a very detailed local level. Due to this detail, the effects of these projects are not visible in the overall corridor compliance rates. In any case, they contribute to capacity enhancement on the CZ corridor lines by eliminating local bottlenecks. Three Czech rail projects are part of a project package dealing with the improvement of the corridor section between the DE/CZ border and Plzeň.

### **Inland Waterways**

None of the implemented inland waterway projects had an influence on the static KPI. Only the dynamic indicator measuring the achievement of the targeted depth according to the waterway manager varies from year to year, depending on both, hydrological and infrastructure conditions. Nevertheless, progress was made through the realization of a number of activities, which mostly relate to the improvement of the fairway availability, the reliability of locks and the coordination of national approaches towards the provision of a concerted infrastructure quality. Implementation of RIS at the Sava was finalized by the end of 2016. Works at the Upper Main to increase the permissible depth are consistently progressing; building permissions for the realization of river training works between Straubing and Vilshofen are currently pending and experiences from the "Integrated River Engineering Project East of Wien" are casted into the next implementation step. River Training and Dredging Works between Bačka Palanka and Beograd (Serbia) have been prepared and approved in 2014; works and their supervision have been contracted in 2017. The on-going preparatory study "Fairway Danube" aims at an increased transparency on navigation conditions and is paving the way for well-founded improvement measures.

### **Ports**

Ports KPI have also been stable since 2013, with the positive exception of the availability of clean fuels. In 2015, the private company Bulmarket Ltd. completed an LNG terminal in an inland port in Ruse (Bulgaria). A number of projects contributed to the qualitative improvements of ports capacity, road and rail connections or intermodal capacities and thus added to the development of the Rhine-Danube

Corridor. Examples for such projects are the increase of rail capacity of the Port of Constanța (RO), the restoration of the quay wall in the Port of Regensburg (DE) and the rehabilitation and development of the waterside infrastructure in the Port of Budapest/Csepel (HU). The study phase for the capital project "High-Performance Green Port Giurgiu" was finalized and the construction phase is currently being implemented, with the plans to complete the entire project by the end of 2018. Aiming at further integration of inland ports into the multimodal logistic chains the "Expansion of the tri-modal inland port of Wien by land recovery" was completed in 2015.

### **Intermodal terminals**

Facilities of the Rail-Road Terminals München-Riem Ubf (interim storage area), Linz Stadthafen (Land reclamation, extension of the container terminal and extension of railway tracks by 12/2014 as well as studies for the expansion of the trimodal Port of Linz by 12/2015), Ennshafen (significant improvement by 4/2015), Žilina – Teplice (construction of a new public terminal by end of 2015) have been extended and improved. Preparatory steps to build an intermodal terminal in Ruse (namely feasibility study, preliminary design, Cost-Benefit Analysis, approved EIA Report) have been completed in 2015. Works at the hub terminals Wien-Süd (Inzersdorf) by ÖBB and Budapest by Metrans (subsidiary of the German HHLA group) for two additional large size Rail-Road Terminals are continuing. Both shall become operational in the year 2017.

### **Road**

Between 2014 and 2016 road infrastructure on the Rhine-Danube Corridor has slightly improved from 76.7% to 78.1% in terms of motorway compliance. 10 road and one innovation project related to ITS, located in four Member States – Austria, Hungary, Slovakia and Romania, were completed in this period. 4 projects are new construction projects and have a direct impact on the corridor development; 4 further projects can be considered with regards to capacity enhancements; 1 project improves the safety installations; 1 project refers to a feasibility study. The feasibility study for the new motorway between Arad and Timisoara has been completed. Of particular importance is the removal of the cross-border bottleneck between Mako (HU) and Nadlac (RO), providing a continuous motorway connection between both Member States.

### **Airports**

Airport related KPI did not change since 2014, even if five projects have been completed. 3 projects improved the connection of the airports to the rail network; they refer to the rail connection of airport Wien to the Wien Central Station (KPI target achieved), the adaptation of the rail platform at the airport Wien and the connection of the Ostrava airport to the railway network. Other projects have been studies on rail connections to the airports of Frankfurt and München.

## **Plan for the removal of physical and technical barriers – future challenges and need for action**

The Study on the Rhine-Danube Corridor has led to identify critical issues hampering the operation of this major European transport connection in line with the provisions of Regulation 1315/2013. The plan for the removal of physical and technical barriers presents assumptions on the compliance with Regulation 1315/2013 by 2030, based on the expected contributions of the identified planned projects to the Corridor's development and shows issues, where there is still a need for actions.

### **Rail**

The analysis of the project list regarding contributions to KPIs (line speed, electrification, axle load, train length) and other parameters (line capacity, single track sections, strong inclines) shows that substantial progress can be expected until 2030



on numerous corridor parts. In this context, the following global projects can be highlighted: "Stuttgart 21" + High-speed line Stuttgart – Ulm, High-speed line Salzburg – Wien ("Neue Westbahn"), Northern Romanian TEN-T core route Curtici – Predeal, Southern Romanian TEN-T core route Arad – Craiova, Nürnberg - DE/CZ border Cheb – Plzeň and DE/CZborder – Ceska Kubice – Plzeň (with exception of section Stod - Česká Kubice, where line speed will not be compliant according to current status of project data).

However, it also becomes evident that according to the current planning status the envisaged development of the corridor is jeopardized by several risks, particularly

- Bottlenecks or projects without reliable finalisation date, interrupting throughout KPI compliance on large, connected corridor parts. Main sections and corridor parts affected are München-Freilassing (axle load), Schwandorf – DE/CZ border (electrification), DE/CZ border – Domazlice (speed), Rajka – Heyeshalom (axle load, train length), Predeal – București (axle load, train length), Craiova – București (axle load), București – Constanta - existing line (train length), large parts of Slovakia and Czech Republic (train length), sections in Hungary on the line between Budapest and Lököshaza (axle load).
- Missing link București – Constanta (new high-speed line). According to EU Regulation 1315/2013, this new line shall be part of the TEN-T Core Network (Rail Passenger) and the Rhine-Danube Core Network Corridor (CNC); the existing line is defined as a CNC freight rail. However, according to information provided by CFR-SA from July/August 2017, it is not planned to realise this new line until 2030;
- Single track lines, which currently show no capacity problems with mostly regional traffic, but might become severe bottlenecks with the envisaged (long-haul) increase of volumes by 2030. In this respect, the following line sections should receive particular attention: Germany: Marktredwitz – border DE/CZ, Regensburg - DE/CZ border, Mühldorf - Freilassing; Czech Republic: DE/CZ border – Plzeň (both lines from Nürnberg and Regensburg); Slovakia: border-crossing sections between Bratislava and Austria/ Hungary; Hungary: Békescsaba – Lökösháza.
- Not yet approved, complete financing of projects or missing respective information. As all information have been gathered from official documents and furthermore approved by the Ministries of Transport or other stakeholders, the envisaged dates for realisation have been taken for granted. It has to be noted that such gaps in project financing might just be due to missing information. Such information gaps shall be closed in the further corridor development process involving official documents as well as additional data from Ministries of Transport or from other stakeholders.
- Projects with an end date in 2030. This concerns especially projects from the new German Federal Transport Infrastructure Plan ('BVWP 2030'). In agreement with the German MoT (BMVI), the end date of those projects was set to end 2030, if a detailed implementation plan was not yet available. In case of deviations in the project schedule, corresponding KPI improvements might not be achieved until 2030 as requested by Regulation 1315/2013. This might apply for the electrification of the lines München – Freilassing and Nürnberg – DE/CZ border. In these cases, a continuous progress monitoring is recommended.

Figure 2 gives an overview on the expected compliance situation of the corridor in 2030. Critical sections are marked in red and yellow-dotted, where a need for action exists. The figure also contains new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017.

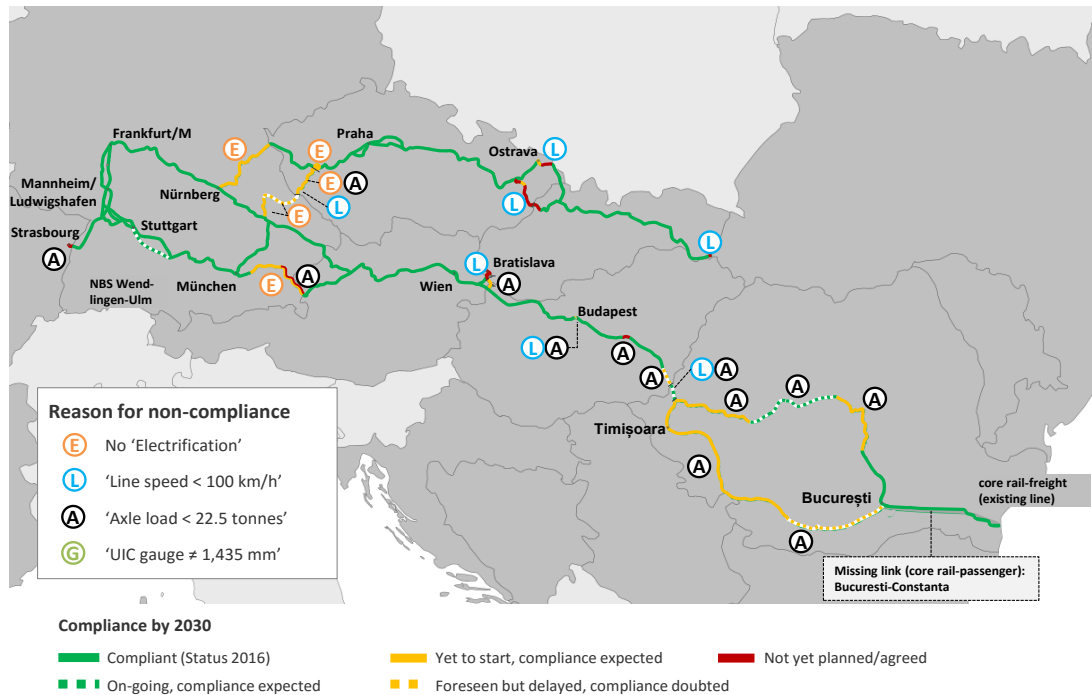
Making up the balance, the prospected development of the corridor shows a heterogeneous picture: on the one hand, the KPIs 'Electrification' and 'Line speed', which have a high degree of compliance already today, show only small progress, but



shall be close to 100% by 2030. On the other hand, the parameters 'Axle load' and 'Train length' will improve notably until 2030. However, from the today's perspective, the target value of 100% will be missed, though, in case of 'Train length' even clearly.

In summary, it has to be stated that from today's point of view an overall compliance with the core rail parameters will not be achieved until 2030. Additionally, some projects with a planned end date close to 2030 are based on verbal commitments or feature unsecure financing. This might lead to further delays in the project realisation.

**Figure 2: Rail compliance by 2030**



Source: HaCon, status 09/17

## Inland waterways

In summary, the identified planned projects are expected to increase the permissible draught at the Upper Main (Germany) and will contribute to the provision of targeted fairway depths between Wien and Devin (Austria/Slovakia) as well as between Szob and Budapest (Hungary).

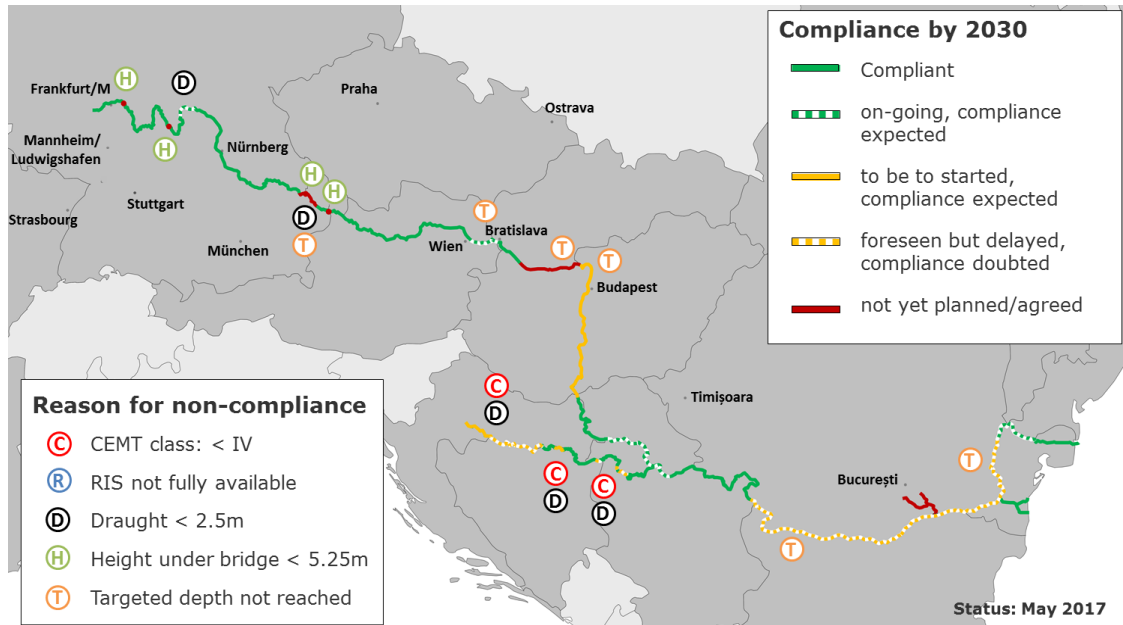
Most critical is the section between Straubing and Vilshofen, where activities are ongoing but the set targets are below the requirements of regulation 1315/2013. Activities related to the upgrade of the Sava are planned but the timing and financing is still unclear, therefore the completion is considered to be at risk. Intentions to increase the bridge clearance are missing for all of the bridges not complying with regulation 1315/2013.

Activities at the Slovakian-Hungarian border section, the Bulgarian-Romanian border section and in Romania in order to reach the targeted fairways depth and thereby increase navigation reliability still need to be followed-up by subsequent steps in order to complete the network.

River Information Services are already available at all sections of the Rhine-Danube Corridor, even if to a different extent and quality.

Figure 3 shows the expected compliance of inland waterways with Regulation 1315/2013 by 2030.

**Figure 3: IWW compliance by 2030**



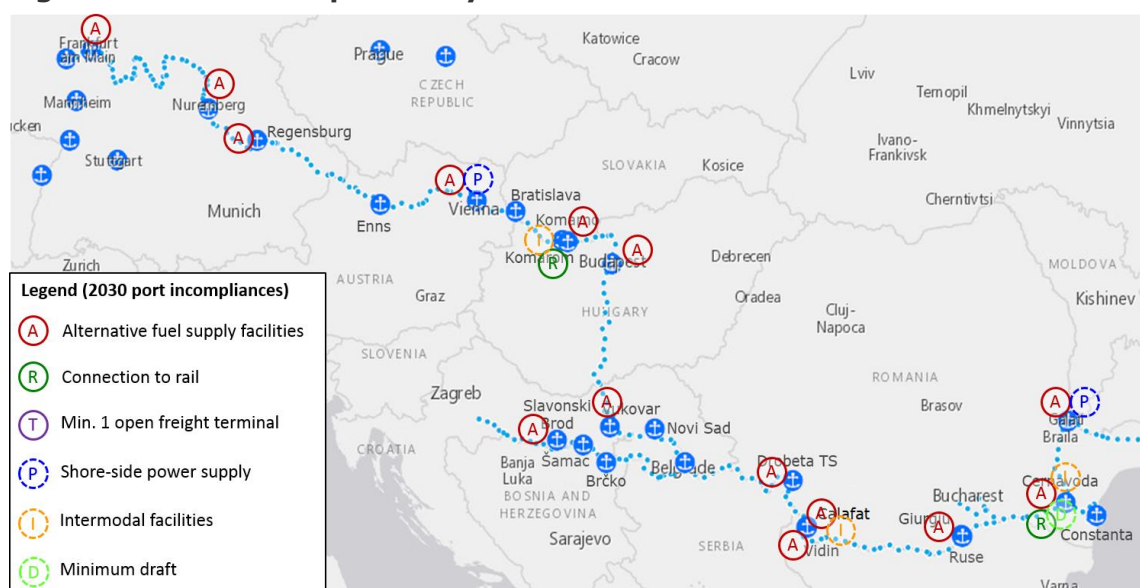
Source: viadonau, May 2017

### Ports

Currently, no projects tackling missing functional railway connection in the ports of Komarom (HU) and Cernavodă (RO) are planned, thus impeding the development of intermodality in these ports and the Corridor itself and not contributing to the improvement of the railway connection KPI.

In terms of incompliance with technical parameters, the ports of Cernavodă (RO) and Vidin (BG) do not provide minimum draft of 2.5m at all water levels, but the port of Vidin aims to solve this incompliance within a larger global project on inland waterways interventions. No such projects have been planned for the port of Cernavodă. Concerning the provision of alternative clean fuels supply facilities, ports of Constanta (RO), Bratislava (SK) and Enns (AT) have reported projects involving construction of such facilities. Projects combating the lack of intermodal facilities have been reported and identified by the ports of Slavonski Brod (HR) and Drobeta Turnu Severin (RO). Ports of Calafat (RO), Cernavodă (RO) and Komarom (HU) have not planned any actions related to provision of intermodal facilities.

Although not strictly a demand in terms of TEN-T Regulation, but being one of the Corridor objectives, the provision of shore-side power supply facilities is not provided in the ports of Wien (AT) and Galati (RO) and no plans to provide such facilities have been reported.

**Figure 4: Ports compliance by 2030**

Source: iC consulenten, May 2017

## Roads

Slovakia and Romania plan to proceed with their ambitious construction programme on their motorway network in the upcoming years. From a total number of 113 road projects in the project list 2017 about 16 projects are located in Romania as well as in Slovakia. The identified on-going and planned projects will improve the KPI on motorways/express road to 92%. Still some sections in Slovakia (towards the Ukraine border), in Hungary on the ring road around Budapest and in Romania (between Craiova and Bucuresti and sections of the ring road around Bucuresti) are expected to remain incomplete.

High traffic utilisation, capacity constraints, lacking safety and overaged infrastructure are an issue at road sections in Germany, Austria, Czech Republic and in Hungary around Budapest as well as in Romania around București. 15 projects are dealing with telematics applications; the investment cost need for the ongoing and planned 103 projects sum up to 23.4 bn EUR.

## Airports

About 29 projects were collected in the 2017 consultation round with the stakeholders. More than 80% of all airport projects include infrastructure works, either the rehabilitation or the upgrade or a new construction. Six projects are pure studies and one project relates to the telematics application SESAR.

15 projects refer to the intermodal connection of the airport, thereof 14 projects to rail and one to the road connection of the respective airport. Eight airport projects contribute to the achievement of the KPI target "Connection to rail". Two of these projects are located each in Germany, Austria and in Hungary and each one project in the Czech Republic and in Romania. Three of the listed projects are already completed.

The Airport of Praha (Václav Havel International) and Budapest Airport (Ferenc Liszt International) are to be connected to heavy rail until 2050 and have plans to do so. The airports of Frankfurt and München have further projects to improve the rail connection. Larger projects are dealing with the development of the airports in München, Timisoara and Bucuresti.

## **Intermodal Terminals**

Only Linz Stadthafen will be capable of handling intermodal transport units and be accessible by electrified trains with a length of 740m. Several terminals will fulfil the requirements of Regulation 1315/2013 to a higher degree in 2030 than they do now but are still expected to lack the compliance with all three parameters. However, for the majority of terminals no project is foreseen at all.

## **Administrative and operational barriers**

Continuity of passenger and freight flows by rail is jeopardized at cross-border sections, due to changing technical parameters. Full exploitation of train capacities is particularly impacted for long-haul train runs, as they have to cope with frequent changes and multi-system locomotives are needed. Border control procedures influence transport/travel times, costs and resource efficiency of rail transport negatively. Also deviating infrastructure parameters at last mile connections or missing interconnections hamper the increase of rail transport.

Inland waterway transport might be improved by providing waterway infrastructure managers with adequate budget to fulfil their national maintenance duties. Also the well qualified human resources for the preparation and implementation of complex, integrated waterway management and engineering projects is not sufficiently available in some countries. As Member States struggle with providing the required fairway depths at free flowing river sections, intentions to legally relieve themselves from their responsibilities have been observed (e.g. Restrictions of vessel draught, Force Majeure Certificates). Administrative processes and paperwork are seen as a significant competitive disadvantage for inland waterway transport on the Rhine-Danube Corridor, which typically runs long distances. Information on current fairway conditions is often not available or difficult to access; therefore planning of inland waterway transports is overly complex. Fees on the Danube-Black Sea Canal are calculated according to loading capacity and double punish shipping companies in case of bad fairway conditions.

Ports set their charges autonomously and may differ substantially in line with the applied organisational scheme. Increased transparency, e.g. by an obligation to publish tariffs on the ports websites would support inland waterway transport. Non-harmonized administrative procedures in ports delay or prolong transports significantly. Harmonization of requirements for vessel, crew and cargo related documents for vessels' calling in ports is highly recommended.

Interoperability of ITS and road tolling systems between Member States is an obstacle and burden for the hauliers and freight forwarders on long distance transport. The only cross-border cooperation system is established between Austria and Germany (TOLL2GO). The European Electronic Toll Service shall enable the logistic operator to pay the toll fees under one single contract in all member states. Compatibility of the units is required, as in some member states the DSRC (Dedicated Short Range Communication) is in operation and in other states a satellite based toll system.

While advanced road traffic management systems are operational in many places throughout Europe, regional and national ITS services still form a fragmented patchwork. The general objective is national ITS to be mutually compatible, which means a general ability of a device or system to work with another device or system without modification. Thus, the scope of ITS compatibility is much wider and lies beyond the R-D Corridor. Distance or time based charging schemes exist in all countries of the Rhine-Danube Corridor, but only five use an electronic fee collection system.

Regarding the lacking of rail connection of ports and RRT to the hinterland it is recommended that rail infrastructure managers and terminal managers cooperate

towards realizing the tracks-side and terminal side improvement of that parameters in a coordinated way.

## Urban nodes

The Rhine-Danube corridor core network contains thirteen urban nodes, located in seven Member States (France, Germany, Czech Republic, Slovakia, Austria, Hungary and Romania): Strasbourg (FR), Mannheim (DE), Frankfurt/M (DE), Nürnberg (DE), Stuttgart (DE), München (DE), Ostrava (CZ), Praha (CZ), Bratislava (SK), Wien (AT), Budapest (HU), Timișoara (RO) and București (RO).

In Table 2 the overall corridor network compliance check for Rhine-Danube urban nodes is displayed. The data provided herein also contains new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017.

**Table 2: Corridor lines compliance check on the Rhine-Danube urban nodes**

Parameters	Strasbourg	Mannheim	Frankfurt	Nürnberg	Stuttgart	München	Ostrava	Praha	Bratislava	Wien	Budapest	Timișoara	București
Rail	Train length (≥ 740m)	n.i.										P	
	Axle load (≥ 22,5t)										P	P	P
	Speed (≥ 100km/h)						P		P		P		
	Electrification				P								
	Capacity utilisation		P	P	P			P		P	P		
IWW	ECMT class (≥ IV)	n.a.				n.a.	n.a.					n.a.	n.a.
	Draught (≥ 2.5m)	n.a.					n.a.	n.a.	P	P		n.a.	n.a.
	Height (≥ 5.25m)	n.a.					n.a.	n.a.	P			n.a.	n.a.
	RIS implementation	n.a.					n.a.	n.a.				n.a.	n.a.
	Good navigation status	n.a.	n.a.			n.a.	n.a.	n.a.		P		P	n.a.
Road	Express road / motorway												

GREEN	Compliant
YELLOW	Partly compliant / non-compliant
RED	Non-compliant

GREY	Not applicable (n.a.)
WHITE	No information (n.i.)
P	Project for the improvement of a non-compliant parameter (according Project list 2017)

Source: HaCon, 09/2017

Considering all nodes, just over 70% of the analysed parameters are compliant with Regulation 1315/2013. Some 20% are partly compliant and 7% of the parameters are non-compliant.

Corridor rail lines within the thirteen nodes suffer from several bottlenecks. About 65% analysed rail parameters per node are compliant while about 35% of them are not satisfying on at least a rail section within the urban node. Rail parameters most afflicted by bottlenecks are "train length" and "capacity utilisation", that are partly compliant or non-compliant in 45-50% of nodes. Moreover, the "axle load" criterion of 22.5t is completely fulfilled in 70% nodes only. Instead, the most of the rail corridor is electrified and only two nodes out of thirteen present some non-electrified sections. With the exception of the train length parameter, several projects for the total or partial resolution of the above mentioned bottlenecks have been identified. Projects with the purpose of achieving train length 740m have been planned in one urban node only (in Timișoara).

Corridor lines for inland waterways have been analysed for eight urban nodes. About 75% IWW parameters per node taken into account are compliant with the Regulation and 25% are partly or non-compliant. Parameters showing the most of problems are "draught" and "good navigation status", that are compliant in 50% analysed nodes only. On the contrary, requirements referring to the "ECMT class", "height under bridges" and "RIS implementation" parameters are fulfilled in almost all nodes. With regards to the resolution of inland waterway bottlenecks, various projects have been

foreseen principally for the improvement of the navigation status and for the fulfilment of the minimum draught requirement of 2.5m.

The road corridor in Rhine-Danube nodes is almost totally compliant with the Regulation. With the only exception of the local road L98 between Strasbourg and the motorway A5, all corridor lines for road are classified as motorways (express ways).

In general, results of the analysis show a discrepancy in terms of corridor lines compliance between Western and Eastern Europe. Urban nodes with the majority of bottlenecks are Bratislava, Budapest, Praha and Ostrava. Their corridor sections are afflicted by at least a bottleneck for 45%-55% parameters taken into account. On the other hand, corridor lines in München, Frankfurt, Mannheim and Stuttgart are compliant in more than 90% of the cases.

The rail connection of inland ports, trimodal terminals and rail-road terminals to the core network has been analysed according to the three parameters axle load, electrification and train length. Rail connections to airports have been evaluated on the basis of heavy rail connection. Half of the analysed last-mile lines (23 out of 45) are completely compliant with regard to the above mentioned parameters. The remaining 22 out of 45 last-mile connections are not totally compliant and improvement works are needed on the rail lines.

The parameter showing the most of bottlenecks is "train length", that is non-compliant in 40-45% last-mile connections. Axle load parameter is non-compliant in 20-25% of the cases while just over 10% freight connections are not electrified. In total, 11 airports have been inspected and 4 of them are not connected to heavy rail.

No projects with the purpose of achieving line electrification and axle load 22.5t requirements on the non-compliant sections have been identified. A project in Ostrava for the achievement of the train length 740m-criterion at the rail-road terminal Ostrava Paskov has been planned. Two projects with the scope of connecting the airport in Praha and in Timișoara to heavy rail have been recognised.

### **Innovation and environmental impact**

Around 16% of all the eligible projects in the Rhine Danube corridor project list 2017 are innovative, most of them being related to innovation which is transferable innovation across the EU, typically already implemented in one part/country and due its success – implemented in more (e.g. CEF or Horizon 2020). Most of the projects address safety development and data sharing. This is to be expected as the member states still need to be more coherent in terms of regularization. As expected, existing funds (public and private) are the most important enablers for innovative projects, whilst common barriers are the insufficient standardization and regulation, high investment costs and lack of sufficient public funding.

The importance of developing more innovation projects is also stressed by conducting a study on the risks from climate change in the corridor. The research concluded that each country has several risks mostly depending on its geographical location. In particular, most common risks include road related ones and bridge scour. Certain parts (the outer part of the corridor) would face droughts possibly in 100 years, whilst the centre ones will face the opposite – floods and heavy rain.

### **Overall investment analysis of the Rhine-Danube Corridor**

The overall investment costs of all the 563 projects in the CNC project list sum up to a total of 91.9 bn EUR. 86 projects were already completed up to end of 2016 with an investment sum of 5.27 bn EUR. The on-going projects (241) are financed with a total investment of 37.8 bn EUR.



From the total number of projects about 75% of the projects contains full set of information on the investment costs (equal to investment volume of 68.8 bn EUR), for 25% of the projects the information are not complete (equal to an investment volume of 23 bn EUR).

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

- Financing by MS/public grant: 64.7% or 44.8 bn EUR;
- EU grants: 23.5 % or 16.2 bn EUR;
- IFI bank loan: 25 Mio EUR (negligible);
- Private financing/own resources: 6.3% or 4.3 bn EUR;
- Other financing sources: 5.5% or 3.7 bn EUR.

The breakdown of funding by EU grants shows following situation:

- Cohesion Fund, CEF, OPT: 13.1 bn EUR or 81%;
- CEF/TEN-T: 1.9 bn EUR or 12%;
- ERDF: 685 Mio EUR or 4%;
- ESIF: 432 Mio EUR or 3 %;
- IPA: 40 Mio EUR;
- Not specified: 26.6 Mio EUR.

When analysing the financing of projects through EU grants a share of 51.5% of the investment volume is approved (equal to 8.3 bn EUR) and the share of 48.4% can be considered as potential for funding (equal to 7.8 bn EUR). The investment analysis of the RD CNC and the structure of the EU grants breakdown reflects the typical situation of the RD CNC, which has a high share of Member States receiving financial means under the Cohesion Fund.

Would the same EU funding ratio (i.e. 23.5%) be applied to the entire corridor work plan investment amount of 91.9 bn EUR, it can be expected that over the next years, 11.1 bn EUR (calculated on basis of approved EU grants) and 21.6 bn EUR (calculated on basis of entire EU grants) will be demanded from project promoters and Member States.

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

An analysis of the growth and jobs impact of the corridor development was performed by applying a multiplier methodology based on the findings of the study "*Cost of non-completion of the TEN-T*"<sup>4</sup>.

The projects for which cost estimates are available and that are planned to be implemented over the period 2016 until 2030 were taken into evaluation, they amount to an investment of 87.7 bn EUR<sub>2015</sub>. The implementation of these projects on the corridor will lead to an increase of GDP over the period 2016 until 2030 of 725 bn EUR<sub>2015</sub> in total. Further benefits will occur also after the year 2030.

The investments will also stimulate additional employment. The direct, indirect and induced job effects of these projects will amount to about 2 million additional job-years created over the period 2016 to 2030. It can be expected that also after 2030 further job-years will be created by the projects.

<sup>4</sup> Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "*Cost of non-completion of the TEN-T*". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

## 1 Introduction

On 17<sup>th</sup> April 2015, the European Commission has published the invitation to tender MOVE/B1/2014-710 "Studies on the TEN-T core network corridors and support of the European Coordinators". The announced studies are the logical follow-up of the nine corridor studies that have been carried out in 2014 also on behalf of the European Commission (= Phase 1). Following the TEN-T Regulation 1315/2013 and the CEF Regulation 1316/2013, these studies constitute the main basis for drawing up corridor work plans by the European Coordinators approved by the concerned Member States in May 2015 (for Work Plan I) and in December 2016 (for Work Plan II). The current study (Phase 2) is carried out by the same consortium as for the phase 1 with

- iC consulenten (AT) as lead partner,
- HaCon (DE),
- Panteia (NL),
- University Politehnica of Bucharest (RO),
- viadonau (AT),
- KombiConsult (DE)
- and local experts.

This study is elaborated for and in close cooperation with:

**Ms Karla Peijs, European Coordinator for the Rhine – Danube Corridor**

**Ms Désirée Oen, Advisor of the Coordinator**

**European Commission, DG MOVE, Unit B.1,**

the members/participants of the Corridor Forum, the stakeholders and with the other Corridor Consortia.

### 1.1 Background and road map

Adopted by the EU in 2013, the new TEN-T Regulation 1315/2013<sup>5</sup> and the CEF Regulation 1316/2013<sup>6</sup> forms the current legal basis for the development of the Trans-European Networks (TEN-T). In order to efficiently organise the future development of the core network towards its 2030 key completion milestone, nine (multimodal) core network corridors were defined, each led by a European Coordinator. An integral task specified by the Regulation for each Coordinator is the development of a Work Plan for the implementation of the core network based on a detailed analysis of each corridor. To support each Coordinator in the preparation of the corridor Work Plan, the European Commission launched nine corridor studies. Furthermore additional studies were launched for the preparation of two more Work Plans and to support the respective Coordinators, dealing with the deployment of ERTMS and with MoS.

The main outcomes of the 2014 study entailed the identification and description of the Corridor's characteristics, i.e., the multimodal transport infrastructure and the market-related transport flows, as well as their compliance with the Regulations' stipulations. This led to an identification of critical issues, which hinder an efficient and seamless operation of the Corridor, and the definition of Corridor development objectives. Finally, the study included a record of all on-going and planned infrastructure projects making up a Corridor Implementation Plan. The infrastructure analysis was presented and discussed in four meeting of the Rhine-Danube Corridor Forum with

<sup>5</sup> 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

<sup>6</sup> REGULATION (EU) No 1316/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing the Connecting Europe Facility



representatives of the member states, regions and infrastructure managers of all modes.

The results of the study and the support by the members of the Corridor Forum established the basis for the European Coordinator for the Rhine Danube Corridor, Ms. Karla Peijs, to draw up the First Corridor's Work Plan in December 2014 for the Member States. The final version was issued in May 2015 (Art.47 of TEN-T Regulation). The Work Plan paid particular attention to the priorities of the guidelines: cross border bottlenecks, interoperability and multimodality and focused on the characteristics of the Corridor, the results of the multimodal Transport Market Study, the critical issues and objectives, concluding in a general outlook, as well as a number of key recommendations.

Subsequently the work on the updating and refinement of the First Work Plan started in September 2015 with the support of the same external consultants for the second phase of the Corridor study aiming to achieve further development of the study. Seven further meetings of the consultation Forum were held between September 2015 and December 2017 presenting and discussing the next steps in the updating of the study and the Work Plan. The Second update of the Work Plan was discussed with the member states and issued in its final version in December 2016.

The Final report include the main findings and conclusions of the activities performed for the elaboration of the Third update of the Rhine-Danube Corridor Work Plan envisaged for December 2017.

## 1.2 Outline

The present report constitutes the **Final Report** of the 2<sup>nd</sup> phase of the corridor process, and in accordance with the tender specifications, focusses in particular on the conclusions and results of the analysis made in the tasks 2, 3 and 4.

The elements included in this report are:

### Summaries and conclusions

- An executive summary of the analysis at the beginning of the report;
- Conclusions and analysis drawn from previous tasks;
- Conclusions providing for the further development of the corridor, including the update of the Coordinator's third Work Plan (separate document, due end of 2017).

### Mode specific analysis

- Analysis of potential market uptake for modes with highest unused capacity – in particular inland waterway transport;
- Identification of measures to fulfil this potential;
- Analysis of further development of co-operation with the Rail Freight Corridor.

### Modal shift and environmental impact

- Mitigation of environmental impact

### Clustering and mapping of projects

- Objective criteria to prioritise investments on the corridor, based on the characteristics of the corridor, taking into consideration outcomes of Task 3 (wider elements);
- Proposals for a mapping of projects or their groups/categories.

### Corridor accomplishments

- Summary of actions accomplished between 2014 and 2016.

### Impact of corridor development

- Impact on jobs and growth.
- Infrastructure funding and financial sustainability of projects

## 2 Conclusions and key aspects from the analysis

The Rhine-Danube Core Network Corridor is the transport backbone of the region from the Black Sea towards the very heart of the European Union, connecting the entry ports at the Black Sea, Constanța and the ports in the Danube Delta, to southern Germany and to the ports of the Rhine along the river Danube, while the other branch links the Ukrainian-Slovakian border to the same Rhine ports and central European regions.

It is quite a vast region and all modes of transport are important for its internal and external connection including France, Germany, Austria, Czech Republic, Slovakia, Hungary, Croatia, Bulgaria and Romania. The corridor also crosses four non-EU States, Serbia, Bosnia-Herzegovina, Moldova and Ukraine. In all these countries the main focus on the infrastructure deployment is laid on the development of navigation on the rivers Danube and Sava and on rail. In order to enhance multimodality the respective locations for the interchange of freight and passengers along the rail network and the river Danube are of utmost importance.

When considering the transport aspect of rivers like Danube, Sava it is also mandatory to keep in mind that they are not only a transport axis, but they are important as a natural habitat, as a recreation area, as a source of energy, as water for irrigation and for drinking, etc.

The Rhine-Danube Corridor has a number of overlapping and crossing sections with other CNC:

- OEM Corridor (starting at Vidin/BG, the western part in RO, HU, in CZ between Brno and Praha, Vienna node/AT and Bratislava node/SK)
- BA Corridor (in CZ between Přerov and Ostrava, Žilina in Slovakia, Vienna node/AT)
- Scan-Med Corridor (in DE Würzburg – Nürnberg, München - Rosenheim)
- RALP Corridor (in DE on the Rhine between Frankfurt and Strasbourg)
- MED Corridor (Budapest node/HU)

Table 3 provides the background characteristics on network characteristics and socio-economic statistics of the catchment area for the Rhine-Danube Corridor.

**Table 3: Background information on the Rhine-Danube Corridor**

Indicator	Remarks/2010	2013	2014	2016
GDP in €*)	1,835 billion	1,957 billion (estimated)	2,009 billion (estimated)	--
Employment *)	42.30 million	42.64 mio	43.21 mio	--
Population *)	96.09 million	94.87 mio	94.43 mio	--
Rail network	-	5,715 km	5,715 km	5,715 km
Road network	-	4,470 km	4,470 km	4,488 km
Inland waterway network EU	Without the Tisza River (173 rkm) and the planned Danube-București Canal (112 km)	3,656 rkm	3,656 rkm	3,656 rkm

Indicator	Remarks/2010	2013	2014	2016
Seaports	Maritime/ IWW (mixed) port	1	1	1
Inland ports	Total no of ports	18	18	18
Airports	-	11	11	11
RRTs	Only RR/total (RR and trimodal)	27/41	27/41	27/43
Urban nodes	-	13	13	13
Number of missing links - IWW	Danube - Bucuresti Canal	1	1	1
Number of missing links – high speed rail	Germany: new high-speed line Stuttgart-Ulm Romania: new high-speed line București – Constanta**)	2	2	2
Number of missing links - road (aggregated)	Czech Republic: border section CZ/SK	1	1	1
	Slovakia: SK/CZ border, Hricovske Podhradie –	2	2	2
	Ukrain border Romania	3	3	3
Kms of Missing Infrastructure	Danube - Bucuresti Canal	112	112	112
Kms of Missing Infrastructure - rail	Germany: new high-speed line Stuttgart-Ulm	About 60	About 60	About 60
	Romania: new high-speed line București – Constanta**)	About 220	About 220	About 220
Kms of missing infrastructure – highway road	Hungary	-	56	33
	Czech Republic	-	58	58
	Slovakia	-	215	170
	Romania	-	968	720

\*) according to catchment area

\*\*) According to EU Regulation 1315/2013, this new line shall be part of the TEN-T Core Network (Rail Passenger) and the Rhine-Danube Core Network Corridor (CNC); the existing line is defined as a CNC freight rail. However, according to information provided by CFR-SA from July/August 2017, it is not planned to realise this new line until 2030.

Source: Panteia Status 05/2016, study 09/2017

## 2.1 Compliance with the technical infrastructure parameters of the TEN-T guidelines

Article 4 of the TEN-T Guidelines describes the objectives of the trans-European transport network. They shall lead to the creation of a single European transport area, which is efficient and sustainable, increases the benefits for its users and fosters inclusive growth and social, economic and territorial cohesion. The Member States agreed to the list of specific objectives, which have to be met by the Rhine-Danube Corridor by December 2030, the latest.

The TEN-T Guidelines contain certain priorities and requirements, general and mode-related. These provide the basis of the target values for 2030 on which compliance is checked. The compliance analysis compares the infrastructure baseline values of 2013 with the current parameters and with the target values set for the year 2030. The analysis uncovered the respective deficits on mode sections and nodes. To assist monitoring the achievement of the priorities, Key Performance Indicators (KPIs) have been defined. The results of the compliance analysis in 2014 provide the baseline value of 2013 for the generic supply-side KPIs that were defined (see Table 4).

**Table 4: Generic supply-side KPI**

Mode	KPI	Baseline value 2013
Rail network	Electrification	91%
	Track gauge 1435mm	100%
	ERTMS implementation	7% <sup>1</sup>
	Line speed $\geq 100$ km/h	95%
	Axle load $\geq 22.5$ t	75% <sup>2</sup>
	Train length (740m)	47%
Inland waterway network <sup>3</sup>	CEMT requirements for class IV IWW	85%
	Permissible Draught (min 2.5m)	77%
	Permissible Height under bridges (min. 5.25m)	86% (5)
	RIS implementation (minimum requirements set out by the RIS directive are met)	100%
	Targeted depth according to waterway manager reached <sup>4</sup>	45%
Seaport	Connection to rail	100%
	Connection to IWW CEMT IV	100%
	Availability of clean fuels	0%
	Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%
	Facilities for ship generated waste	100%
Inland ports	Class IV waterway connection	100%
	Connection to rail	89%
	Availability of clean fuels	0%
	Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%
Road network	Express road/ motorway	77%
	Availability of clean fuels	available
Airport	Connection to rail <sup>5</sup>	67%
	Availability of at least one terminal open to all operators in a non-discriminatory way and application of transparent, relevant and fair charges	100%
	Capacity to make clean fuels available to airplanes	Intentionally available
	Availability of clean fuels (ground services)	67%
Rail Road Terminals (RRT)	Capability for Intermodal (unitised) transshipment	44%
	740m train terminal accessibility	2%
	Electrified train terminal accessibility	16%
	Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%

<sup>1</sup> Includes level 1, 2 and 3 ERTMS implementation<sup>2</sup> Compliance figures modified due to new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017<sup>3</sup> Member States and Western Balkan, number of bridges, which do not comply with the KPI<sup>4</sup> Corridor specific indicator<sup>5</sup> Considers only airports, which are to be connected to rail by 2050

Source: study team 09/2017

From the overall RD Corridor perspective the KPI values for the inland waterway network refer to the entire stretch of the Danube and the Sava River (Member States, Serbia and Bosnia and Herzegovina).

Later on the KPI values for the inland waterway network are referring to the Danube River in the Member States only.

Although a high level of compliance of the infrastructure of the Rhine-Danube Corridor with the requirements of the Regulation 1315/2013 in 2013 was identified, important steps will still to be taken to full compliance.

### **Rail network**

91% of the rail lines are electrified and gaps only relate to some sections in Germany (München-Mühldorf-Salzburg), the cross-border sections between Germany and the Czech Republic and in the Czech Republic. The entire rail infrastructure of the corridor provides for standard gauge (1,435 mm). An operating speed of at least 100km/h for freight traffic is enabled at more than 90% of the rail lines. Line sections with insufficient operating speeds are located on the "CS branch" and on the eastern part on the "Black Sea branch" (Romania; Hungary: local speed drops in Budapest node). Lowest compliance rates for rail relate to axle load, train length and ERTMS. 75% of the rail network allows for 22.5 tonnes axle load; this value incorporates new information on Romanian infrastructure provided by CFR-SA in July/August 2017. Line sections not fulfilling the requested standards are mostly located in Hungary and Romania. If speed limitations are accepted, the required axle load may be reached in Hungary. A maximum train length of 740m is permitted at 47% of the rail infrastructure. Sections which only provide for shorter trains are located on the "CS branch" (CZ/SK) as well as in Romania and on some sections in Austria. Operational ERTMS is exceptional at the Rhine-Danube Corridor and restricted to some line sections in Austria and Hungary.

### **Inland waterway network**

85% of the inland waterway network, including Serbia, is classified as a class IV waterway or higher, only the Sava River is assigned to a lower class. A draught of 2.50m is targeted to be reached at 77% of the inland waterways. Shortfalls relate not only to the above mentioned sections of the Sava but also to the Upper Main and the Danube between Straubing and Vilshofen (1.6m at 94% of days per year). Five bridges offer a clearance below 5.25m; 86% of the sections length complies with the requirement. Two of the bridges can represent a particular challenge for the navigation of passenger vessels and would also represent an obstacle if container transport on the Danube develops. With the exception of the river Tisza (not part of the RD Corridor), Information Services are available along the Inland Waterway Core Network (95%) but to a different extent and quality. International and national exchange of fairway or traffic related data between the RIS operators is not always ensured. The specific indicator showing the percentage of section kilometres on which the targeted fairway depth was met, reveals the particular challenges of the Rhine-Danube Corridor. Achievement of targeted depths varies dynamically as it depends not only on the waterway infrastructure conditions, but mainly on the hydrologic circumstances. Above all at free flowing river sections, they are challenging to be met. In 2013 the targets were met at 45% of the inland waterways sections length, in 2014 at 58%, in 2015 at 42% and in 2016 at 40%.

### **Ports**

The majority of the Corridor core ports comply with the requirements set by Regulation. Only two ports, Vidin (BG) and Cernavodă (RO), do not meet the minimum

depth and therefore require dredging activities. All core ports<sup>7</sup> have a road connection but of varying quality in terms of number of lanes and capacities. The situation is similar in view of railway connection; only two ports, Komarom (HU) and Cernavodă (RO), have no fully functional rail connection to the hinterland and the rest of the network. The level of availability of intermodal facilities in ports is varying and, generally, declines further downstream. There are five ports with reported incompliances in the provision of intermodal facilities: Komarom (HU), Slavonski Brod (HR), Drobeta Turnu Severin (RO), Calafat (RO) and Cernavodă (RO), but the ports of Slavonski Brod (HR) and Drobeta Turnu Severin (RO) have reported projects tackling this issue. Plans for alternative clean fuel facilities have been reported by the Port of Constanța, Port of Bratislava and Port of Enns while some of the remaining core ports on the Corridor took part in the LNG Master Plan on the Rhine-Main-Danube axis, meaning that plans for provision of alternative clean fuels facilities might be considered at a later stage depending on the timing of actual introduction of LNG fuelled vessels into operation on the Danube, creating the initial demand. Irrespective of this project, the Port of Ruse completed a LNG terminal with fuelling facilities for future LNG vessels in 2015. As regards the shore-side (external) supply of electricity to vessels in ports, most of the ports reported the existence of shore-side electricity supply facilities for vessels, except for the ports of Wien (AT) and Galați (RO).

### **Rail-Road terminals**

The compliance of intermodal terminals (rail – road and trimodal terminals), is rather low (see Table 4): in 2013 only 44% of the terminals are able to handle all three types of loading units (containers, swap bodies, semi-trailers). While the focus on single types of loading units might be explained by the past/current market orientation (e.g. focus on maritime or continental transport, key customers with special logistics profiles), the electrified rail access, which is fulfilled by only 16% of the sites and the limited length of the handling tracks, where only two sites fulfil the Regulation target, create a real burden for an efficient supply of intermodal transport services. The largest challenge for the present sites is their historically grown access to the rail infrastructure (single sided, non-electrified, annex to shunting yard or port railway line) and the limitation of the (wagon) train length by either the reception/departure siding or the transshipment track(s). Only Budapest BILK is proving transshipment tracks of  $\geq 740\text{m}$  length, while four sites are covering the present industry standard of 700m. With respect to the criterion “non-discriminatory access” all terminals are basically fulfilling this requirement.

### **Road network**

About 77% of the total length of roads is classified as motorways (express ways) and 23% are conventional roads. The majority of conventional roads are still in the eastern part of the corridor, in the Czech Republic, Slovakia and in Romania. Alternative clean fuels along the road corridor are provided to a limited extent; supply stations for compressed natural gas (CNG) and liquefied petroleum gas (LPG) are available in all Member States at different density. Electric charging station and battery swap station deployment along the corridor is in the early stage of implementation. Different tolling systems are implemented on the road network in the Member States. First improvements in the provision of safe and secure parking areas for trucks have been established. The implementation of Intelligent Transport Systems (ITS) for managing the traffic on motorways has started around the urban nodes.

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<sup>7</sup> Rhine ports are tackled in the study on Rhine-Alpine Corridor, while the Czech ports are tackled in the Orient-East Med Corridor study.

## Airports

There are in total 11 airports along the Rhine-Danube Corridor, which can be assigned to Core network nodes. According to part 2 of Annex II of Regulation 1315/2013 there are 6 dedicated main airports that shall be connected with the trans-European rail network by 2050 wherever possible with a high-speed rail network connection: Frankfurt, München, Stuttgart, Praha, Wien and Budapest.

Airports assigned to the core network, which do not fall under the obligation of Art. 41(3) of Regulation 1315/2013 do not have to be connected to the TEN-T rail and road network by 2050; they are the remaining 5 airports of the list, namely: Nürnberg, Ostrava, Bratislava, Bucureşti and Timișoara.

The airports of Frankfurt, Stuttgart, München and Wien have a rail connection (at least S-Bahn); Bucuresti and Ostrava have also a rail connection. Nürnberg, Praha, Bratislava, Budapest and Timișoara do not have a rail connection. Thus, the airport of Praha (Václav Havel International) and Budapest Airport (Ferenc Liszt International) are to be connected to rail by 2050. Relevant studies for rail connections are under preparation. Frankfurt, Stuttgart, München and Wien started to make provisions for the use of alternative clean fuels for ground services. Charging stations for e-cars are under implementation. No provision for the supply of clean fuels for aircrafts has started. All airports have cargo terminals, which are open to all operators in a non-discriminatory way.

## 2.2 Progress of Corridor development

Member States have started to implement a number of measures in order to achieve an operational trans-European transport network in line with the provisions of Regulation 1315/2013 by 2030. However, KPI values improved slightly in the period between December 2013 and December 2016.

86 projects with an investment volume of 5.27 bn EUR have been completed in that period (about 15% of the total number of projects - 563 projects).

41% have started before or in the period and are classified as on-going projects with an investment volume of 37.8 bn EUR.

Out of this figure 117 projects receive CEF funding.

The main focal points of the projects completed are studies and infrastructure works (rehabilitation, upgrade and new construction).

**Table 5: Scope of work of projects finalised in 2014, 2015 and 2016**

Scope of work	Number of projects
Studies	23
Infrastructure works rehabilitation	15
Infrastructure works upgrade	29
Infrastructure works new construction	25
Maintenance equipment IWW	3
Rolling stock, vehicles, barges	5
Clean fuels provision	3
Administrative procedures (IWW ports)	2
Telematics applications (RIS, ITS, ERTMS)	10
Total (multiple scope assignment possible)	86

Source: Project list 2017, status 05/2017

The projects with the largest investment costs made are listed in the following Table 6.

**Table 6: Largest investment of projects finalised in 2014, 2015 and 2016**

Project name	Project category	Member States	Cross-border section	Last-mile section	Pre-identified CEF section	Project end date	Total costs in mio EUR
Vienna Central Railway Station (Wien Hbf)	Rail	AT		x	x	2015	997.10
Works and studies for upgrading the Wien-Bratislava railway line in Austria (6 sub-projects)	Rail	AT	x	x	x	2015	846.60
Modernisation of railway station Salzburg	Rail	AT		x	x	2015	224.30
St. Pölten Railway station	Rail	AT			x	2015	177.50
Optimisation of the rail stations between Zbiroh - Rokycany	Rail	CZ			x	2014	163.00
New motorway construction: Orastie – Sibiu	Road	RO				12/2016	579.49
Construction Nadlac - Arad Motorway	Road	RO	x			07/2015	207.52
New motorway construction: Timisoara – Lugoj	Road	RO				12/2015	160.86
HU Motorway M43 Construction of a 2x2 lanes motorway between Makó-Csanadpalota-Nadlac Border HU/RO	Road	HU	x			07/2015	150.00

Source: Study team project list 2017, status 05/2017

## Rail

All recently completed rail projects are located in Austria and in the Czech Republic. Two Austrian projects refer to the new Wien main rail station and its connection to regional and long-haul rail traffic. Another four projects located in Austria deal with upgrades of stations and short sections of the "Westbahn" (Salzburg-Wien). These actions do not remedy non-compliant infrastructure as the requirements of the Regulation have already been fulfilled before. However, they adjust the configuration of rail stations to the demands of high-speed traffic; in this context, they enhance rail capacity and allow for higher speed of passenger trains. Also the finalised Czech Rail projects refer to line upgrades and modernisation of important nodes or station areas (e.g. Plzeň, Praha, Ústí nad Orlicí, Přerov). All these projects achieve and/or improve KPIs, mostly on a very detailed local level, such as upgrade of single tracks or switches in the stations, removal of level crossings or equipment of new passenger stations with up-to-date infrastructure and technology. Due to their small scale, the effects of these projects are not visible in the overall corridor compliance rates. In any



case, they contribute to capacity enhancement on the CZ corridor lines by eliminating local bottlenecks. Three Czech rail projects are part of a global project dealing with the improvement of the cross border section and the corridor section between the DE/CZ border and Plzeň.

The corridor's status of compliance regarding the rail parameters 'Electrification', 'Line speed  $\geq 100$  km/h' and 'Axle load  $\geq 22.5$  tonnes' achieved by 12/2016 is presented in Figure 5. The figure also incorporates new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017. Furthermore, the rail passenger line București – Constanta is marked as "missing link". According to EU Regulation 1315/2013, this new line shall be part of the TEN-T Core Network (Rail Passenger) and the Rhine-Danube Core Network Corridor (CNC) in parallel to the existing one (defined as CNC freight rail). However, according to information provided by CFR-SA from July/August 2017, it is not planned to realise this new rail passenger line before 2030.

**Figure 5: Rail compliance by 2016**



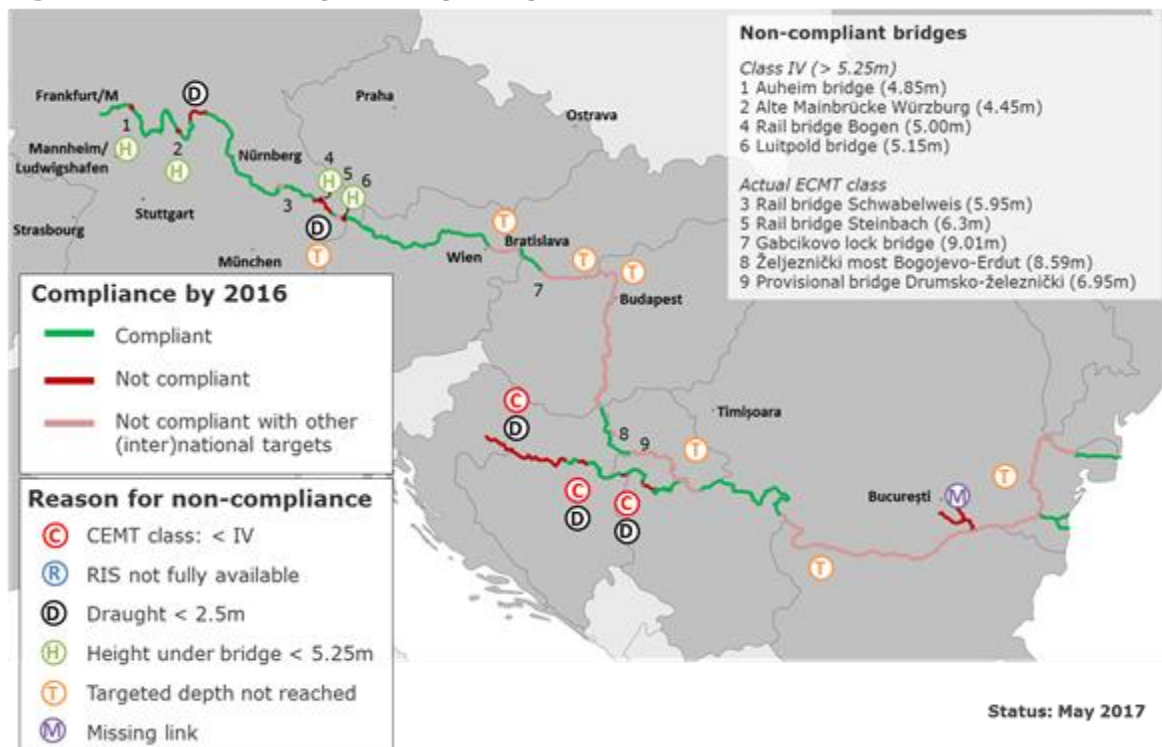
Source: HaCon, status 09/017

### Inland waterways

None of the implemented inland waterway projects (7) had an influence on the static KPIs. Only the dynamic indicator measuring the achievement of the targeted depth according to the waterway manager varies from year to year, depending on both, hydrological and infrastructure conditions. In the past shortcomings were tackled mostly on national level and often with limited success. Since the first CEF Transport Call progress was made through the realization of a number of activities (mainly studies with pilot activities having now not an impact to the KPIs), which prepare the works for the future, the improvement of fairway availability, add to the reliability of locks and most important support the coordination of national approaches towards the provision of a concerted infrastructure quality. Implementation of RIS at the Sava was finalized by the end of 2016. Works at the Upper Main to increase the allowed draught in line with the requirements of the TEN-T regulation are consistently progressing. Between Straubing and Vilshofen a decision to increase the draught to 1.80m was taken (but which is below the requirement of 2.50m), building permissions for the first part are still pending. Experiences from the "Integrated River Engineering Project East of Wien" are to be capitalised during the next implementation step and will contribute to the achievement of the targeted depths. River Training and Dredging Works

between Bačka Palanca and Beograd (Serbia) have been prepared and approved in 2014; works and their supervision have been contracted in 2017. The on-going preparatory study "Fairway Danube" aims at improving navigation conditions through providing a better foundation for fairway related improvement measures.

**Figure 6: IWW compliance (2016)**



Source: viadonau, status May 2017

## Ports

Ports KPIs have not changed since 2013 except for the positive change in terms of the availability of clean fuels. In 2015, the private company Bulmarket Ltd. completed a LNG terminal and LNG bunkering facility in the inland port in Ruse (Bulgaria). So far, there were no initiatives towards in-depth analysis (e.g. master plan similar to the "LNG Master Plan for the Rhine-Main-Danube") for large scale introduction of electric propelled vessels or vessels using any other type of alternative clean fuels other than LNG. Therefore, no considerations have been made on the possible provision of electric charging stations, or any other alternative clean fuels supply facilities in ports. Although not related to the defined KPI, a number of projects contributed to the qualitative improvements of port capacity, road and rail connections or intermodal capacities and thus added to the list of port development projects of the Rhine-Danube Corridor. Examples for such projects are the increase of rail capacity of the Port of Constanța (RO), the restoration of the quay wall in the Port of Regensburg (DE) and the rehabilitation and development of the waterside infrastructure in the Port of Budapest/Csepel (HU). The study phase for the flagship project "High-Performance Green Port Giurgiu" was finalized; the construction phase is now under implementation, with the completion planned by the end of 2018. Aiming at further integration of inland ports into the multimodal logistic chains the "Expansion of the tri-modal inland port of Wien by land recovery" was completed in 2015.

## Rail-Road terminals

Facilities of the Rail-Road Terminals München-Riem Ubf, Linz Stadthafen, Ennshafen, Žilina–Teplička have been extended and improved. Preparatory steps to build an intermodal terminal in Ruse have been completed in 2015. However, the newly built

terminal in Žilina, which was completed end of 2015, is the only of the present 43 terminals of the Rhine-Daube Corridor, which fully complies with all three KPI (see Table 2). Works at the hub terminals Wien-Inzersdorf - ÖBB and Budapest - Metrans for two additional large size Rail-Road Terminals were completed in 2016/17.

## Road

Between 2013 and 2016 road infrastructure on the Rhine-Danube Corridor in terms of the KPI motorway/express road improved slightly by the completion of 10 roads and one ITS project, located in four Member States – Austria, Hungary, Slovakia and Romania. New construction projects (4 projects) as well as capacity enhancements (4 projects), 1 project with safety installations and a feasibility study for the new motorway between Arad and Timisoara have been completed. Due to the completion of short sections of road projects there is only a slight improvement of the KPI on motorways from 76.6% (2013) to 77.4% (2015) and 78.1% (2016). Of particular importance is the removal of the cross-border bottleneck between Mako (HU) and Nadlac (RO), providing a continuous motorway connection between both Member States. The availability of clean fuels along the road network is a dynamic commercial process depending on various factors such as the number of operative vehicles suited for alternative drive technology, petrol price and other incentive factors. Alternative fuels (CNG, LPG and LNG and electric charging stations) are widely available in all RD countries although the density of stations along the Corridor differs from section to section and country to country. The majority of the stations are located in the vicinity of urban nodes.

## Airports

Airport related KPI did not change since 2013, although five projects have been completed. Most relevant are the completion of rail connection of Airport Wien to the Wien Central Station, the adaptation of the rail platform at the Airport Wien and the connection of the Ostrava Airport to the railway network. Other projects include studies on rail connections to the airports of Frankfurt and München.

Table 7 presents the development of the corridor measured by the agreed KPIs between the baseline year and end of 2016 in the Member States.

**Table 7: Generic supply-side KPI – member states only**

<b>Rail KPI</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
Electrification	91%	91%	91%
Line speed ≥ 100 km/h	95%	95%	95%
Axle load ≥ 22.5 t	75%*)	75%*)	75%*)
Train length ≥ 740 m	47%	47%	47%
Track gauge = 1,435 mm	100%	100%	100%
<b>IWW KPI</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
CEMT requirements for class IV IWW	89%	89%	89%
Permissible Draught (min 2.5m)	80%	80%	80%
Permissible Height under bridges (min. 5.25m)	83% (5)	87% (4)	87% (4)
RIS implementation (minimum requirements set out by the RIS directive)	100%	100%	100%
Targeted depth according to waterway manager reached	51%	43%	44%
<b>Inland ports KPI &amp; TP</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
CEMT Class IV waterway connection (KPI)	100%	100%	100%

Connection to rail (KPI)	89%	89%	89%
Availability of clean fuels (KPI)	0%	6%	6%
Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges (KPI)	100%	100%	100%
Intermodal facilities (TP)	72%	72%	72%
Minimum draft (TP)	89%	89%	89%
Shore-side power supply facilities (TP – non-compulsory)	89%	89%	89%
<b>Seaports KPI &amp; TP</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
Connection to rail (KPI)	100%	100%	100%
CEMT Class IV waterway connection (KPI)	100%	100%	100%
Availability of clean fuels (KPI)	0%	0%	0%
Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges (KPI)	100%	100%	100%
Facilities for ship generated waste (KPI)	100%	100%	100%
Intermodal facilities (TP)	100%	100%	100%
Shore-side power supply availability (TP)	100%	100%	100%
<b>Road KPI</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
Express road/ motorway <sup>**)</sup>	77%	77%	78%
Availability of clean fuels <sup>***)</sup>	available	available	available

<sup>\*)</sup> Compliance figures modified due to new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017

<sup>\*\*)</sup> Note: The recalculation of the High Navigable Water Level in Hungary revealed its decrease and lead to a higher bridge clearance of the Margit-híd in Budapest in compliance with Regulation 1315/2013.

<b>Airport KPI</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
Connection to rail <sup>*)</sup>	67%	67%	67%
Availability of at least one terminal open to all operators	100%	100%	100%
Capacity to make available clean fuels to airplanes	available	available	Available
Availability of clean fuels	67%	67%	67%

<sup>\*)</sup> The KPI includes only those airports, which are to be connected to rail by 2050.

<b>Rail Road Terminals</b>	<b>Baseline 2013</b>	<b>Status 2015</b>	<b>Status 2016</b>
Capability of handling intermodal transport units	44%	44%	44%
Accessibility by trains of 740m train length	2%	2%	5%
Accessibility by electrified trains	16%	16%	21%
Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%	100%	100%

## 2.3 Results of the transport market study

In this section a brief summary of the Transport Market Study including future transport volumes and the KPI demand side data is presented.

In the 2014 study detailed data of the transport market has been collected and presented. For detailed transport statistics on region and on corridor basis the 2014 work is seen as the most recent and complete data.

As a new exercise, data were collected on generic demand side KPIs under the KPI framework. These are more recent data (when available) on country level. This work was completed in 2016. One of the difficulties that are present in this type of work is that data need to be available for all corridor countries, for all modes. Only in this way, the complete picture of the corridor can be presented on a year-to-year basis. This was not always the case for the data of 2014 or 2015.

Both for passenger and freight transport road has grown as a transport mode in the period up to 2013. Looking in detail at the period 2010-2013 it can be seen that passenger and freight transport volume by road is growing, but that the relative modal share is no longer growing. This is the case for both passenger and freight transport. For passenger transport it should be noted that air travel has increased as well in the time period as can be seen in table 6. The stabilisation of modal share is visible in Germany, where a lot of transport takes place. In fact German transport volumes have a large influence on the transport performance of the whole corridor. The effect is not limited to Germany. In the other Member States the road mode share is also not growing.

**Table 8: Demand side KPI**

Node	KPI	Unit	2010	2013	2014
Core seaports	Total passenger flows	# of trips per year	21,286	54,226	64,861
	Total freight flows	Million tonnes per year	43.0	47.2	46.6
Core inland ports	Total freight flows	Million tonnes per year	54.8	56.0	55.8
Core airports	Total passenger flows	Million passengers per year	150.2	161.4	165.6
Core airports	Total freight flows	Million tonnes per year	2.8	2.6	2.8

Source: Panteia, April 2016

Freight transport volume on IWW varied nonlinearly since 2009 but remains with 38.3 million tonnes transported on the Danube in 2015 more than 10 million tonnes below the level before the financial crisis. Container transport on the Danube amounts to only 0.5%, which is compared to 13.5% on the Rhine a particularly low level. Passenger transport on the Danube steadily increased, due to the sharp raise of cruise vessels on the Upper Danube between Passau and Budapest. Even if comprehensive statistics on Inland Waterway Passenger Transport for the whole Corridor are scarce, steady increases in cruise vessels have been reported at several spots in the last years: for example, between 2010 and 2016 river cruise vessel passengers increased by 40% in Passau (314,000 passengers in 2016) and by 70% in Vienna (415,000

passengers in 2016). In particular, the number of cruising vessels increased from 70 vessels (2010) to 170 vessels (2015)<sup>8</sup>.

The amount of passengers handled at the airports is growing in the time frame 2010-2014 (see table 6). 10% more passengers used the Corridor airports in 2014 compared to 2010, leading to a total of 166 million passengers in 2014. Frankfurt was and is the largest airport. Frankfurt airport has also grown the most in the time period. Freight volume for air is stable in the period 2010-2014. The trend is to make less use of dedicated freight airplanes and more of passenger airplanes. This is facilitated by the increase of passenger flights.

Freight volume for seaports has increased in the period 2010-2014 (see table 6). There was a decline of volume in 2014 compared to 2013 due to the economic downturn. The port of Constanța is the largest seaport with about 46 million tonnes volume. Galați is considered as inland waterway port with maritime access with a volume of about 1.3 million tonnes. The largest growth in the period 2010-2014 was identified for Constanța. Freight transport plays a far bigger role compared to the passenger function.

The volume of inland ports shows a similar freight pattern as the seaport. In the period 2010-2014 the volume increased and there was a decline of volume in 2014 compared to 2013. The growth in the period 2010-2014 is 2%. This is calculated over all ports. Individually, the ports grow and decline in volume frequently. There is no specific pattern over the years.

### International transport volumes and modal share

The existing transport pattern indicates that road is the most used cross-border transport mode for both passenger and freight. . This is the result of the current market conditions, most notably the transport costs and travel time.

For **passenger transport** road covers 83% of the total trips, followed by rail with 13% and air with 4%.

- For all modes combined the bidirectional passenger flow between Austria and Germany is the largest traffic flow.
- The single French Strasburg region on the Corridor has high transport volumes related to the corridor; furthermore it has a high number of road traffic.
- For rail the largest flow is between Austria and Hungary.
- For road the bidirectional traffic flow between Austria and Slovakia is the second highest.
- For rail the highest intensity is the flow between Germany and Austria.

The **freight transport** volume in tonnes within the Rhine-Danube Corridor is dominated by road. However due to the alternative modes present, the share of road is lower compared to passenger transport. In percentages the modal freight shares are: 56% for road, 27% rail and 17% IWT.

- International freight transport demand is concentrated on the western part of the Corridor. The transport in between the areas of Austria, Germany, Czech Republic and Slovakia accounts for 82% of the total Corridor transport.
- The Czech Republic has the highest rail and highest road volume of the Corridor countries.

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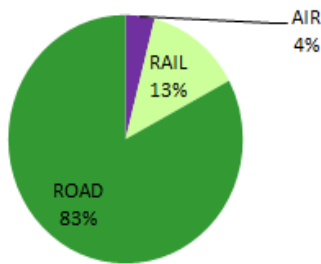
<sup>8</sup> Danube Commission, Market observation report 2016

- The IWT freight pattern presents an imbalance in loads. For example the load from Hungary to Romania is twice the volume of the load from Romania to Hungary. The load from Slovakia to Austria is also a considerable volume, but the flow from Austria to Slovakia is not.
- In terms of IWW transport volume on the Danube Romania ranks highest.
- For rail, the connection between the Czech Republic and Slovakia transport represents a significant volume. The Czech-Slovak connection accounts for about 34% of the volume.

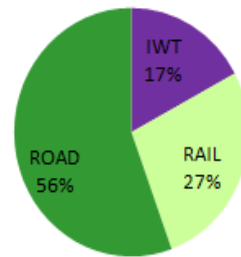


**Figure 7: Modal Split 2010**

International passenger modal split. 2010 in Pax per year

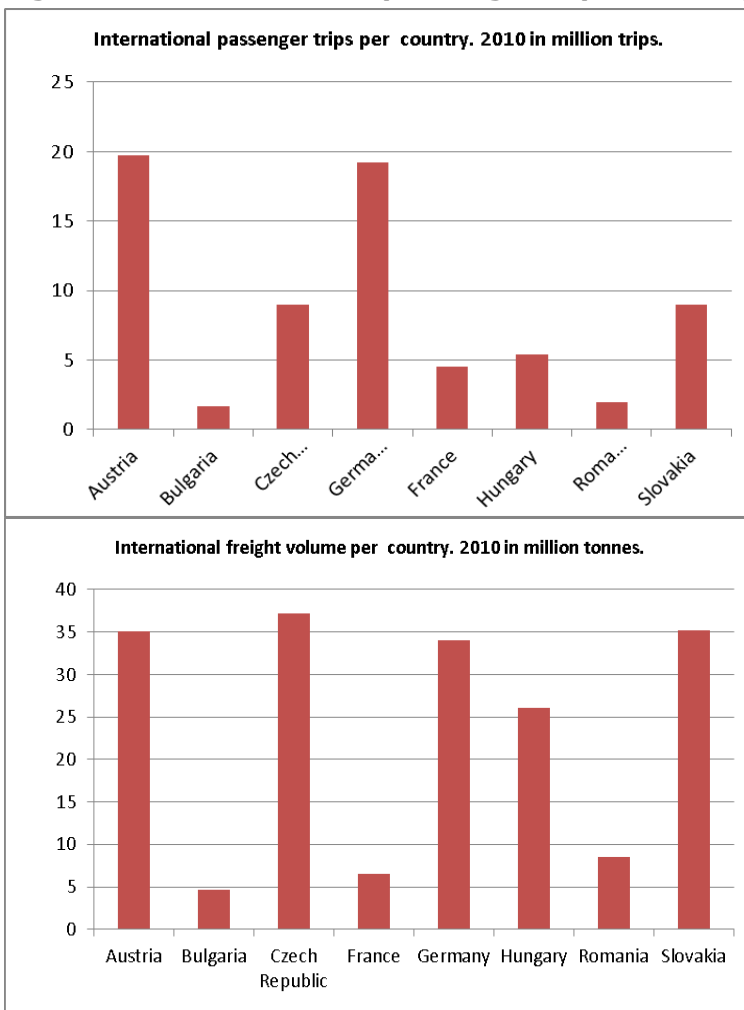


International Freight transport modal split. 2010 in tons per year



Source: Study on the Rhine-Danube Corridor (2014)

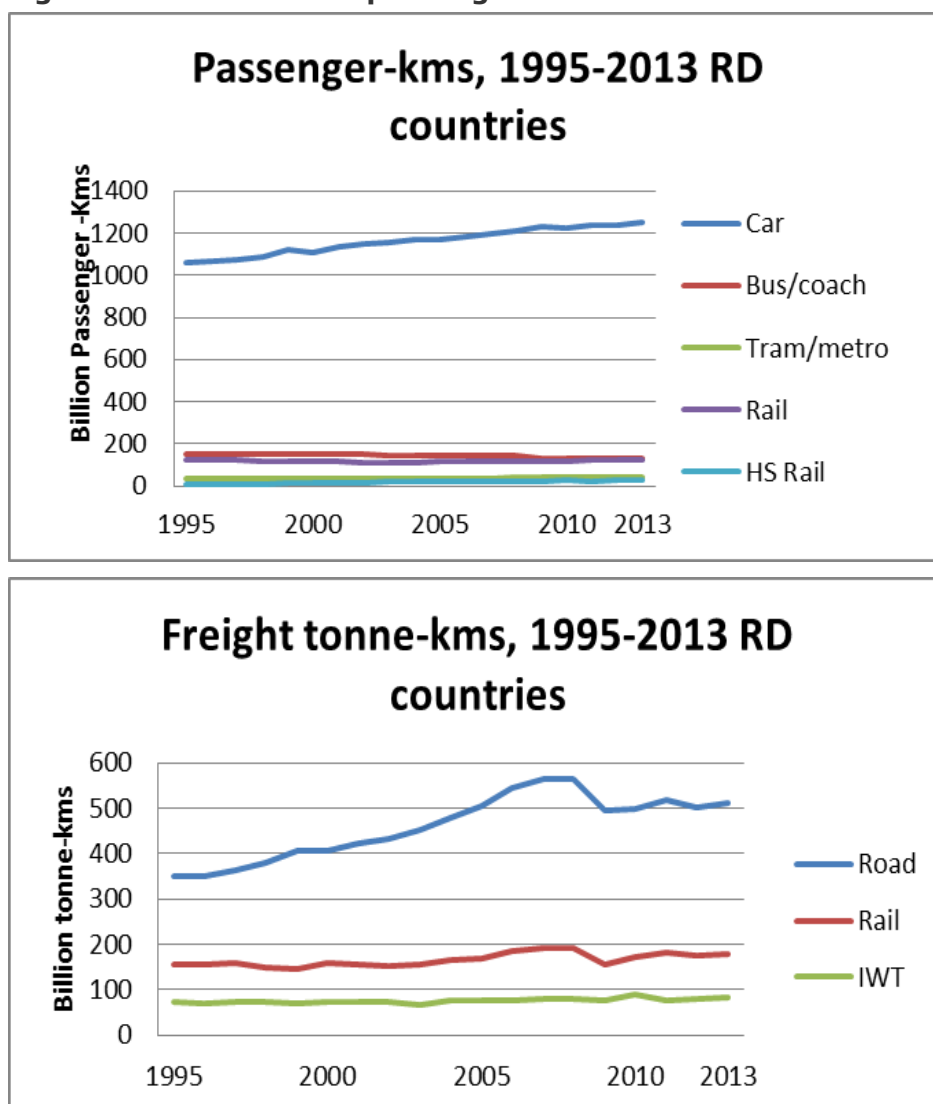
**Figure 8: International passenger trips and freight volume 2010**



Source: Study on the Rhine-Danube Corridor (2014)<sup>9</sup>

<sup>9</sup> With reference to the Corridor alignment in chapter 2.1, Croatia and Bulgaria are not included in this statistics.



**Figure 9: Evolution of passenger- and tonne-kms**

Source: Eurostat 2016

### Traffic forecast

The conclusion on the demand side is that road transport would be dominant in the future market in the baseline scenario. Currently road is dominant and the position can be expected to strengthen practically Corridor wide in the baseline situation. This is the case for international and national traffic, passenger and freight. In a number of cases the *growth rates are higher for alternative modes of transport*, but the *net volume growth* is generally highest for road.

Passengers are forecasted to have more individual wealth, to own more cars and, in certain countries, to face deteriorating public transport. In the existing public baseline scenarios for freight, a continued trend is generally assumed; if a mode shift has not taken place in the past years, no future shift can be forecasted. This strengthens the results for road transport, relative to the other modes. In scenarios of higher road costs and improved alternatives, road would still be expected to remain dominant. This leads to the conclusion that there is a need to strengthen the rail and inland waterway transport modes on the Corridor to take over future transport volumes through the improvement of the rail and the inland waterway network and not to stop there to support modal shift. International traffic, import, exports and transit is

expected to grow according to all forecasts. This would provide a larger playing field for intermodal operations. The traffic of the Eastern part of the Corridor will grow at a higher rate, roughly twice as much. On the other hand, the Member States Austria, Czech Republic, Germany and entry/exit node France (Strasbourg) on the Corridor are expected to maintain the high transport demand by 2030. In Germany the latest forecast of 2016-2030 indicates a more moderate transport growth compared to that of 2007-2025. For Germany, both freight and passenger transport especially road transport has more moderate growth. This result in lower volume growth, but also in a more favourable modal split compared to the previous forecast.

### **Capacity issues**

Capacity issues are defined as a lack of traffic throughput at a location, or congestion. The capacity is closely related to the transport demand and focusses on the development of the supply side of the infrastructure. This is a summary of the 2014 results and overall understanding on the corridor.

Information on capacity and the level of utilisation of the infrastructure has been analysed. This is called the supply side of infrastructure. The main findings are:

- Road currently has short distance capacity issues around urban nodes, this also influences the long distance travel. Germany has the most urban areas and also the most utilised road infrastructure. In the expected implementation plan Germany has the highest number of capacity upgrades projects. Slovakia also has a high number of capacity projects in the implementation plan. Other supply characteristics presented in the TMS are border waiting time and infrastructure charges.
- Rail faces capacity issues on short and long distance areas. This does include cross border sections, but is not limited to them. Future capacity supply is foreseen in the implementation plan for rail. For Germany the implementation plan will improve the capacity and lower the critical utilisation rates, leading to fewer expected capacity bottlenecks in 2030. For the Czech Republic and Slovakia rail free capacities are expected to remain stable. The added capacity is to be consumed by the higher transport demand. In Hungary the most relevant capacity issue is at the Budapest node. Due to large increase of traffic, the node is expected to become a significant bottleneck. The lack of a second track between Hungary and Romania may become an important bottleneck in the future although for the time being the existing traffic is handled properly.
- IWT would have sufficient capacity if the parameters according to fairway ECMT classifications were observed. However, this is not the case. Existing locks on the sections have sufficient capacity for the near future but some are in a bad state of maintenance and have therefore become a bottleneck. Lock projects are identified in the implementation plan. Furthermore, the Danube freight fleet is operating under low water conditions and therefore the barges cannot use their full loading capacity. This has significant consequences for the transport costs. All free-flowing sections on the Corridor are problematic in terms of fairway depth, depending on the season. Icing periods, which commonly occur between January and February, limit the capacity as well. The operation of larger ships and convoy arrangements may increase the capacity of the Danube fleet. To improve the IWW capacity supply in the future all bottlenecks are to be relieved and all fairway maintenance needs to be coordinated until 2030 and beyond.
- Core and comprehensive ports have been evaluated. For a number of ports, intermodal connections in particular with rail have to be improved. Air passenger traffic is the overall fastest growing transport mode in the reviewed forecasts of the TMS. The current air volume is low, both for freight and passengers. Capacity expansions at the largest air nodes of Germany, Austria

and the Czech Republic are considered as needed and are ongoing. Hungary also has a large air node, but further capacity is not needed immediately.

The German part of the corridor (South of Germany) has the busiest infrastructure for road and rail. Expected infrastructure investments will help increase supply. In the latest German national transport plan BVWP 2016-2030 a capacity analysis was performed on the future transport volumes and the current network was compared with the 2030 network. In Germany the same locations are problematic in 2030 as in 2010 for both road and rail. However, the current road congestion around München and Nürnberg nodes is forecast to decrease to more acceptable levels by 2030, as a result of the ongoing road projects. The node of Stuttgart will remain congested despite the road projects taking place. For rail the Frankfurt – Nürnberg – Passau section is presently considered the most congested section in 2030. Ongoing projects are funded to reduce such forecast. The rail section Frankfurt – Nürnberg will improve, but congestion will remain a topic on this section. The section South of München is also congested, however it is expected that this rail bottleneck will be solved by 2030.

### **Potential market uptake**

The Rhine Danube corridor demonstrates available shift capacity for rail and inland waterways. Both are environmentally friendly modes of transport when compared to road per tonne transported. When looking at the whole corridor the shift capacity for rail is limited. The rail conditions differ from country to country, but since rail is an efficient medium distance mode of transport more capacity for international relations is needed. Inland waterways' capacity remains abundant. Due to this reason IWW potential has been analysed in more detail. Specifically, the potential market uptake of IWT was analysed from two angles:

- In-depth analysis of specific high-potential commodity groups
- Macro analysis of modal shift potential for containers

Commodity groups showing a moderate (some renewables and steel) to a high (the other commodity groups) IWT potential are: Renewable resources, chemical products, ores, building materials, mineral resources and petroleum products, recycling products and high & heavy cargo. Attested potentials result from the present transport volumes, demand prospects, handling and storage facilities in ports, transport and storage requirements, stowage factors and time sensibility.

According to model calculations a significant modal shift potential for container transport from roads to waterways exists and as much as 42.0% to 43.3% of the potential tonnes can be transported more cheaply by IWT.

In order to seize this potential, several measures can be taken. Providing a more reliable inland waterway infrastructure is the absolute precondition for further development of inland waterway transports. But also market related activities, such as cooperation platforms on national and international basis, targeted provision of information or promotion of industrial sites near ports and terminals. Further, simplification and harmonisation of administrative processes for inland waterway transports will increase the competitiveness of waterway transport. These activities, which are related to logistics as well as the transport infrastructure, are of great importance to shifting transport towards environmentally friendly inland waterways.

## **2.4 The identified projects to be realised by 2030**

In order to improve compliance with the requirements of Regulation 1315/2013, Member States and other stakeholders initiate number of projects to address bottlenecks on the Rhine-Danube Corridor. A first compilation of these activities has been provided in Work Plan I, followed by an update within Work Plan II. The updated version of the project list has been submitted in spring 2017. It is the basis for

measuring progress regarding KPI compliance and requirements of the market (chapter 3).

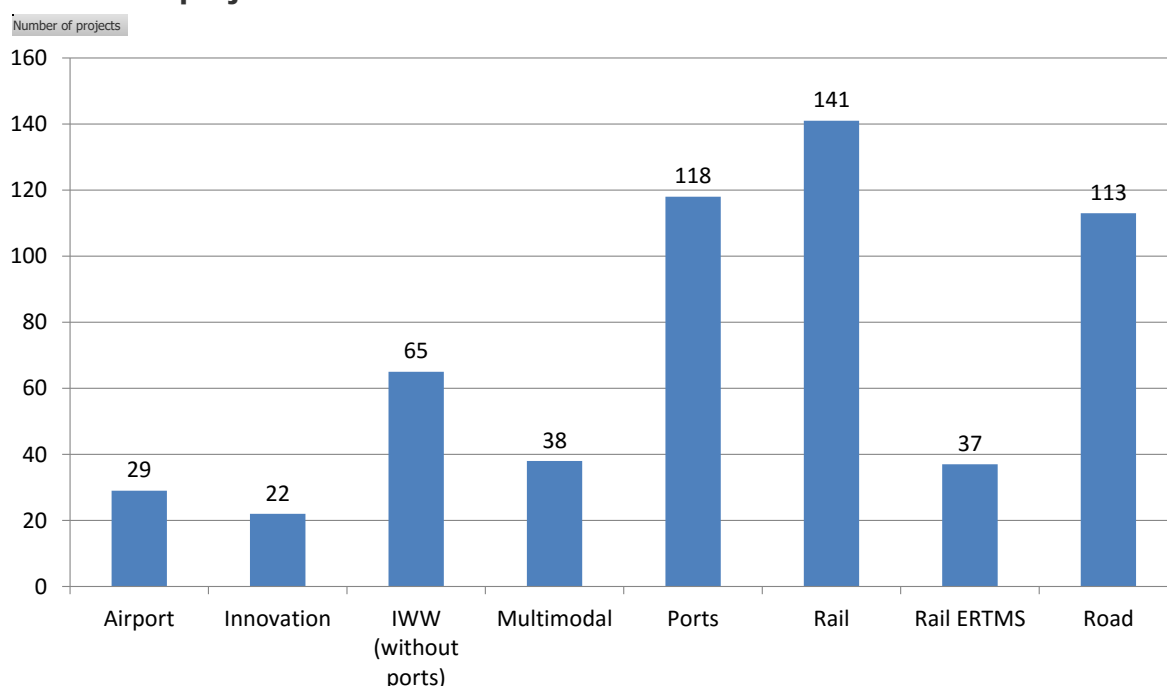
In principle, the update of the project list 2017 follows the same procedure as already performed for the project list 2016, forming the basis for the Work Plan II. Basis for the 2017 update was the project list with status of June 2016 including the project proposals of the 2014 and the 2015 CEF Transport calls. Project proposals of the 2016 CEF Transport call were only incorporated in the case, when the respective project promoter had submitted directly the project data by March 2017. Otherwise, such project proposals may be considered in the project list for the next update in 2018.

### General overview

By end of March 2017, the Rhine-Danube project list contains 563 projects altogether. This figure comprises all projects that have been concluded between 2014 and 2016 (i.e. since 11th December 2013, when the TEN-T Regulation was published) and all projects with envisaged finalisation in 2017 or later. Compared to the first version of the Work Plan in 2014, this means an increase by 225 projects (+67%).

Figure 10 shows the distribution of the projects to categories. The overall picture shows no significant differences to the 2014 work plan structure: The lion's share (178 projects = 32%) refers to Rail (incl. ERTMS). The number of Port projects increased substantially (almost double compared to 2014), raising the Port category to the second place of the ranking, followed by Road (20% share) and Inland waterways (without ports) representing 12% of corridor projects. Multimodal, Airport and Innovation projects contribute only with minor shares to the overall sum of projects.

**Figure 10: Total number of corridor projects by category, total = 563 projects**



Source: HaCon, based on project list, status 05/2017

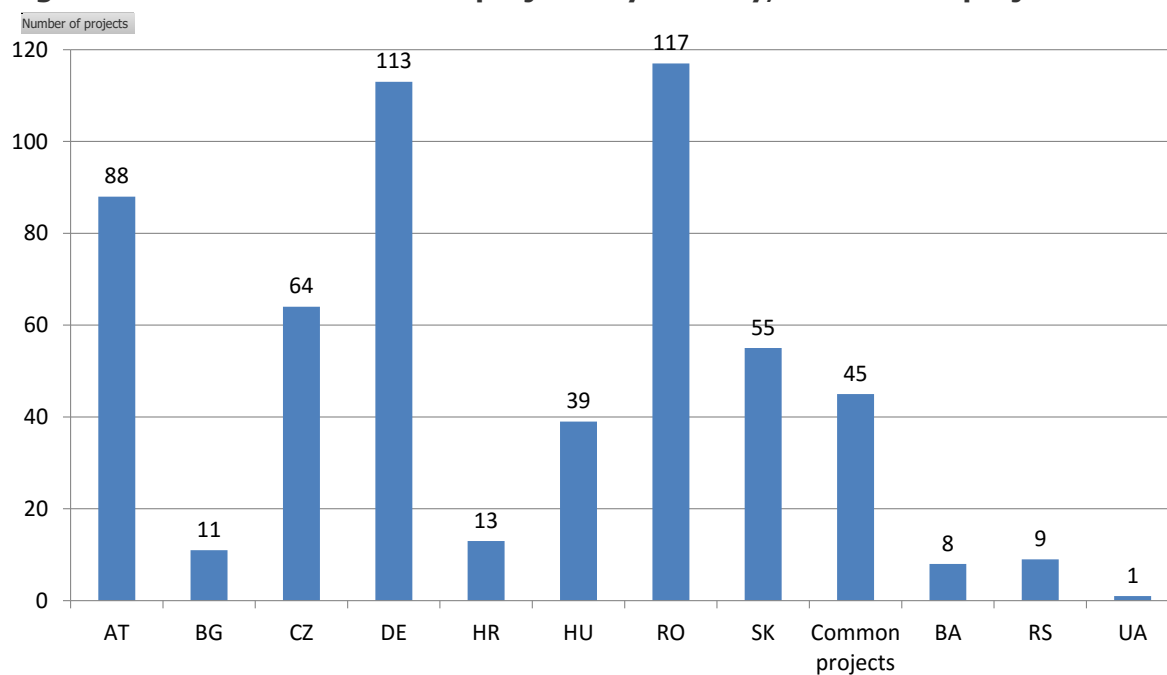
Projects with innovation components can be found in the category "Innovation", but also in the mode specific categories; the latter applies for all those projects that integrate one or more innovation components into the infrastructure part (e.g. upgrade of a rail line, including ERTMS installation). Innovation projects can be identified by dedicated project attributes in the project list such as "Clean fuels", "Telematics application" or "Sustainable freight transport services". In this sense, 142

projects (=25% of all RD projects) show innovation components. The majority (119) of these projects refers to Telematics applications (ERTMS, ITS, RIS, SESAR and others). 19 further projects deal with the provision of clean fuels and the remaining four projects with sustainable freight transport services.

As Figure 11 shows, the geographical distribution of projects is led by Romania, representing 21% of all projects; more than half of these Romanian projects refer to port related measures. Germany follows closely with 113 projects; this number has increased particularly since the 2016 version of the project list due to the new German Transport Masterplan (BVWP 2030); Austria, Czech Republic and Slovakia each contribute by 16-10% to the total number of projects.

Looking at the costs, all 563 projects sum up 91.9 bn EUR, which means an increase by 22 bn EUR (+31%) compared to the 2016 project list version and even by 27.2 bn EUR (+42%) compared to the 2014 work plan. 47% of these overall costs are allocated to Germany (with only 20% share of project quantity) meaning that particularly German projects show an above-average volume. About 80% of the German investments refer to rail projects; also in Austria the major share of project costs can be allocated to rail, whereas Romania, Slovakia and the Czech Republic also show a considerable or even higher share of road related project costs.

**Figure 11: Number of corridor projects by country, total = 563 projects**



Source: HaCon, based on project list, status 05/2017

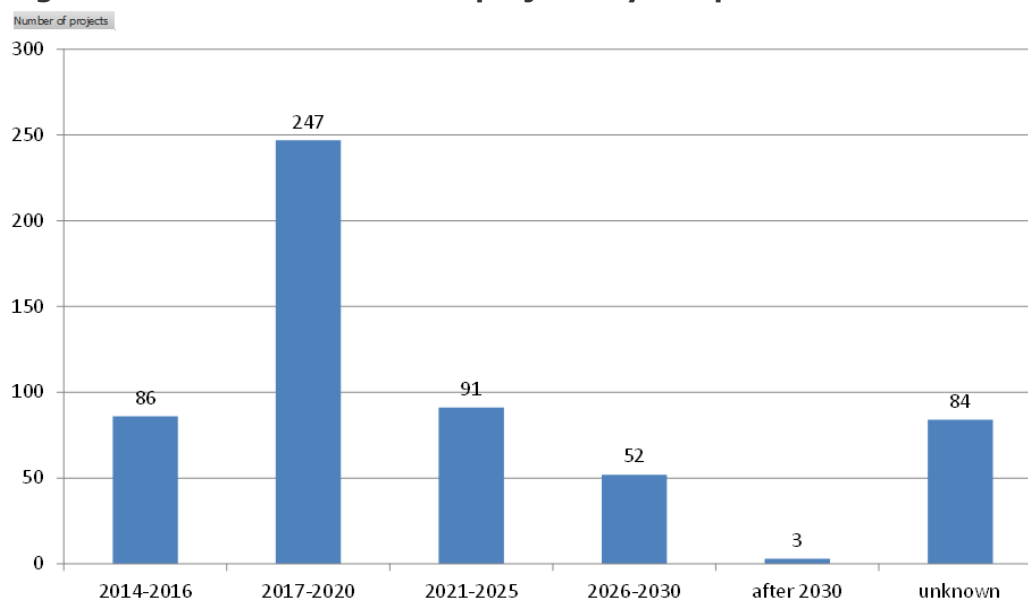
Next to the country assignment, the following aspects complete the “geographical picture” of the project list:

- 315 out of overall 563 projects (= 56%) are located on the Rhine-Danube Corridor exclusively; another 145 projects (= 26%) have common sections with one and 73 projects (= 13%) with two other corridors. Further 30 projects (5%) are allocated to four or more corridors. Most common projects can be found on the Orient/East-Med (152 projects) and on the Baltic-Adriatic Corridor (91 projects).
- 149 Rhine-Danube Corridor projects are related to a cross-border section. 23 out of these 149 projects were also marked as bilateral or multilateral projects.

- 116 projects refer to last-mile infrastructure between the corridor lines and transshipment or interchange points (ports, terminals, airports, main stations). Urban nodes with particularly numerous last-mile projects are Bratislava (19 projects) and Wien (13 projects).
- 277 projects (= 49% of all RD projects) are allocated to “pre-identified sections including projects” according Regulation 1316/2013 Annex I, Part I. These pre-identified CEF projects show a clear affinity to rail, waterway and multimodal transport: about half of these RD projects is allotted to Rail and Rail ERTMS category, followed by Ports, IWW (without ports) and Multimodal projects.
- 299 projects (= 53 % of all RD projects) belong to countries receiving financial assistance from the Cohesion funds: Bulgaria, Czech Republic, Croatia, Hungary, Romania and Slovakia.

The expected or achieved year of finalisation of the projects is shown in Figure 12. 86 projects have already been concluded between 2014 and 2016. They are however listed here to document the progress made on the corridor since implementation of EU Regulations. With dedicated view on the year 2030 it can be stated that - except for two road and one rail projects - all projects with a known end date are expected to be completed until then. Moreover, the majority (333 projects) has been already concluded or will be finished already by 2020 latest. Between 2026 and 2030, only few (mostly rail and road) projects are still to be finalised. 84 projects (= 15%) are lacking information about the completion date. This missing information is partially due to actual uncertainty about the end date and partially due to not existent data.

**Figure 12: Number of corridor projects by completion time class**



Source: HaCon, based on project list, status: 05/2017

. To conclude it can be asserted that the hereunder presented list of projects is one of the main inputs needed to assess the level of achievement of objectives and to identify the bottlenecks and non-compliant sections along the Corridor (gap analysis). In this regard, the project list is one of the main pillars of the updated Work Plan.

## 2.5 Future challenges per mode

The Study on the Rhine-Danube Corridor has led to identify critical issues hampering the operation of this major European transport connection in line with the provisions of Regulation 1315/2013. The plan for the removal of physical and technical barriers presents assumptions on the compliance with Regulation 1315/2013 by 2030, based

on the expected contributions of the identified planned projects to the Corridor's development.

## 2.5.1 Rail

### 2.5.1.1 Rail development up to 2030

The Rhine-Danube project list contains 141 rail projects (excluding pure ERTMS projects). The vast majority of these activities (113 projects = 80%) is matter of infrastructure works of different development stages (rehabilitation, upgrade or new construction). Most of these projects (94) have been assigned to "upgrade" measures, in 34 cases new construction works are foreseen and 19 projects deal with rehabilitation actions. Many projects consist of several infrastructure work types (e.g. rehabilitation + upgrade). 35 rail projects combine infrastructure works with the implementation of ERTMS; this particularly applies for new construction or large scale upgrade measures of rail lines, which normally include ERTMS line components by default.

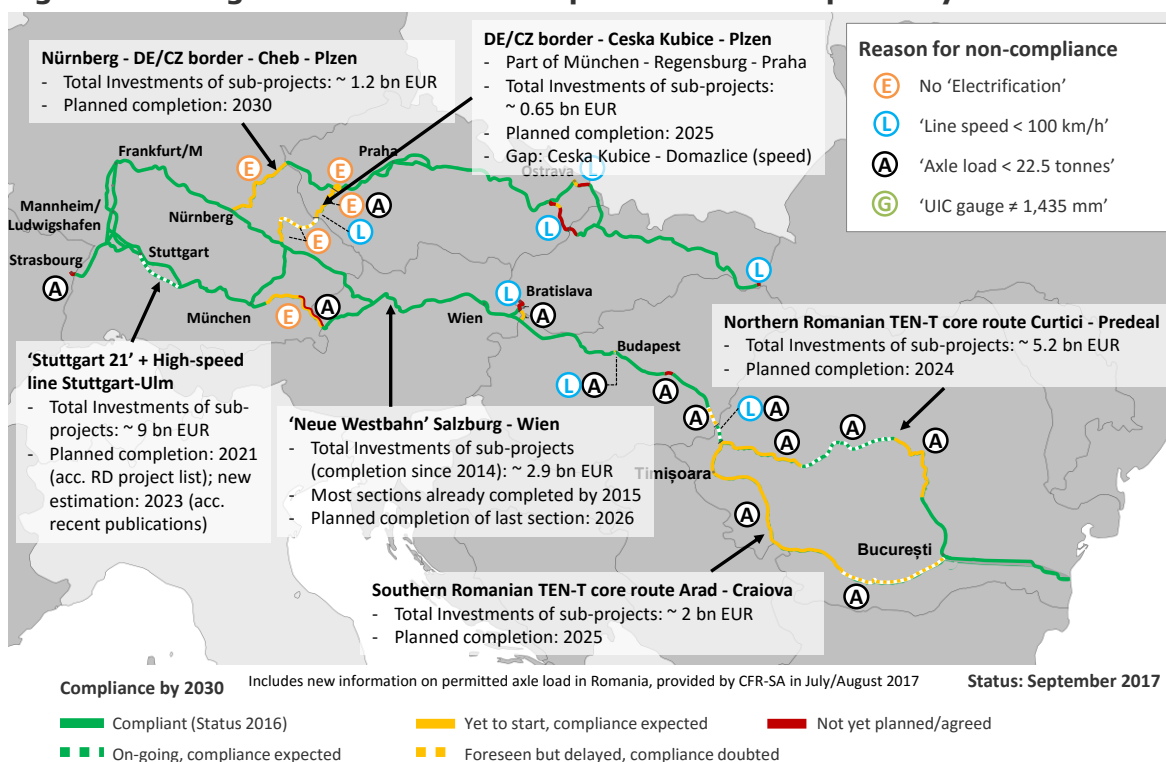
49 rail projects contain components of innovation, all referring to telematics applications. Most of these projects are combined with infrastructure works; this particularly applies for ERTMS, being part of 35 infrastructure rail projects. One further project, dealing with an information system of the integrated transport system of Bratislava region, has been assigned to "ITS". The remaining 13 projects with innovation components are about signalling systems, dispatching centres and tools/procedures on data transfer and exchange.

Overall, the rail projects of the Rhine-Danube Corridor show that substantial progress can be expected until 2030 on most corridor sections; this applies for the impact on the KPIs (line speed, electrification, axle load, train length) as well as on other parameters (line capacity, single track sections, strong inclines). In this context, the following global projects, which will provide large, connecting and compliant corridor sections, can be highlighted (see also Figure 13):

- "Stuttgart 21" + High-speed line Stuttgart – Ulm,
- High-speed line Salzburg – Wien ("Neue Westbahn"),
- Northern Romanian TEN-T core route Curtici – Predeal (Brasov-Sighisoara),
- Southern Romanian TEN-T core route Arad – Craiova,
- Nürnberg - DE/CZ border Cheb – Plzeň and
- DE/CZ border – Ceska Kubice – Plzeň (with exception of section Stod - Česká Kubice, where line speed will not be compliant according to current status of project data).

With exception of Stuttgart – Ulm, all these corridor parts are cross-border sections at the same time.



**Figure 13: Large corridor sections expected to be compliant by 2030**

Source: HaCon, status 09/2017

### 2.5.1.2 Rail persisting bottlenecks by 2030

The analysis of the identified rail projects and their impact on the KPIs revealed the following deficiencies or risks concerning achievement of the target values 2030:

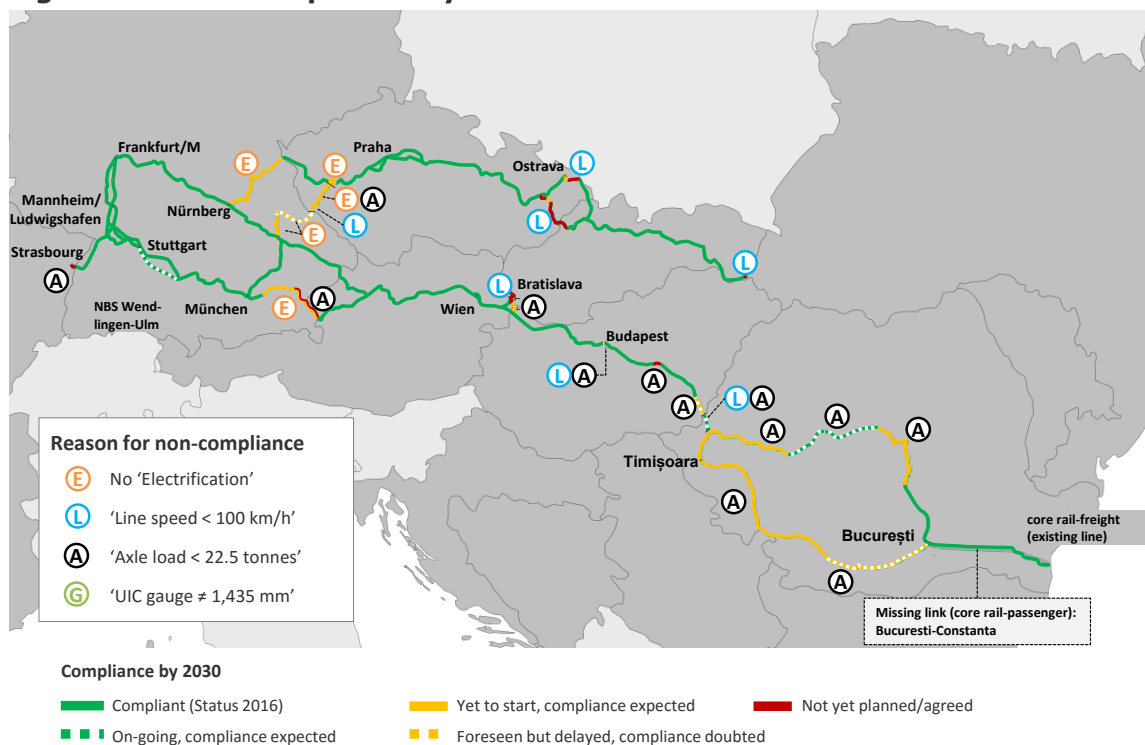
- Bottlenecks or projects without reliable finalisation date, leaving KPI compliance gaps on large, connected corridor parts (compare Figure 14). Main sections and corridor parts affected are
  - Schwandorf – DE/CZ border (electrification),
  - DE/CZ border – Domazlice (speed),
  - large parts of Slovakia and Czech Republic (train length),
  - München- Freilassing (axle load),
  - Rajka – Heyeshalom (axle load, train length),
  - Sections in Hungary on the line between Budapest and Lököshaza (axle load).
  - Predeal – Bucureşti (axle load, train length),
  - Craiova – Bucureşti (axle load),
  - Bucureşti – Constanta - existing line (train length),
- Missing link Bucureşti – Constanţa (new high-speed line): According to EU Regulation 1315/2013, this new line shall be part of the TEN-T Core Network (Rail Passenger) and the Rhine-Danube Core Network Corridor (CNC); the existing line is defined as a CNC freight rail. However, according to information provided by CFR-SA from July/August 2017, it is not planned to realise this new line before 2030.
- Single track lines, which currently show no capacity problems with mostly regional traffic, but might become severe bottlenecks with the envisaged (long-haul) increase of traffic by 2030. In this respect, the following line sections should receive particular attention:



- Germany: Marktredwitz – border DE/CZ, Regensburg - DE/CZ border, Mühldorf - Freilassing;
  - Czech Republic: DE/CZ border – Plzeň (both lines from Nürnberg and Regensburg);
  - Slovakia: border-crossing sections between Bratislava and Austria/Hungary;
  - Hungary: Békescsaba – Lőkösháza.
- Not yet approved, incomplete financing of projects or missing respective information. As all information has been gathered from official documents and furthermore approved by the Ministries of Transport or other stakeholders, the envisaged dates for realisation have been taken for granted even in case of (partially) missing or unknown financing.
  - Projects with an end date in 2030. This concerns especially projects from the new German Federal Transport Infrastructure Plan ('BVWP 2030'). In agreement with the German MoT (BMVI), the end date of those projects was set at the end of 2030, if a detailed implementation plan was not yet available. In case of deviations in the project schedule, corresponding KPI improvements might not be achieved before 2030 as requested by Regulation 1315/2013. This might be the case for the electrification of the lines München – Freilassing and Nürnberg – DE/CZ border. In these cases, a continuous progress monitoring is recommended.

Figure 14 gives an overview on the expected compliance situation of the corridor in 2030. Critical sections are marked in red and yellow-dotted. The figure also contains new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017.

**Figure 14: Rail compliance by 2030**

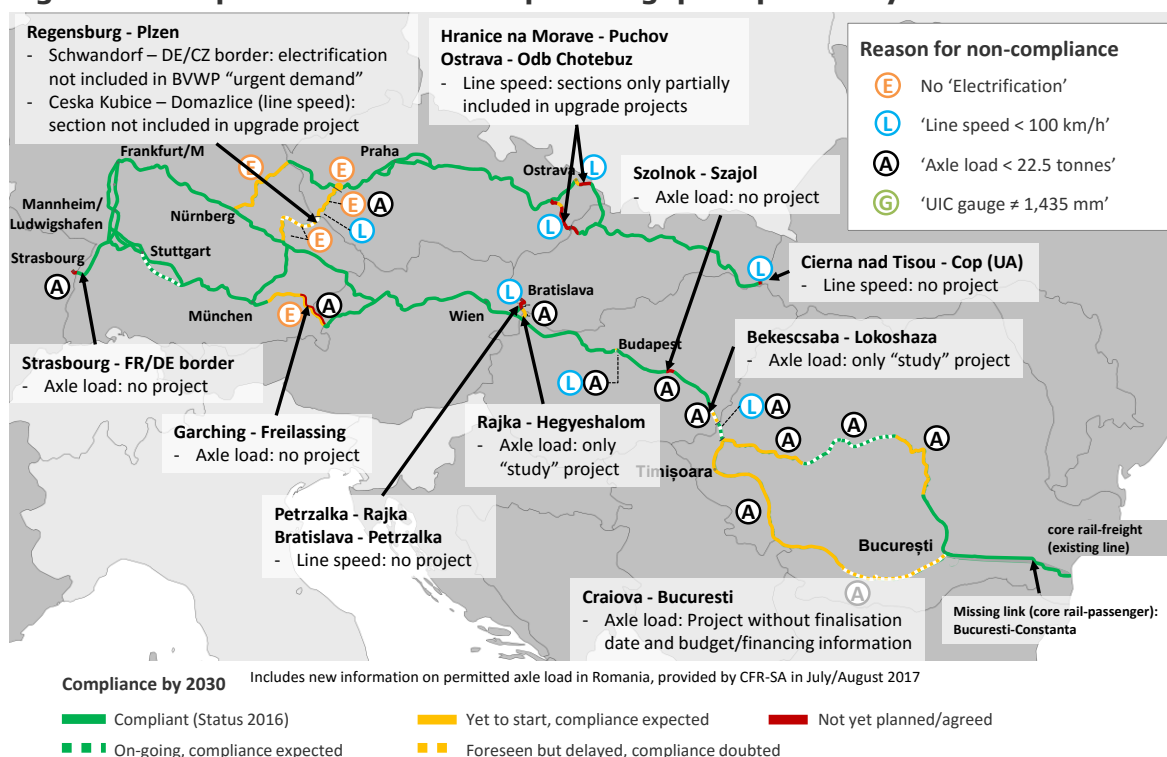


Source: HaCon, 09/017

The red and yellow-dotted sections represent compliance gaps that are expected to remain until 2030. These gaps and their reasons are described in Figure 15. With the

exceptions of the Craiova – Bucuresti line and the missing link Bucuresti - Constanta, all displayed compliance gaps refer to cross-border sections.

**Figure 15: Explanation of rail compliance gaps expected by 2030**



Source: HaCon, status 09/2017

In order to further specify the need for action, the compliance gaps of Figure 15 have been listed in Table 9, supplemented by the "Train length" criterion that had not been included in Figure 14 and Figure 15. Moreover - and in addition to the final status of the project list - the non-compliant sections were also checked against the funded projects of the 2016 CEF call.<sup>10</sup>

**Table 9: Corridor sections with particular need for action (by country)**

Corridor section	Pre-ident. section/project (y/n)	Non-compliant parameter(s)	Project gaps	Remarks
<b>France</b>				
Strasbourg - FR/DE border	y	Axle load	No project	
<b>Germany</b>				
Garching (Alz) - Freilassing	y	Axle load	Upgrade project does not tackle axle load	
Schwandorf - DE/CZ border	y	Electrification	No project	Section is included in BVWP, but not as "urgent demand"
<b>Czech Republic</b>				
Ceska Kubice - Domazlice	y	Line speed	Section is not included in upgrade	

<sup>10</sup> This impact of the 2016 CEF projects on the incompliant sections has been considered only within the Table 9 listing! In total, these effects are rather small and do not change the main conclusions.

Corridor section	Pre-ident. section/ project (y/n)	Non-compliant parameter(s)	Project gaps	Remarks
			projects DE/CZ border - Ceska Kubice - Plzen	
Ostrava-Kunice - Odb Chotebuz	n	Line speed	No project	
Hranice na Morave - CZ/SK border	y	Line speed	Section is only partially covered by upgrade projects	
CZ corridor rail network	n.a.	Train length	Several projects designed to improve, but not to fulfil the parameter requirements	Sections compliant by 2030: Čelákovice- Lysa n. Labem*); Lysa n. Labem - Kolin; Usti nad Orlici - Chocen; Dluhonice - Přerov - Prosenice*)
<b>Slovakia</b>				
CZ/SK border - Puchov	y	Line speed	No project	
Cierna nad Tisou - Cop	y	Line speed	No project	
Petrzalka - Rajka	y	Line speed Train length	No project	
Bratislava - Petrzalka	n	Line speed Train length	Section is not included in Bratislava node upgrade project	Bratislava node upgrade project does not achieve line speed KPI, financing is unknown
SK corridor rail network	n.a.	Train length	Most upgrade projects do not tackle train length parameter	Sections compliant by 2030: Čadca - Krásno nad Kysucou; Púchov - Považská Teplá - Žilina; Váh - Varín -Strečno*); Liptovský Mikulás - Poprad-Tatry
<b>Austria</b>				
Several sections in Wien node	n	Train length	No project	
Gramatneusiedl - Petrzalka	n	Train length	No project	
Parndorf - Nickelsdorf	n	Train length	No project	
<b>Hungary</b>				
Rajka - Hegyeshalom	n	Axle load Train length	Only project "study"	
Szolnok - Szajol	y	Axle load	No project	
Bekescsaba - Lokoshaza	y	Axle load	Only project "study"	
<b>Romania</b>				
Curtici - Arad	y	Train length	Upgrade project does not tackle parameter "Train length"	

Corridor section	Pre-ident. section/project (y/n)	Non-compliant parameter(s)	Project gaps	Remarks
Brasov - Predeal	y	Train length	RD upgrade project is designed to improve, but not to fulfil the required standard	Compliance of the section will be achieved due to CEF 2016 project*)
Predeal - Bucuresti	y	Train length	"Study project" "Work project" is designed to improve, but not to fulfil the req. standard	
Brasov - Bucuresti - Constanta	y	Train length	No project	
Craiova - Bucuresti	y	Axle load	Project without finalisation date and without budget/financing information	Final decision on project still pending
Bucuresti - Constanta (passenger high speed line)	y	Missing link	No project	New rail line is foreseen in Reg. 1315/2013, but not in Romanian Transport Masterplan

\*) Compliance of the section will be achieved due to CEF 2016 project

Source: HaCon, status 10/2017

The expected development of the corridor shows a heterogeneous picture (see Table 10): on the one hand, the KPIs 'Electrification' and 'Line speed', which have a high degree of compliance already today, show only small progress. On the other hand, the parameters 'Axle load' and 'Train length' will improve notably until 2030; however, from today's perspective, the target value of 100% will be missed (see Table 10)

In summary, it has to be stated that from today's point of view an overall compliance with the core rail parameters will not be achieved until 2030. Additionally, some projects with a planned end date close to 2030 are based on verbal commitments or feature unsecure financing. This might lead to further delays in the project realisation.

**Table 10: Prospects for the evolution of Rail KPIs until 2020 and 2030**

Rail KPI	Status 2016	Prospects 2020	Prospects 2030	Target 2030
Electrification	91%	91%	97%	100%
Line speed $\geq$ 100 km/h	95%	96%	96%	100%
Axle load $\geq$ 22.5 tonnes	75%*)	79%*)	92%*)	100%
UIC track gauge = 1,435 mm'	100%	100%	100%	100%
Train length $\geq$ 740 m	47%	52%	68%	100%
ERTMS	7%	n.a.	n.a.	100%

\*) Compliance figures modified due to new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017

Source: HaCon based on RD compliance analysis and project list, status 09/2017

## ERTMS

In the course of the updating of the project list in 2017, 37 projects on Rail-ERTMS (finalization date 2014 or later) including a number of common projects (10) were reported. Regarding the ERTMS deployment plan we refer to the relevant update of the Work Plan of the ERTMS Coordinator, providing an overview on the deployment of ERTMS in the Corridor.

The deployment of an interoperable Single European Rail Area has faced numerous barriers by implementing ERTMS over the last 10 years. However, an ERTMS Deployment Action Plan, adopted by the Commission as a Commission Staff Working Document on [...] has been officially introduced. It defines the actions to remove all identified obstacles with the responsible parties in the frame of well-defined timelines. This Action Plan is the last step in a thorough analysis of the ERTMS deployment in the European Union, followed by detailed negotiations with the Member States and the Rail Sector, including their commitment in terms of actions and execution times.

On 5 January 2017 the European Commission adopted the Implementing Regulation (EU) 2017/6 on European Rail Traffic Management System European Deployment Plan (ERTMS EDP) that replaces the old deployment plan of 2009. The reviewed ERTMS EDP adapts the geographical scope of deployment to the TEN-T Regulation, and sets new targets for ERTMS deployment on CNC's until 2023. These target dates are firm commitments made by Member States and Infrastructure Managers during the consultation and negotiations, led by Mr Vinck, European ERTMS Coordinator, between 2014 and 2016.

In 2023, the ERTMS European Deployment Plan will be updated again setting out the precise implementation dates for the remaining part of the Corridors between 2024 and 2030. ERTMS Coordinator proposed this two-step approach for defining the consistent deployment of CNC's by 2030 which was appreciated by all affected stakeholders. This approach ensures that the reviewed EDP sets out more realistic dates and therefore it can serve as the basis for business planning of railway undertakings.

## 2.5.2 Inland waterways

### 2.5.2.1 IWW development up to 2030

The scope of ongoing and planned IWW projects of the EU Member States comprises 21 ongoing and planned inland waterway studies or has at least a study phase, which aims at preparing works including the coordination with neighbouring countries; public consultation, environmental impact assessments, detailed designs etc. This number increased since 2016, when the number of studies was only 18.

Another twelve projects contribute to infrastructure rehabilitation (compared to ten projects with this scope in the 2016 project list). Infrastructure rehabilitation projects aim at re-establishing a good navigation status, and also include the renewal of locks, the removal of obstacles (e.g. sunken vessels), etc. A higher number of activities (15) deals with the upgrade of infrastructure in order to comply with waterway class IV or higher. Another ten inland waterway projects aim – at least partly - at the construction of new infrastructure; this comprises the building of new barrages or winter shelters for vessels as well as the construction of the Danube-Bucharest Canal.

Further projects contribute to "Maintenance equipment" (7) and "Telematics applications", which are in the case of inland waterways, River Information Services (4). The remaining two projects refer to "Sustainable freight transport services".

Germany implements the deepening of the Main, the reconstruction of locks and the activities between Straubing and Vilshofen with national financial resources. Hungary implements four projects with the support of CEF-funding, the improvement of the marking system, the enhancement of RIS and a preparatory study for the

improvement of navigation conditions. In Romania three projects are approved: the Rehabilitation of locks on the Danube-Black Sea Canal and the Poarta Alba-Midia Navodari Canal, the banks consolidation on the Danube-Black Sea Canal and the banks consolidation on the Poarta Alba-Midia Navodari Canal are approved. In Serbia River Training and Dredging Works on critical sectors between Bačka Palanca and Beograd, the implementation of AtoNs and the upgrade of the Iron Gate I lock is supported through IPA. In Slovakia the upgrade of the Gabčíkovo locks is approved.

The project list contains a larger number of common projects (two concluded, eleven ongoing and four planned) which is due to the fact that 42% of the navigable Danube constitutes a state border. The number of common projects increased compared to last year's report by four (from 13 to 17). Not only the number of common IWW projects is comparably high but also the number of projects located on a cross-border section. Out of the 65 the vast majority of 49 projects deal with the improvement of cross-border sections. In addition, most projects (47) are situated on pre-identified sections as identified by the CEF regulation, Annex I.

Most projects, for which funding was approved are common projects (15). The category comprises the two FAIRway Danube studies (one grant for the cohesion countries involved and one for Austria), the Komárom-Komarno Bridge, the FAST Danube study on the Romanian-Bulgarian border section, the RIS COMEX project (two project grants), SWIM - SMART Waterway Integrated Management and the DTP funded projects Danube STREAM, Danube SKILLS, DANTE and Green Danube.

Projects related to alternative clean fuels, telematics applications or sustainable freight transports services are considered to have an innovative character. In terms of IWW six projects with such innovative aspects are ongoing. They include the construction of a LNG terminal in Ruse, the horizontal project RIS COMEX and other national activities focusing on RIS. To tackle the lack of data exchange and differences in the extent and quality of offered River Information Services, CEF is co-financing a broad European initiative called RIS COMEX, which is going to implement harmonized information services at European level.

Including the costs of already completed projects of 192 Mio EUR the overall project costs amounts to some 4.2 bn EUR. The total costs of ongoing and planned projects related to the development of inland waterways of the Rhine-Danube Corridor sum up to 3,964 Mio EUR.

- The largest investment refers to the Danube-Bucharest canal (1.38 billion EUR), actually scheduled for some time after 2030.
- Integrated river engineering projects, rehabilitation and maintenance equipment and River Information Services would require 1.3 billion EUR as foreseen at the moment although not all projects are running and many are still in a feasibility study phase.
- The rehabilitation and upgrading of several locks in Obernau, Erlangen, Kriegenbrunn, Gabčíkovo, at the Iron Gate I and II and at the Danube - Black Sea Canal including the Poarta Alba - Midia Navodari Canal would require 935 mio EUR.

Next to the implementation of infrastructure projects the Joint Statement Process, the METEET initiative and the study to substantiate the concepts of "Good Navigation Status" and "Good Ecological Status" play an important role related to the Inland Waterways of the Rhine-Danube Corridor.

- In the last years the Joint Statement process proofed again to provide an important and useful Danube-wide platform for exchange and discussion in order to align inland waterway transport projects with the environmental requirements stemming from EU legislation;

- Important steps were taken and continuous progress in approaches and processes for the involvement of relevant actors and stakeholders can be observed. A shift in paradigm is taking place from process oriented exchange towards the presentation of real projects thanks to CEF. More technical and practically oriented topics (e.g. which practical measures work, what are the impacts of certain engineering solutions to improve navigation and on the environment, etc.) might therefore be needed for the future to ensure the continuous added value of the process;
- The new METEET initiative, jointly launched by MOVE, ENV and REGIO, and implemented together with the DC, ICPDR and ISRBC, is generally well accepted. A discussion and decision on the follow-up will be needed after the pilot training workshop in Vukovar (28-29 September 2017);
- A coherent approach for Good Navigation Status (TEN-T) and Good Ecological Status (WFD) (but also other relevant EU environmental legislation like the Habitats Directive), and the application of respective exemptions is needed for the finalisation of the GNS study. A specific exchange needs to be organised on this issue between MOVE, ENV and the GNS project consortium based on the already existing exchange.

### 2.5.2.2 IWW persisting bottlenecks in 2030

In terms of KPIs, the permissible draught of 2.5m is expected to be met after the deepening of the Upper Main (Germany). In addition, targeted depths are expected to be reached through the implementation of improvement measures East of Vienna. A follow-up project to implement the study results on improving navigability on the Hungarian section of the Danube will contribute to reach targeted fairway depths between Wien and Devin (Austria/Slovakia) as well as between Szob and Budapest (Hungary).

The following figure shows the expected compliance of inland waterways with Regulation 1315/2013 by 2030.

**Figure 16: IWW compliance by 2030**



Source: viadonau, May 2017



In contrast to the before mentioned projects that contribute to increase the level of compliance, works planned at the section between Straubing and Vilshofen follow a political decision at federal state level that sets targets below the draught requirements of Regulation 1315/2013.

Activities related to the upgrade of the Sava are under way at two sections, but the timing and financing is still unclear at others, therefore the completion is considered to be at risk. Intentions to increase the bridge clearance are missing for all of the bridges not complying with the Regulation. An improvement is expected for the KPI "Targeted depth reached", which relates to the goals set by the waterway administration itself. Stable water levels lead to compliance with this KPI at the Main, the Main-Danube Canal and the Danube-Black-Sea Canal. The non-compliant sections are free-flowing and include Straubing-Vilshofen, the Slovak-Hungarian, the Bulgarian-Romanian border sections and the section between Călărași and Brăila. Further downstream on the Danube, only the section between Brăila and the Black Sea is expected to be compliant. As a consequence, this KPI is estimated to reach only 54% in 2030.

To reach the targeted fairways depth and thereby increase navigation reliability a joint solutions at the Slovakian-Hungarian border section needs to be foreseen. In Hungary and at the Bulgarian-Romanian border section the implementation steps taking up the results of ongoing studies are required. Between Călărași and Brăila an environmental and technical consensus is needed in order to complete the network.

The Danube-Bucharest canal is now not planned to be realized before 2030 and is expected to remain a missing link.

In the following the non-compliant sections in 2030 from today's point of view are summarised:

**Table 11: Non-compliant IWW sections by 2030**

Corridor Section	Pre-identified	Project	Reason for non-compliance	Comments by MS/IM
<b>Germany</b>				
Straubing - Vilshofen	Y	Upgrade of the Danube between Straubing and Vilshofen: Pursuing Variant A (ID 9256)	A permissible draught of 2.5m at low navigable water level is not a project target.	Germany and Bavaria agreed on the realization of Variant A, increasing the possible draught loaded at low navigable water level by 20 cm, from 1.60m to 1.80m.
Rail and Road Bridge Auheim (Main-km 59.55)	Y	No project	Bridge clearance of 4.85m is below Regulation requirement of 5.25m	Two bridge segments have already been raised to the current height in 2005.
Alte Mainbrücke Würzburg (Main-km 252.32)	Y	No project	Bridge clearance of 4.45m is below Regulation requirement of 5.25m	National assessment of options is on-going.
Rail bridge Bogen (Danube-km 2,311.27)	Y	No project	Bridge clearance of 5m is below Regulation requirement of 5.25m	National assessment of options is on-going.
Luitpoldbrücke Passau (Danube km 2,225.75)	Y	No project	Bridge clearance of 5.15m is below Regulation requirement of 5.25m	In the middle of the suspension bridge sufficient bridge clearance is available so that the Luitpoldbrücke in Passau is no obstacle to navigation.



Corridor Section	Pre-identified	Project	Reason for non-compliance	Comments by MS/IM
<b>Slovakia - Hungary</b>				
Sap-Szob	Y	DaReM project - Danube Rehabilitation Measures (ID 9262)	Targeted depths are regularly not met. Joint, comprehensive solutions for the SK-HU cross-border stretch are not planned.	
<b>Hungary</b>				
Szap - Mohacs port / Batina	Y	Improving navigability on the Hungarian section of the Danube in the Rhine-Danube corridor: Extended study to prepare implementation (ID 9251)	Targeted depths are regularly not met. The extended study needs to be followed up by works implementing the study results.	
<b>Croatia – Bosnia Herzegovina - Serbia</b>				
Sava	Y	Detailed design and EIA for the sections Jaruge – Novi Grad and Puska – Preloščica (ID 9509 and ID 9508)	Partly classified as class III, several sections of the Sava do not comply with the requirement to reach class IV.	Implementation steps after the EIA and complementary actions at other sections need to be implemented.
<b>Romania - Bulgaria</b>				
Porțile de fier II (Iron gates) - Călărași	Y	FAST Danube (ID 9248) and SWIM (ID 9510)	Targeted depths are regularly not met. Complexity of river engineering works at highly dynamic, free flowing rivers which are mostly classified as Natura 2000 areas makes a plausible EIA over a distance of 470 km highly challenging. Completion of works at all critical sectors until 2030 is considered overly ambitious and entails many risks.	
<b>Romania</b>				
Călărași - Brăila	Y	Improving Danube Navigation Conditions between Calarasi and Braila (ID 9289)	Targeted depths are regularly not met. Implemented construction works do not satisfy environmental or nautical demands.	
Danube-București Canal (București - Oltenița)	Y	Systematization of Argeș and Dâmbovița Rivers for navigation and other uses (ID 9290)  Scheduled for after 2030,	Missing link	

Corridor Section	Pre-identified	Project	Reason for non-compliance	Comments by MS/IM
		financing of costs amounting to 1.38 billion Euros is not secured.		

Source: viadonau, project list May 2017

This leads to the conclusion, that infrastructure gaps in the development of the IWW corridor will remain in 2030 as the target value of the various IWW KPIs will not be met. The following table shows the prospects on the compliance measured by KPIs.

River Information Services are already available at all sections of the Rhine-Danube Corridor, even if to a different extent and quality.

The analysis of already completed, on-going and planned IWW projects, in total 59 projects can be summarised as follows: The largest investment refers to the Danube-Bucharest canal (1.38 billion EUR), actually not yet even planned. Integrated river engineering projects, rehabilitation and maintenance equipment and River Information Services would require 1.3 billion EUR as foreseen at the moment although not all projects are running and many are still in a feasibility study phase. The rehabilitation and upgrading of several locks in Obernau, Erlangen, Kriegenbrunn, Gabčíkovo, at the Iron Gate I and II and at the Danube - Black Sea Canal including the Poarta Alba – Midia Navodari Canal would require 935 million EUR. This leads to the conclusion, that gaps in development of the IWW corridor will remain in 2030 as the target value of the various IWW KPIs will not be met.

**Table 12: IWW – KPI development and prospects – Member States only**

IWW KPI	Baseline 2013	Status 2015	Status 2016	Prospects 2020	Prospects 2030	Target 2030
CEMT class: > IV	89%	89%	89%	89%	89%	100%
Permissible Draught > 2.5m	80%	80%	80%	86%	86%	100%
Permissible Height under bridges > 5.25m	83% (5)	87% (4)	87% (4)	87% (4)	87% (4)	100% (0)
RIS fully available	100%	100%	100%	100%	100%	100%
Targeted depth reached	51%	43%	44%	45%	54%	100%

Source: via donau, May 2017

The most important step for the improvement of the infrastructure conditions is to enhance fairway rehabilitation and maintenance of the Danube and its navigable tributaries. Based on the joint "Rehabilitation and Maintenance Master Plan for the Danube and its navigable tributaries" the majority of the concerned Member States committed themselves to increase their efforts in order to provide a more reliable waterway infrastructure. This commitment was re-confirmed by the Conclusions signed by the Transport Ministers (or their representatives, except Hungary) in June 2016 in the framework of the TEN-T Days. With FAIRway Danube and the regular elaboration of National Action Plans first progress is made in order to accelerate the removal of bottlenecks. As the study results and the critical issues map above show subsequent activities are desperately needed to complete the inland waterway network of the Rhine-Danube Corridor in line with the provisions of Regulation 1315/2013 by 2030.

Next to improvable technical infrastructure conditions, the operational and administrative barriers described below undermine the development of inland waterway transport along the corridor.

Waterway administrations are often not provided with the necessary resources to fulfil their duties, particularly concerning maintenance of good navigability conditions; they struggle with limited human and financial resources and inadequate organisational structures. Therefore state of the art approaches, inclusive service-oriented project implementation are taken up only slowly. Often stated by environmental stakeholders, waterway administrations sometimes have only limited experience with the integrated approach – taking into account the interests of inland navigation and ecology at the same time.<sup>11</sup> As a result, projects do not reach the set targets, are designed and implemented inefficiently or lack acceptance which leads to delays in the provision of a reliable and high-quality inland waterways. Exchanges between experts of the waterway administrations as supported by several initiatives (e.g. METEET, Danube STREAM, FAIRway Danube) address these issues. Still, all Member States would need to assure the availability of sufficient financial and personnel resources.

Administrative processes and paperwork are seen as a competitive disadvantage for inland waterway transport on the Rhine-Danube Corridor as they cause time losses and operational costs. Besides differences between national rules, it has to be taken into account that not all Danube riparian states are EU Members and not all EU states are part of the Schengen area. The most important measures can be summarised into the following main areas: harmonisation, simplification and digitalisation of border controls in order to increase both effectiveness and efficiency. In the upcoming years, a dedicated flagship initiative to alleviate administrative red tape (see chapter 8) will address these issues.

### 2.5.3 Ports

#### 2.5.3.1 Ports development up to 2030

Out of total 118 port projects (including inland ports of the Western Balkans) 87 projects (74%) are related to pure (standard) infrastructure works and only 6 projects (5%) are reported as mixture of studies and works. These infrastructure works involve various categories of works, ranging from infrastructure rehabilitation and upgrade to completely new construction works on port infrastructure. Small share of port projects belongs to telematics project (1 project) and clean fuels supply facilities (4 projects). Remaining projects are related with studies only, rolling stock (vessels and barges) and administrative/operational issues.

The total costs of all 118 identified and reported port projects reached 2,638 Mio EUR. The largest share of the projects (54%) and their costs (78%) comes from Romania. This is due to the fact that Romania has the largest number of ports per country (6) and the only seaport on the Rhine-Danube Core Network Corridor. The Port of Constanta is the largest seaport in South-East Europe and is frequently considered as “the Rotterdam of the East”. Consequently, the largest share of projects in terms of numbers (49 projects or 41%) and in terms of project costs (1,729 Mio EUR or 66%) belongs to this seaport.

Out of 118 port projects, 68 of them are pre-identified projects. Aiming at an improvement of their hinterland connections, ports undertook and planned a total of 27 projects related to the last mile connection.

<sup>11</sup> *Guidance Document “Inland waterway transport and Natura 2000 – sustainable inland waterway development and management in the context of the EU Birds and Habitats Directives”*

It is important to note that, although no LNG-fuelled ships are currently operating on the Danube and its tributaries, a number of ports have already undertaken measures towards the facilitation of LNG bunkering for future vessels. Port of Ruse (BG) has already completed such terminal which provides facilities for LNG bunkering for vessels, while ports of Constanta, Bratislava and Enns have reported planned projects for LNG bunkering facilities.

The majority of ports comply with most of the key performance indicators. However, this does not completely reflect the qualitative situation of ports. It is recommended that the aspects of port modernization, infrastructure efficiency and greening of port development and operations shall be taken into account in future spatial planning and policy documents.

### **2.5.3.2 Ports persisting bottlenecks in 2030**

Based on the identified port development projects, their contents and major intervention fields, as well as the gap analysis, it can be concluded that certain bottlenecks remain to be addressed in the future. Currently, no projects tackling the missing functional railway connections in the ports of Komarom (HU) and Cernavodă (RO) are planned, thus impeding the development of intermodality in these ports and the Corridor itself and not contributing to the improvement of the railway connection KPI. Nevertheless, according to the list of approved projects from CEF Transport 2016 Call, a project (2015-HU-TM-0152-S) will study the possibilities for railway connection in the port of Komarom (HU).

Concerning the provision of alternative clean fuels supply facilities, the ports of Frankfurt (DE), Nürnberg (DE), Regensburg (DE), Wien (AT), Komarno (SK), Komarom (HU), Budapest (HU), Vukovar (HR), Slavonski Brod (HR), Drobeta Turnu Severin (RO), Calafat (RO), Giurgiu (RO), Galati (RO), Cernavoda (RO) and Vidin (BG) have not reported any projects with plans to provide such facilities. According to the latest information, based on the the list of approved projects from CEF Transport 2016 Call, a project (2015-HU-TM-0349-M) will investigate the possibilities for provision of alternative clean fuels (LNG) supply facilities in the port of Budapest (HU). Although selected as a KPI, availability of alternative clean fuels currently does not have any target value, due to the setup of the current legislative framework for alternative clean fuels. Currently, Directive 2014/94/EU imposes only the time horizon (31 December 2030) for the provision of an "appropriate" number of refuelling points for LNG for inland and maritime vessels (Article 6), while the TEN-T Regulation 1315/2013 does not venture into the determination of the number of such refuelling stations. Therefore, no targets in terms of numbers of refuelling points have been established. The decision on the location of the LNG refuelling points at ports will be based on a cost-benefit analysis including an examination of the environmental benefits. In this view, an action towards the realistic assessment of the demand and prospects of utilization of LNG-powered vessels is strongly recommended, following a cost-benefit and environmental analyses.

In terms of non-compliance with the non-KPI technical parameters, the ports of Cernavodă (RO) and Vidin (BG) do not provide minimum draft of 2.5m at all water levels, but the port of Vidin aims to solve this non-compliance within a larger global project on inland waterways interventions. No such projects have been planned for the port of Cernavodă.

As regards to the plans for provision of intermodal facilities, the ports of Komarom (HU), Calafat (RO) and Cernavodă (RO), have not reported any plans for construction/provision of such facilities, by the cut-off date for project database formation (March 2017). However, according to the list of approved projects from CEF 2016 Call, projects 2015-SK-TM-0116-S and 2015-HU-TM-0152-S will study the possibilities for construction of intermodal facilities in the ports of Komarno (SK) and Komarom (HU), respectively.

Although not strictly a requirement in terms of TEN-T Regulation, but being one of the corridor objectives, the provision of shore-side power supply facilities is still not provided in the ports of Wien (AT) and Galati (RO) and no such plans have been reported until 2030. As per information received from the port infrastructure manager (CN APDM SA) during the Corridor Forum 9 and 10, projects of construction of shore-side power supply are too small to be standalone projects. In this view, the consultant has been informed that all projects involving quay wall construction and/or modernization will include construction of shore-side power supply facilities.

The analysis of the already completed, the on-going and planned port projects (118 projects in total with an investment volume of 2.6 bn Euro) leads to the conclusion, that gaps in development of the ports in the corridor will remain in 2030 as the target value of the various port KPIs will not be met.

Moreover - and in addition to the final status of the project list - the non-compliant sections were also checked against the funded projects of the 2016 CEF transport call. The results are summarized in the below Table 13.

**Table 13: Non-compliant ports by 2030**

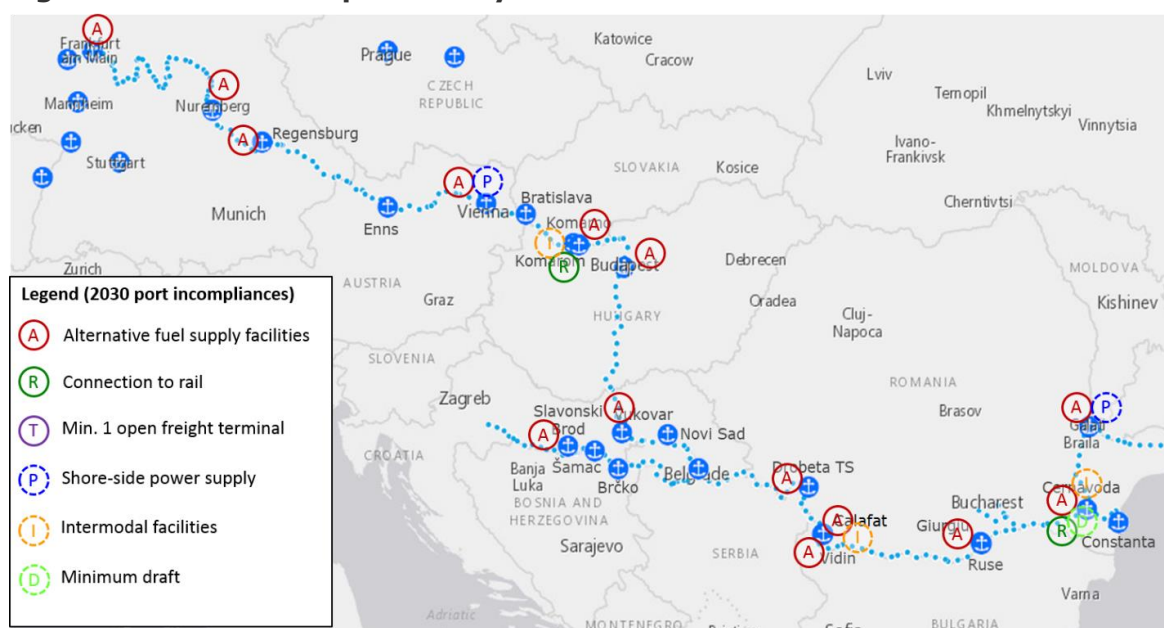
Corridor Section	Pre-identified	Project	Reason for non-compliance	Comments by MS/IM
<b>Germany</b>				
Frankfurt (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities	No targets in terms of numbers of refuelling points have been established. The decision on the location of the LNG refuelling points at ports should be based on a cost-benefit analysis including an examination of the environmental benefits. In this view, an action towards the realistic assessment of the demand and prospects of utilization of LNG-powered vessels is strongly recommended, following a cost-benefit and environmental analyses.  Directive 2014/94/EU imposes only the time horizon (31 December 2030) for the provision of an "appropriate" number of refuelling points for LNG for inland and maritime vessels (Article 6), while the TEN-T Regulation 1315/2013 does not venture into the determination of the number of such refuelling stations.
Regensburg (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities	Same as comment for Frankfurt (port)
Nürnberg (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities	Same as comment for Frankfurt (port)

Corridor Section	Pre-identified	Project	Reason for non-compliance	Comments by MS/IM
<b>Austria</b>				
Wien (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities	Same as comment for Frankfurt (port)
Wien (port)	N	No project	No existing and/or planned shore-side power supply	
<b>Slovakia</b>				
Komarno (port)	N	No project	No existing and/or planned intermodal facilities	According to the list of approved projects from CEF 2016 Call, a project 2015-SK-TM-0116-S will study the possibilities for construction of intermodal facilities.
Komarno (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
<b>Hungary</b>				
Komarom (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
Komarom (port)	N	No project	No existing and/or planned intermodal facilities.	According to the list of approved projects from CEF 2016 Call, a project 2015-HU-TM-0152-S will study the possibilities for construction of intermodal facilities.
Komarom (port)	N	No project	No railway connection .	According to the list of approved projects from CEF 2016 Call, a project 2015-HU-TM-0152-S will study the possibilities for provision of railway connection.
Budapest (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port). <b>Addition:</b> According to the list of approved projects from CEF 2016 Call, a project 2015-HU-TM-0349-M will investigate the possibilities for provision of alternative clean fuels (LNG) supply facilities.
<b>Croatia</b>				
Vukovar (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
Slavonski Brod (port)	Y	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
<b>Romania</b>				
Drobeta Turnu	N	No project	No existing and/or planned alternative clean fuels	Same as comment for

Corridor Section	Pre-identified	Project	Reason for non-compliance	Comments by MS/IM
Severin (port)			supply facilities.	Frankfurt (port).
Calafat (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
Calafat (port)	N	No project	No existing and/or planned intermodal facilities.	
Giurgiu (port)	Y	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
Cernavoda (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
Cernavoda (port)	N	No project	No existing and/or planned intermodal facilities.	
Cernavoda (port)	N	No project	No railway connection.	
Cernavoda (port)	N	No project	No minimum depth.	
Galati (port)	Y	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).
Galati (port)	Y	No project	No existing and/or planned shore-side power supply	As per information received from the port infrastructure manager (CN APDM SA) during the Corridor Forum 9 and 10, projects of construction of shore-side power supply are too small to be standalone projects. In this view, the consultant has been informed that all projects involving quay wall construction and/or modernization will include construction of shore-side power supply facilities.
<b>Bulgaria</b>				
Vidin (port)	N	No project	No existing and/or planned alternative clean fuels supply facilities.	Same as comment for Frankfurt (port).

(Source: iC consulenten, based on project list 05/2017 and updated info received during Corridor Fora)



**Figure 17: Port incompliances by 2030**


Source: iC consulenten, based on port survey and project list analysis

Compliance of inland and sea ports with established ports KPI, in a simplified form (percentages) is summarized in the following two tables.

**Table 14: Inland Ports – KPI development and prospects (2030)**

Port KPI	Baseline 2013	Status 2016	Prospects 2030	Target 2030
CEMT Class IV waterway connection	100%	100%	100%	100%
Connection to rail	89%	89%	89%	100%
Availability of clean fuels	0%	6%	17%	TBD
Freight terminal open to all operators and transparent charges	100%	100%	100%	100%

Source: iC consulenten, May 2017

**Table 15: Seaports – KPI development and prospects (2030)**

Seaports KPI & TP	Baseline 2013	Status 2016	Prospects 2030	Target 2030
Connection to rail (KPI)	100%	100%	100%	100%
CEMT Class IV waterway connection (KPI)	100%	100%	100%	100%
Availability of clean fuels (KPI)	0%	0%	100%	TBD
Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges (KPI)	100%	100%	100%	100%
Facilities for ship generated waste (KPI)	100%	100%	100%	100%

Source: iC consulenten, May 2017



## 2.5.4 Roads

### 2.5.4.1 Road development up to 2030

With regard to road infrastructure 113 projects were collected in the phase of the update of the project list 2017. Out of the total number of projects 10 were completed in the period between 2014 and 2016. With regard to the scope of the projects 18 projects are studies, 10 projects are rehabilitation projects, 64 projects (the majority) include infrastructure upgrade works, 31 projects are new construction works and 15 projects are dealing with telematics applications and 4 projects with the provision of clean fuels along the Corridor.

According to national master plans all Member States plan to proceed with their ambitious upgrading/construction programme on their motorway network in the upcoming years. The identified on-going and planned projects will improve the KPI on motorways/express road to 92% up to 2030.

Critical sections or bottlenecks due to high traffic utilisation, capacity reasons and safety reasons, but also need for rehabilitation of the aged infrastructure are existing on the motorways in Germany, Austria, Czech Republic, in Hungary around Budapest and in Romania around Bucureşti.

With status of April 2017 (update of project list) missing sections of the core parameter motorway/express way exist in the CZ, in Slovakia and in Romania.

While the missing section in CZ is related to the cross-border project Zlin – Žilíná, in Slovakia the situation regarding the corridor alignment is as following:

The connection from the CZ border to the motorway D1 is the R6 at Lysá pod Makytou – Púchov to Beluša. The R6 is classified as express way, has a length of approximately 26km, whereby 7.5km are in operation. The project is under study→ Status: unfinished EIA process;

The corridor alignment follows then the D1 motorway up to the border to the Ukraine. The preparation and construction of the following missing sections is envisaged:

- D1 Bidovce via Dargov and Pozdisovce to Border with the Ukraine,
- D1 Branisko to Beharovce,
- D1 Hričovské Podhradie – Lietavská Lúčka (2nd phase),
- D1 Lietavská Lúčka – Višňové – Dubná Skala (2nd phase),
- D1 Hubová – Ivachnová (2nd phase),
- D1 Turany – Hubová,
- D1 Budimír – Bidovce,
- D1 Prešov, West – Prešov, South

In Romania the situation is as follows:

- A1 motorway between Bucuresti and Nadlac: 66% of total length of the A1 (576km) is in operation, 11% under construction and 23% are planned. The section between Deva and Lugoj (length 99.5km) is partially open, partially under construction. The main missing links are the sections between Sibiu and Pitesti and Dumbrava – Deva.
- A6 motorway between Lugoj and Calafat, length 260km, 4% of the motorway are open (section Balint and Lugoj), the remaining 96% are planned.

Regarding the requirements of Directive 2010/40/EU setting the framework for the deployment of Intelligent Transport Systems in the field of road transport and interfaces with other modes of transport, at moment, the existing systems do still not sufficiently provide real-time traffic and weather information (RDS-TMC), facilitating seamless corridor road traffic. Within the CROCODILE project, traffic information service providers of RDCN-countries (Austria, Czech Republic, Germany, Hungary, and

Romania plus the associated members Bulgaria and Slovakia) have set up a data exchange infrastructure with the goal to provide harmonized cross-border real-time traffic information services along the whole corridor. A specific focus within the CROCODILE project lies on safety-related and truck parking information services. Two Memoranda of Understanding on improvement of information exchange were signed in 2014 and 2015 among Austria, Hungary, Romania and other MS.

Another innovative Intelligent transport system receiving CEF funding is Cooperative Intelligent Transport Systems (C-ITS), allowing vehicles to communicate with other vehicles, with traffic signals and roadside infrastructure as well as with other road users. With alerts generated from the increased information available, these systems have a strong potential to improve road safety and the efficiency of the road transport. For example, information about a traffic jam ahead can be displayed to the drivers inside the car.

C-Road is a platform of Member States working on the deployment of C-ITS services. C-ITS pilot sites will be installed across the EU for testing and later operation of "Day-1" applications as recommended by EC "C-ITS platform".

Member States will invest in their infrastructure, while the industry will test components and services. Technical and organisational issues will be tackled by the C-Roads platform to ensure interoperability and harmonisation of C-ITS between pilots. Austria will act as coordinator of the overall C-Roads platform.

The Austrian C-ITS pilot includes test sites in the Vienna area, the motorway section from Vienna to Salzburg, as well as around Innsbruck and the greater Graz area. Cross-border tests will also be conducted with other C-Roads Member States. The Austrian C-ITS pilots will implement several C-ITS applications, including "Traffic jam ahead warning", "Road works warning", "Weather conditions" and "In-vehicle signage". Austria is cooperating with Germany and the Netherlands to establish the ITS Corridor Rotterdam – Frankfurt – Wien.

Other C-ITS projects are taken place in the Czech Republic. The Czech Pilots will take place on motorways, urban nodes, and on two railway crossings. ITS-G5 and 4G mobile networks will be used to provide C-ITS services, like Hazardous location notification or Road works warning to all road users, thus fostering widespread deployment of C-ITS.

Hungary is an associated member of the C-road platform.

In Romania a project receives CEF funding, which shall contribute to a network of certified safe and secure parking areas and optimize its use by designing and delivering an Intelligent Transport System (ITS) tool.

First investments are done in Germany, Austria, Hungary, Czech Republic and Romania in equipping truck parking areas along the motorways with intelligent infrastructure (towards safe and secure truck parking).

Toll systems along the corridor are not harmonised, hampering in particular the freight transport; the only cross-border cooperation system is established between Austria and Germany, extended now with Hungary. Distance or time based charging schemes exist in all countries of the Rhine-Danube Corridor, but only five use an electronic fee collection system.

#### **2.5.4.2 Road persisting bottlenecks in 2030**

The analysis of identified projects in the previous chapter leads to the conclusion that some road sections are expected to remain noncompliant in 2030:

- in Slovakia (from Bidovce towards the Ukrainian border with approximate length of 74km),

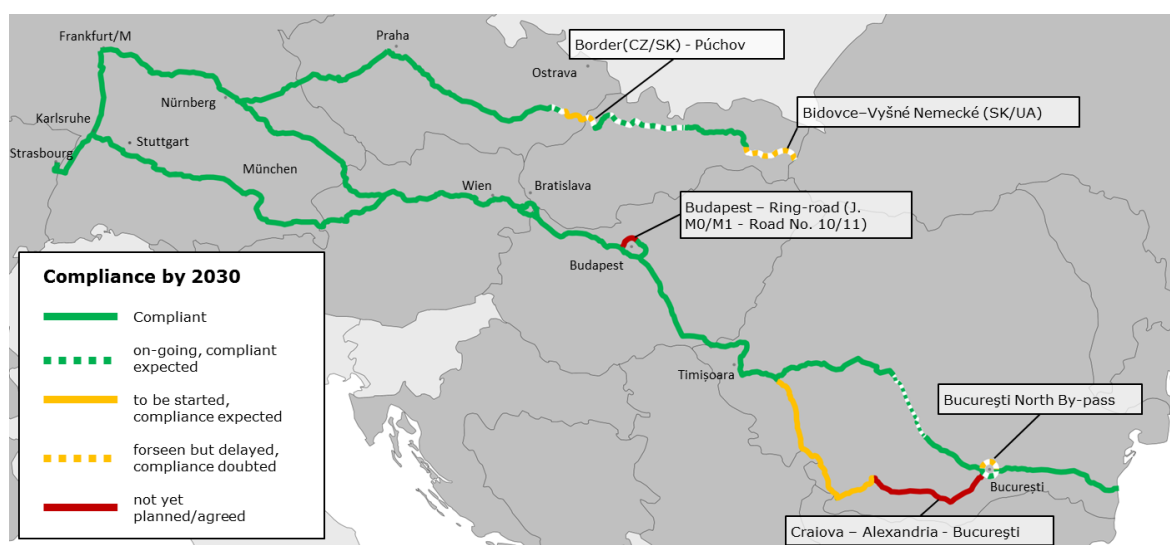
- the section between Beluša and Lysá pod Makyitou (SK/CZ) border, length 26km,
- the closing of the ring road around Budapest (approx. length 30km) and
- in Romania (between Craiova and București with a length of 218km and
- sections of the ring road around Bucuresti

High traffic utilisation and capacity constraints are an issue at some road sections in Germany, Austria, and Czech Republic and in Hungary around Budapest as well as in Romania around București. In the Czech Republic there are additional critical sections regarding over-ageing of construction parts, bridges and in Slovakia regarding safety.

The project list includes a number of road projects with an end date in 2030. This concerns especially projects from the new German Federal Transport Infrastructure Plan ('BVWP 2030'). In agreement with the German MoT (BMVI), the end date of those projects has been set in 2030, where detailed implementation plans are not yet available. In case of deviations in the project schedule, corresponding KPI improvements set by Regulation 1315/2013 may not be achieved before 2030.

The analysis of the already completed, the on-going and planned road projects (103 projects in total with an investment volume of 23.4 bn Euro) leads to the conclusion, that gaps in development of the road corridor will remain in 2030 as the target value of the road KPI will not be met by about 8%.

**Figure 18: Road compliance by 2030**



Source: iC consulenten, June 2016

**Table 16: Road – KPI development and prospects (2030)**

Road KPI	Status 2015	Status 2016	Prospects 2030	Target 2030
Motorway/Express Road	77%	78%	92%	100%

Source: iC consulenten, May 2017

The following Table 17 provides the results of the gap analysis for sections and nodes where a project is missing or project data are not available thus limiting the project majority by the year 2030.

**Table 17: Non-compliant sections by 2030**

Sections with a need for action	Project identified	Reason for non-compliance by 2030
<b>Slovakia</b>		
Bidovce via Dargov and Pozdisovce to Border	D1 Bidovce – Dargov - Pozdišovce – border SK/UA	Project end date unknown, no funding source
R6 Border CZ/SK – Mestečko	construction of new section	EIA not started, construction date unknown, no funding source
R6 Mestečko – Púchov	R6 Mestečko – Púchov,	feasibility study, no construction details
<b>Hungary</b>		
Budapest ring road	M0 motorway around Budapest: Western section between main roads No. 10. and motorway M1	Design study for 18km section (2017-19), no construction details, no costs
Budapest ring road	M0 motorway around Budapest: North-Western section between main road No. 10. and No. 11	Design study for 8km section (2016-18), no construction dates, no costs
<b>Romania</b>		
Craiova – Bucuresti	Craiova – Bucuresti - Upgrade - TransRegio on TEN-T Core Corridor	no financing source available, end date by 2031
<b>Germany</b>		
German/French border crossing - Offenburg	Road connection Strasbourg – Illich – Offenburg (ordinary road, L98)	No project planned

Source: iC consulenten, project list May 2017

With regard to the availability of clean fuels along the motorways it can be concluded that the provision is a dynamic commercial process, which will accelerate in the future. Alternative fuels are widely available along the the member states, although the density of stations differs from member state to member state. LPG stations are available in a good coverage along the corridor. CNG stations dispose of a limited coverage and electric charging stations are available to a larger extend in DE, AT and SK; Supply stations are not available in CZ, HU and RO.

With regard to other infrastructure requirements such as the availability of safe parking and resting areas on motorways and ITS a number of projects are under implementation or planned improving the situation for the truck driver and the safety on the road. Further investments in ITS test infrastructures are done by the Czech Republic, Germany, Austria and Hungary for connecting the vehicle with the infrastructure (C-ITS). Here traffic information services will be transmitted directly from the infrastructure operators into the vehicles and vice versa vehicles will be used as "driving sensors" to improve the data necessary for traffic management.

## 2.5.5 Airports

### 2.5.5.1 Airport development up to 2030

The project list contains 29 projects, 5 projects are indicated as concluded and finished, 9 will be finished until 2020 and 5 between 2021 and 2025. For 10 projects no information on the implementation time is available. From the remaining 24

projects in progress, 9 seek to improve the connection of the core airports in Frankfurt, Stuttgart, München, Praha and Budapest with the rail and road infrastructure of the TEN-T network (KPI). However, the airports of Praha (Václav Havel International) and Budapest (Ferenc Liszt International) shall be connected to heavy rail by 2050. For both airports studies are ongoing to connect them to railways.

Vienna airport has improved the rail connection to Vienna central station. There are studies to connect Vienna Airport with the "Ostbahn" in easterly direction by double track heavy rail, thus filling the missing link to the east, specifically to Slovakia and Hungary. 5 projects are seeking to improve the connection of the other airports in Timisoara, and Bucuresti. Ostrava airport connection, although not required, has been completed.

10 projects out of the total number of projects are studies and construction projects on capacity extension or innovation (SESAR).

Regarding the capacity of airport infrastructure to make available alternative clean fuels (KPI) to air services, the core airports are in the position to provide capacity when airline operators request clean fuels for their airplanes. With regard to provision of clean fuels to ground services some of the core airports already offer it and have plans to modify their ground fleet.

## **2.5.6 Rail/Road Terminals**

### **2.5.6.1 Rail/Road Terminals: Development up to 2030**

The 38 projects included in the Final Project List concern the upgrading or new building of 18 intermodal terminals and one (not-recommended) CEF-application for establishing a multimodal door-to-door service along the Rhine-Danube Corridor.

Six of the projects consist of (only) studies, 31 relate to infrastructure works and one is said to treat administrative procedures (Ruse project, Bulgaria).

Infrastructure work projects cover several interventions: one project addresses rehabilitation, 21 include upgrades and 12 new constructions; none of the projects includes telematics applications as explicitly defined in Article 31 of the TEN-T Regulation although it can be expected that some type of hard- and software for terminal management and data sharing with related modes of transport will be included in the scope of works. However, it can be assumed that the costs will be negligible compared to construction costs. To conclude none of the multimodal projects has been flagged to be "innovative" in the sense of the Regulation.

Five projects, namely in Enns, Linz (2 projects), München-Riem and Žilina have already been completed since the adoption of the Regulation, 12 projects are planned to be completed by 2020, further 10 until 2025 and 2 until 2030. For the remaining 9 projects no timing was indicated by the stakeholders. With the hub terminals Wien – Süd (Inzersdorf) of ÖBB and Budapest of Metrans (subsidiary of the German HHLA group) building activities for two additional large size Rail-Road terminal projects are in progress. Both shall become fully operational in the year 2017.

For the measuring of progress with respect to the TEN-T objectives it can be concluded that:

- 23 terminals will be capable of handling all types of intermodal transport units;
- Projects will lead to accessibility with 740m trains in 10 terminals. In another 11 terminals the permitted train length will be improved, however without achieving the 740m target.
- Electrified rail access will be achieved in 12 terminals; another 5 projects will contribute to an improvement of the situation.

Moreover, 16 (out of 38) projects do not contribute to any of the KPI at all while the other projects address at least one KPI. After completing the respective works, nine terminals will be capable of handling all

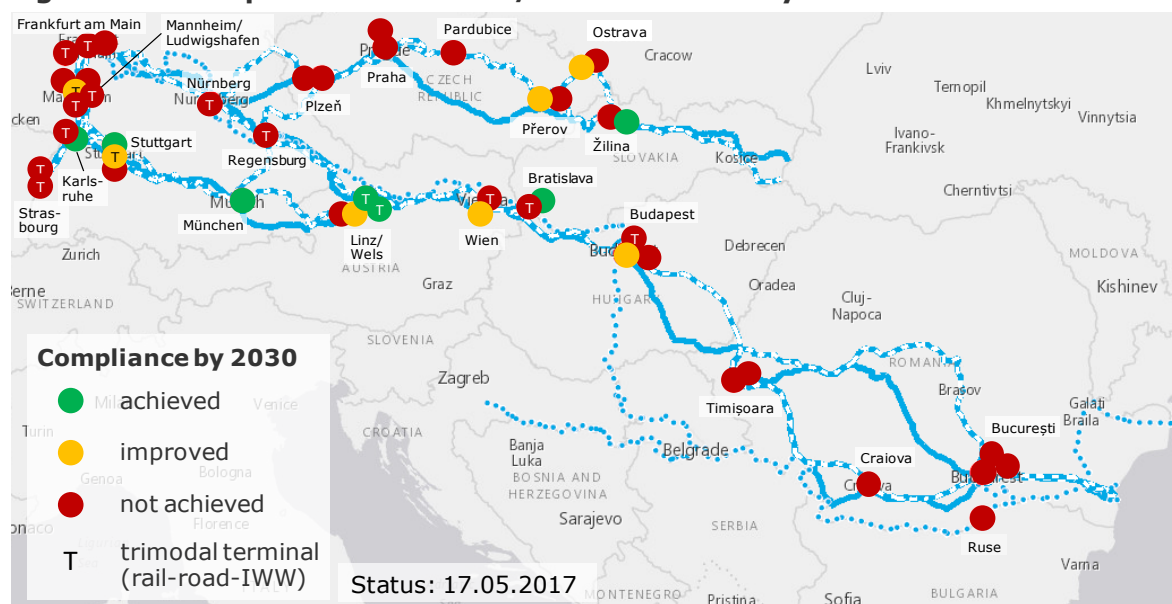
After all, only the terminals Karlsruhe Rbf, Kornwestheim Rbf, München (new terminal), Linz Stadthafen, Enns, Bratislava and Žilina will be capable of handling intermodal transport units and be accessible by electrified trains with a length of 740m in 2030. Next to these, seven terminals will fulfil the requirements of the Regulation to a higher degree in 2030 than they do now but are still expected to lack the compliance with all three parameters. In addition, it is to be noted that for the majority of terminals no project is foreseen at all.

### 2.5.6.2 Rail/Road Terminals persisting bottlenecks in 2030

The results on the contribution of the identified planned terminal projects on the improvement of the 3 commonly defined KPIs are visualized in Figure 19. It reflects that only seven terminals namely Karlsruhe Rbf, Kornwestheim Rbf, München (new terminal), Linz Stadthafen (trimodal terminal in the port), Enns, Bratislava ÚNS and Žilina Teplička will comply with all three criteria after implementing the projects by 2030. Several terminals are "improved" after their planned projects have been concluded, but they will not reach all three parameters, though. For most sites no projects are defined, yet.

While the focus on specific types of intermodal transport units, e.g. containers, might be explained by the present market orientation, the low level of meeting the electrification and track length is a real burden for the development of efficient intermodal transport services. Thus, the largest challenge for the present sites is their historically grown access to the rail infrastructure (single sided, non-electrified, annex to shunting yard or port railway line) and the limitation of the (wagon) train length by either the reception/departure siding or the transshipment track(s) which will prevail until 2030. After completion of the planned projects in 2030, ten terminals will be equipped with tracks of at least 740 m length; electrified access will be provided by 15 RRT. In order to achieve the KPI also in the other terminals, it is recommended that rail infrastructure managers and terminal managers cooperate towards realizing the track-side and terminal side improvement of these two parameters in a coordinated way.

**Figure 19: Compliance of the Rail/road terminals by 2030**



Source: KombiConsult analysis, 05/2017



Table 18 lists all RRT which are expected to miss at least one of the three KPI targets for the year 2030. For each of these terminals it is indicated which KPI will not be met as well as the identified reason for non-compliance.

**Table 18: Reasons for expected non-compliance of RRT concerned by 2030**

Terminal name	Expected compliance 2030			Reason for non-compliance			
	KPI: Capability of handling intermodal units	KPI: 740m train terminal accessibility	KPI: Electrified train terminal accessibility	No improvement measure defined	Unclear if KPI will be achieved or only improved	KPI only improved, but not achieved	Other (comment)
<b>France</b>							
Strasbourg CT Nord	yes	no	no	x			
Strasbourg CT Sud	no	no	no	x			
<b>Germany</b>							
Karlsruhe Hafen	no	no	no	x			
Mannheim Handelshafen	yes	no	no	x			
Mannheim MCT	no	no	no	x			
Mannheim-Mühlauhafen	yes	no	no		x		
Ludwigshafen KTL	yes	no	yes	x			
Ludwigshafen Kaiserwörthhafen	no	no	no	x			
Stuttgart Container Terminal SCT	yes	no	no		x		
Stuttgart-Hafen	yes	no	no	x			
Frankfurt/Main FIT	no	no	no	x			
Frankfurt/Main-Ost	yes	no	yes		x		
Frankfurt/Main-Osthafen	no	no	no	x			
Nürnberg-Hafen TriCon	yes	no	yes	x			
Regensburg Hafen	no	no	no				Project does not improve these parameters
<b>Austria</b>							
Wien Nordwest/Inzersdorf	yes	no	yes			x	
Wien Freudenau Hafen	yes	no	yes	x			
Wels Vbf	yes	no	yes			x	
Wels RoLa	no	no	yes				RoLa terminal with dedicated RoLa operating conditions
<b>Slovakia</b>							
Bratislava Palenisko	no	no	no	x			
Žilina	no	no	no	x			
<b>Hungary</b>							
Budapest (Soroksár)	yes	yes	no	x			
Budapest Mahart Container Center	no	no	no	x			
Budapest (Metrans)	yes	no	no			x	
<b>Romania</b>							
București Intermodal Terminal	yes	no	no	x			
București Noi	no	no	no	x			
București Sud	no	no	no	x			
Timișoara Semenic	no	no	no	x			

Terminal name	Expected compliance 2030			Reason for non-compliance			
	KPI: Capability of handling intermodal units	KPI: 740m train terminal accessibility	KPI: Electrified train terminal accessibility	No improvement measure defined	Unclear if KPI will be achieved or only improved	KPI only improved, but not achieved	Other (comment)
Timișoara Remetea Mare	no	no	no		x		
Craiova	no	no	no		x		
<b>Czech Republic</b>							
Ostrava-Paskov	yes	yes	no		x		
Ostrava-Šenov	no	no	no	x			
Plzeň-Koterov	no	no	no	x			
Plzeň-Nýřany	no	no	no	x			
Praha (Uhřetěves)	no	no	no	x			
Praha (Žižkov)	yes	no	no	x			
Pardubice	no	no	no	x			
Přerov	no	no	no		x		
Přerov (new)	no	yes	yes				No project promoter identified; costs not known, maturity not advanced
<b>Bulgaria</b>							
Ruse Tovarna	no	no	no		x		

Source: KombiConsult analysis, 05/2017

In quantitative terms it means the KPI for RRT are expected to be improved compared to the status in 2016 but the Corridor's Rail-Road Terminals are far from reaching compliance if the present speed of implementation is not improved. For an orientation we have also made a rapid assessment on the impact of the six projects to be completed by the year 2020 and inserted the results in the following Table 19.

**Table 19: Evolution of KPI for RRT since 2013**

Rail Road Terminals	Baseline 2013	Status 2015	Status 2016	Expected 2020	Expected 2030	Target 2030
Capability of handling intermodal transport units	44%	44%	44%	44%	49%	100%
Accessibility by trains of 740m train length	2%	2%	5%	11%	23%	100%
Accessibility by electrified trains	16%	16%	21%	21%	32%	TBD
Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100%	100%	100%	100%	100%	100%

Source: KombiConsult, based on desk research, KombiConsult knowledge base and project list 2017

### 2.5.7 Innovation projects

Projects with innovation components can be found in the category "Innovation", but also in the mode specific categories; the latter applies for all those projects that consist of an infrastructure related and on an innovation part (e.g. upgrade of a rail line + ERTMS installation). Projects with innovation components have been identified by setting respective filters in the project list on the "scope of work" attributes "Clean fuels", "Telematics application" and "Sustainable freight transport services". This leads to the identification of 142 RD projects with innovation components (=25% of all RD



projects). The majority of these projects refer to Telematics applications (ERTMS, ITS, RIS, SESAR and others). 19 further projects deal with the provision of clean fuels.

A brief analysis of the projects listed with innovative project components included in a larger project shows the following:

- 50 projects include telematics applications such as ITS (road), RIS (IWW), SESAR (airport) or other telematics applications, except ERTMS;
- 15 of them are telematics applications (ITS and other telematics applications) categorised under road projects, nine are RIS projects under IWW projects, three (SESAR, ITS and other telematics application) are under airport projects and one (other telematics application) is categorised under maritime projects;
- 19 projects include ITS, nine projects belong to RIS, one project refers to SESAR and 21 projects relate to other telematics applications;
- 7 projects are related to the promotion of alternative fuels, mainly LNG. These projects belong to the categories Road (4), IWW (2) and Airport (1).

Only 22 projects are directly classified under the category "innovation" in the project list. Looking at the scope of work the 22 projects belong to:

- Clean fuels: 12 projects;
- Telematics applications (ITS): 5 projects;
- Other telematics applications: 3 projects;
- Sustainable freight transport services: 1 project in connection with clean fuel provision and one project for IT application in logistic chain.

For innovative projects no Key Performance Indicators are defined and no compliance check was performed. Nevertheless it can be concluded that the projects have an impact on capacity enhancement of the respective mode, on reduction of CO<sub>2</sub> emissions and on improvement of multimodality. A larger number of projects can be allocated to more than the Rhine-Danube CNC; they are often grouped under common project category.

## 2.6 Administrative and operational barriers

In addition to physical and technical barriers, also administrative and operational barriers hinder the seamless transport on the Rhine-Danube Corridor. Both have an important impact on the choice of transport routes and modes and thus influence transport demand and modal share.

Administrative and operational barriers mostly consist of changing infrastructure standards at borders, extensive border waiting times and diverging and non-transparent charging systems.

But not only transport itself has to cope with administrative and operational barriers, also hindrances within responsible organisations effect the progress in the Corridor's development. Inefficient organisational structures, a lack of human and financial resources often impede the successful implementation of already approved projects.

Continuity of passenger and freight flows by **rail** is jeopardized at cross-border sections, due to changing technical parameters. Full exploitation of train capacities is particularly impacted for long-haul train runs, as they have to cope with frequent changes and multi-system locomotives are needed. Also, deviating infrastructure parameters at last mile connections or missing interconnections hamper the increase of rail transport.

Regarding **administrative** barriers border control procedures influence transport/travel times, costs and resource efficiency of rail transport negatively thus creating barriers such as:

- Border-control and customs clearance in both sides on the same cross-border point;
- Schengen border – **principle of trust** does not work, resulting in time-consuming double-checking, although Schengen/Non-Schengen status should be irrelevant;
- Certain traditional national **operational rules** are existing with no specific purpose at cross-border points that should be jointly identified and eliminated (non-sense rules);
- Normative differences between Corridor countries, although common regulations (UIC,COTIF,TSI) exist, these are not applied similarly, thus harmonization is required;
- Lack of coordination of operations and current modernisation and rehabilitation works along the Corridor, especially between neighbouring national IMs;
- Lack of consistent and updated information exchange system for capacity planning, train operations and document transfer across cross-borders;
- Information gaps and barriers in communication, which have high impact on the planning of activities, personnel and rolling stock, as well as on current operation of international freight trains;

**Inland waterway** transport might be improved by realising soft measures in order to achieve results, which are tangible and visible in a shorter period of time, such as:

- Providing waterway infrastructure managers with adequate budget to fulfil their national maintenance duties;
- Well qualified human resources for the preparation and implementation of complex, integrated waterway management and engineering projects is not sufficiently available in some countries; Several projects (e.g. METEET, Danube STREAM and FAIRway Danube) address these issues.
- As Member States struggle with providing the required fairway depths at free flowing river sections, intentions to legally relieve themselves from their responsibilities have been observed (e.g. Restrictions of vessel draught, Force Majeur Certificates);
- Administrative processes and paperwork are seen as a significant competitive disadvantage for inland waterway transport on the Rhine-Danube Corridor, which typically runs long distances crossing several borders and administrative areas of competence;
- Information on current fairway conditions is often not available or difficult to access; therefore planning of inland waterway transports is overly complex;
- Fees on the Danube-Black Sea Canal are calculated according to loading capacity and doubly punish shipping companies in case of bad fairway conditions.

Besides differences between national rules, it has to be taken into account that not all Danube riparian states are an EU Member State and not all EU states are in the Schengen area. Therefore, for instance, border checks for passengers and crews are necessary, as well as required customs clearance procedures for imports and exports. Delays are significant and do weaken the competitiveness of inland waterway transport in comparison to other transport modes.

**Ports** set their charges autonomously and may differ substantially in line with the applied organisational scheme. Increased transparency, e.g. by an obligation to publish tariffs on the ports websites would support inland waterway transport. Non-harmonized administrative procedures in ports delay or prolong transports

significantly. Harmonization of requirements for vessel, crew and cargo related documents for vessels' calling in ports is highly recommended. In the very near future, efficiency of ports, their climate change resilience and the greening of port operations will become crucial aspects of the port development. In this view, further planning and policy documents must take these aspects into account.

**Road** tolling systems along the Corridor remain fragmented and non-harmonized, distance or time based charging schemes exist in all countries of the Rhine-Danube Corridor, but only five use an electronic fee collection system. Non-interoperability of diverse road tolling systems between Member States is an obstacle and burden for the road hauliers and freight forwarders on long distance transport.

The systems for the provision of real-time traffic and weather information are not yet capable of offering cross-border traffic information. Thus, it is explicitly recommended that special attention is paid to the deployment of intelligent transport systems, especially in the MS where basic IT infrastructure for data transmission is not yet in place.

Provision of safe and secure parking areas is also an issue to be considered. Although the provision of such facilities is market-driven, some regulation might be needed especially in setting clear definitions of the "safe and secure parking" notion. This would facilitate disputes between road hauliers and insurance companies and might trigger private initiative in offering adequate parking services. First investments were done in Germany, Austria, Hungary, Czech Republic and Romania in equipping truck parking areas along the motorways with intelligent infrastructure (towards safe and secure truck parking).

Since the managers of **rail/road terminals** as well as the terminal users were not directly involved in the Corridor Forum and the analysis, detailed administrative or operational bottlenecks for the terminals cannot be reported yet. Since the terminals are under the legislation for railways and roads and of inland waterways (trimodal terminals) as well as those governing transport in general, the mode-related obstacles identified above apply also to the terminals.

The European Parliament<sup>12</sup> has adopted the update of the Directive 96/53 on weights and dimensions in international road transport, which needs to be implemented into national law by mid of 2017. There will be an impact on terminals due to the new rules for longer vehicles and aerodynamic devices, as well as the – anticipated – increase of the allowed container size to 45 feet.

The Directive 92/106 of 7 December 1992 on the establishment of common rules for certain types of combined transport of goods between Member States, which is of equal importance for combined transport, still needs to be improved. The consultation process<sup>13</sup> started in early 2017 and should involve also terminals so that proper definitions as regards e.g. "nearest appropriate terminal" can be agreed upon which are easily applicable by the market parties and the authorities.

## 2.7 Urban nodes

The Rhine-Danube corridor core network contains 13 urban nodes, located in seven Member States (France, Germany, Czech Republic, Slovakia, Austria, Hungary and Romania): Strasbourg (FR), Mannheim (DE), Frankfurt/M (DE), Nürnberg (DE), Stuttgart (DE), München (DE), Ostrava (CZ), Praha (CZ), Bratislava (SK), Wien (AT),

<sup>12</sup> Directive (EU) 2015/719 of 29 April 2015 amending Council Directive 96/53/EC laying down for certain road vehicles circulating within the Community the maximum authorised dimensions in national and international traffic and the maximum authorised weights in international traffic.

<sup>13</sup> [https://ec.europa.eu/transport/themes/urban/consultations/2017-CTD\\_en](https://ec.europa.eu/transport/themes/urban/consultations/2017-CTD_en)

Budapest (HU), Timișoara (RO) and București (RO). Regulation 1315/2013 states that "those nodes are the starting point or the final destination ("last mile") for passengers and freight moving on the trans-European transport network and are points of transfer within or between different transport modes."

In order to scrutinise the status of the Rhine-Danube urban nodes against these requirements, a comprehensive check has been performed referring to (1) CNC infrastructure line sections (rail, road, inland waterway) inside the urban nodes and (2) the connection of access points (ports, terminals, airports) to these corridor line sections ("last-mile"). These compliance checks also include new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017.

### **Check of CNC infrastructure line sections**

In Table 20 the overall corridor network compliance check for Rhine-Danube urban nodes is displayed. The data provided herein also contains new information on permitted axle load in Romania, provided by CFR-SA in July/August 2017.

It is obvious that particularly rail lines within the nodes present several bottlenecks. Rail parameters with the lowest level of compliance are "train length" and "capacity utilisation", that are partly compliant or non-compliant in 45-50% of the nodes. Moreover, the "axle load" criterion of 22.5t is completely fulfilled in 70% of the urban nodes only. In contrast, most of the rail corridor sections within the urban nodes are electrified; only two of them show some non-electrified sections. With the exception of the train length parameter, several projects for the total or partial resolution of the above mentioned issues have been identified. Projects with the purpose of allowing for 740m train length have been planned in one urban node only (Timișoara).

The status of inland waterways has been analysed for eight urban nodes along the Corridor. The most problematic parameters are "draught" and "good navigation status" being compliant in 50% of the analysed nodes only. On the contrary, requirements referring to the "ECMT class", "height under bridges" and "RIS implementation" parameters are fulfilled in almost all nodes. With regards to the resolution of inland waterway bottlenecks, various projects have been foreseen principally for the improvement of the navigation status and for the fulfilment of the minimum draught requirement of 2.5m.

The road network inside the Rhine-Danube nodes is almost totally compliant with the Regulation. With the only exceptions of the local road L98 between Strasbourg/Illkirch and the motorway A5 at Offenbourg, all corridor road sections of the urban nodes are classified as motorways (express ways).

Summing up all modes, the analysis shows different compliance results in Western and Eastern Europe. Urban nodes with a particularly high share of red and yellow fields are Bratislava, Budapest, Praha and Ostrava. In contrast, München, Frankfurt, Mannheim and Stuttgart are compliant regarding almost all checked parameters.

**Table 20: Corridor lines compliance check on the Rhine-Danube urban nodes**

	Parameters	Strasbourg	Mannheim	Frankfurt	Nürnberg	Stuttgart	München	Ostrava	Praha	Bratislava	Wien	Budapest	Timișoara	București
Rail	Train length (≥ 740m)	n.i.											P	
	Axle load (≥ 22,5t)											P	P	P
	Speed (≥ 100km/h)							P		P		P		
	Electrification				P									
	Capacity utilisation		P	P	P			P		P		P		
IWW	ECMT class (≥ IV)	n.a.					n.a.	n.a.					n.a.	n.a.
	Draught (≥ 2.5m)	n.a.					n.a.	n.a.	P	P			n.a.	n.a.
	Height (≥ 5.25m)	n.a.					n.a.	n.a.	P				n.a.	n.a.
	RIS implementation	n.a.					n.a.	n.a.					n.a.	n.a.
	Good navigation status	n.a.	n.a.			n.a.	n.a.	n.a.		P		P	n.a.	n.a.
Road	Express road / motorway													

<span style="background-color: green; color: white; padding: 2px;">GREEN</span>	Compliant
<span style="background-color: yellow; color: black; padding: 2px;">YELLOW</span>	Partly compliant / non-compliant
<span style="background-color: red; color: white; padding: 2px;">RED</span>	Non-compliant

<span style="background-color: grey; color: white; padding: 2px;">GREY</span>	Not applicable (n.a.)
<span style="background-color: white; color: black; padding: 2px;">WHITE</span>	No information (n.i.)
P	Project for the improvement of a non-compliant parameter (according Project list 2017)

Source: HaCon, status 09/2017

### Check of connection of access points (“last mile”)

The underlying question for this compliance check was whether it is possible to perform a continuous, seamless traffic from the CNC lines via the last mile connection to the respective access points and vice versa. This requirement can be considered as generally fulfilled for road connections. As inland waterways are usually not used for these purposes, the check of the last mile connections has been restricted to rail.

The rail connections of inland ports, trimodal terminals and rail-road terminals to the core network have been analysed for the three parameters “axle load”, “electrification” and “train length”, since these criteria decide whether a seamless transport from/to the access point along the last mile is possible or not. For rail connections to airports, the availability of heavy rail connection is relevant.

The analysis showed that half of the analysed last-mile sections (23 out of 45) are completely compliant with regard to the above mentioned parameters (see Table 21). The remaining 22 out of 45 last-mile connections are not totally compliant and require respective improvement works.

Missing compliance of last mile-rail connections in the urban nodes is predominantly a matter of insufficient train length (40-45% of the last-mile connections). The parameter on axle load is not compliant in 20-25% of the cases, while just about 10% of the last-mile connections are not electrified. In total, 11 airports have been inspected and 4 of them are not connected to heavy rail.

As Table 21 points out, only few projects are currently planned or ongoing, which are designed to enhance compliance on the last-mile connections within the urban nodes. Two of them will establish rail connections of airports; another project shall enable 740m trains to and from Ostrava Paskov terminal.

No projects with the purpose of achieving the line electrification and axle load (22.5t) requirements on the non-compliant sections have been identified. A project in Ostrava to achieve the 740m train length parameter at the rail-road terminal Ostrava Paskov is planned. Two projects aiming at connecting the airport in Praha and in Timișoara to heavy rail have been recognised.

**Table 21: Compliance check of last-mile rail connections between the CNC network lines and access points, status 2016**

Urban node	Access point		Connection to CNC			
	Infrastructure	Type	Axle load (≥ 22,5t)	Electrification	Train length (≥ 740m)	Connected to heavy rail
Strasbourg	<b>Strasbourg CT Nord</b>	Trimodal terminal	X	<input type="checkbox"/>	X	n.a.
	<b>Strasbourg CT Sud</b>	Trimodal terminal	X	<input type="checkbox"/>	X	n.a.
Mannheim	<b>M. Handelshafen (DUSS)</b>	Rail-road terminal	<input type="checkbox"/>	X	<input type="checkbox"/>	n.a.
	<b>Ludwigshafen KTL</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>M. Handelshafen (Contargo)</b>	Trimodal terminal	<input type="checkbox"/>	X	<input type="checkbox"/>	n.a.
	<b>Mannheim MCT</b>	Trimodal terminal	<input type="checkbox"/>	X	<input type="checkbox"/>	n.a.
	<b>Ludwigshafen Kaiserwörthhafen</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
Frankfurt	<b>Frankfurt-Osthafen</b>	Inland port	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Frankfurt-Gutleuthafen</b>	Inland port	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Frankfurt-Ost</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Frankfurt-West</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Frankfurt-Osthafen</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Frankfurt-Airport</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>
Nürnberg	<b>Nürnberg Hafen</b>	Inland port	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Nürnberg Hafen</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Nürnberg Airport</b>	Airport	n.a.	n.a.	n.a.	X
Stuttgart	<b>Kornwestheim</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Stuttgart Hafen</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Stuttgart Container Terminal</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Flughafen Stuttgart</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>
München	<b>München-Riem</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>München Flughafen</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>
Ostrava	<b>Ostrava Paskov</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	X	n.a.
	<b>Ostrava Šenov</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	X	n.a.

Urban node	Access point		Connection to CNC			
	Infrastructure	Type	Axle load (≥ 22,5t)	Electrification	Train length (≥ 740m)	Connected to heavy rail
	<b>Letiště Leoše Janáčka Ostrava</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>
Praha	<b>Praha Holešovice</b>	Inland port	X	X	X	X
	<b>Praha Uhrineves</b>	Rail-road terminal	n.i.	n.i.	X	n.a.
	<b>Praha Žižkov</b>	Rail-road terminal	n.i.	n.i.	X	n.a.
	<b>Václav Havel Airport Prague</b>	Airport	n.a.	n.a.	n.a.	X
Bratislava	<b>Bratislava-Palenisko</b>	Inland port	<input type="checkbox"/>	<input type="checkbox"/>	X	n.a.
	<b>Bratislava ÚNS</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	X	n.a.
	<b>Bratislava-Pálenisko</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	X	n.a.
	<b>Letisko Bratislava</b>	Airport	n.a.	n.a.	n.a.	X
Wien	<b>Wien Freudenau Hafen</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	X	n.a.
	<b>Vienna Airport</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>
Budapest	<b>Port of Csepel</b>	Inland port	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Budapest Soroksár (BILK)</b>	Rail-road terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Budapest MCC</b>	Trimodal terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	n.a.
	<b>Budapest Airport</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>
Timișoara	<b>Timișoara Semenik</b>	Rail-road terminal	X	<input type="checkbox"/>	X	n.a.
	<b>Aeroportul Internațional Traian Vuia</b>	Airport	n.a.	n.a.	n.a.	X
București	<b>București Intermodal Terminal</b>	Rail-road terminal	X	<input type="checkbox"/>	X	n.a.
	<b>București Noi</b>	Rail-road terminal	X	<input type="checkbox"/>	X	n.a.
	<b>București Sud</b>	Rail-road terminal	X	<input type="checkbox"/>	X	n.a.
	<b>Aeroportul Internațional Henri Coandă - București</b>	Airport	n.a.	n.a.	n.a.	<input type="checkbox"/>

<input checked="" type="checkbox"/>	Compliant last-mile connection
<input type="checkbox"/>	Partly/ non-compliant last-mile connection
<input type="checkbox"/>	Compliant
X	Non-compliant
X	Non-compliant, but project for improvement existing



Urban node	Access point		Connection to CNC			
	Infrastructure	Type	Axle load (≥ 22,5t)	Electrification	Train length (≥ 740m)	Connected to heavy rail
n.a.	Not applicable					
n.i.	No information					

Source: HaCon, 09/2017

## 2.8 Wider elements of the work plan

In parallel with the infrastructure requirements, the consequences of the TENT-T requirements for the corridor and the overall infrastructure status by 2030, wider elements in terms of innovation, climate change adaptation and decarbonisation have been addressed in the corridor work.

The decarbonisation impact for the corridor (i.e. realizing the projects of the project list), is estimated in a modelling exercise common for all corridors to address climate change adaptation and mitigation measures' impact to the corridor development. Funding gaps on this sector should be analysed to.

### 2.8.1 Innovation Deployment

Innovative projects are defined as projects which incorporate new technologies designed to improve the current transport system. In the RD corridor around 18% of the projects are classified as innovative. The share of innovation projects of the RD corridor is relatively low (18%) compared to the corridor average of 23.5%; however the total number of projects is around the average.

The highest amount of innovative projects relate to road and IWW. More than half (50 projects) have been categorised as "Catch-up innovation" or otherwise defined as projects related to transferable innovation across the EU. These have already been implemented in other sections of the Corridor or other Member States. "Radical and Incremental innovation" account for a bit more than 40% (38) of all innovative projects, with seven projects being categorised as "Radical innovation". Radical innovation defined as project which involve new technologies for the EU, for instance in the RD these are projects involving alternative fuels in areas where this has never been done before (e.g. LNG infrastructure in port areas). Incremental projects are in between "Catch-up innovation" and "Radical innovation", a common example being ERTMS level 3. The majority of projects (80) are classified as transferable, meaning that they can be implemented in different regions on the same corridor or other corridors.

The innovation projects were categorized according to their contribution in the framework of the TEN-T Regulation:

- Telematic applications,
- Sustainable freight transport initiatives,
- Safety improvement,
- Contribution to development of European technological industry and
- Transport efficiency improvement through data sharing.

All 5 policy objectives are being addressed by innovation projects in all corridors. For the RD Corridor it can be observed that the focus is on safety improvement and transport efficiency improvement through ITS and e-mobility applications.

Innovation in freight and passenger transportation is mostly related to Data sharing and safety & security projects. Although the budget dedicated to innovation projects is small, their impact is important. Funding has been found a strong enabler in projects from all types of transport modes (road, rail, maritime and IWW) and various scopes

of work – from infrastructure to studies Innovative projects for rail and road account for more than 80% of the total costs of innovative projects. Furthermore, CEF contributions to these projects are 6% which is higher/lower compared to the CEF investments in the RD corridor.

Regarding the specific issue of the contribution of innovation projects to transport decarbonisation a more detailed assessment was performed. It makes it very clear that innovation projects in all CNC are leading efforts for the use of Natural Gas and Biofuels in transport, and that a large number of projects for electricity and hydrogen are also being implemented. Decarbonisation is addressed by a third of the innovative projects (22) in the RDC, with a vast majority of them being related to the use of alternative fuels. These types of projects are found in each of the member states, with the most in Romania (7). The maritime projects are mainly new infrastructure works related to increasing the use of alternative energy (specifically LNG, solar and wind power). The road projects also aim to incentivize the use of alternative fuels through an increase in the number of electric supply stations for vehicles and deployment of CNG stations. The remaining decarbonisation projects (outside of Romania) are 16 and mainly focus on increasing the incentives for the usage of electric and hydrogen energy and constructions of LNG stations. There is also one project concerning the sustainability of the Vienna airport through providing clean fuels and renewal of electric lighting system.

CNC innovative projects show a very high level of transferability, meaning that the TEN-T can potentially position as a space for deploying transport innovations in a larger scale, helping project promoters better develop their innovations before transferring them to wider environments. The RD corridor has an average number of projects that are transferable and an average number that is scalable compared to the other corridors.

### **2.8.2 Mitigation of environmental impacts, decarbonisation**

According to the calculations on decarbonisation and emissions conducted for the period 2015 – 2050 the emissions for road and rail will decrease, while at the same time their number of passengers and tonnes of freight will increase. The emissions from rail will slightly rise in 2030 but would decrease in 2050. For Inland waterway transport (IWT) the emissions will increase slightly. Aviation is a sector where the number of passengers will almost double and as a result the emissions will increase but only slightly.

The EU REFERENCE scenario 2016 is applied for the calculations of emissions in 2030 and 2050:

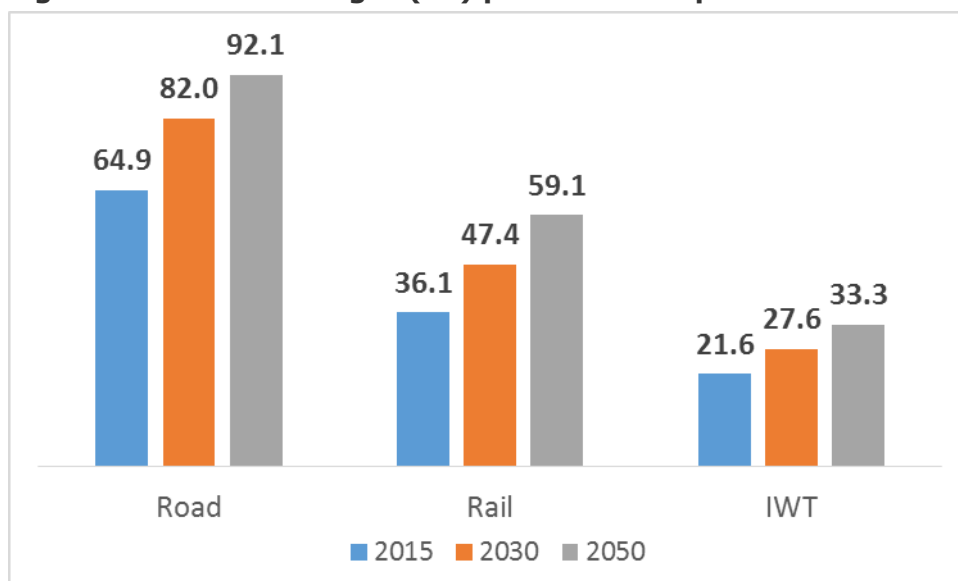
RD Member States account for around 25% of the EU28 total on current socio economic & transport. However, growth rates of population, GDP and passenger traffic growth up to 2030 are lower compared to EU-28 average. Passenger traffic is forecasted to increase from 114 billion pkm today to 135 billion pkm by 2030 (road, rail and aviation) - fastest growing sector in the REFERENCE scenario is aviation (at 2.6% per annum).

Freight traffic is forecasted to increase from 149 billion tkm today to 189 billion tkm by 2030 (road, rail and inland waterway) - fastest growing sector in the REFERENCE scenario is rail (at 1.8% per annum).

Based on the REFERENCE scenario the emissions (2015) are 20.4 million tonnes of CO<sub>2</sub> equivalent. Energy efficiency is forecasted to increase over the 2015-2030 time period. According to the forecasted traffic growth and the increase of energy efficiency emissions of 19.6 million tonnes of CO<sub>2</sub> equivalent in 2030 for the REFERENCE scenario are forecasted.

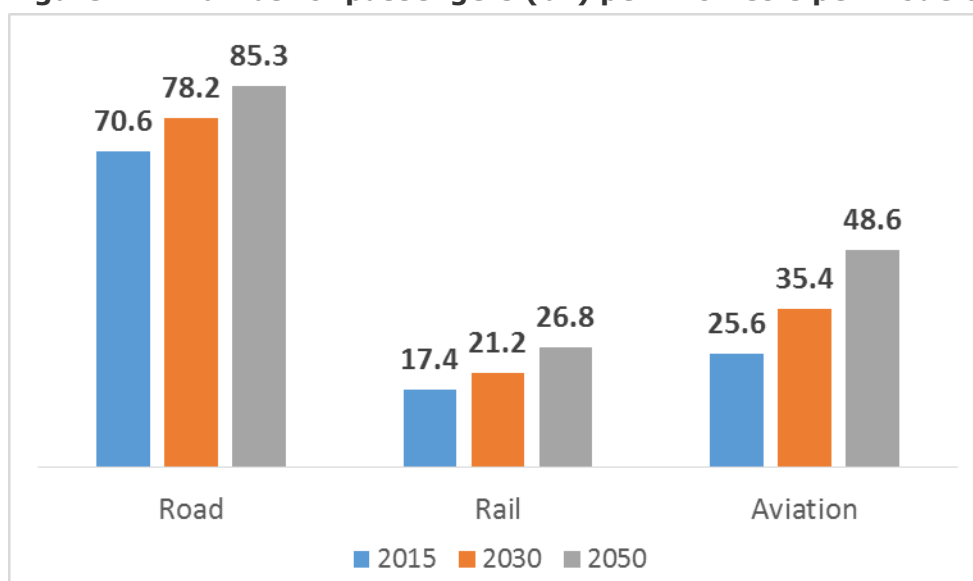
This is illustrated in the following figures:

**Figure 20: Tons of freight (bn) per kilometre per mode of transport**



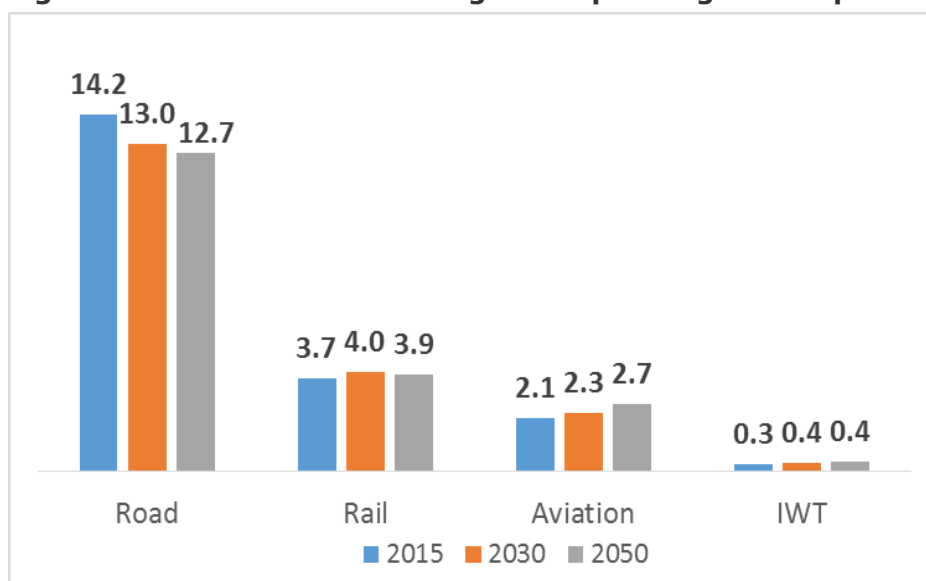
Source: Panteia, Wider elements study 06/2017

**Figure 21: Number of passengers (bn) per kilometre per mode of transport**



Source: Panteia, Wider elements study, 06/2017

As a result of modal shift and various decarbonisation initiatives, energy efficiency is forecasted to increase over the time period between 2015 and 2030, and emission factors are estimated to fall. This is an observation seen also in other corridors. Most of the 2030 decrease in CO<sub>2</sub> is attributed to greater efficiency in the passenger road sector, whereby relatively low expected growth is outweighed by increases in efficiency. In the freight sector and aviation, traffic growth outweighs efficiency gains.

**Figure 22: Emissions from freight and passenger transport**

Source: Panteia, Wider elements study, 06/2017

### 2.8.3 Climate Change Adaptation

The Rhine Danube corridor has a temperate oceanic climate in the West with gradually transitions into a continental climate. In the southern part of Germany, Slovakia, Hungary, and eastern Romania there will be a large increased vulnerability when heat stress of road pavement occurs. The other parts of the corridor will experience a smaller increase in heat stress vulnerability in the upcoming century. The eastern part of Austria, Southern Romania, and to lesser extent southwest Germany will become more vulnerable to rail track buckling. In the eastern parts of the Czech Republic and Austria as well as southern Romania, bridges are expected to become more exposed to bridge scour. The areas surrounding the most outer parts of the corridor are likely to be exposed to droughts more often in the next century. The centre part of the corridor (southeast Germany and the Czech Republic) will become wetter.

Against this background there have been 4 projects identified on the project list, directly contributing to Climate Change Adaptation. Further during the study, national climate change adaption strategies have been evaluated. This indicates that this topic is only just beginning to mature for transport infrastructure.

## 2.9 Infrastructure investments and funding

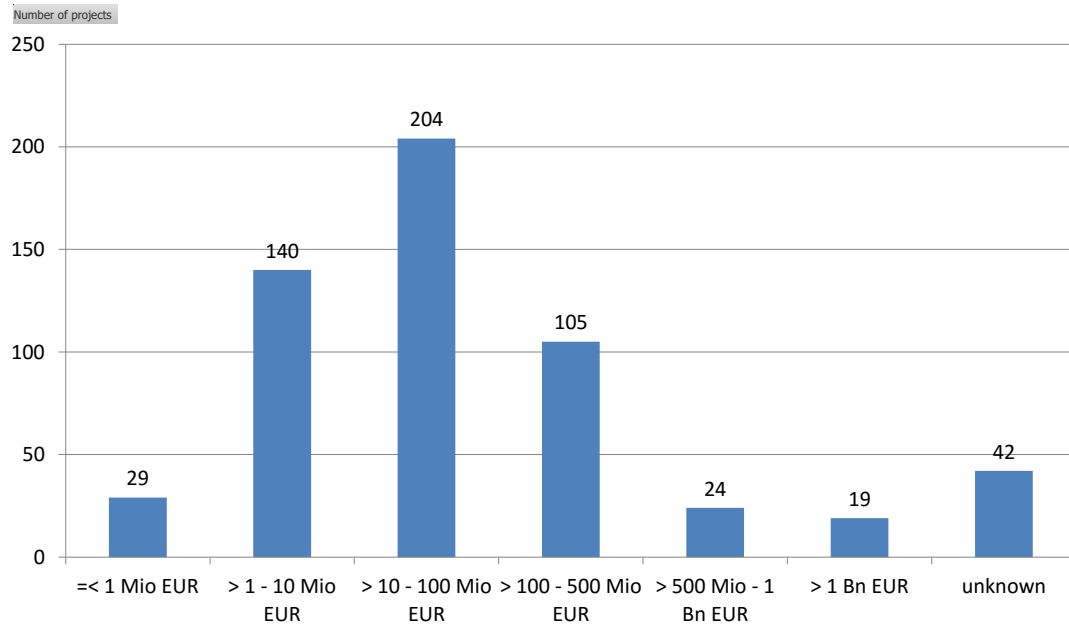
### 2.9.1 Financial requirements

Looking at the costs, all 563 projects sum up 91.9 bn EUR, which means an increase by 22 bn EUR (+31%) compared to the 2016 project list version and even by 27.2 bn EUR (+42%) compared to the 2014 work plan. The average cost per project is the same as in 2016 (163 Mio EUR), but notably lower than in 2014 (193 Mio EUR). This is due to the fact that some particular high-cost projects had been finalised before 2014 and are thus not included in 2017 project list any more. Furthermore, it must be observed that for 42 projects no information about costs is available.

The project specific costs show a large variety, reaching from 50,000 up to 6.4 bn EUR per project. As Figure 23 points out, most of the projects are attributed to the classes ">10 - 100 Mio EUR" (204 projects = 36%), ">1 - 10 Mio EUR" (140 projects = 25%) and ">100 - 500 Mio EUR" (105 projects = 19%). Particularly Innovation, IWW, Port and Multimodal projects are mostly assigned to the lower costs classes (max. 100 Mio EUR). In contrast, projects with more than 100 Mio EUR of invest are mainly

represented by Rail and Road. In total, about 60% of the overall projects costs refer to Rail, followed by Road (27%).

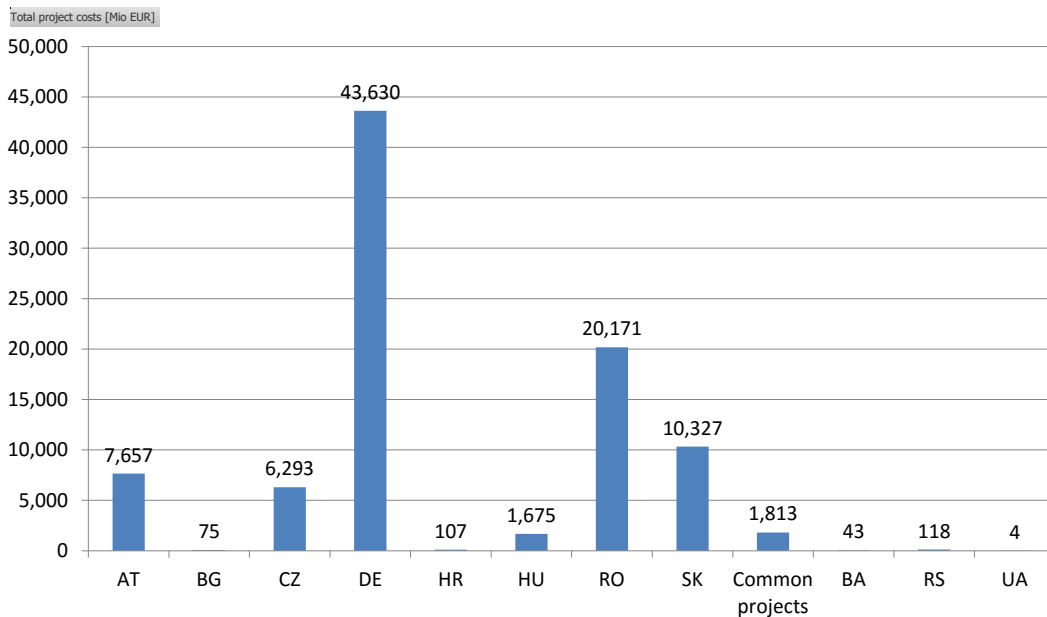
**Figure 23: Number of corridor projects by cost class**



Source: HaCon, based on project list, status 05/2017

As Figure 24 shows, 47% of these overall costs are allocated to Germany (with only 20% share of project quantity) meaning that particularly German projects show an above-average volume. About 80% of the German investments refer to rail projects; also in Austria the major share of project costs can be allocated to rail, whereas Romania, Slovakia and the Czech Republic also show a considerable or even higher share of road related project costs.

**Figure 24: Total project costs by country [Mio EUR], total = 563 projects**



Source: HaCon, based on project list, status 05/2017

About 86 projects were completed between 2014 and 2016 with an investment volume of 5.27 bn EUR (5.7% of total investment requirement).

241 projects are on-going projects, thus considering that the financing is secured. The investment volume is 37.8 bn EUR or 41% of total investment requirement,

From the total number of projects about 75% of the projects contains full set of information on the investment costs (equal to investment volume of 68.8 bn EUR), for 25% of the projects the information are not complete (equal to an investment volume of 23 bn EUR).

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

- Financing by MS/public grant: 64.7% or 44.8 bn EUR;
- EU grants: 23.5 % or 16.2 bn EUR;
- IFI bank loan: 25 Mio EUR (negligible);
- Private financing/own resources: 6.3% or 4.3 bn EUR;
- Other financing sources: 5.5% or 3.7 bn EUR.

The breakdown of funding by EU grants shows following situation:

- Cohesion Fund, CEF, OPT: 13.1 bn EUR or 81%;
- CEF/TEN-T: 1.9 bn EUR or 12%;
- ERDF: 685 Mio EUR or 4%;
- ESIF: 432 Mio EUR or 3%;
- IPA: 40 Mio EUR;
- Not specified: 26.6 Mio EUR.

When analysing the financing of projects through EU grants a share of 51.5% of the investment volume is approved (equal to 8.3bn EUR) and the share of 48.4% can be considered as potential for funding (equal to 7.8 bn EUR).The investment analysis of the RD CNC and the structure of the EU grants breakdown reflects the typical situation of the RD CNC, which has a high share of Member States receiving financial means under the Cohesion Fund.

Would the same EU funding ratio (i.e. 23.5%,) be applied to the entire corridor work plan investment amount of 91.9 bn EUR, it can be expected that over the next years, 11.1 bn EUR (calculated on basis of approved EU grants) and 21.6 bn EUR (calculated on basis of entire EU grants) will be demanded from project promoters and Member States.

The assessment of the Rhine-Danube project pipeline regarding the potential of projects for EIB/EFSI support depicts the following:

- Of the 316 projects about 100 projects or approximately 18% are identified as financially sustainable. All projects with the indications of potential revenue generating by the promoters are summarised in the share of 18%.
- It was also deemed that additional 49% of the projects or 276 projects could be a potential for financial sustainability, if properly structured (i.e. potentially financially sustainable). Here the projects are summarised by following the guidelines for the distinction between non-financially sustainable and potentially financially sustainable projects as given by EC in email of 9 January 2017.
- The remaining 187 projects or 33% are considered as non-financially sustainable.

- Would the same percentages apply to the investment amount relative to all the projects included in the work plan, approximately, 7.1 bn EUR capital expenditure would be relative to financially sustainable projects and 82.5 bn EUR would be relative to projects, which could be sustainable, if properly structured.

### 2.9.2 Project funding under CEF (2014 – 2017)

During the first 4 years of the CEF Transport implementation period, the RDC had a very intensive period of launching new infrastructure and study projects. 117 projects receive CEF funding of total 4.9 bn EUR in the RDC from the 3 Transport calls 2014 - 2016. The disbursement of funding to the different sectors is summarised in the following table.

**Table 22: Investment and CEF funding 2014 - 2017 (in EUR)**

No projects	Mode/sector	Total eligible costs	CEF funding	Share of funding (%)
117	Total projects	8,833.8 mio	4,923.9 mio	56 %
32	Rail	7,054.8 mio	3,625.8 mio	51
17	ERTMS	723.5 mio	590.6 mio	82
22	IWW/RIS	415.8 mio	324.3 mio	78
31	Road/ITS/clean fuel	504.1 mio	296.7 mio	59
3	Innovation	16.8 mio	8.4 mio	50
4	Airport/SESAR	43.1 mio	21.5 mio	50
8	Multimodal, ports	75.5 mio	56.4 mio	75

Source: INEA, 2017

These concerned 117 projects are including 43 studies, 27 mixed projects (studies + works) and 47 infrastructure works.

An important pipeline of mature projects has been identified and has translated into a huge success of all calls for proposals. This has led to a fast and efficient use of the available CEF financial means. The average co-funding rate of all projects is 56%. The co-funding rates for rail is 51%, for ERTMS 82% and for IWW/RIS projects 78%. 74% of the CEF funding supports rail projects, 12% goes to ERTMS projects, 7% to IWW projects and 6% to road/ITS/clean fuel projects

### 2.9.3 Infrastructure funding and innovative financial instruments

The projects to be developed can be ranked in three different categories from the point of view of funding and financing needs:

1. For several revenue generating projects "closer to the market" in terms of development (technological components, including on large infrastructure of key European Interest, brownfield upgrade) or service provision (terminals for freight/passengers, enhancement of infrastructure capacity / performances), a substantial component of the project funding can come from own resources (e.g. equity) and financing resources gathered by the project promoters on the market (e.g. in the form of equity, loans or bonds). The private investors would need to recover their initial costs of capital and receive a reward for the risk born (the higher the risk the higher the return required).

The project may look at conventional lending from public and private banks, alternative financing from institutional investors (e.g. bonds) and at financial instruments for instance to cope with the unbalances of cash-flow during its construction and rump-up phase until a sustainable flow of revenues is secured,



and to address particular risks and market failures, and to secure lending with long maturity. Financial instruments could be provided in the form of credit enhancing and guarantees (be it a specific legal guarantee or a financial guarantee to ease access to financing).

2. Hard-infrastructure, greenfield, risky, long-term projects such as the majority of cross-border railway connections as well as inland waterways navigability improvements might require a substantial public support through public funding, even if innovative approaches can apply to project development and/or to specific components of the investment. Public funding can be structured in different ways (also depending on the budgetary constraints of the public authorities) such as lump sum subsidy (grant), fiscal incentives, and operational deficit coverage and availability payment schemes.
3. In a variety of intermediate cases the project will require a more limited funding component in order to reinforce its financial viability – these projects could be supported through a blending of funding (e.g. grants) and financing.

In this respect, beside the national budget, the funding contribution can effectively come from the EU centralized managed funds, such as the Connecting Europe Facility (CEF) and from decentralized managed funds such as the European Structural and Investment Funds (ESIF) while the financing resources may come from the EU financial instruments, such as the CEF Debt Instruments and financial products available under the European Fund for Strategic Investment (EFSI).

For all these 3 different categories of projects the public intervention with the different degree of intensity is justified on the ground that these projects of high socio-economic and EU added value, substantially address overall public service obligations, suboptimal investment level, market failures and distortion due to externalities (positive, for the projects supported, including in terms of strategic added-value, and negative for competing modes), and therefore calls for the transfer of resources.

When considering the project funding structure in a comprehensive and multimodal setting, earmarking of revenues and cross-financing solutions, applying "Polluter-pays" and "user-pays" principles ought to be duly explored.

A project can be fully developed through project financing if the revenue stream (secured by public and/or private funding), exceeds the investment and operational costs (CAPEX+OPEX). Such an approach calls for a careful risk sharing between the Member States (project management) and private partners.

Notwithstanding the project self-financing potential linked to user fees, a cautious and innovative approach aimed at exploiting the project' life-cycle and define clear responsibilities and risk sharing between project promoters, sponsors and implementing bodies is more and more needed to deliver projects on time, cost and quality and to fully exploit the potential, while minimising future liabilities on public budgets.

A pre-condition for project financing is a conducive regulatory and legal environment, in order to set the incentives right to enhance the public and private sector involvement in the delivery of infrastructure investment.

## **2.10 Impact to jobs and growth**

An analysis of the growth and jobs impact of the corridor development was performed by applying a multiplier methodology based on the findings of the study "*Cost of non-*

completion of the TEN-T"<sup>14</sup>. For the analysis the projects contained in the project list of May 2017 are classified into three mutually exclusive categories:

- Cross-border projects,
- Innovation projects,
- Other and thus average projects

The projects for which cost estimates are available and that are planned to be implemented over the period 2016 until 2030 were taken into evaluation, they amount to an investment of 87.7 bn EUR<sub>2015</sub>. The implementation of these projects on the corridor will lead to an increase of GDP over the period 2016 until 2030 of 725 bn EUR<sub>2015</sub> in total. Further benefits will occur also after the year 2030.

The investments will also stimulate additional employment. The direct, indirect and induced job effects of these projects will amount to 2,002,000 additional job-years created over the period 2016 to 2030. It can be expected that also after 2030 further job-years will be created by the projects.

## 2.11 Pilot Initiative

Taking up the topics of the Issues Papers by the European Corridor Coordinators and translating the basic work of the issue Papers into concrete actions, the Commission wants to boost the generation of innovative flagship projects/initiatives on the core network corridors. Such a flagship initiative may be characterized by:

- **Additionality:** the initiative would not have seen the light without the stimulation by the Corridor Coordinator
- **Regional suitability:** it matches the particularities of the Corridor, supports its development by taking up existing limitations and bases on solid grounds (e.g. preparatory activities)
- **Short term implementation:** it can be realized in near future
- **Corridor wide:** Deployment on the whole Corridor, the Corridor shall take the ownership.
- **Forerunner:** other Corridors may follow the example of a successfully implemented pilot initiative

During summer 2017, the pilot initiative named "**Digital solutions to alleviate administrative red tape**" was developed. This thematic cluster aims at improving border control procedures in Danube navigation.

Administrative processes in Danube navigation are currently not harmonised in some areas and lead to partly avoidable controls and to delays in waterway operations. This causes significant competitive disadvantages for Danube navigation. The overall aim of the flagship initiative is to simplify, harmonise and digitalise administrative processes (in this specific order) in Danube navigation, in order to raise efficiency and effectiveness of administrative control procedures, while at the same time reducing costs and delays for shipping companies. The focus is on simplification and harmonisation for the coming 2-3 years.

The Working Group on „Administrative Processes“ of the Priority Areas 1a and 11 of the **EU Strategy for the Danube Region** in combination with the project „Removal of administrative barriers along the Danube“ (nationally financed within the Austrian

<sup>14</sup> Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

Action Programme on Danube Navigation) as well as the DTP-financed DANTE project have already done important preparatory work, which was aimed at the simplification and harmonisation of the border control processes and forms along the Danube.

A first step towards simplification was provided by the „Practical manual on border controls along the Danube and its navigable tributaries“, which increases transparency and offers guidance to waterway users. By the end of 2017 a first set of harmonised control forms (Danube Navigation Standard Forms – „DAVID forms“) shall be elaborated by PA1a and accepted by border control authorities of PA11. The first set of harmonized forms pertains to arrival and departure reports, crew lists and passenger lists (based on IMO FAL forms).

The flagship initiative is complementary to existing initiatives and shall cluster and consolidate working groups and projects. Most importantly it shall accelerate the necessary implementation steps towards simplification, harmonisation and digitalisation of border control procedures.

In 2018 the flagship initiative shall show its effect during the preparation of technical content for recommendations on administrative level which is expected to facilitate the application of the harmonized forms on national level. The flagship initiative raises the importance of the issue in all concerned countries and may therefore lead to a faster agreement on the actual use of new forms and procedures.

Depending on the progress of simplification and harmonization in the previous steps possibilities for digitalisation and the effective use of River Information Services in administrative processes shall be explored.

The flagship initiative has been accorded and coordinated with the main stakeholders involved: the EUSDR Priority Area 1a (Inland Waterways) and PA11 (Security) Coordinators, viadonau (as project coordinator of nationally financed project „Removal of administrative barriers along the Danube“and the CEF-financed project RIS COMEX) as well as Pro Danube International (Lead Partner for DANTE project).

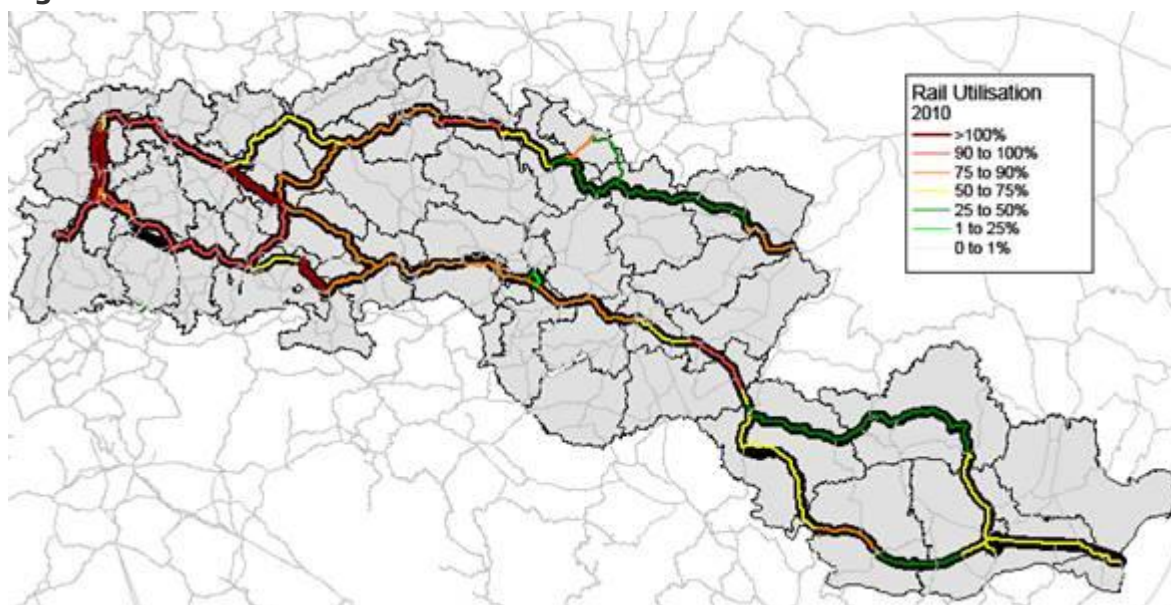
### 3 Mode specific aspects: Potential Market Uptake and Identification of unused capacities

The first step in this analysis is to look for environmental friendly transport modes with underutilised capacity. Looking at environmental transport modes, the rail and inland waterway transport modes are relevant on this corridor.

The Rhine Danube corridor demonstrates available shift capacity on rail (limited when looking at the whole corridor, see Figure 25) and waterways (abundant). Rail utilization researched in the 2014 Corridor study shows that rail reaches maximum its utilization rate (100%) on sections that are important for transport over longer distances. Further, the 2014 Corridor study shows that Waterways have abundant capacity left to take up transport from roads.

In particular, the strengths of the Danube navigation include the ability to convey large quantities of goods per vessel unit, the low transport costs, especially the case for bulk goods and its environmental friendliness. For transports of high & heavy cargo such as wind turbines, cranes, large engines are especially suitable for Danube navigation due to the availability around the clock, with no prohibition on driving at weekends or during the night. Inland navigation also has a high level of safety and low infrastructure costs.

**Figure 25: RFC rail utilisation**



Source: HaCon, Panteia

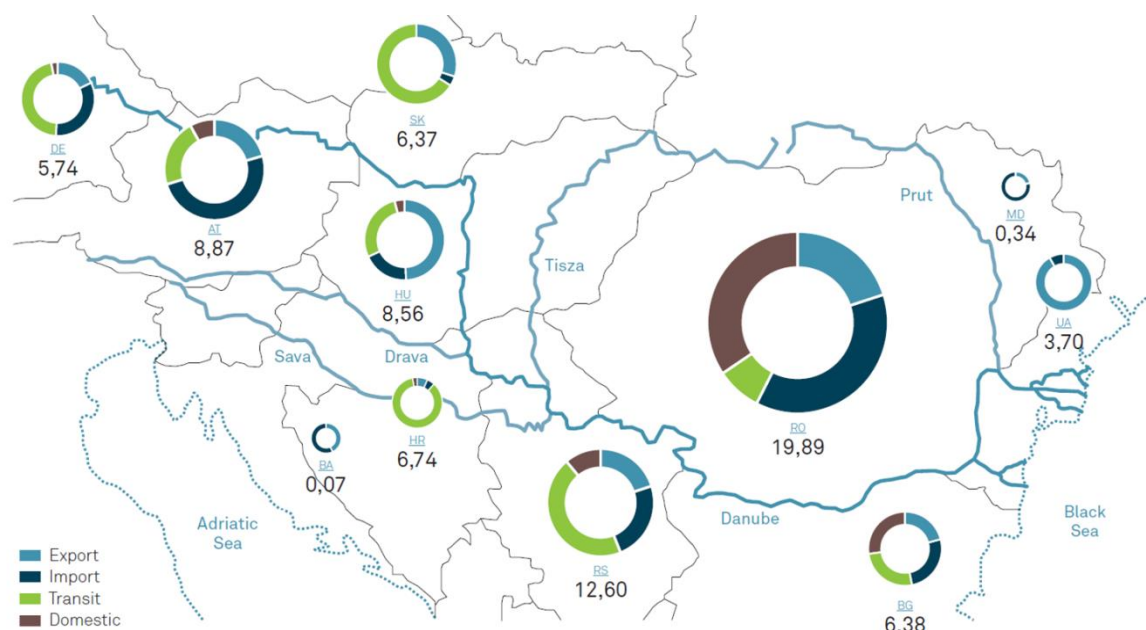
In total, nearly 38.3 million tons of goods were carried on the Danube waterway and its tributaries in the year 2015. The largest transport volume was achieved by Romania, accounting to 19.9 million tons, followed by Serbia with more than 12.6 million tons and Austria with over 8.9 million tons in 2015 (see Table 23).<sup>15</sup>

<sup>15</sup> viadonau (2017)

**Table 23: Freight transport (export, import, transit and domestic) on the entire Danube in year 2015**

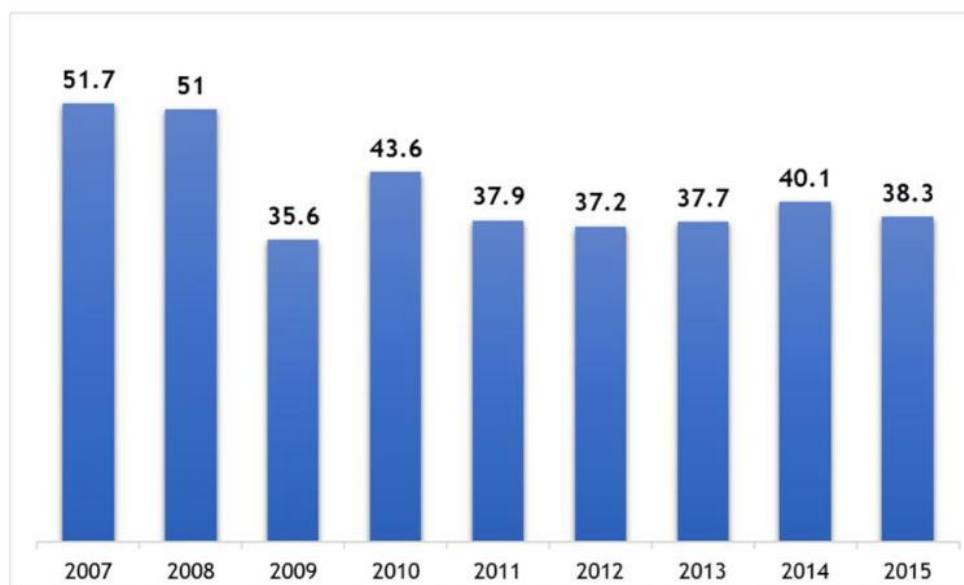
In millions of tons	DE	AT	SK	HU	HR	BA	RS	RO	BG	MD	UA
Export	1,03	1,85	2,07	4,29	0,34	0,03	2,46	3,98	1,34	0,07	3,38
Import	1,91	4,43	0,10	1,61	0,17	0,04	3,06	7,45	1,66	0,27	0,31
Transit	2,64	1,91	4,18	2,44	6,18	0,00	5,71	1,68	1,68	0,00	0,00
Domestic	0,16	0,68	0,02	0,22	0,05	0,00	1,37	6,78	1,70	0,00	0,01
<b>Total</b>	<b>5,74</b>	<b>8,87</b>	<b>6,37</b>	<b>8,56</b>	<b>6,74</b>	<b>0,07</b>	<b>12,60</b>	<b>19,89</b>	<b>6,38</b>	<b>0,34</b>	<b>3,70</b>

Source: viadonau, Annual Report on Danube Navigation in Austria 2016

**Figure 26: Freight transport on the entire Danube in year 2015**


Source: viadonau, Annual Report on Danube Navigation in Austria 2016

During the period 2007 and 2015 (Figure 27) the total cargo transport volume on the Danube River was varying nonlinearly. While in 2015 the total volume of cargo transport reached 38.3 million tons, in 40.1 million tons had been transported in 2014. In the previous three-year period from 2011 to 2013, the total volume was more similar to the 2015 value. A considerable decline of around 10 million tons was recorded from the starting value in 2007, which was the highest: 51.7 million tons. After 2008 the financial crisis became obvious also in terms of inland waterway transport statistics.

**Figure 27: Danube cargo transport volume period 2007-2015**

Note 1: Data in Million Tons

Note 2: Data for 2015 are the latest cargo transport volume data available for all countries

Source: Danube STREAM consortium, Common Danube Report 2016 based on national statistics offices

The total cargo turnover of all Danube ports was around 65 million tons in year 2015 which is an increase of 18 million tons compared to 2014 (+ 27.7 percent) as shown in Table 24. The highest cargo turnover share took place in Romania (around 10 million tons), followed by Austria and Serbia (7.4 and 6.5 million tons). The only figures regarding transshipment volume in the entire Danube region are provided by the Danube Commission. Consequently, deviations from national recorded transshipment volumes might occur due to different calculation methods.

**Table 24: Total cargo turnover of the Danube Ports for 2014-2015 (based on statistical data forms ST-12)**

in thous.t

Country	Loaded			Unloaded			Total cargo turnover		
	2015	2014	in % to 2014	2015	2014	in % to 2014	2015	2014	in % to 2014
UA	4 433,0	4 335,0	102,3	358,0	212,0	168,9	4 791,0	4 547,0	105,4
MD	..	..	..	..	..	..	..	..	..
RO (2014=2013) <sup>1</sup>	5 090,0	5 483,0	92,8	5 030,0	4 523,0	111,2	10 120,0	10 006,0	101,1
BG	1 180,0	1 491,0	79,1	3 367,0	3 020,0	111,5	4 547,0	4 511,0	100,8
RS	2 622,0	3 589,0	73,1	3 880,0	3 674,0	105,6	6 502,0	7 263,0	89,5
HR	347,0	205,0	169,3	146,0	236,0	61,9	493,0	441,0	111,8
HU	4 190,0	3 572,0	117,3	1 788,0	1 420,0	125,9	5 978,0	4 992,0	119,8
SK	1 624,0	1 937,0	83,8	113,0	184,0	61,4	1 737,0	2 121,0	81,9
AT	2 444,0	2 832,0	86,3	5 005,0	5 782,0	86,6	7 449,0	8 614,0	86,5
DE <sup>2</sup>	1 202,0	1 225,0	98,1	2 055,0	2 806,0	73,2	3 257,0	4 031,0	80,8
<b>TOTAL</b>	<b>23 132,0</b>	<b>24 669,0</b>	<b>93,8</b>	<b>21 742,0</b>	<b>21 857,0</b>	<b>99,5</b>	<b>44 874,0</b>	<b>46 526,0</b>	<b>96,4</b>
RO (2014=2013) <sup>3</sup>	..	5 483,0	..	..	4 523,0	..	30 020,0	10 006,0	300,0
<b>TOTAL</b>							<b>64 774,0</b>	<b>46 526,0</b>	<b>139,2</b>

<sup>1</sup> Data for 2015 by five ports: Galați, Brăila, Tulcea, Giurgiu and Harsova.

<sup>2</sup> Ports on the German section of the Danube, see "Binnenschifffahrt in Bayern im Dezember und im Jahr 2015 (2014)".

<sup>3</sup> Data from Romania for 2015 in total for all Danube ports (ST-12).

Source: Danube Commission, Danube Navigation Statistics 2014-2015 (2016)

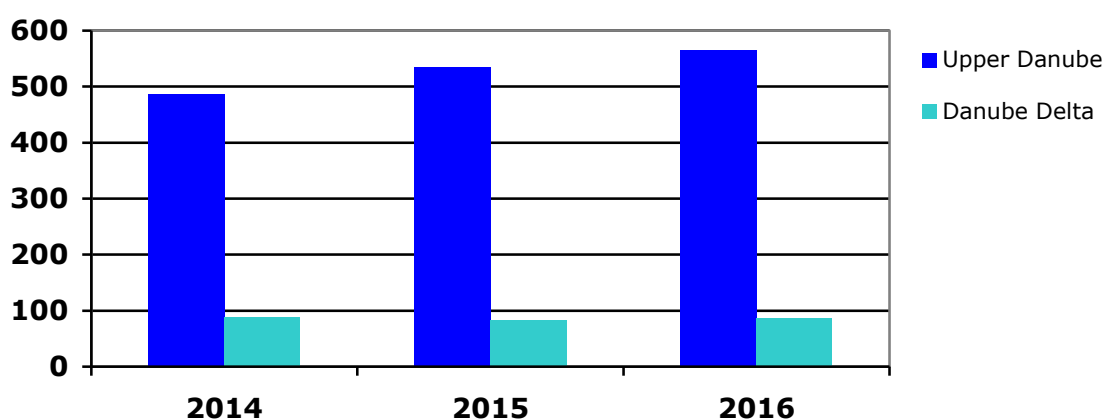


Container transport volumes on the Danube remain insignificant and made up only 0.5% in 2016, while container transport on the Rhine amounts to 13.5% of total transport volume. Several attempts have been started to establish container lines from Constanța in the direction of Beograd, Budapest, Wien and Krems but proved not to be competitive compared to rail transport. The critical mass of container volumes could not be reached due to uneven transport relations resulting in empty journeys in one direction and the low density of Container Terminals along the Danube.

Comprehensive statistics on Inland Waterway Passenger Transport for the whole Corridor are scarce. Steady increases in cruise vessels have been reported at several spots in the last years: For example, between 2010 and 2016 river cruise vessel passengers increased by 40% in Passau (314,000 passengers in 2016) and by 70% in Vienna (415,000 passengers in 2016). In particular, the number of cruising vessels increased from 70 vessels (2010) to 170 vessels (2015).

The steep rise in passenger transport is observed mainly for the Upper Danube with the most popular short trips of 5, 7 or 8 days at the relations Passau-Wien-Bratislava-Budapest-Passau and Wien-Bratislava-Budapest. Also the share in total turnover retrieved from passenger transport is remarkably high in Austria with 66%. In Hungary the share of goods transport makes up the predominant part: 73%.<sup>16</sup>

**Figure 28: Dynamics of passenger traffic on the Danube, in thousand passengers**



Source: Danube Commission, *Marktbeobachtung der Donauschifffahrt: Bilanz 2016*

The analysis of market potential of environmental friendly transport modes with underutilised capacity consists of an approach from two angles:

1. An in-depth analysis of selected promising market segments focusing on production respectively trade volumes, on the evaluation of the market potential in the Danube riparian countries and on the special transport requirements for the selected commodity groups. Following commodity groups are discussed in detail: Renewable resources, chemical products, mineral resources, building material, energy raw material (diesel and gasoil), recycling products and high & heavy cargo.

<sup>16</sup> CCNR, *Market Observation, Annual Report 2017*.



2. A macro analysis of modal shift potential for containers to identify individual transport flows that, brought together, could bring enough volume to operate a liner service between two (or more) Inland Terminals.

Passenger transport also has potential to increase but has been neglected within the further analysis, as it seems to be taken-up by the market without further supporting measures. Thus the analysis of market potential strongly focusses in freight transport.

Besides the transport price the shipper's modal choice depends especially on the characteristics of the transported goods, e.g. dimension of the cargo, the stowage factor and the potential risks. On the other hand, the modal choice for logistic providers depends on the quality of the transport service: reliability, door-to-door transit time, flexibility, safety/security, frequency, network coverage availability of loading units, information exchange, etc. These factors are particularly defined by the location of shippers, recipients, availability and quality of transport network infrastructure as well as legal and political framework.

At the end of the analysis we will highlight the measures need to be set and the lessons learned to overcome the barriers behind modal shift towards inland navigation.

### **3.1 Market potential of specific commodity groups**

#### **3.1.1 Renewable Resources (RES)**

Renewable resources are agricultural and forestry products which are intended for material, energetic use or as food as well as feedstuffs. The availability of renewable resources is, in comparison to fossil raw materials, not limited and through secure as well as constant regrowth guaranteed.

Agricultural and forestry products make up to 20% of the total volume of goods transported annually on the Danube. Despite of their dependency on weather conditions (precipitation, temperature, days of sunshine per year) and the resulting production fluctuations, agricultural goods were and are one of the most important cargo type for inland navigation for the vast majority of the Danube countries.

The following advantages of Danube navigation can be highlighted for agricultural and forestry products, according to their typical characteristics and special transport requirements:

- Cost efficient transport solution, especially for bulk cargo
- High volume of renewable resources along the Danube axis, vast agricultural areas in the vicinity of ports and terminals
- High loading capacity of Danube vessels compared to truck and railway
- Reliable partners in Danube navigation with many years of experience in establishing transport chains for these products
- High density of Danube ports with efficient handling and storage facilities for agricultural and forestry products along the Danube. From Kelheim (Germany) to the Black Sea there are more than 50 transshipment locations with adequate equipment, either ports or sites, for agricultural and forestry products.

More than 50 Danube ports have appropriate handling equipment for agricultural products and forestry (transshipment services for renewable resources) as shown in the figure below. The majority of handling locations is located in the Upper and Middle Danube. It is also notable that transshipment locations along the Danube correspond to the areas of cultivation (as illustrated in Figure 29).

**Figure 29: Danube ports and transshipment sites for renewable resources**



**Agricultural products in the Danube region**

Renewable resources are traded in great quantities by Danube countries: Large importers of agricultural goods are Austria and Germany while countries in the Middle and Lower Danube (Hungary, Serbia, Romania, Bulgaria and Ukraine) are predominantly exporting these goods.

A huge share of European growing areas of agricultural goods is located within the vicinity of the Danube as shown in the map below.

**Figure 30: Growing areas of agricultural goods and forestry products**



Starchy agricultural products such as wheat or maize are processed in the food and fodder industry as well as in the paper and pulp industry. Further application areas are the chemical and textile industry, pharmaceutical industry and the bioethanol production. In total, eight bioethanol plants with a production capacity of round 1 million m<sup>3</sup> are located in the vicinity of the Danube River. The inland navigation has the potential to become an important transport mode for the delivery of e.g. starchy agricultural products.

Oilseeds such as sunflower, soya and rape are also used in various industries: chemical, bio-based synthetic materials, lubricants, pharmaceutical and biofuel industry. Rape and sunflower are the base products of biodiesel with press cake or seed meal as important by-products which can be used as feed, the catalyser as fertilizer and the glycerol can be used as an important substance in the pharmaceutical industry.

The production of biodiesel in all Danube countries accounted for more than 6.3 million tonnes in 2014<sup>17</sup> - an increase of 100% compared to 2013 - and the transport of the oilseeds as well as biodiesel and by-products can be easily facilitated by inland navigation.

Having in mind the target of a 10% share of renewable resources in transport according to the EU "Directive on the promotion of the use of energy from renewable sources" but also the diversified utilization possibilities of esp. bioethanol, biofuels production companies will become increasingly important in the future.

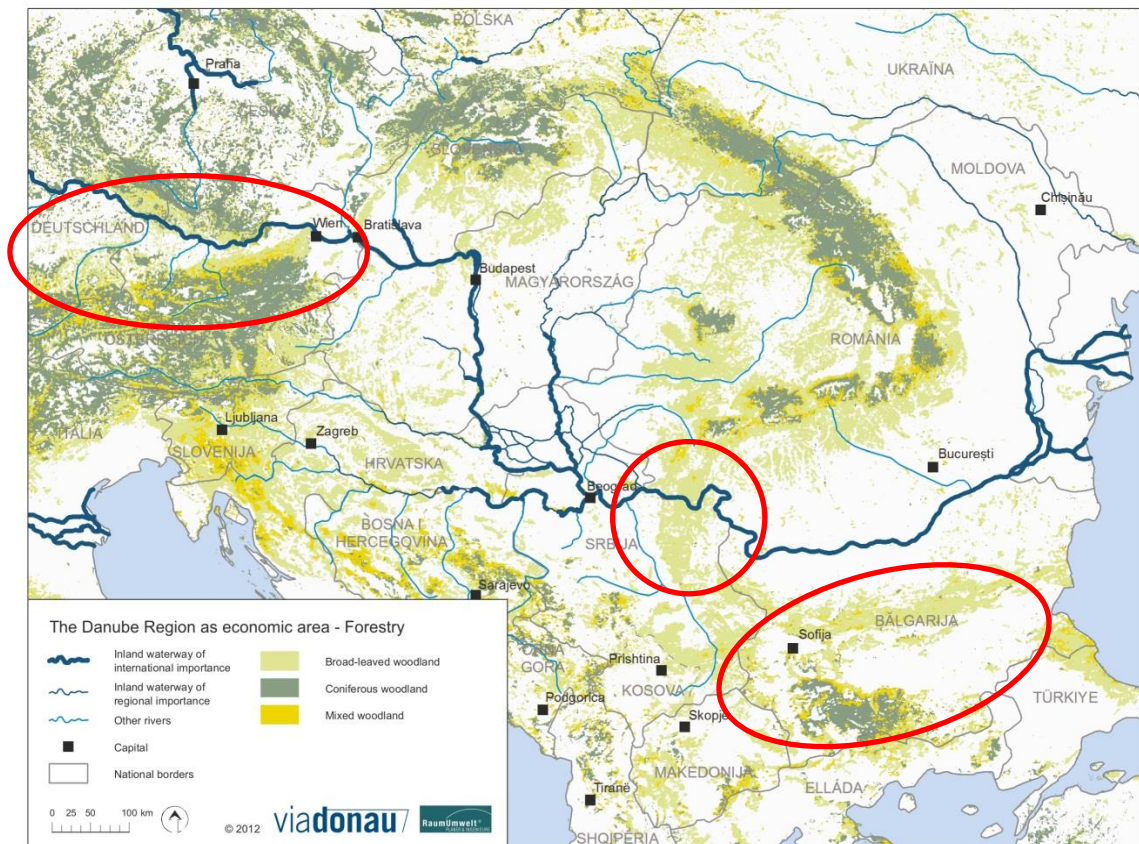
### **Forestry products**

Forestry products are used for material (wood-based panels, plywood, construction material and furniture) as well as for energy production (pellets, fuel wood and chips). Since 1990 forestry areas increased between 13% and 20% (or stayed stable) in the Danube region. There are three important forest areas which are located in the vicinity of the Danube River: Austria/Bavaria, Serbian/Bulgarian/Romanian border area and in Bulgaria, in the south of the river (highlighted in red, see Figure 31).

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<sup>17</sup> *European Biodiesel Board (2017)*



**Figure 31: Forest areas in Danube region<sup>18</sup>**

Wood based products for material and for energetic use are traded in large volumes in the Danube region. The basic wood product is round wood which is used as raw material for the sawn industry, industrial wood and for energy purposes. Wood for energetic use such as wood briquettes and pellets play also an important role when evaluating the potential of inland waterway transports.

Having in mind the EU2020 goals towards increased use of renewable resources as expounded in the introduction of the chapter, advantages of pellets as energy source should be emphasized at this point:

- Pellets can save up to 50% of energy costs from fuel oil and natural gas;
- Pellets are bundled energy: 1 kg pellets equal 4.9 kW → 2 tonnes pellets equal 1,000 litres fuel oil;
- With efficient heating boilers 90% of the pellet energy be processed to heat;
- CO<sub>2</sub> emission during the burning process equals the absorption of CO<sub>2</sub> during the wood growth period;
- Pellets origin from renewable resources, namely wood.

There are more than 300 pellets producers in the Danube countries with a total capacity of more than 8 million tonnes per year. The capacity is however not exploited since the actual production accounted for 4 million tonnes in 2012. The greatest demand for pellets is given in Germany (esp. Bavaria) and Austria. The reason for that might be the large imports to Europe from the US, which are transported to Central European countries via ARA (Amsterdam-Rotterdam-Antwerp) ports. Nevertheless,

<sup>18</sup> © viadonau

there is a great unused potential in the sector due to existing forest areas in the vicinity of the Danube, the great number of producers and growing demand in the European Union.

### Transport requirements

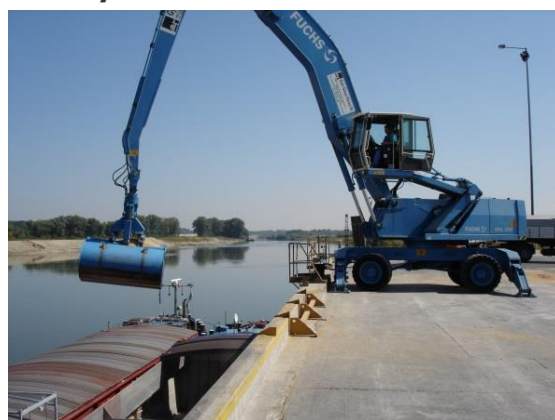
Agricultural products are mainly transported as bulk and are transhipped with grabbers and/or suction equipment. Forestry products such as round wood, wood-based panels and sawn wood are defined as break bulk and require grabbers, hooks for palettes, etc. Renewable resources are in general sensitive to moisture and mechanical damages which can be caused by inappropriate handling.

In order to ensure a high level of service, ports' handling equipment and storage equipment must be available along the Danube.

**Figure 32: left: Transhipment of round wood; right: Transhipment of agricultural products in Győr Gönyü**



© Mierka Donauhafen Krems;



© viadonau

If agricultural products are shipped as food products (e.g. wheat, maize, soybeans, etc.), special attention must be paid to the condition of the load compartment, which has to be clean and dry. Residues of previous non-compatible cargo, e.g. genetically modified products, or diverse pest, e.g. grain beetles, may contaminate the load compartment. Therefore, attention must be paid to the latest three previous cargoes and the method of cleaning after the last cargo. At least wet cleaning may be required.

If agricultural products are to be transported under GMP (Good Manufacturing Practice) regulation, all storage facilities, handling equipment as well as transport vehicles throughout the whole transport chain must be GMP certified.

Round wood should be protected from humidity in order to prevent quality loss and tonnage variations. For transhipment of round wood, grabbers are suitable.

Pellets are either transported as bulk cargo or in bags. Transhipment of pellets requires caution in order to prevent damages. This cargo can be handled with pneumatic pumps which is recommendable or with cranes and grabbers. Pumps have the advantage of optimal cargo transportation speed and of elimination of dust formation.

**Figure 33: Types of storage facilities<sup>19</sup>**

Types of storage facilities			
Construction	Open	Covered	Special warehouse
Examples	Open storage in ports, container depots	Special warehouse for oversized goods, warehouse for general cargo	Grain silos, liquid cargo tanks, dangerous goods and cold storage
Types of goods	Coal, ore, containers, gravel etc.	General cargo on pallets, carton packed goods, paper rolls etc.	Grain, soya, gasoline, oil, liquid gas, chemicals etc.

Source: via donau

**Figure 34: Transhipment equipment<sup>20</sup>**

Cargo					
General cargo or break bulk				Bulk cargo	
Roll-on-Roll-off e.g. cars	High and heavy goods	Container	Other general cargo e.g. big bags	Dry bulk e.g. coal, ore, grain	Liquid bulk e.g. crude oil
Ramp	Hook, grabber, spreader, rope			Grabber	Suction equipment Pump
Transhipment					

Source: via donau

Transhipment by type of cargo

<sup>19</sup> viadonau (2013)

<sup>20</sup> viadonau (2013)

### 3.1.2 Chemical products

Another major sector of promising commodity groups constitutes the fertilisers which are currently being transported in large quantities on the Danube. These account for example approximately 10% of the total transport volume on the Austrian stretch of the Danube. Plants from the petrochemical industry are often found in the immediate vicinity of refineries; these plants manufacture plastics and other oil-based products from the oil derivatives. Due to its great bulk freight capacity Danube navigation is also the ideal solution for this market segment. However, economical concepts for pre- and end-haulage are required here. Combined transport represents an attractive alternative for integrating the inland vessel into the logistics chain of the chemical industry in addition to the construction of warehouses for bulk cargo.<sup>21</sup>

The European chemical industry is one of the largest industries in global scale and ensures the supply of chemical products for various economic sectors. The chemical industry plays an essential role in providing all manufacturing sectors, as well as construction, health and agricultural sectors, with essential products and services.

In respect to inland waterway transports, fertilizers are one of the suitable cargo groups for inland navigation transport and are already transported on the Danube in respectable volumes.

The European Chemical Industry Council (CEFIC)<sup>22</sup> conducted a survey among large chemical companies and logistics service providers in order to identify main chemical transport corridors and volumes as well as bottlenecks and barriers in terms of intermodal transport. According to the survey about 1.4 million tonnes may be shifted towards intermodal transport solutions, if the requirements would be met.

With regard to Danube navigation the identified intermodal flows of more than 200,000 tonnes per year towards Turkey and Russia are relevant and should be considered as a great opportunity for IWT. Another reason for fostering the modal shift to IWT is that the European Union<sup>23</sup> aims at shifting 30% of road freight over 300 km to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050.

#### Transport requirements

In this section transport requirements only for fertilizers such as ammonium nitrate or urea are described. Fertilizers are usually transported as bulk or bagged cargoes. Fertilisers are liable to deterioration following moisture ingress and should be stored as soon as possible.<sup>24</sup>

When shipping ammonium nitrate as cargo, explosion may be caused by ignition or heating and it should not be stored with inflammable substances or certain fertilizers, especially urea. Ammonium nitrate has a critical relative humidity of 59.4 %, above which will absorb moisture from the atmosphere. Therefore ammonium nitrate should be shipped in dry containers.

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<sup>21</sup> *viadonau (2013)*

<sup>22</sup> *CEFIC (2014)*

<sup>23</sup> *European Commission (2014)*

<sup>24</sup> *Cargo Handbook (2014)*



**Figure 35: Granular ammonium nitrate as fertilizer**<sup>25</sup>

Urea is the most used nitrogen fertilizer in the world and also the most concentrated fertilizer which is usually available as granulated form and therefore suitable for IWT transport. Urea can be shipped in bags or bulk and is a moisture sensitive cargo. Contact with alkaline materials such as basic slag or lime must be avoided. Cool storage should be ensured in order to prevent emission of toxic gases due to heating.

**Figure 36: Granular urea as fertilizer**<sup>26</sup>

### 3.1.3 Mineral resources and mineral oil products

This group covers a wide range of different products which are applicable in a wide range in business sectors:

- Non-metallic mineral resources;
- Metallic mineral resources.

#### Non-metallic mineral resources

The commodity group non-metallic mineral resources consist of aggregates (sand, sandstone, limestone, etc.) and derived products (such as cement) which are mainly used in the building industry for foundations, roads, drainage, asphalt, etc.

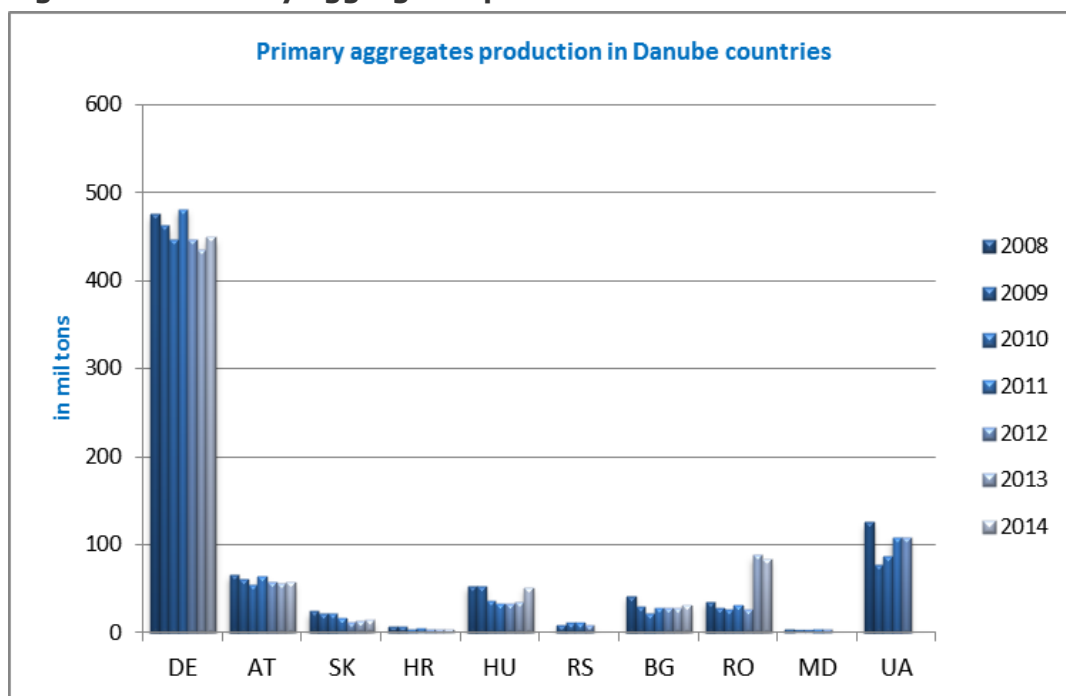
<sup>25</sup> <https://sc02.alicdn.com/kf/UT8GEu8XxRaXXagOFbXH/Calcium-Ammonium-Nitrate-CAN-.jpg> (2017-05-15)

<sup>26</sup> Brissi Ltd. (2015)



The building industry in the Danube region is characterized by stable production volumes, as illustrated below. It is expected that construction activities in Central and South East Europe will increase and will lead to a higher demand for construction materials in the Danube region. This is due mainly to the high requirements of renovating and expanding the infrastructure, although structural and civil engineering as well as residential construction also play a significant role.<sup>27</sup>

**Figure 37: Primary aggregates production in Danube countries**



Note: no data available for RS, MD and UA in the years 2013 & 2014.

Germany's aggregates production of more than 400 million tonnes covered more than half of the total output in the entire Danube region, followed by Ukraine with 100 million tonnes in 2012. Germany is also the largest importer and exporter of aggregates, whereby Ukraine is mainly dominating the exports of these goods.

Cement is a mineral-based product which is primarily used in the production of mortar and concrete. Numerous production sites are located in the vicinity of the Danube River.

Although transport of aggregates via inland waterways is nowadays common practise there is still great potential due to the large unused trade volumes of this cargo group.

Imports of raw material such as magnesia and bentonite from Turkey to Central Europe offer great opportunities for the inland navigation sector as well as

Road transport still plays a predominant role for this cargo while benefits in terms of costs deriving from the bulk capacity of inland vessels offer unused possibilities. Inland vessels could be used here for both bulk cargo (e.g. bentonite, limestone, cement, etc.) as well as general cargo (e.g. construction machinery, cranes, etc.).

### Transport requirements

Non-metallic mineral resources cover numerous different products which require heterogeneous transport conditions. A small extract is summarized in the table below.

<sup>27</sup> viadonau (2013)

**Table 25: Logistics requirements non-metallic mineral resources**

Product	Usage	Stowage factor	Transport	Transshipment	Storage	Potential risks
Bentonite	Bentonite is hydrophilic: surface Impoundment of tunnels and other embankments, cat litter, used in the agricult. and food industry	1,14 m <sup>3</sup> /t (bulk)	- Big bags - bulk	hook (grabber)	Covered storage – keep dry	Moisture Contamination
Magnesite/ Magnesia	sintered magnesite – bricks: used for high-grade ceramic refractory products for industrial high-temperature processes, production of cement	0,5 - 1m <sup>3</sup> /t (big bags)	- Big bags - bulk	hook (grabber)	Keep dry	Moisture
Slag	road construction, iron and steel production,	0,9m <sup>3</sup> /t	bulk	grabber	Open /covered	No risks: not flammable, waste or recycling product?
Lime/ limestone	production of cement, iron and steel production, road construction, paper and pulp industry, chemical industry	0,67- 0,84m <sup>3</sup> /t	- Big bags - bulk	Grabber, pneumatic equipment, hook	Covered storage – protect from moisture	caustic lime mixed with water can cause heat development

Source: viadonau

### 3.1.4 Metallic mineral resources

In this section, metallic mineral resources comprise following product groups: metallic raw material, iron ore (rocks and minerals from which metallic iron can be extracted) and semi-finished steel products such as blooms, ingots and billets.

Iron ore is predominantly used for steel production. Approximately 98% of the mined iron ore is processed in blast furnaces, together with scrap metal, limestone and coal. In addition, iron ore is also used in the construction and transport industry e.g. in automobiles, trucks, trains.

The iron ore deposits in the Danube region are centred in Ukraine, since Ukraine has about 30 billion tonnes of iron ore deposits which represent the largest extraction potential worldwide. Ukraine is also the leading European iron ore producer and outlines Ukraine as a major player on the global scale (Ukraine holds 4% in the total world production and is the sixth largest iron ore conveyer).<sup>28</sup>

<sup>28</sup> US Geological Survey

In total, Ukraine exported round 35 million tonnes iron ore of which 9 million tonnes were shipped to Danube countries in 2012. The most relevant target markets were Austria and Slovakia with a share of 70%.

The largest Austrian steel producer “voest alpine” receives iron ore to a large share extent from Ukraine and to a small share from Romania via inland navigation.

In Slovakia, the transshipment of iron ore between rail and waterway plays also a big role.

### **Transport requirements**

Iron ore can be shipped as fine powder, pellets or lump whereby in e.g. Austria the transport of iron ore pellets has with more than 60% the highest share in inland navigation, followed by iron ore fine powder with a share of round 30%.

The cargo is not sensitive to moisture and temperature and can be handled with grabbers.<sup>29</sup>

### **Figure 38: Iron ore**



© www.voestalpine.com

### **3.1.5 Steel products**

The largest crude steel producers are Germany, Ukraine and Austria. The export activities of steel semi-products such as ingots, coils, plates is focused on Ukraine as the most important exporter with an average share of 80% in the entire Danube region. Imports are mainly realized through Germany while the remaining Danube countries import varying annual quantities.

### **Transport requirements**

Risk factors during transport and transshipment for all mentioned steel products are corrosion resulting from moisture, mechanical damage and contamination or defilement. Cargo handling should be carried out in dry weather or under cover, due to moisture sensibility of the products.

In general three types of steel are transported via waterways in large quantities: sheets, roiled sections and small section material, rods and wire. Steel sheet is mainly carried in the form of coils, but smaller quantities are frequently carried in packs.

Steel coils are especially sensitive to mechanical damages. Consequently, special equipment should be used such as C hooks, coil lifters, vertical coil lifters, coil mandrels, webbing slings, chain slings.<sup>30</sup>

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<sup>29</sup> Cargo handbook (2013)

<sup>30</sup> CargoHandbook (2016) & TIS-Transport Information Service (2017)

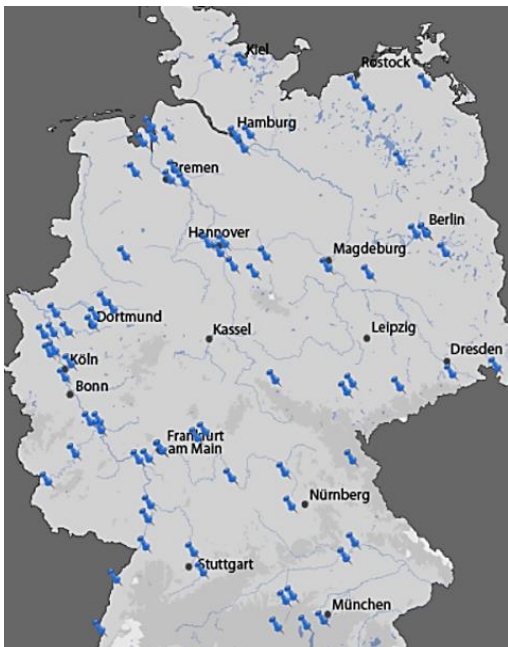
**Figure 39: Transhipment of steel coils**

© viadonau

### 3.1.6 Energy raw materials - diesel and gasoline

In the Danube region, the total output of diesel production is accounted for 60 million tonnes in 2012, while 43 million tonnes of diesels were produced in Germany. Production in the remaining markets did not exceed 4 million tonnes in the same year.

Petroleum products which are intended for export or import are mostly stored in tank farms for some time after being distributed via pipeline or trucks to gas stations or industrial plants. Only in Germany, there are 40 tank farms which are located in the vicinity of a waterway (Danube, Rhine and Main).

**Figure 40: Tank farms in Germany<sup>31</sup>**

In the remaining Danube countries, numerous tank farms also have attractive locations for inland waterway transports.

<sup>31</sup> viadonau (2014)

Even though inland navigation is an integral part for petroleum products in some countries there is still potential for improvement and intensification left.

### **Transport requirements**

Petroleum products are transported in tankers which have to fulfil certain requirements. According to the UNECE "European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways" (ADN), diesel and gasoline are classified as dangerous goods. Consequently, special transport conditions are required for this product. Furthermore, ADN requires double hull transport vessels, which should prevent leakage of petroleum products into the water in case of ship damages.<sup>32</sup>

#### **3.1.7 Recycling products**

Recycling products such as used materials and waste are bulk goods of relatively low value and inland navigation is a very promising alternative to road and rail for waste management. Recycling means the extraction of raw materials from waste, their return to the economic cycle and application in new products. Products suitable for recycling are in particular scrap glass, waste paper and waste wood, plastics as well as scrap metal such as iron, non-ferrous metals which arise in households, production and processing sites as well.

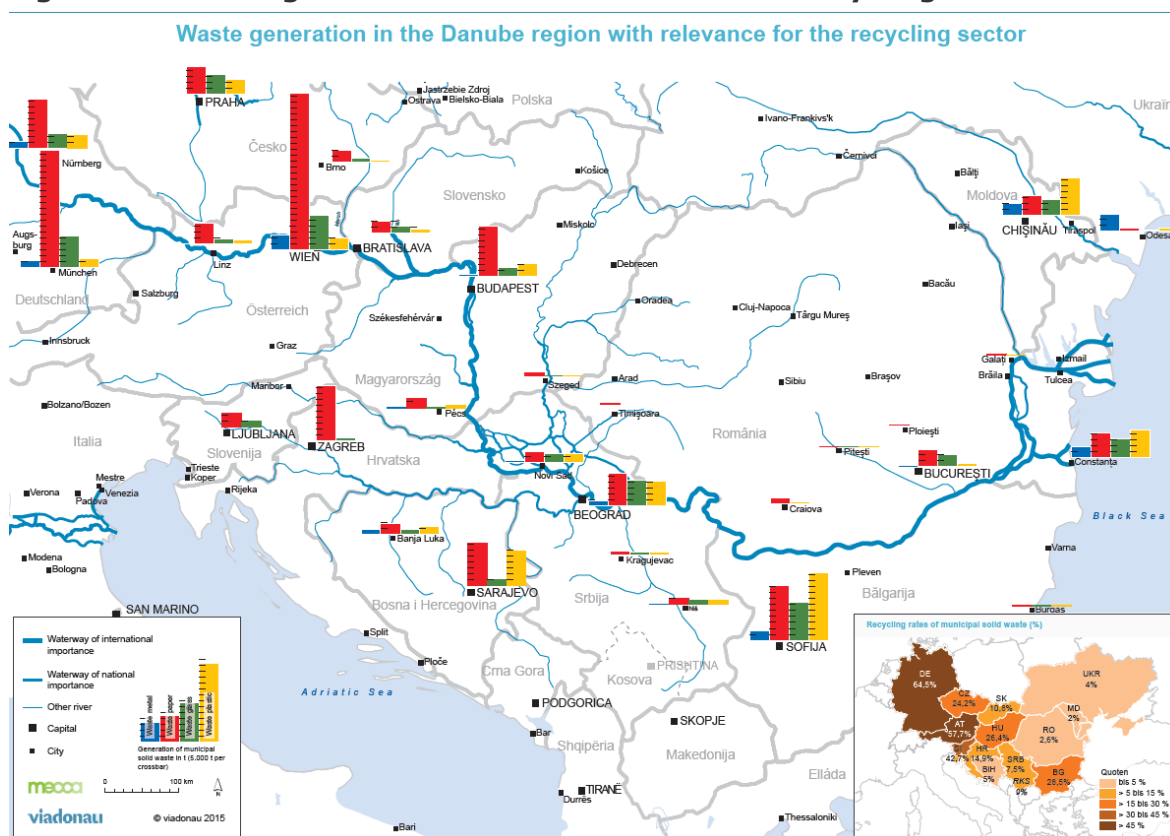
Raw materials will be preserved by recycling increasingly due to rising global resource scarcity. Therefore special attention should be paid on this cargo group. For that reason the EC proposed the increase of recycling rates for paper, plastics, wood, scrap metal and other waste-related targets in the EU Waste Framework Directive 2008/98/EC, the Landfill Directive 1999/31/EC and the Packaging and Packaging Waste Directive 94/62/EC. According to the EC legislative proposal recycling rates should reach 90 % for paper by 2025, 60% for plastics, 80% for wood and 90% of ferrous metal, aluminium and glass by the end of 2030.

There are several reasons for inland navigation to be considered as a suitable means of transport for these goods:

- Growing demand for secondary raw materials,
- Recycling products are globally traded goods,
- High cost sensitivity of recycling products and little time-sensitive transportation,
- Ability to convey large quantities of goods per unit,
- Environmental performance of inland navigation.

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<sup>32</sup> *Observatory of European Inland Navigation (2017)*

**Figure 41: Waste generation with relevance for the recycling sector<sup>33</sup>**

Recycling products in general are especially suitable for inland waterway transport due to several favourable characteristics of the cargo group: Recycling products are of low value and therefore, require low transportation costs in order to ensure economic efficiency. On the other hand, recycling products are mostly destined for primary storage and for that reason no time-sensitivity of the product group is given, which would otherwise question the suitability of inland navigation. Finally, there is a huge potential for increase of recycling rates in all Danube countries with the exception of Germany and Austria and it can be expected that the efficient collection, processing and transportation of recycling products will become more and more important in these countries in future.

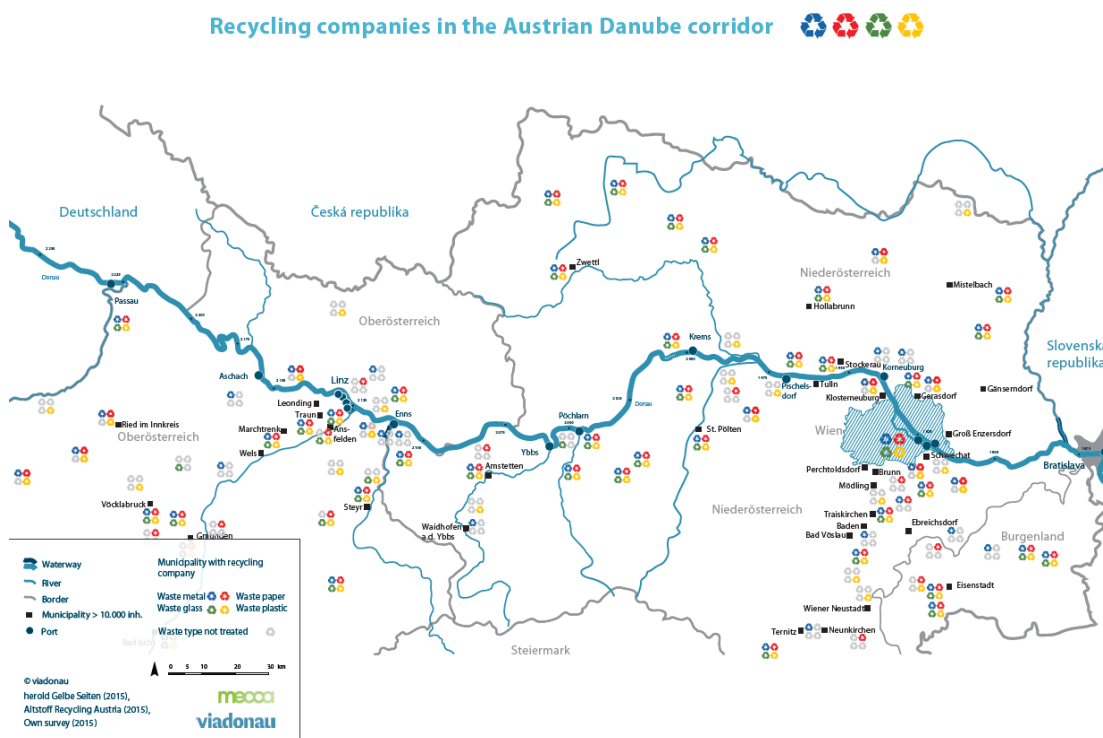
The major urban areas located directly on the Danube (e.g. Vienna, Bratislava, Budapest and Belgrade) are reliable suppliers of waste metal, household refuse and other waste materials.

For example, numerous Austrian recycling companies (with focus on recycling of metal, glass, plastic and paper) are located within vicinity of the Danube River as shown below. Energetic utilisation by waste power plants is also leading to an additional demand for the transport of waste.<sup>34</sup>

<sup>33</sup> © viadonau

<sup>34</sup> viadonau (2013)



**Figure 42: Recycling companies in the Austrian Danube corridor (types of waste: waste metal, waste glass, waste plastic, waste paper)<sup>35</sup>**

The identification of recycling companies in the vicinity of the Danube River in all Danube riparian countries was conducted in the framework of the Austrian market survey carried out by the Austrian Institute for Spatial Planning (ÖIR, only in German language). The different types of waste (metal, paper, glass and plastic) are discussed in detail in the following sections.

### 3.1.8 Scrap metal

Round 15 million tonnes of scrap metal were exported from Danube countries in total in 2012 while imports reached amounted 7.2 million tonnes. These quantities prove that inland navigation does have large potential especially in regard to its characteristics and its suitability for inland waterway transports. It has to be mentioned that the scrap metal market is volatile and that supply and demand are exposed to frequent changes. Nevertheless, this does not minimize the possibilities which are offered to inland navigation in this sector.

An interesting target market for scrap metal is Turkey, the largest worldwide importer with 19 million tonnes in 2014. More than 3 million tonnes were exported to Turkey from the Danube countries in 2014, however inland navigation is not used in a satisfactory amount for these transports. The main reason might be the difficult bundling possibilities of small amounts in order to achieve the adequate quantity for inland waterway transports. Scrap is mainly collected regionally all over the countries where without achieving sufficient volumes for IWT. For that reason information and knowledge transfer and cooperation between the stakeholders in this sector is essential.<sup>36</sup>

Figure 43 shows the locations of all primary steel making locations in the entire Danube region.

<sup>35</sup> © viadonau

<sup>36</sup> Report on market potential and up-take measures for the Danube Region



**Figure 43: Primary steel making locations in the entire Danube region<sup>37</sup>**

### Transport requirements


Inland navigation is particularly suited for transporting cargo of low value in large volumes. Metal scrap is usually transported as bulk; however, container shipping is becoming more important in regard of maritime global trade. Bulk transports allow visual inspections of the cargo and the identification of apparent hazards and potential danger factors.

Metal scrap in the form of borings, shavings, turnings, cuttings, dross is liable to self-heating and to ignite spontaneously due to oxidation processes (rust) and the resulting heat. In case the material is wetted and or contaminated with oil the oxidation process will be speeded up. These high temperatures may cause damages to the steelwork of the vessel.

Metal scrap is often stored outdoor, as for instance in the port of Straubing-Sand in Germany. The equipment used for transshipment of metal scrap includes predominantly grabbers.

<sup>37</sup> © viadonau

**Table 26: Logistics requirements metal scrap**

Scrap type	Transport	Transshipment	Processing	Storage
<b>„Problematic scrap“:</b> automotive scrap, consumption scrap (mixed and collective scrap), industrial packing material  <b>„Unproblematic scrap“:</b> machine and plant scrap, demolition scrap	- compressed - loose  Consider the GMP guidelines when transporting scrap glass & small-scale scrap metal!	- polyp grabber - electro round magnets - bucket grabber	- shredder plant - scrap shear - scrap mill - scrap and metal press - burner    - increase in bulk weight (charge-ready commodity) - purity	- open and closed (depending on the extent to which scrap and scrap metal can be exposed to the weather; depending on quality and type of metal)

Source: viadonau

**Figure 44: Left: Metal scrap in the Port of Straubing-Sand (DE) | Right: Transshipment of metal scrap**


© Donauhafen Straubing-Sand,



© Dortmunder Hafen AG

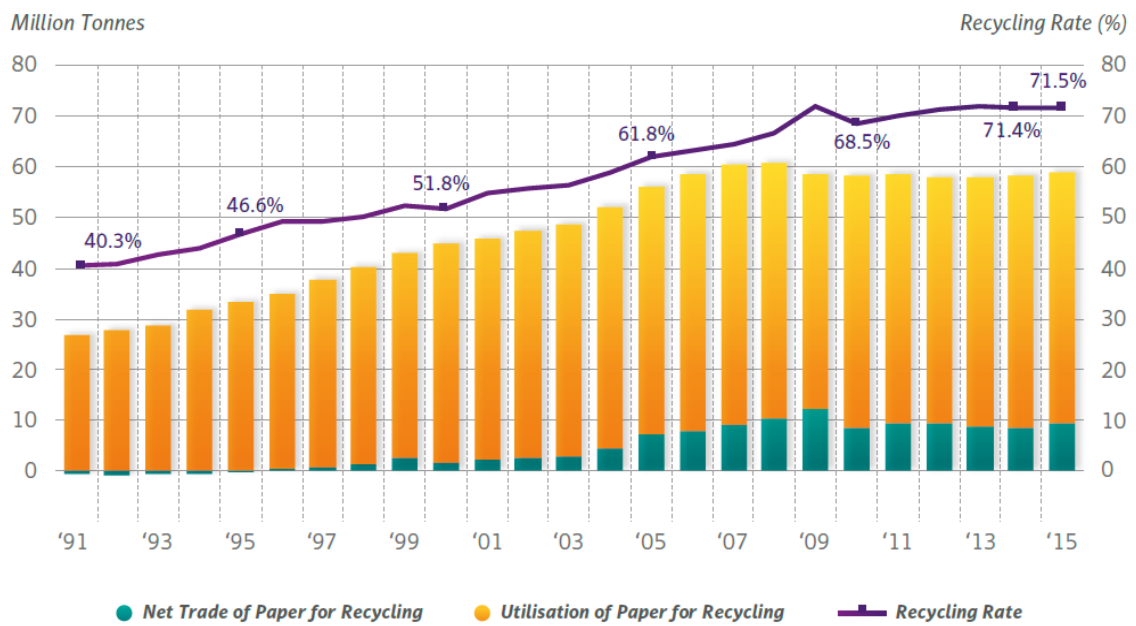
### 3.1.9 Waste paper

Germany and Austria are the dominating traders of this commodity in the Danube region with shares up to 70% of the total trade volume (4 million tonnes of exports and 6 million tonnes of imports). These two countries are the most relevant trading partners for each other among all Danube countries, however despite of the high volumes, IWT does not have the relevance as one might assume. The total recycling rate and the total net trade respectively the utilisation of paper in Europe is presented in Figure 45.

The reason for this circumstance can be surely compared to scrap metal and other recycling products namely the missing bundling possibilities due to regional or local collection across the entire countries. Cooperation platforms for the recycling business should be established in order to demonstrate the potential and provide platforms for positioning of inland navigation.

As for all recycling products, not only collection but also delivery of the cargo to the processing sites should be cost-effective.

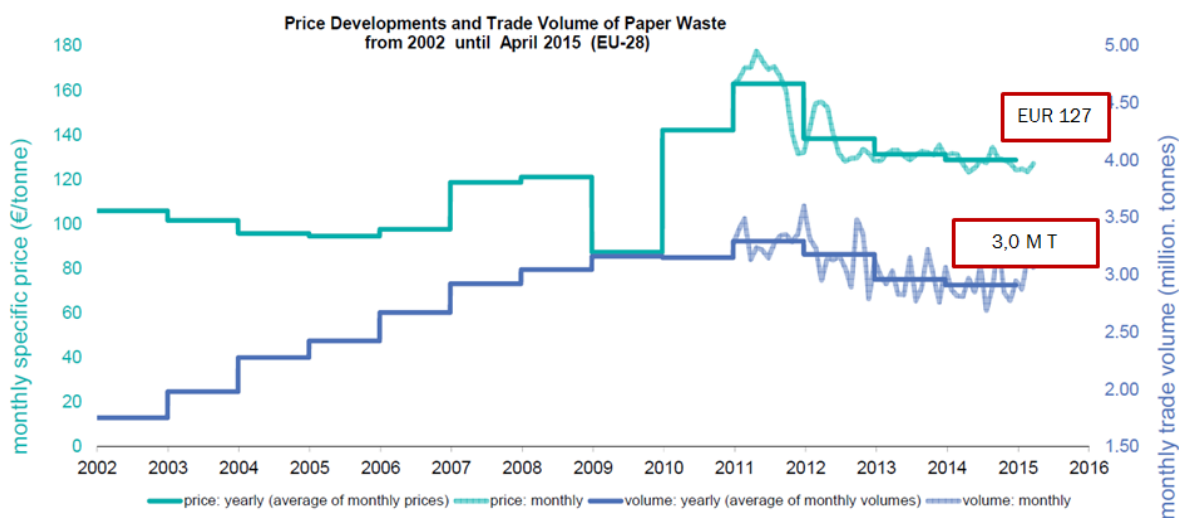
**Figure 45: Utilisation, net trade, recycling trade of paper for Recycling in Europe (= EU-28 plus Norway and Switzerland)<sup>38</sup>**



<sup>1</sup> Recycling Rate = "Utilisation of Paper for Recycling + Net Trade of Paper for Recycling", compared to Paper & Board Consumption  
<sup>2</sup> Europe means EU-28 countries plus Norway and Switzerland

The graph below underlines that waste paper is a commodity which is traded on European level. Since 2012 the monthly traded volumes accounts for round 3 million tonnes in EU28. These volumes require consequently, transport solutions which should include inland navigation due to already mentioned advantages.

<sup>38</sup> CEPI (2016)

**Figure 46: Price developments and trade volume of paper waste from 2002 until April 2015 (EU-28)<sup>39</sup>**

Extraction from the Foreign Trade Statistics:  
17/07/2015, Update price indicator: 20/07/2015 , General Disclaimer of the EC



### Transport requirements

Before waste paper is strapped with wire it is pressed together into bales. Waste paper should always be protected from humidity (rain and snow) during storage and transshipment due to risk of spontaneous combustion.

Damage of bales and wires should be avoided in order to ensure the compression of the bales during the transport.<sup>40</sup>

**Table 27: Logistics requirements waste paper**

Waste paper type	Transport	Transshipment	Processing	Storage
cardboard, telephone books, newspapers, magazines, beverage box packings	- pressed into bales - strapped with wire	- Depot containers, emptying containers or lattice boxes - Polyp grabber/ traverse with hooks - do not bale the straps as they can break - protect against moisture	- sorting and disposal systems - pressing - dispersing machines - shredders and kneaders - bale press	- Open/covered storage - Dry - Increased risk of fire

Source: viadonau

<sup>39</sup> © Eurostat

<sup>40</sup> Cargo Handbook (2012)

**Figure 47: Left: Storage of waste paper Right: Transshipment of waste paper in Ennshafen (AT)**



© www.eu-recycling.com



© Ennshafen

### 3.1.10 Used Glass

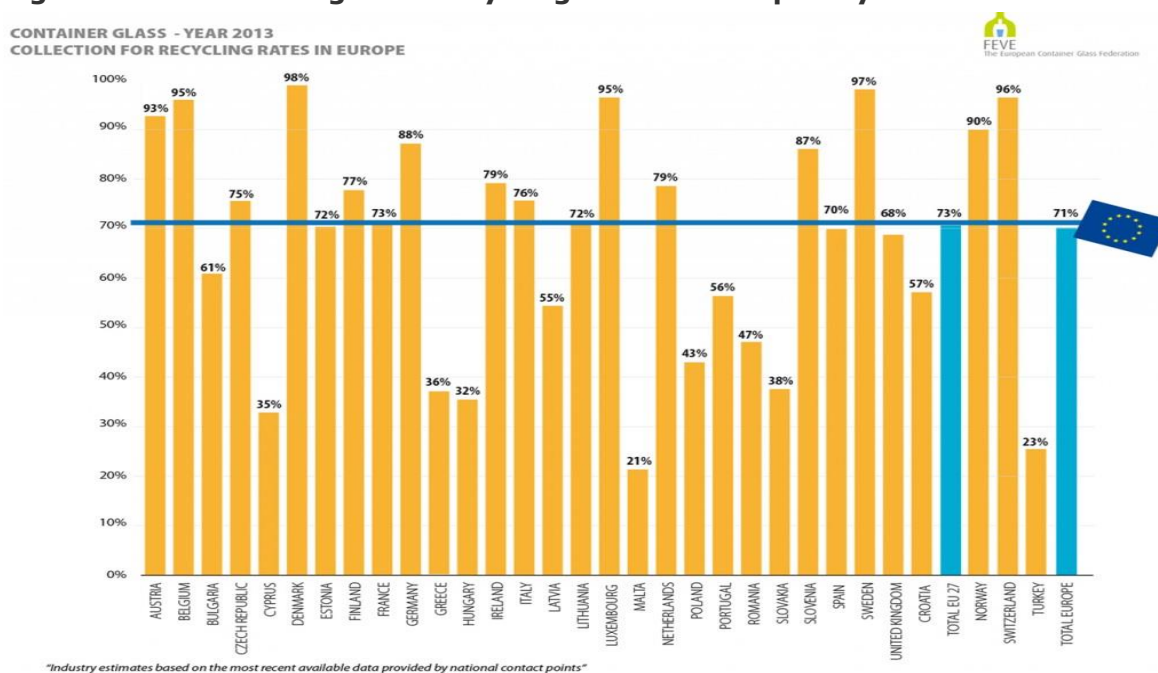
Glass has a recycling rate of 100% and can be recycled endless times. The quality of the recycled glass does not decrease in the course of time which is a unique characteristic in comparison to any other food and beverage packaging alternative.<sup>41</sup>

From 1990 to 2012 European glass products consumption rose by nearly 40% however, glass recycling even increased by 130% in the same period of time. Consequently, more than 189 million tonnes raw materials were saved and 138 million tonnes of glass waste did not end up in landfills. In the entire EU-28 region 22 million tonnes of used glass are recycled and reused per year.

The leader in glass collection for recycling in the Danube region was Austria with 93% followed by Germany with 88% while Hungary's rate accounted for 32% which was one of the lowest rates in the whole European Union (see Figure 48).<sup>41</sup>

<sup>41</sup> The European Glass Container Federation – FEVE (2015)



**Figure 48: Container glass - recycling rates in Europe in year 2013<sup>42</sup>**

## Transport requirements

Small amounts of stained glass have the ability to colour large volumes of white glass (1 green bottle can colour 500 kg white glass). For that reason, used glass should be separated in order to enable a smooth recycling process. Furthermore, used glass should be protected from humidity since unfavourable chemical processes during the recycling process may occur from high water content. The entire logistic chain should ensure protection from contamination and water respectively snow ingress.<sup>43</sup>

Used glass is mainly transported as bulk. Equipment for transshipment includes mainly grabbers.

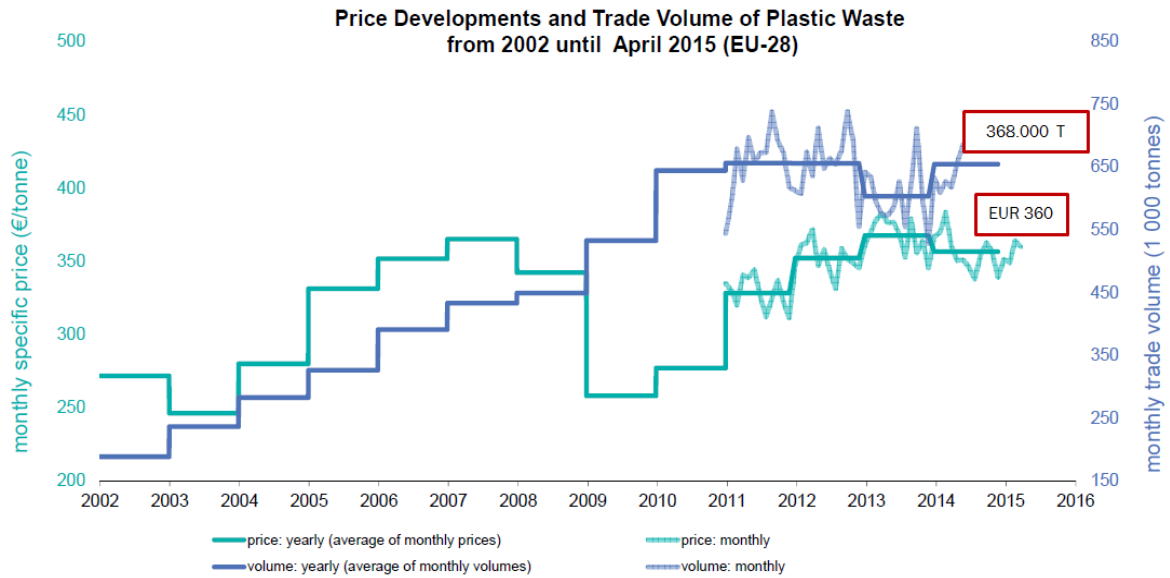
### 3.1.11 Plastic Waste

Plastic waste covers different types of plastics, such as thermoplastic (plastic bags, packaging, technical parts (industry), thermosetting plastics (such as glass-fibre reinforced plastic or car body parts) or elastomers (rubber bands, car tires or hygiene articles). The collected volumes of plastic waste amount to 25 million tonnes in the entire EU-28 region. The separation and sorting of plastic waste is difficult since sorting facilities does not detect plastic waste. As a consequence, plastic waste is directly fed to waste incineration. Plastic waste is very suitable for energy production due to its high oil content. There is a strong price competition between waste incineration facilities and the recycling industry. The price level has remained stable during the past years, while the trade volumes have risen in the EU-28 region (see figure below). The average yearly trade volume amounts to around 650.000 tonnes which shows the great potential for transports of plastic waste on inland waterways. The largest share of plastic waste is assigned to Germany and Slovakia.

<sup>42</sup> © feve.org

<sup>43</sup> Austria Glas Recycling (2014)

**Figure 49: Price development and trade volume of plastic waste from 2002 until April 2015 (EU-28)<sup>44</sup>**



Extraction from the Foreign Trade Statistics: 17/07/2015, Update price indicator: 20/07/2015, General Disclaimer of the EC



**Transport requirements**

Transport in form of bales, big bags or as bulk cargo. Possible residues must not come into contact with fodder or grain. Therefore a thorough cleaning of compartments due to possible plastic leftovers is required. The transshipment carried out by bale grabber, bucket grabber, polyp grabber or by a traverse with hooks. Waste plastic is stored in open or covered storage facilities.

**Figure 50: Left: Transshipment of plastic waste in port Straubing-Sand (DE), Right: Storage of plastic waste**



© Hafen Straubing-Sand;



© www.eu-recycling.com

<sup>44</sup> © Eurostat



### 3.1.12 High & Heavy cargo

High & Heavy (H&H) cargo is not allocated to a specific economic sector but refers to the specific characteristics of the product and the transport. High & Heavy goods can be defined as cargo which cannot be transported as regular load, but requires special measures resulting from its weight and /or big dimensions. Examples of such cargo are power transformers, building machines, engines, wind power plants and tanks, etc. Inland vessels are ideally suited for special transport of H&H cargo due to their size and the available infrastructure.<sup>45</sup>

The advantages of IWT of High & Heavy cargo compared to rail and road are:

- In terms of space, there are almost no limitations. A typically used pushed lighter on the Danube is 76.5 meters long, 11 meter wide and has a load capacity of 1,700 tonnes. The dimensions of the cargo hold of a typical motor vessel varies, depending on the type, from 67 to 87 meters length, 8.2 to 8.7 meters width with loading capacities up of 2,400 tonnes and more;
- Inland waterways transports of H&H do not require special cost-intensive transit permissions are as for road transports;
- There are no obstructions through traffic lights, signs, tunnels and bridge passages;
- No detailed routing needed compared to road transport;
- Little transport restrictions compared to road (e.g. weekend bans).

Inland navigation is becoming increasingly important the High & Heavy sector nevertheless, there is still a great potential for shifting products from road to inland navigation.

**Figure 51: High & Heavy ports in the Danube region<sup>46</sup>**



In the future the growing markets in South East Europe and the Black Sea region will bring a big increase of H&H transports especially for the construction industry (e.g. bridges) and energy supply (e.g. wind energy). Furthermore there is a trend towards larger cargo. At the same time the maximum sizes allowed on roads and motorways could be potentially reduced to improve the safety on the road. This could lead to an additional shift of oversized and heavy cargo to inland navigation.<sup>44</sup>

<sup>45</sup> Report on market potential and up-take measures for the Danube Region

<sup>46</sup> © viadonau

### Transport requirements

The transshipment from road to rail or inland navigation needs special equipment. Some special ports exist along the Danube and the Rhine which offer stationary equipment for more than 100 tonnes (see Figure 52).

In addition mobile cranes and Ro-Ro transshipment technology also offer reasonable possibilities for the transshipment of High & Heavy cargo.<sup>44</sup>

**Figure 52: Transshipment of High & Heavy cargo**



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### 3.1.13 Summary market potential

The potential for promising market segments is summarized in Table 28 below. This summary takes into account production volume, trade volume, production and processing sites as well as feedback received from the industry and logistics sector.

Additionally the use of a “traffic light system” clearly illustrates the identified potential for modal shift towards inland navigation.

**Table 28: Summary IWT potential assessment including influencing factors**

Cargo	Present transport volume	Demand prospects	Handling and storage facilities in ports	Transport and storage requirements	Stowage factor m3/to	Time sensibility	Potential			
<b>Wheat</b>	Up to 20% for the whole Danube Region	High volume of renewable resources along the Danube	High density of ports with appropriate equipment and lots of experienced logistics service providers	Bulk, transhipped with grabbers and/or suction equipment, sensitive to moisture and contamination	1,4	Not critical				
<b>Maize</b>					1,4-1,6					
<b>Soybean</b>					1,3-1,6					
<b>Rape</b>					1,7					
<b>Sunflower seeds</b>					3,0					
<b>Round wood</b>							Bulk or break bulk, transhipped with grabbers and hooks, protect from humidity	1,3-2,5	Not critical	
<b>Sawn wood</b>										
<b>Wood-based panels</b>										
<b>Pellets</b>				Bulk, transhipped with grabbers, better with pneumatic equipment to prevent damages	1,4 - 1,6	Not critical				
<b>Chemical products /fertilizers</b>	Approx. 10% (Austrian stretch)	More than 200.000 tonnes p.a. shifting potential	e.g. fertilizers: no special equipment needed	Bulk/ break bulk; risk of deterioration following moisture ingress; moisture sensitive cargo; problem of self-heating	eg. fertilizer: 0,90 - 1,40	Not critical				
<b>Non-metallic mineral resources</b>	Approx. 10% (Austrian stretch)	Development strongly influenced by the building industry	No special equipment needed	Bulk/sometimes break bulk, risk of quality loss due to moisture	1,2 (Bentonit) Depends on the product	Not critical				
<b>Iron ore</b>	Approx. 30% (Austrian stretch)	Development strongly influenced by the steel industry	No special equipment needed	Bulk; transhipped with grabbers; no sensitive cargo	0,45 - 0,52	Not critical				
<b>Steel</b>	Approx. 10% (Austrian stretch)	Development strongly influenced by the steel industry	Depending on the steel product; eg. steel coils need a c hook	Break bulk; transhipment with hooks; Risks: corrosion resulting from moisture, mechanical damage and contamination or defilement	Depends on the product	Not critical				

Cargo	Present transport volume	Demand prospects	Handling and storage facilities in ports	Transport and storage requirements	Stowage factor m <sup>3</sup> /to	Time sensibility	Potential
<b>Diesel &amp; gasoline</b>	Approx. 15% (Austrian stretch)	Many tank farm in Europa are located nearby rivers	Some tank farms along the Danube with transshipment facilities (transshipment via pumps)	diesel and gasoline are is classified as dangerous goods; ADN requires double hull transport vessels		Not critical	
<b>Metal scrap</b>	No detailed figures available	Raw materials will be preserved by recycling increasingly due to rising global resource scarcity; great demand of metal scrap in the Black Sea Region	No special equipment needed	Bulk or pressed to bales, dry storage (especially for waste paper)	Depends on metal type 2,5 -4,0	Not critical	
<b>Waste paper</b>							
<b>Used glass</b>							
<b>Plastic waste</b>					Depends on plastics type		
<b>High &amp; Heavy</b>	No detailed figures available	Increased transports because of project in the Danube region in the Building industry and the energy sector	Lots of ports offer roll on/ roll off ramps for transshipment, additional mobile cranes can be used	Lift on/ Lift off or Roll on/Roll off transshipment; high value of the cargo needs careful transshipment	Depends on the product	critical	
<b>Legend:</b>							
	<b>Green</b>	great potential, IWT should be considered					
	<b>Yellow</b>	moderate potential, ITW suitability should be checked on a case-to-case basis					
	<b>Red</b>	low potential					

### 3.2 Macro analysis container shift potential study

In this section, the focus lies on the potential for container transport over water.

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

All regions that are connected to the CEMT class IV inland waterway network (TEN-T + all other waterways) have been selected. This includes both interconnected and isolated waterway regions. Moreover, non-connected regions that are within a range of a 100 kilometres from a CEMT IV waterway have been included too.

Containerized goods have been selected. These goods are suitable to be transported in containers, however not all goods necessarily need to be transported in a containers. It are mostly goods that are currently being transported by road, but it for example excludes specifically living animals and the already captive IWT markets of crude oil, coal, iron ore and dry bulk, sand and gravel. See Annex E for the full list of NST-2 good categories that can be containerized.

Two distance criteria have been applied:

- Regarding the selection of relevant regions for a potential model shift to IWT the regions have been selected which have access to the IWT network using pre-/end haulage over a distance of maximum 100 km.
- The OD transport distance for road haulage should be at least 200 km. If the origin and destination are both located directly along waterways ("wet locations") already at transport distances from 20 km IWT can be competitive compared to road haulage. However, if locations are situated away from waterways (i.e. "dry locations") pre-/end haulage is needed resulting in an increase of break-even distance. For dry-dry locations the break-even distances are between 180 and 200 km<sup>47</sup>. The potential based should however be a direct result of comparison of the intermodal vs. road transport costs, therefore no pre selection was made on distance classes for road haulage. Short distance transports by road (i.e. between Slovakia and Czech Republic) are thus also considered in this multimodal analysis.

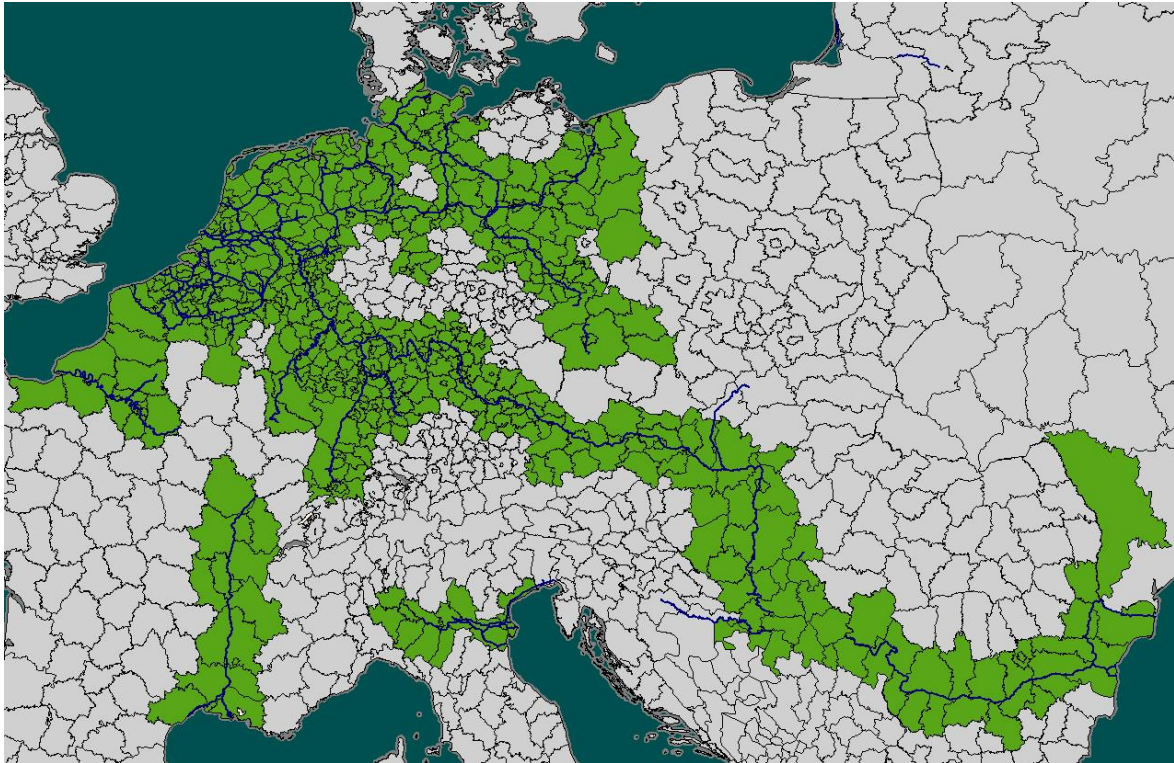
On the basis of the assumptions and criteria mentioned above the scope for the continental container transport model has been determined. The scope is illustrated in the figure below by a selection of NUTS-3 regions (in green) with relatively close access to inland waterway network of Europe. For road transport, the ETISplus road matrix has been used (year 2010).

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<sup>47</sup> Based on extensive research on door-to-door costs for several types of transport chains for IWT for the situation in The Netherlands, a country with a high density waterway network. Source: NEA and Policy Research Corporation, 2006, Market Study IWT.



**Figure 53: Overview scope market potential continental container market (NUTS-3 regions)**



Source: PANTEIA

The selection results in a more refined road OD matrix presenting information the following variables:

- Origin (NUTS-3 level);
- Destination (NUTS-3 level);
- Tonnage transported of containerized goods between selected regions;
- Region types<sup>48</sup>: IWT-connected regions both on isolated as on interconnected waterways;

The resulting selection of transport between OD pairs was assigned to the existing network to help identify the study areas for continental multimodal potential. The service network for the transport of continental containers via IWT has been designed following from upon existing and, possibly, planned barge services<sup>49</sup>.

Based on the availability of inland container terminals,<sup>50</sup> combined with existing and planned barge services a hub and spoke network is foreseen as the most promising to link O/D's and branches of the network. This approach uses the possibility to connect multiple branches and individual / separate barge services together through a hub and spoke network.

<sup>48</sup> The ETISplus OD-matrix can also present the tonnage transported from/to maritime regions for road transportation. However, given that this study focusses on the potential shift of continental road transport this transport flow has not been taken into account.

<sup>49</sup> ETISplus terminal database (2010), completed with information from IDVV, VNF, NPI (Navigation, Ports et Intermodalité) and Schiffahrt, Hafen, Bahn und Technik.

<sup>50</sup> Ibid

### 3.2.1 Potential intermodal transport vs. direct trucking

In order to determine the potential modal shift from direct trucking to intermodal transport via barge for continental containerized cargo for every O/D pair as selected in the scope a comparison must be made whether intermodal transport is less expensive than direct trucking. When this is demonstrated, there is a potential for modal shift.

#### Adding terminals to the network

The cost model is set up by assigning a selection of (inland) container terminals to the IWT networks (closed + EU Interconnected) where containers can be transhipped from inland shipping to road transport and vice versa. Also planned inland container terminals have taken into account. For the simplicity of the model, in certain NUTS-3 regions with a high density of (inland) container terminals (along the Rhine and in The Netherlands and Belgium) not all possible terminals have been taken into consideration. For neighbouring terminals within the same NUTS-3 region the differences in transport costs to and from all destinations in that region are considered to be relatively small. In total, 97 terminals have been added to the IWT networks in Europe.

#### Waterway and ship characteristics

For determining Inland waterway transport costs for all container barge services the characteristics of each waterway corridor / channel / river has been taken into consideration; Meaning that either dimensions of the vessels based on the barge services or the maximum permissible vessel dimensions according to PC Navigo software.

#### Figure 54: Information about PC Navigo

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

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

The amount of locks on the route, according to PC Navigo software.

The flag of the vessel, having influence on the costs structure of the vessel. Costs information is obtained from the yearly Panteia costs models (costs per hour)<sup>51</sup>. Trip times differ depending on fairway characteristics: sailing upstream implies different speeds than sailing downstream, and so do load factors, vessel sizes, etc.

A ship is assumed to load 70% of its container capacity.

2/3rd of the containers on board are assumed to be laden, others are assumed to be empties that need to be repositioned. This way, also empty return loads are taken in to account.

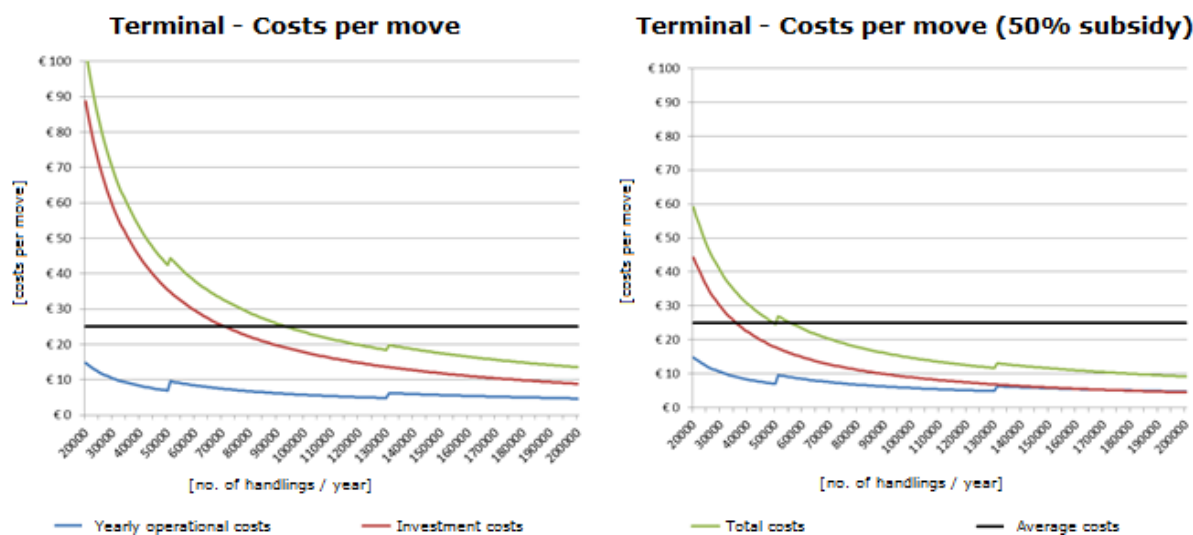
<sup>51</sup> Panteia (2014): *Kostenontwikkeling binnenvaart*



## Handlings costs and rental container

Based upon the network of barge services the number of transshipments made per O/D pair has been determined. Every transshipment (move) is multiplied by EUR 25,-. No distinction is made between terminals or the various countries. For additional transshipments, besides the origin or destination, an additional transshipment of EUR 25 per move has been added, e.g. for terminals with hub functions in the network. In general, two moves are needed at terminals with a hub function (ship – shore and shore – ship). HaCon and KombiConsult indicate EUR 20 - EUR 32.5 as a range for handling costs.<sup>52</sup>

**Figure 55: Handlings costs in IWT**



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

The costs for the rent / use of containers are assumed to be EUR 15 per container<sup>53</sup>. HaCon and KombiConsult indicate EUR 12 to EUR 20 for the rental of containers per trip.<sup>54</sup>

## Pre- and end haulage

Costs for Pre-/End haulage to and from the container terminals in the network have been based on distances of the road network in ETISplus. The model uses the distance from industrial areas within NUTS-3 regions to/from the terminals. The costs for pre/end haulage are determined by cost function based on these distances. It should be noted that variable costs add up from EUR 0.47 per kilometre to EUR 0.65 per kilometre. The costs for trucks are based on the variable and fixed costs for trucks plus fixed costs for drivers originating from the country where the terminal is situated. Information about costs originates from Panteia costs models. A different time-distance relation is specified in the costs-function, making direct road transport cheaper than intermodal road transport for the same distance.

## Intermodal costs – Lowest costs algorithm

The model calculates out of  $512^2$  (O/D's)  $\times$   $97^2$  (terminals) = about 2,500,000,000 options the cheapest path out of all possible options to transport continental containers per O/D.

<sup>52</sup> This includes subsidy by governments on terminal investment costs. See: *KombiVerkehr – Entwicklungskonzept*, Hacon et al. (2011).

<sup>53</sup> Panteia et al. (2014) – *Hub en Spoke in de Container Binnenvaart*, Annex Report.

<sup>54</sup> *KombiVerkehr – Entwicklungskonzept*, Hacon et al. (2011)

### Direct trucking scenarios

For direct trucking per O/D pair the model chooses the lowest costs based upon several truck and driver combinations. If it concerns international traffic, the cheapest truck and the cheapest driver of the two countries involved is selected. For more details on costs, see Panteia costs models<sup>55</sup>.

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

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

Comparison of intermodal transport costs vs. direct trucking scenarios yields a range of results.

### Potential continental containerized cargo via IWT

Per O/D it is automatically calculated whether intermodal transport via barge is less or more expensive than direct trucking. When the alternative of intermodal transport via barge is less expensive for a specific O/D, the amount of cargo (in tonnes) following from the transport of continental cargo by road transport for that specific O/D (NUTS-3 level) as selected in ETISplus based on the scope, is shifted from road transport to intermodal transport by barge.

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

#### 3.2.2 Results of Macro Analysis continental cargo study

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

**Table 29: RD corridor volume that can be shifted to IWT (in million tonnes)**

Regions	Low potential	Medium potential	High potential
<b>Total RD corridor</b>	122.9	78.0	32.7

Source: PANTEIA

Table 29 presents information on the maximum utility of the potential per scenario chosen. For the Rhine and Danube, a large potential is available, even in case of the most efficient scenario for direct road transport. Table 30 presents information on the maximum of the potential per scenario chosen per commodity group.

**Table 30: RD corridor volume that can be shifted to IWT (in million tonnes)**

Regions	Low potential	Medium potential	High potential
Agricultural and food products	27.3	17.4	7.4
Energy products and chemicals	21.2	14.0	5.7
High end building materials	14.9	5.8	2.0
End products & other	59.5	40.8	17.7
<b>Total RD corridor</b>	<b>122.9</b>	<b>78.0</b>	<b>32.7</b>

Source: PANTEIA

The largest commodity group with potential is “End products & other”. Included in this group are products already containerised in road transport. Further there are semi-finished metal products, all types of machinery and equipment and all types of end products. The second largest group is agricultural and food products. This consists of raw agricultural materials, hops, animal foods, wood and cork, beverages and foodstuffs.

### 3.3 Recommendations - Measures to facilitate market transfer

Recommendations are given targeting the inland waterway infrastructure (as the absolute precondition for further development of inland waterway transports) as well market related activities.

#### **Neutral platforms for cooperation between Danube ports, shipping companies, forwarders and industry**

Neutral platforms focusing on specific and promising market segments turned out very stimulative for inland navigation and are highly appreciated by the sector. Offering a framework for the development of cooperation possibilities, information and knowledge exchange for all players in Danube logistics is crucial for enhanced usage of waterways. Especially companies which produce, process and trade products suitable for inland waterway transports such as renewable resources, recycling products, etc. value the presentation of the possibilities, chances and strengths of inland navigation which they did not consider in the past, due to lack of beneficial information.

Existing players in Danube logistics use cooperation events for identifying synergies in business such as bundling of cargo to achieve optimum capacity utilization and reduce costs.

Cooperation platforms on national but also on international basis with thematic focus should be fostered for the promotion, positioning and raise of awareness of inland navigation.

#### **Create and publish freely accessible information about inland navigation**

Lack of information regarding Danube logistics are one of the mayor restraints for this mode of transports. Information regarding existing shipping and forwarding companies, ports services in terms of handling equipment, storage capacities, contacts, etc. should be published in a user friendly way and updated regularly. A unique platform with all relevant data for (potential) users of waterways at one spot should ensure a high qualitative and transparent collection of information. In particular, this information is essential for the industry when searching and identifying transportation providers.

### **Improvement of facilities in ports and transshipment sites along the Danube**

Suitable port facilities for transshipment and storage is essential for the Danube logistics network. From the point of view of the shipping industry, Danube ports and transshipment sites shall be equipped with efficient infra- and superstructure. A ports' infrastructure is formed by quay walls, rail tracks and roads as well as other paved surfaces while the superstructure is built on the infrastructure and includes e.g. cranes, warehouses and office buildings.

The availability of adequate, cargo-specific handling and storage equipment at a certain location is therefore – in combination with the overall service quality provided in ports (opening hours, flexibility, etc.) - a crucial factor for the achievement of a modal shift towards inland waterway transport.

For that reason, port operators as well as national authorities are asked to improve port facilities and provide a satisfying and demand oriented service portfolio to inland navigation users.

In order to assist financially weak port operators it is essential to offer co-financed project models. Particularly, downstream Danube ports face financial and structural difficulties with missing investments in infrastructure as a result. In that sense, extension of national and international funding opportunities for port development should be fostered and improved.

### **Promoting the industrial locations in the vicinity of ports and terminals**

The efficiency of inland navigation is faced with limitations if costs for pre- and end-haulage to the waterway are high. Experience shows that the actual distance to Danube ports is often a decisive factor for considering inland waterway transports or not. Consequently, stimulative measures should be defined in order to promote industrial locations in the vicinity of the Danube.

The identification of existing companies within the catchment area of the Danube ports and transshipment sites is essential as a first step for the identification of possible users of the Danube River. Not only existing business locations should be examined, monitored and directly approached, but current projects for establishments of new business locations in terms of production, processing and storage of cargo have to be integrated in the IWT promotion activities.

A qualified network of Danube logistics promotion centres ("one-stop-shops") in Danube countries are requested to provide consulting and assistance to the industry from the initial planning phase of business locations followed by regular contact regarding Danube navigation. The adequate consulting provided by promotion centres postulates knowledge and customer orientation towards Danube navigation, which should be ensured through capacity building projects and knowledge transfer meetings among experienced Danube logistics promotion centres and new and/or less developed promotion centres.

### **Simplification and harmonisation of administrative processes for inland waterway transports**

Shipping and Danube logistics companies emphasized that inflexible administrative processes and paperwork represent a crucial financial and time-consuming factor, causing significant competitive disadvantages for inland navigation and handicap the modal shift towards inland waterway transports.

The administrative bottlenecks can be summarized into three main areas: administrative bottlenecks related to customs clearance, controls of the border police and navigation surveillance. External EU-borders along the Danube are identified as the most challenging points regarding administrative procedures which were found to take long and consequently cause additional costs for operators.

In order to solve some administrative barriers for Danube navigation and to support modal shift more effectively, control authorities and shipping companies should enter a more intensive dialogue how control procedures can be implemented in a flexible and at the same effective way. In particular solutions in terms of quantity of required documents in different languages, non-transparent and time-consuming border revision procedures led to the conclusion that steps towards simplification and harmonisation of national administrative processes have to be made. It will be necessary to

- harmonize documents by finding a common understanding of required data;
- create single multilingual documents;
- introduce digital documents;
- provide internet – based documents transmission options.

A joint approach and understanding among control authorities for the necessity of modernisation and user friendliness has to be established in order to improve and design border revision forms which will no longer impede control procedures but will disburden inland navigation.

A harmonization of administrative procedures in all Danube countries should also be a mid-term objective in order to ensure seamless transport chains and a higher competitiveness compared to road and rail transport.

The project „Removal of administrative barriers along the Danube” pursues the simplification, harmonisation and digitalisation of the border control processes and forms along the river Danube. The project supports the working group „Administrative Processes” of the Priority Area 1a of „EU Strategy for the Danube Region.

To achieve the objectives, a total of 20 recommendations were elaborated and are expected to be jointly implemented by the working groups PA 1a (Danube logistics sector) and PA11 (border control authorities).

In the first phase, eight priority measures were selected, and detailed implementation plans were elaborated. Preliminary results are the following:

A first set of harmonised control forms (Danube Navigation Standard Forms – „DAVID forms”) was elaborated and is waiting for its approval, a „Practical manual on border controls along the Danube and its navigable tributaries” was issued (meanwhile with a second edition), and the published opening hours of the control authorities at the various control points were monitored.

### **Increasing the reliability of waterway transport is of great importance to the feasibility of liner services**

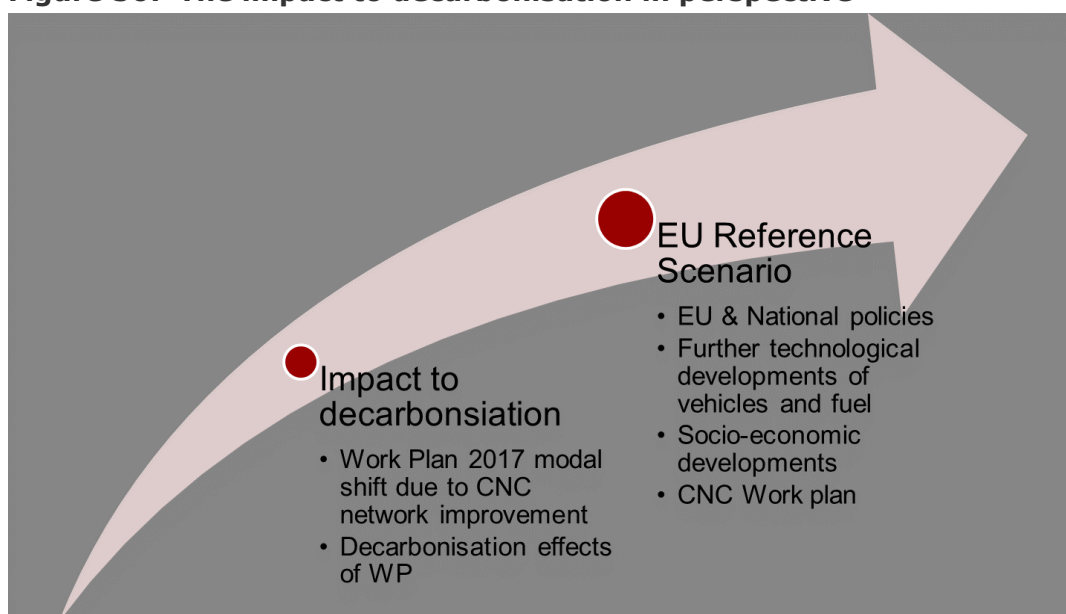
From the macro analysis of the potential container shift from roads to waterways it can be concluded that as much as 42.0% to 43.3% of the potential tonnes can be transported more cheaply by IWT. Developments concerning the efficiency of road transport may affect the modal shift potential, but the Rhine and Danube axis are among the most promising waterways for a modal shift.

As already indicated in the introduction to this analysis: besides the transport price the modal choice also depends on the quality of the transport service: reliability, door-to-door transit time, flexibility, safety/security, frequency, network coverage availability of loading units, information exchange, etc. These characteristics, which are related to logistics as well as the transport infrastructure, are of great importance to setting up a viable liner service for container transport.

### 3.4 Modal shift and impact to decarbonisation and climate change adaptation

The model shift effects and decarbonisation effects of the corridor work plan are determined by a modelling exercise. The modelling exercise exists in between a number of studies that have been performed. These are the 2014 MTMS and the EU Reference scenario 2016. The impact to decarbonisation exercise models the network benefits from the 2017 work plan and takes into account the decarbonisation effects of the corridor. This also has modal shift effects. Then the EU reference scenario results have strong inputs when it comes to model shift and decarbonisation. These are EU & national policies on the topic, a broad perspective on technological developments for logistics operations, vehicle efficiency, and clean fuels and finally the CNC work plan. Therefore this leads to the strongest expected modal shift and decarbonisation. The concept is visualised in the figure below.

**Figure 56: The impact to decarbonisation in perspective**

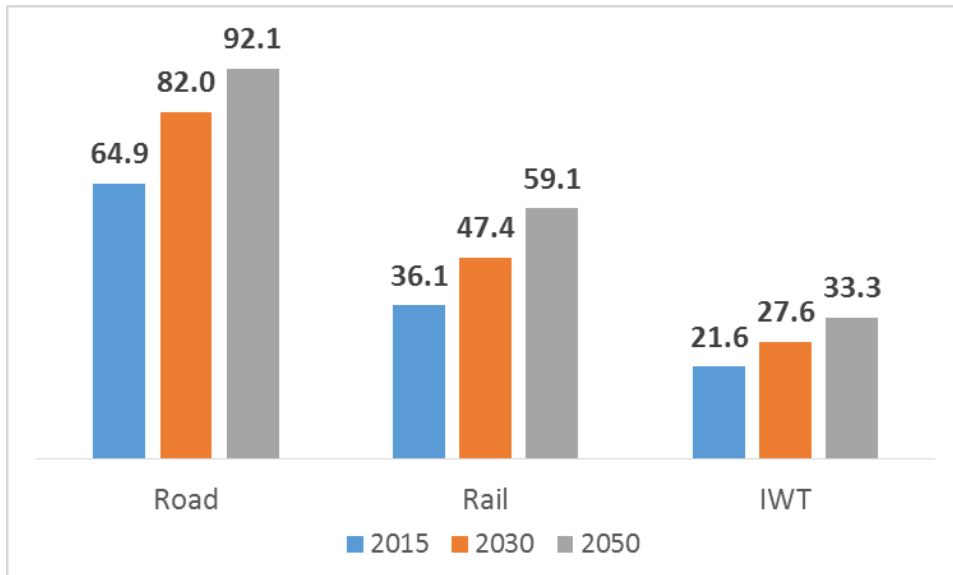


The translation work from EU reference to **EU corridor** results leads to model results for a reference scenario:

- The RD Member States account for around 25% of the EU28 total on current socio economic & transport. However, the forecasted population, GDP and passenger traffic growth is slightly below the EU28 average. Passenger traffic is expected to increase from 114 billion pkm today to 135 billion pkm by 2030 (road, rail and aviation) in the reference scenario. The fastest growing sector is aviation (at 2.6% per annum). Freight traffic is forecast to increase from 149 billion tkm today to 189 billion tkm by 2030 (road, rail, and inland waterway) in the reference scenario. The fastest growing sector in is rail (at 1.8% per annum).
- With regards to the emissions of the RD Member States there currently are 20.4 million tonnes of CO<sub>2</sub> equivalent being emitted by passenger and freight transport. By 2030, this is calculated to decrease to 19.6 million tonnes of CO<sub>2</sub> equivalent in the reference scenario. The traffic on the Corridor will increase, but transport and energy efficiency will also increase, leading to a lower environmental impact in the reference scenario.

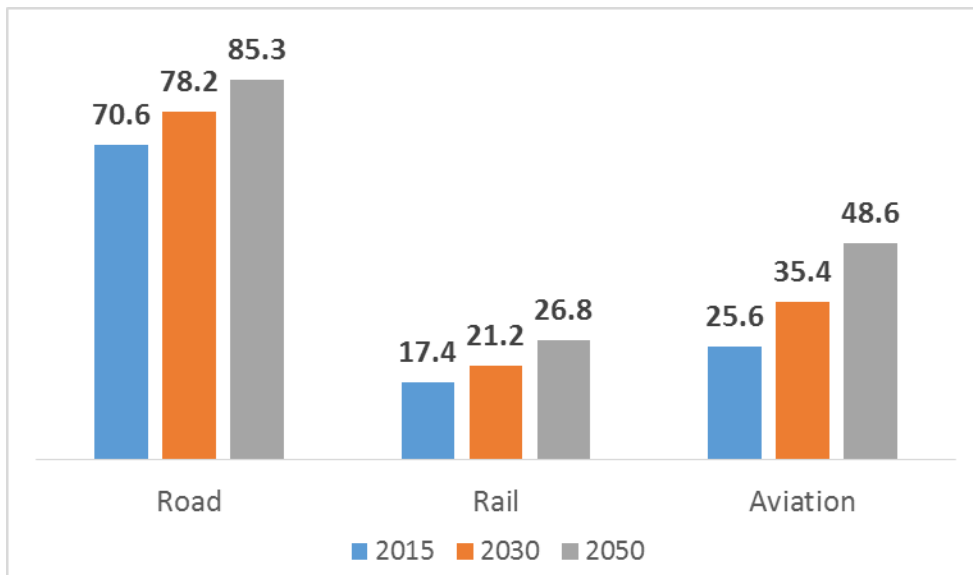
The results are presented in detail in the following figures:

**Figure 57: Tons of freight (bn) per kilometre per mode of transport, Reference scenario**



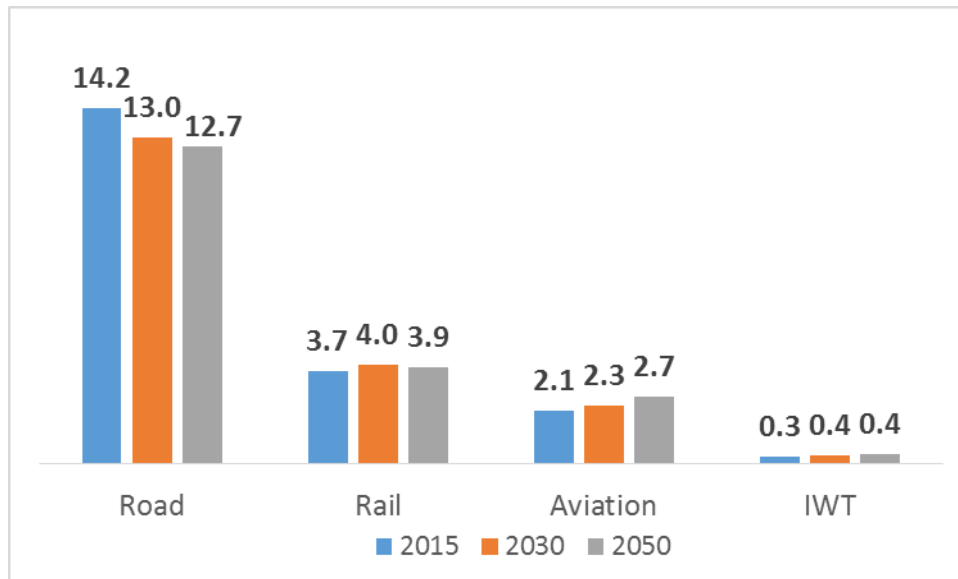
Source: Panteia, September 2017

**Figure 58: Number of passengers (bn) per kilometre per mode of transport, Reference scenario**



Source: Panteia, September 2017



**Figure 59: Emissions from freight and passenger transport, Reference scenario**

Source: Panteia, September 2017

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

## 4 Mode specific aspects: Cooperation with RFC

In 2010, the Regulation (EU) No 913/2010 concerning a European rail network for competitive freight entered into force. It was elaborated with the overall purpose to increase the attractiveness and efficiency of rail freight transport along international transport routes, in order to increase its competitiveness and modal share on the European transport market. The Rail Freight Corridors (RFC) are intended to deal with three main challenges:

Strengthening cooperation between infrastructure managers on key aspects such as allocation of train paths, deployment of interoperable systems and rail infrastructure development;

Finding the right balance between freight and passenger traffic along the RFCs, giving adequate capacity for freight in line with market needs and ensuring that common punctuality targets for freight trains are met;

Promoting intermodality between rail and other transport modes by integrating terminals into the corridor management process.

According Regulation (EU) No 1315/2013 ("TEN-T Regulation"), sentence 46, "the core network corridors should be in line with the rail freight corridors set up in accordance with Regulation (EU) No 913/2010 ...". Currently, there are nine RFCs implemented or planned. The RFCs and their alignment will be further adapted over time (until 2020) to fit with "their" corresponding Core Network Corridors.

## RFCs overlapping with Rhine-Danube CNC

With status of December 2016 there is no dedicated Rail Freight Corridor in place covering the entire alignment of the Rhine-Danube CNC. The biggest overlaps exist to the RFC 7 Orient East Med. The overlapping parts are related to the rail sections between Wien-Bratislava-Györ-Budapest-Arad-Timisoara-Craiova. In the area Wien-Bratislava the CNC Rhine-Danube also goes in parallel to the RFC 5 Baltic-Adriatic.

Currently the set-up of the RFC 9 Rhine-Danube is in progress. The alignment will include the formerly foreseen RFC 9 lines between Praha and Cierna nad Tisou (former CS corridor), rail freight connections between Germany and Czech Republic as well as rail freight lines on the Black sea branch between France/Germany and Romania (Constanta). However the exact routing is not yet fixed.

The rail alignment of the RD CNC and overlapping RFCs is shown in Figure 60.

**Figure 60: Rail Freight Corridors overlapping with Rhine Danube CNC**



Source: HaCon, May 2017

## Coordination with RFCs

Article 48 of the TEN-T Regulation states that “adequate coordination shall be ensured between the core network corridors and the rail freight corridors provided for in Regulation (EU) No 913/2010, in order to avoid any duplication of activity, in particular when establishing the work plan or setting up working groups.”

As a basis for any cooperation and sharing of work it is therefore necessary to outline the scope and structure of these two corridor frameworks. The main characteristics and differences are shown in Table 31 below.

**Table 31: Comparison CNC/RFC scope and structure**

Topic	Core Network Corridor	Rail Freight Corridor
<b>Legal basis</b>	Regulation (EU) 1315 / 2013	Regulation (EU) 913 / 2010
<b>Main objectives</b>	Infrastructure development	Harmonisation of business and technical conditions
<b>Transport modes &amp; types</b>	Multimodal (rail, road, aviation, inland waterways and ports); Passenger and freight	Rail transport, Freight only

Topic	Core Network Corridor	Rail Freight Corridor
<b>Governance structures</b>	EU coordinator (+ advisor) Secretariat (consortium)	Executive Board Management Board
<b>Stakeholder involvement</b>	Corridor fora (2x annually)	Advisory group (2x annually)

Source: HaCon based on RFC7 presentation (Wien, 5/4/2017)

In 2016 DG MOVE has outlined a "Model for cooperation between Rail Freight Corridors and TEN-T Core Network Corridors". This model promotes an easy and transparent flow of information, defines potential topics of information to be exchanged, and proposes mutual consultation for studies or projects carried out in the scope of the CNC or RFC. As it is stated the "CNCs and RFCs can develop their cooperation on the basis of this model. Where cooperation is already in place and satisfactory to all parties, this shall be taken into account."

For the Rhine-Danube CNC cooperation with RFCs is based on the following action fields:

- Areas of joint interest, e.g. Border crossing, Projects to level up joint RFC/TEN-T freight core corridor sections, Coordination of maintenance and construction works;
- Tools of cooperation: Corridor Fora, bilateral exchange of information, working group meeting(s);
- Harmonised approach and sharing of information with parallel TEN-T corridors (especially OEM): OEM working groups on cross-border issues in Budapest (8-9/3/2016) and in Wien (5/4/2017), Rotterdam declaration.

In a next phase cooperation shall be also conducted with the future RFC 9 Rhine-Danube. As stated before, this corridor is currently in the process of foundation. The indicative timetable foresees the establishment of the governance structures, namely Management Board and Executive Board – by end of 2017. Operation start is foreseen for end 2019 the latest. In the current study phase the cooperation topics have been discussed directly with the respective infrastructure managers.

## 5 Clustering of projects

### 5.1 Objective criteria for prioritising investments

For the prioritization of investments, a common methodology was set up for all CNC corridors. This methodology consists of:

- Key objective criteria to prioritise investments on the Corridor based on the characteristics of the Corridor and taking into consideration all the aspects developed in Task 3;
- A proposal for a prioritisation of projects or their groups/categories in the refined list developed under Task 2.

Based on the common methodology applied by all Core Network Corridors (Annex X) there are two criteria groups to be used for Corridor project prioritization. Projects already concluded and project containing only studies shall not be prioritized.

**Project relevance:** related to the purpose of the intervention and its capacity to meet TEN-T and EU priorities, as set by Regulations 1315/2013 and 1316/2013 (reflected by the technical parameter and bottlenecks tackled by the intervention).

**Project maturity:** derived by the assessment of project's technical and institutional readiness, financial/economic maturity and social/environmental maturity.

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

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

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

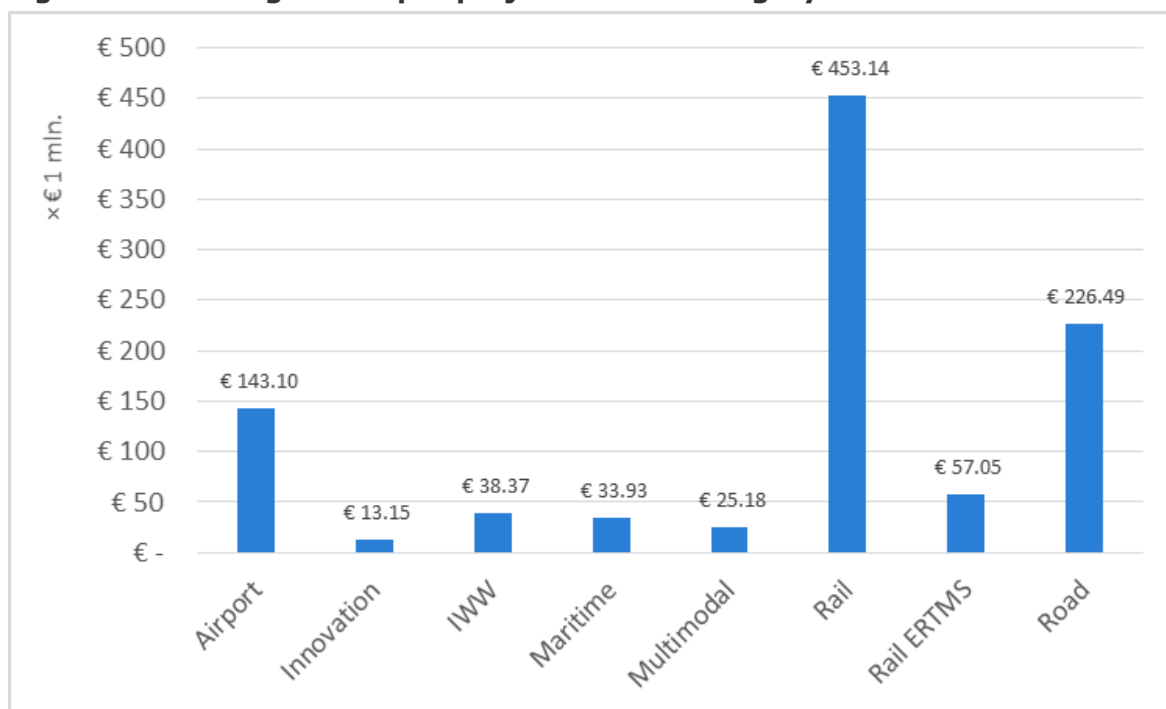
- Ensure economic, social and territorial cohesion and improved accessibility across the EU;
- Create sustainable quality jobs for the regions;
- Sustain or increase competitiveness;
- Improve cross-border links;
- Enhance interoperability;
- Ensure intermodality;
- Mitigating bottlenecks affecting the entire corridor functionality;
- Innovation deployment;
- Impact of climate change on existing infrastructure and measures to enhance resilience;
- Impact on the greenhouse gases, noise and other externalities;
- Development of transport infrastructure with a view to allowing the smooth functioning of the internal markets.

## 5.2 Overview of the identified projects

For the Rhine – Danube Corridor, project prioritization was applied to all 541 projects included in the final version of the project list (result of task 4). After excluding all the completed projects and projects that only include a study, 438 remain to be prioritised. The project clustering was performed in close cooperation with the consultants responsible for other tasks of the Study because this exercise relies heavily on the results of Task 2 (project list) and Task 3 (innovation clustering). The results of those two tasks were the baseline of the clustering exercise. The first version of the project clustering was prepared by the consultant responsible of the task. The results were sent for analysis to Consortium national experts responsible for each Member State. Consortium national experts analysed, changed or validated the final clustering.

Figure 61 shows the average costs a project in each category.

**Figure 61: Average costs per project in each category**



Source: Panteia

Rail projects have the highest average costs per project. Next follow roads and airports projects. Inland waterway projects have a relative low average project cost although there is a sizable amount of projects in this category. Innovation and multimodal projects are relatively inexpensive. However, the absolute number of projects in the innovation and multimodal category is low.

### 5.2.1 Clusters identified: project relevance

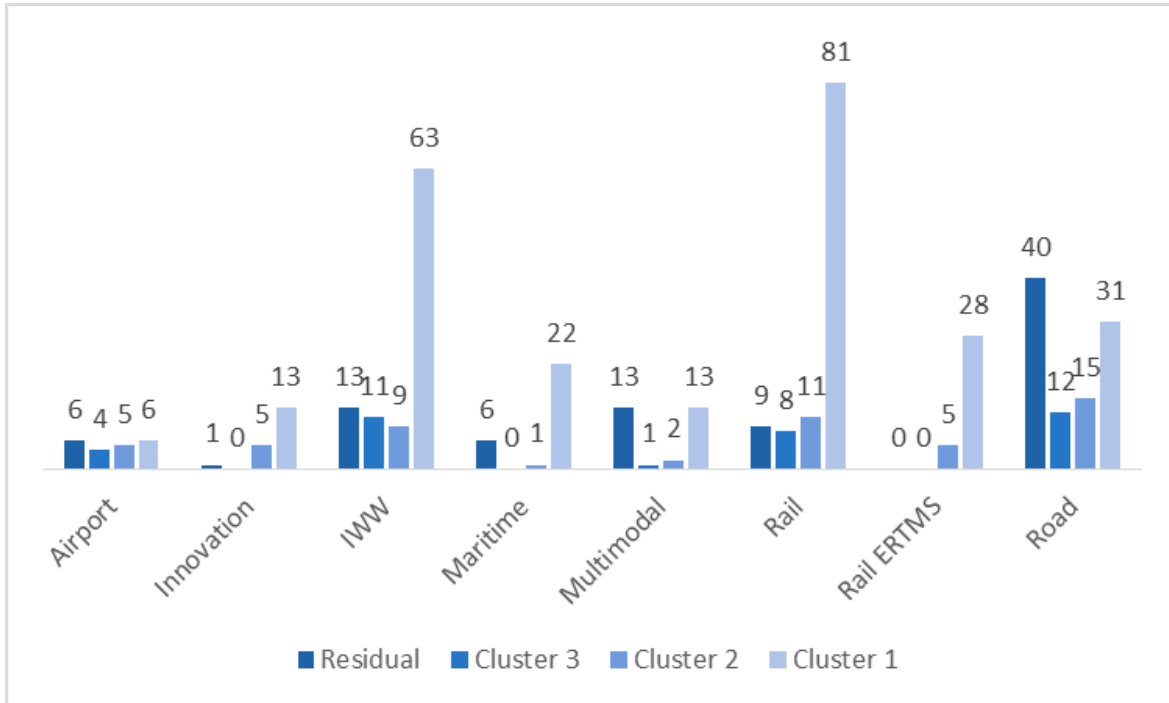
The clustering exercise is based on the transport mode. For each project, related to a specific transport mode. There are 3 clusters identified (together with a residual cluster) which mainly reflect the project relevance according to TEN-T priorities stated by the Regulation. In addition, new technologies and innovation projects according to Art. 33 a-d of Reg. 1315/2013 were assessed in a separate clustering exercise, avoiding any connection with any transport mode.

- Cluster 1 - generally, pre-identified projects as listed in Reg. 1316/2013 annex I-part II and last mile rail/IWW links to RRT, AIRPORTS, SEAPORTS and INLAND PORTS, always belong to Cluster 1; as well as ERTMS, MOS and SESAR Projects. This is coherent with the general theoretical structural of TEN-T Regulation.
- Cluster 2 - other telematics applications (VTMIS, RIS, ITS etc.) depending on the transport mode.
- Cluster 3 - Mostly projects contributing to safe & security, capacity expansion, and last mile connectivity.
- Residual cluster - the Projects not specifically addressing any requirement of the Regulation.

Figure 62 presents the number of projects in each of the clusters from every modality.

From the viewpoint of the clustering, road related projects are less likely to have a high relevance. In contrast, rail and inland waterway projects are often categorised in cluster.

**Figure 62: Number of projects in each of the clusters from every modality**



Source: Panteia

### 5.2.2 Rationale for project maturity

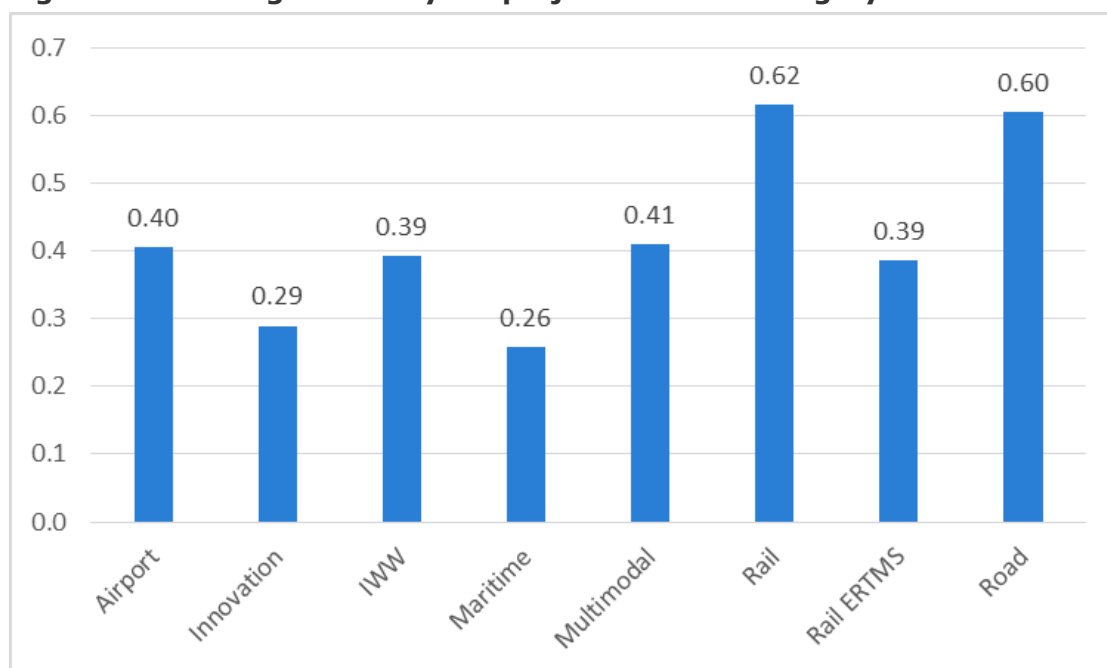
To evaluate each of the project maturity criteria (technical, institutional, financial, environmental) it is necessary to rate and award points for each project according to the following levels: Low maturity level= 0; Medium maturity level= 0.5, High maturity level=1. The general assumption is that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

$$Project\ Maturity\ Indicator = \frac{Tm + Im + Fm + Em}{4} \leq 1$$

Legend

*Tm*: Technical Maturity; *Im*: Institutional Maturity; *Fm*: Financial Maturity; *Em*: Environmental Maturity.

Figure 63 shows the average maturity of projects within each of the project categories on a scale of 0–1. The closer to 1, the more mature a project is. On average rail- and road projects have the highest 'readiness' level. Process wise, innovation- and maritime projects are less mature compared to other categories. Though, it is important to note that the categories innovation and maritime include a lower amount of projects than the rest of the modal categories

**Figure 63: Average maturity for projects in each category**

Source: Panteia

### 5.3 Method to determine project relevance

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

Once each project has been assessed against the criteria and awarded with the number of points for relevance and maturity, it is necessary to incorporate the relative importance criteria by applying the following weighting factors (see Table 32):

**Table 32: Weighing factors clustering exercise**

Criteria groups	Weighting factors
PROJECT RELEVANCE	0,6
PROJECT MATURITY	0,4

Source: Panteia

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

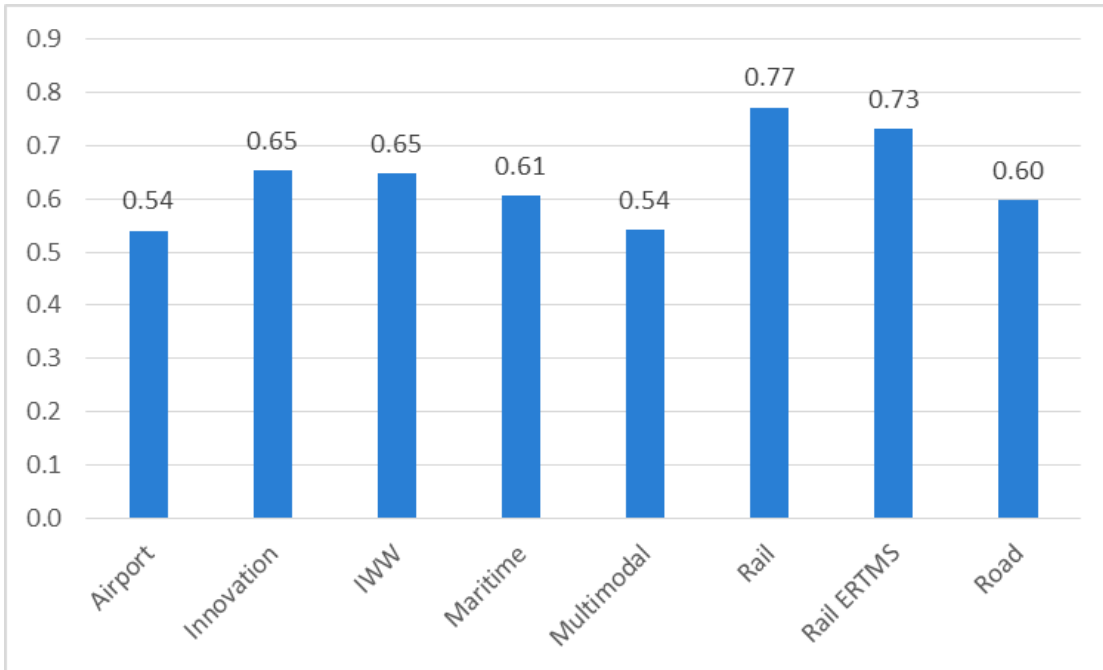
To this end, project relevance and maturity can be assessed according to several criteria which will contribute, with different weights, to the definition of the overall score of the project.



### 5.4 Rhine – Danube corridor project ranking

Figure 64 presents the average project ranking for projects in each category. The figure shows that rail (and rail ERTMS) projects are ranked high (on average). In particular Airport and Multimodal projects score lower in terms of project ranking. Though, it is important to note that the categories innovation and maritime include a lower amount of projects compared to the rest of the modal categories.

**Figure 64: Average project ranking for projects in each category**



Source: Panteia

## 6 Summary of actions already accomplished

Since the adoption of the TEN-T Regulation at the end of 2013 values of Key Performance Indicators changed only slightly. Nevertheless, Member States have implemented and prepared a number of measures in order to provide an operational trans-European transport network in line with the provisions of Regulation 1315/2013 by 2030.

### Rail

All recently concluded Rail projects are located in Austria and in the Czech Republic. Two Austrian projects refer to the new Wien main station and its connection to regional and long-haul rail traffic. Another four projects allocated to Austria deal with upgrades of stations and short sections of the "Westbahn" (Salzburg-Wien). These actions do not remedy non-compliant infrastructure as the requirements of the Regulation have already been fulfilled before. However, they adjust the configuration of rail stations to the demands of high-speed traffic; in this context, they enhance rail capacity and allow for higher speed of passenger trains. Similar to Austria, also the finalised Czech Rail projects show a clear affinity to line upgrades and modernisation of important nodes or station areas (e.g. Plzeň, Praha, Ústí nad Orlicí, Přerov). All these projects achieve and/or improve KPIs, mostly on a very detailed local level, such as upgrade of single tracks or switches in the stations, removal of level crossings or equipment of new passenger stations with up-to-date infrastructure and technique. Due to this detail, the effects of these projects are not visible in the overall corridor compliance rates. In any case, they contribute to capacity enhancement on the CZ corridor lines by eliminating local bottlenecks. Three Czech Rail projects are part of a project package dealing with the improvement of the corridor section between the DE/CZ border and Plzeň.

### Inland Waterways

None of the implemented inland waterway projects had an influence on the static KPI. Only the dynamic indicator measuring the achievement of the targeted depth according to the waterway manager varies from year to year, depending on both, hydrological and infrastructure conditions. Nevertheless, progress was made through the realization of a number of activities, which mostly relate to the improvement of the fairway availability, the reliability of locks and the coordination of national approaches towards the provision of a concerted infrastructure quality. Implementation of RIS at the Sava was finalized by the end of 2016. Works at the Upper Main to increase the permissible depth are consistently progressing; building permissions for the realization of river training works between Straubing and Vilshofen are currently pending and experiences from the "Integrated River Engineering Project East of Wien" are casted into the next implementation step. River Training and Dredging Works between Bačka Palanka and Beograd (Serbia) have been prepared and approved in 2014; works and their supervision have been contracted in 2017. The on-going preparatory study "Fairway Danube" aims at an increased transparency on navigation conditions and is paving the way for well-founded improvement measures.

### Ports

Ports KPI have also been stable since 2013, with the positive exception of the availability of clean fuels. In 2015, the private company Bulmarket Ltd. completed an LNG terminal in an inland port in Ruse (Bulgaria), and this represent the one and only KPI improvement until the moment of writing of this report. Although not related to the defined KPI and although not improving or reaching a target KPI, a number of projects contributed to the qualitative improvements of ports capacity, road and rail connections or intermodal capacities and thus added to the development of the Rhine-Danube Corridor. Examples for such projects are the increase of rail capacity of the Port of Constanța (RO), the restoration of the quay wall in the Port of Regensburg

(DE) and the rehabilitation and development of the waterside infrastructure in the Port of Budapest/Csepel (HU). The study phase for the capital project "High-Performance Green Port Giurgiu" was finalized and the construction phase is currently being implemented, with the plans to complete the entire project by the end of 2018. Aiming at further integration of inland ports into the multimodal logistic chains the "Expansion of the tri-modal inland port of Wien by land recovery" was completed in 2015.

### **Rail-Road Terminals**

Facilities of the Rail-Road Terminals München-Riem Ubf (interim storage area), Linz Stadthafen (Land reclamation, extension of the container terminal and extension of railway tracks by 12/2014 as well as studies for the expansion of the trimodal Port of Linz by 12/2015), Ennshafen (significant improvement by 4/2015), Žilina – Teplička (construction of a new public terminal by end of 2015) have been extended and improved since the adoption of Regulation 1315/2013. Preparatory steps to build an intermodal terminal in Ruse (namely feasibility study, preliminary design, Cost-Benefit Analysis, approved EIA Report) have been completed in 2015. Works at the hub terminals Wien-Süd (Inzersdorf) by ÖBB and Budapest by Metrans (subsidiary of the German HHLA group) for two additional large size Rail-Road Terminals are continuing. Both shall become operational in the year 2017.

### **Road**

Between 2013 and 2015 road infrastructure on the Rhine-Danube Corridor was slightly improved from 76.7% to 78.1% by the completion of ten road projects and one innovation project related to ITS, located in four Member States – Austria, Hungary, Slovakia and Romania. 4 new construction projects as well as 4 projects with capacity enhancements and a feasibility study for the new motorway between Arad and Timisoara have been completed. 1 project improves the safety situation on a road section (SK) and 1 project deals with the provision of ITS on motorway (AT). Of particular importance is the removal of the cross-border bottleneck between Mako (HU) and Nadlac (RO), providing a continuous motorway connection between both Member States.

### **Airports**

Airport related KPI did not change since 2013, even if five projects have been completed. Most relevant are the rail connection of airport Wien to the Wien Central Station (KPI target achieved), the adaptation of the rail platform at the airport Wien and the connection of the Ostrava airport to the railway network. Other projects have been studies on rail connections to the airports of Frankfurt and München.

## **7 Infrastructure implementation and socio-economic effects**

### **7.1 Impact to jobs and growth**

#### **7.1.1 Summary of multiplier-based growth and jobs analysis**

Based on a guideline developed by M-Five, KombiConsult and HaCon each of the nine CNC undertook an analysis of the growth stimulated by the implementation of their corridor as well as of the job-years then created. The methodology of this analysis was following the approach developed and applied in the study on the *Cost of Non-Completion of the TEN-T*<sup>56</sup>. Core of the method are (1) multipliers that have been

<sup>56</sup> • Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

derived by M-Five and provided to the CNC together with the guidelines and (2) the most recent project list as of May 2017 of each of the CNC.

The results of the growth and jobs analysis are divided into two categories:

Impact of an **individual CNC**: these results refer to the growth and job impact of each CNC individually. The individual CNC numbers should not be aggregated as this would include double counting due to the overlaps of a number of projects between the CNC.

Impact of the **nine CNC together**: to generate these results each CNC only included the projects contained in their project list for which the corridor Consortium is responsible to fill in and update the data on a specific project.

The following tables summarize the results of each category for all nine CNCs. Table 33 presents the impact of each CNC. Planned investments of corridors over the period 2016 to 2030 are in the range between 43.6 billion EUR for the Atlantic CNC (ATL) and 191 billion EUR for the Scandinavian-Mediterranean CNC (SCM). These investments would stimulate a growth of GDP of between 356 bn EUR (OEM) and 1,468 bn EUR (SCM) by the different CNC. The number of JOBs created measured in job-years would be in the range between 1,068,000 and 4,176,000.

**Table 33: Investment and growth and job impact on CNC– including overlaps**

2016 to 2030	Unit	ATL	BAC	MED	NSB	NSMED	OEM	RALP	RHD	SCM
Investment	bn €2015	43.6	74.5	102.8	96.0	52.4	69.9	99.6	87.7	191.0
GDP created	bn €2015	419	535	622	715	356	517	743	725	1,468
JOB-years created	#1000	1,092	1,566	1,967	2,061	1,068	1,494	2,139	2,002	4,176

Table 34 lists for each CNC only the values of projects for which the CNC study team is responsible to collect the data. Thus the overlapping projects between different CNC are counted only ones. These numbers are less meaningful for the interpretation of the impact of a specific CNC. But they enable to calculate the aggregated impact of the 9 CNC.

The total planned investment on the nine CNC for 2016 until 2030 amounts to 607 billion EUR. These investments would stimulate additional GDP of 4,551 billion EUR over that period. The number of job-years created by the implementation of the 9 CNC would reach 13,077,000 job-years.

**Table 34: Investment and growth and job impact of without overlaps and total impact of all 9 CNC**

2016 to 2030	Unit	ATL	BAC	MED	NSB	NSMED	OEM	RALP	RHD	SCM	Total
Investment	bn €2015	29.4	53.1	88.5	64.8	17.8	31.7	91.9	58.9	170.6	<b>606.9</b>
GDP created	bn €2015	220	367	540	533	166	263	678	444	1,339	<b>4,551</b>
JOB-years created	#1000	633	1,093	1,702	1,475	438	726	1,962	1,273	3,777	<b>13,077</b>

Comparing these findings with the Cost of Non-completion study of 2015, the investments on the 9 CNC have grown from 468 bn EUR<sub>2005</sub> to 607 bn EUR<sub>2015</sub>. Considering a deflator of 1.16 the value from the first study expressed in EUR<sub>2015</sub> would be 543 bn EUR<sub>2015</sub>. It should be noted that in both calculations there is some uncertainty concerning the actual price base of the investment cost of each project. Also the values of the Cost of Non-completion study refer to the period 2015 to 2030, while the more recent results of Table 34 refer to 2016 until 2030.

In terms of GDP the numbers are 2,981 bn EUR<sub>2015</sub> (2,570 bn EUR<sub>2005</sub>) in the Cost of Non-completion study versus 4,551 bn EUR<sub>2015</sub>. Apart from growth in investment the major reason for this increase is that the cross-border investment have been increasing strongly from 50 bn EUR<sub>2015</sub> (43.2 bn EUR<sub>2005</sub>) to 115 bn EUR<sub>2015</sub>. This could have two reasons: (1) the number and size of cross-border projects has increased in the project lists, or (2) the classification of cross-border projects was narrower in the first study. Actually, in the first study the EC had individually decided which projects should be counted as cross-border. In the current analysis the CNC study teams added a column to classify projects as being cross-border according to the rules of the regulation (1315/2013), which suggests that cross-border links include those sections from a border until the first urban node. This can cover a substantial distance e.g. in the case of the ATL CNC all projects between the border and the city of Mannheim (168 km away from the border) would be classified as cross-border.

In terms of job-years created the results of the Cost of Non-completion study was that 8,900,000 job-years would be created by the implementation of the 9 CNC. In this recent update we concluded that 13,077,000 job-years would be created. Again this increase is a consequence of higher investment and in particular of increased investment into cross-border projects, which to some extent could be a matter of classification as explained above.

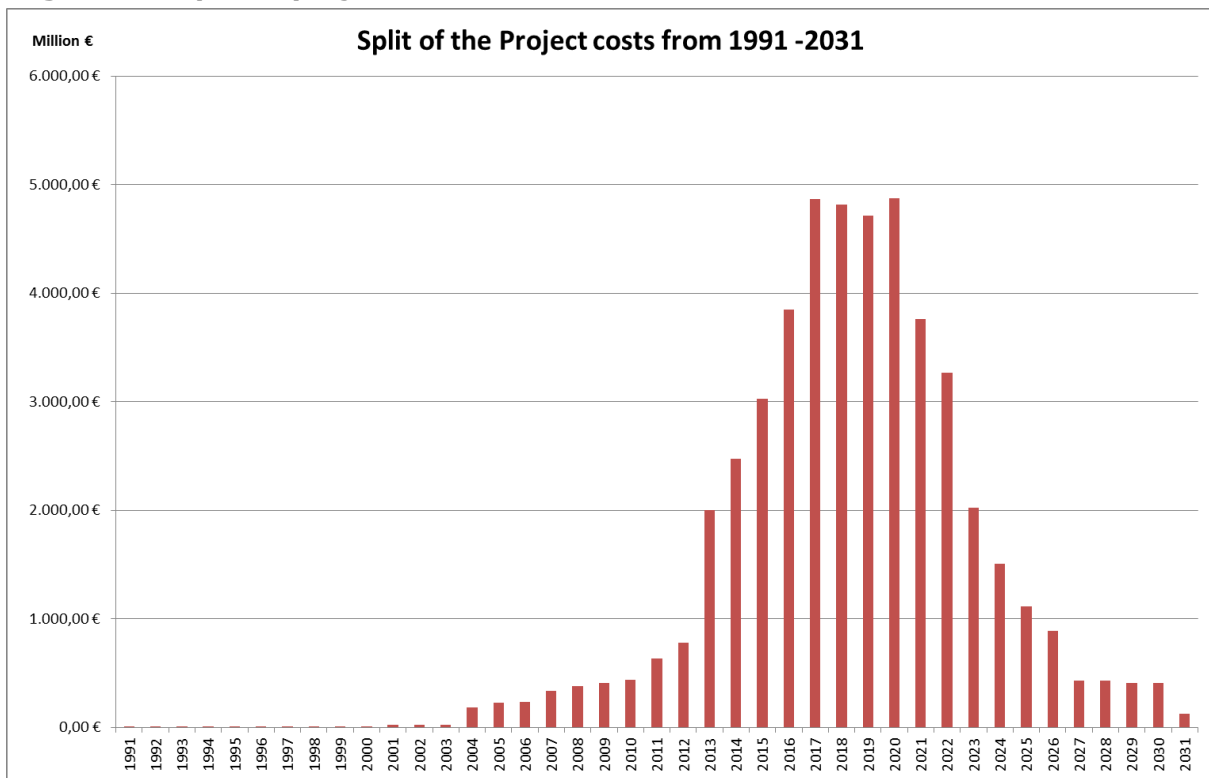
### 7.1.2 Estimation of socio-economic impact

The Commission asked the study teams to allocate the NUTS2 regions to the projects of the project list 2017 and to provide an input matrix to JRC to support them in the assessment of socio-economic effects (direct and indirect employment in FTE/growth of GDP generated by the project implementation phase,

With regard to the allocation of NUTS2 regions to the projects of the R-D CNC the study team developed in cooperation with other corridor consultants a matrix for the calculation of the following topics:

- Indication of the region, where the action takes place with distribution of project costs over the project period, as indicated in the project list 2017.
- This matrix shows the total costs in million € for all projects on the Rhine Danube CNC (basis: Rhine Danube Final Project List 2017) located in the respective NUTS 2 regions and to be implemented in the respective years (based on the start and end date of projects).
- Projects with missing information on start and/or end date were not taken into consideration.
- For all other 328 projects, costs were split evenly between all NUTS-2 regions affected and years of project implementation.
- In the excel table "total costs per region year (2)" the NUTS2 regions relevant only for the R-D CNC are shown, whereas the table "total cost per region and year" include also other NUTS2 regions, which are relevant only for other CNC.

Based on the distribution of the project costs over the project implementation period (mostly planning and construction phase of the projects) the disbursement of the costs on the corridor up to the year 2031 is shown in the following Figure 65.

**Figure 65: Split of project costs**

Source: Hacon calculation based on project list of 04/2017

In parallel the consultant received a number of CBAs from INEA to check, whether there is information available on job creation during construction period. Having analysed a first set of the CBAs it can be concluded that such information are not included in the CBA documents provided to the consultant.

## 7.2 Infrastructure funding and innovative financial instruments

### 7.2.1 Overall investment analysis of the Rhine-Danube Corridor

The analysis aims to identify the funding sources of projects listed within the CNC project list. The rationale of the exercise is to leverage the information provided in the CNC WP project list and determine the presence of funding gaps and the potential for other forms of financing than public grants. In a two-step procedure the funding sources of the projects were analysed:

- Step 1. Macro-level tag: The different “funding sources” are related to macro categories as: MS/public; EU; Private/own resources; EIB/bank loan (revenues); others.
- Step 2. Detailed tag: Specifically for the EU support, a further break down is made to categorise the EU funding sources as: CEF, ESIFs and Other/unspecified.

Based on the identification of the funding sources the cluster funding sources was used to cover investment costs into:

- MS/ public
- EU funds
  - CEF
  - ESIFs

- Other/ unspecified
  - Private/own resources
  - EIB/bank loan (revenues)
  - Other

The overall investment costs of all the projects in the CNC project list sum up to a total of 91.9 bn EUR. From the total number of projects about 75% of the projects contains full set of information on the investment costs (equal to investment volume of 68.8 bn EUR), for 25% of the projects the information are not complete (equal to an investment volume of 23 bn EUR).

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

- Financing by MS/public grant: 64.7% or 44.8 bn EUR
- EU grants: 23.5 % or 16.2 bn EUR
- IFI bank loan: 25 Mio EUR (negligible)
- Private financing/own resources: 6.3% or 4.3 bn EUR
- Other financing sources: 5.5% or 3.7 bn EUR

The breakdown of funding by EU grants shows following situation:

- Cohesion Fund, CEF, OPT: 13.1 bn EUR or 81%
- CEF/TEN-T: 1.9 bn EUR or 12%
- ERDF: 685 Mio EUR or 4%
- ESIF: 432 Mio EUR or 3%
- IPA: 40 Mio EUR
- Not specified: 26.6 Mio EUR

When analysing the financing of projects through EU grants a share of 51.5% of the investment volume is approved (equal to 8.3bn EUR) and the share of 48.4% can be considered as potential for funding (equal to 7.8 bn EUR).The investment analysis of the RD CNC and the structure of the EU grants breakdown reflects the typical situation of the RD CNC, which has a high share of Member States receiving financial means under the Cohesion Fund.

Would the same EU funding ratio (i.e. 23.5%,) be applied to the entire corridor work plan investment amount of 91.9 bn EUR, it can be expected that over the next years, 11.1 bn EUR (calculated on basis of approved EU grants) and 21.6 bn EUR (calculated on basis of entire EU grants) will be demanded from project promoters and Member States.

The assessment of the Rhine-Danube project pipeline regarding the potential of projects for EIB/EFSI support depicts the following:

Of the 316 projects for which complete information is held and further 60 projects with partial investment information (disposing of a potential in financial sustainability due to their scope of work), about 100 projects or approximately 18% are identified as financially sustainable. All projects with the indications of potential revenue generating by the promoters are summarised in the share of 18%.

It was also deemed that additional 49% of the projects or 276 projects could be a potential for financial sustainability, if properly structured (i.e. *potentially financially sustainable*). Here the projects are summarised by following the guidelines for the



distinction between non-financially sustainable and potentially financially sustainable projects as given by EC in email of 9. January 2017.

The remaining 187 projects or 33% are considered as non-financially sustainable.

Would the same percentages apply to the investment amount relative to all the projects included in the work plan, approximately 7.1 bn EUR capital expenditure would be relative to financially sustainable projects and 82.5 billion EUR would be relative to projects, which could be sustainable, if properly structured.<sup>57</sup>

## 8 Pilot initiative

Taking up the topics of the five „Issues Papers“ by the European Coordinators innovative pilot projects had to be identified, which are characterized by:

- A set of connected actions which – as a whole – generate, in a period of no more than 3 to 4 years, clear benefits for users or/and society, and which should be expressed in KPI such as time gains, emissions' reduction, enhanced service quality etc.
- A listing of all actions belonging to this project, relevant promoters, cost and timing; total cost and implementation time
- An agreement of all promoters, confirming their commitment to the project as a whole

At a meeting between the Corridor Coordinators and the consortium leaders on 13th March 2017 the following pilot/flagship projects have been presented for the Rhine-Danube Corridor:

- Good Navigation Status along the Danube
- Europe-wide River Information Services
- Iron Gate I and II
- Upgrading CS branch of Rhine-Danube corridor to intermodal standard
- Exploiting potential intermodal freight volumes by adequate terminal landscape and related service concepts along Rhine-Danube corridor
- Enhancement of multimodality in Rhine-Danube Core Ports
- Galati multimodal platform - Stage II - Upgrade of the infrastructure for land access to the port of Galati
- LNG Bunkering Station at Berth no. 99
- Construction of the LNG Terminal in public port of Bratislava
- New trimodal terminal in port of Drobeta -Turnu-Severin
- Development of the existing container terminal in Nürnberg

In their reply mid-April, the European Corridor Coordinator particularly welcomed the project “Europe-wide river information services (RIS)” and encouraged to spread the progress made related to inland waterways to other Corridors. Therefore three fiches have been prepared to be discussed at the Inland Waterways and Ports Working Group and the 10th Corridor Forum Meeting on 13./14.06.2017:

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<sup>57</sup> As per definition, it does not mean that the entire capital expenditure can necessarily be sustained with other-than-grant funding sources. It however means that at least part of the investment can be sustained through financing.

## The Rhine-Danube Corridor Fiche

The Rhine-Danube Corridor is the main east-west link between continental European countries, connecting France, Germany, Austria, Czech Republic, Slovakia, Hungary, Croatia, Romania and Bulgaria all along the Main and the Danube rivers to the Black Sea by improving (high speed) rail and inland waterway interconnections.

### FAIRway Danube Fiche

Up-to-date recordings of the riverbed, combined with precise water level measurements are fundamental tools for navigation, shippers and logistics providers. In a joint effort, the project partners will make the collected data available to the waterway users, thus improving the planning accuracy of transports. Waterway authorities benefit from the accuracy of the collected data and use them for planning of future measures. Better navigation conditions contribute to better load factors and the reduction of the carbon footprint.

### RIS COMEX Fiche: towards Europe-wide River Information Services

Harmonised implementation of River Information Services made considerable progress during the last years but actual cross-border interworking is still limited, especially concerning (inter-)national data exchange. Therefore 15 partners from 13 different European countries joined their forces under the coordination of the Austrian Waterway Administration viadonau with the common goal to realise Corridor RIS

### Pilot Initiative Proposal

Discussions during the 10<sup>th</sup> Corridor Forum Meeting on 14.06.2017 and a phone conference between DG MOVE, INEA and the consultants on 05.07.2017 resulted in a refined definition of now called "pilot initiatives":

- **Additionality:** the initiative would not have seen the light without the stimulation by the Corridor Coordinator
- **Regional suitability:** it matches the particularities of the Corridor, supports its development by taking up existing limitations and bases on solid grounds (e.g. preparatory activities)
- **Short term implementation:** it can be realized in near future
- **Corridor wide:** Deployment on the whole Corridor, the Corridor shall take the ownership.
- **Forerunner:** other Corridors may follow the example of a successfully implemented pilot initiative

**Table 35: Pilot Initiative of the Rhine-Danube Corridor**

Digital solutions to alleviate administrative red tape	
Main issue	Administrative processes in Danube navigation are currently not harmonised in some areas and lead to partly avoidable controls and to delays in waterway operations. This causes significant competitive disadvantages for Danube navigation.
Main objective	The overall aim is to <b>simplify, harmonise and digitalise administrative processes</b> (in this specific order) in Danube navigation, in order to raise efficiency and effectiveness of Administrative control procedures, while at the same time reducing costs and delays for shipping companies . The focus is on simplification and harmonisation for the coming 2-3 years.

Digital solutions to alleviate administrative red tape	
Involved stakeholders	<ul style="list-style-type: none"> <li>▪ EUSDR Priority Area 1a Coordinators (Inland Waterways)</li> <li>▪ EUSDR Priority Area 11 Coordinators (Security)</li> <li>▪ viadonau (Project coordinator of nationally financed project „Removal of administrative barriers along the Danube“ and the CEF-financed project RIS COMEX)</li> <li>▪ Pro Danube International (Lead Partner for DANTE project)</li> </ul>
EU-Policy context	<ul style="list-style-type: none"> <li>▪ <b>European Union Strategy for the Danube Region</b> Priority Areas 1a (Inland Waterways) and PA11 (Security)</li> <li>▪ <b>NAIADES II Action Programme</b> "Towards quality inland waterway transport" (2014-2020): aiming at creating the conditions for inland navigation transport to become a quality mode of transport.</li> <li>▪ <b>eGovernment Action Plan 2016-2020</b>: Accelerating the digital transformation of government, helping to remove existing digital barriers and preventing further fragmentation arising in the context of the modernisation of public administrations.</li> </ul>
Existing initiatives – what has been done so far?	<ul style="list-style-type: none"> <li>▪ <b>Working group on „Administrative Processes“</b> of the Priority Areas 1a and 11 of the EU Strategy for the Danube Region in combination with the project „Removal of administrative barriers along the Danube“ (nationally financed within the Austrian Action Programme on Danube Navigation) the simplification, harmonisation and digitalisation of the border control processes and forms along the Danube is pursued. <p style="margin-left: 20px;">A total of 20 recommendations have already been elaborated and are expected to be jointly implemented by the stakeholders of PA 1a (including Danube logistics sector) and PA11 (border control authorities). In the first phase, eight priority measures were selected, and detailed implementation plans have been elaborated. Preliminary results are the following:</p> <ul style="list-style-type: none"> <li>○ Simplification: a „Practical manual on border controls along the Danube and its navigable tributaries“ was issued (meanwhile with a second updated edition)</li> <li>○ Harmonisation: A first set of harmonised control forms (Danube Navigation Standard Forms – „DAVID forms“) was elaborated and is currently under discussion with border control authorities of PA11</li> </ul> </li> <li>▪ <b>DANTE</b> project: the DTP financed project DANTE (Improving administrative procedures and processes for Danube IWT) has started in January 2017 and will end in June 2019. The main objective of DANTE is to improve administrative procedures and to reduce time losses and costs by eliminating redundant administrative processes. DANTE will feed the PA1a/PA11 working group by identifying further administrative barriers and proposing viable solutions for their elimination.</li> <li>▪ <b>RIS COMEX</b> project: the CEF-funded RIS COMEX project explores</li> </ul>

Digital solutions to alleviate administrative red tape	
	<p>further possibilities for digitalisation and the effective use of River Information Services in administrative processes in Danube navigation.</p>
Main implementation steps (planned)	<ol style="list-style-type: none"> <li>1. <b>Simplification</b> and practical guidance (mid-2017) – Publication of „Practical manual on border controls along the Danube and its navigable tributaries“ (meanwhile in a second updated edition).</li> <li>2. <b>Harmonisation</b> of selected administrative forms (end 2017) – a first set of harmonised control forms (Danube Navigation Standard Forms – „DAVID forms“) was elaborated by PA1a and is currently under discussion with border control authorities of PA11. The first set of harmonised forms pertains to Arrival and departure reports, crew lists and passenger lists.</li> <li>3. Preparation of technical content for <b>recommendations on administrative level</b> (end 2018) to facilitate the application of the harmonised forms on national level by PA1a (end 2018).</li> <li>4. Publication of Strategy paper of PA1a (end 2018), a <b>“Strategy on administrative processes”</b> is planned to be released by the end of 2018, summarising the most urgent policy needs and recommendations, based on the results of the PA1a/PA11 working group results.</li> <li>5. <b>Steps towards Digitalisation</b> (after 2018): Depending on the progress of simplification and harmonisation in the previous steps, the RIS COMEX and DANTE projects will explore possibilities for digitalisation and the effective use of River Information Services in administrative processes in Danube navigation. Integration of digital vessel-related data could for instance be a promising option to avoid multiple data entry and multiple vessels controls.</li> </ol>
Proposed way forward	<p>All existing initiatives in this field should be well coordinated, synchronised and clustered in order to produce the expected results and impacts in the medium term. A bundling of efforts is needed to mobilize the limited resources to tackle the issues at hand.</p> <p>The nomination of this cluster of activities as “flagship initiative” in the framework of the Rhine-Danube Corridor Coordination work could help to mobilize forces and accelerate the necessary implementation steps.</p>
Value added of Corridor Coordinator’s involvement	<p>The support of the Rhine-Danube Corridor Coordinator would especially be valuable in order to accelerate the follow up activities for the implementation of step 3 (corridor-level administrative agreement to facilitate application of the harmonised forms).</p>

In conclusion, the pilot initiative focussing on border controls can build on existing actions and takes up a major issue of the Rhine-Danube Corridor owed to the internationality of its main inland waterway. The Danube connects EU-and Non-EU Member States, Schengen and Non-Schengen Members as well as maritime and inland ports. If more efficient and effective border controls can be introduced here, the

processes will be most probably applicable at other Corridors as well. The Rhine-Danube Corridor can be a forerunner for others.

All together three issues papers address the activities covered by the pilot initiative:

Multi-modality and efficient freight logistics

- Efficiency through reduced costs and delays
- Improved competitiveness adds to shift towards IWT

Cooperation with third countries

- Predominantly the cooperation with Serbia is essential but also Bosnia and Hercegovina and Ukraine are sharing Corridor Infrastructure

Intelligent Transport Systems

After 2018 digitalisation may boost competitiveness even more.