Study on Mediterranean TEN-T Core Network Corridor

2nd Phase

Final Report

December 2017

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List of abbreviations

CBA - Cost Benefit Analysis
CEF - Connecting Europe Facilities
CNC - Core Network Corridor
EC - European Commission
EIA - Environmental Impact Assessment
EIB - European Investment Bank
ERTMS - European Railway Traffic Management System
ESIF - European structural and investment funds
ETCS - European Train Control System
ETIS
GDP - Gross domestic product
GHG
IWT - Inland Water Transport
IWW - Inland Water Ways
KPI - Key Performance Indicator
MCA - Multi Criteria Anlaysis
MED - Mediterranean Corridor
MS - Member State
MTMS
RFC - Rail Freight Corridor
RRT - Rail Road Terminal
SEA - Strategic Environmental Assessment
TEN-T - TransEuropeanNetwork - Transport
TMS - Transport Market Study
WP – Work Plan-

Disclaimer

Executive summary

The Mediterranean corridor is the main east-west axis in the TEN-T network south of the Alps. It runs between the south-western Mediterranean region of Spain and the Ukrainian border with Hungary, following the coastlines of Spain and France and crossing the Alps towards the east through Italy, Slovenia and Croatia and continuing through Hungary up to its eastern border with Ukraine. The Mediterranean corridor's ports lie within very important global trade routes, such as traffics from the Sea of China through Suez channel.
This Corridor of about 3,000 km, integrating former Priority Projects 3 and 6, ERTMS Corridor D and corresponding to the Mediterranean Rail Freight Corridor, will provide a multimodal link for the ports of the western Mediterranean with the centre of the EU. It will also create an east-west link through the southern part of the EU, contribute to modal shift from road to rail in sensitive areas such as the Pyrenees and the Alps, and connect some of the major urban areas of the EU with high speed trains.
The regions along the Mediterranean Corridor represent an important socio-economic area within the EU. With 18% of EU's population, the Corridor regions generated 17% of the EU's 2014 GDP. Economically speaking the most important regions of the Corridor are Piedmont ant Lombardy, the Rhone-Alpes region, Catalonia and Madrid.

Compliance with the technical infrastructure parameters of the TEN-T guidelines in 2017

In the TEN-T Regulation the transport infrastructure requirements have been defined for the core network which will have to be met by 2030 at the latest.
The 2014 Corridor Study contains an in-depth analysis as to how the current infrastructure in the six Corridor countries complies with the TEN-T Regulation's technical parameters set for each transport mode or infrastructure category.
Key Performance Indicators (KPIs) are used within the 2015-17 CNC studies to assess and monitor the evolution of the corridors and the potential effects of individual projects or groups of projects on infrastructure interoperability and performance. A common or "generic" KPI framework has been developed for all nine corridors, in order to permit comparability across the whole network.
Electrification is ensured on 92% of the Corridor's **railway** lines, while track gauge is still an issue as France, Italy, Slovenia, Croatia and Hungary feature the 1435 mm standard UIC gauge, whereas in Spain, the standard gauge (used on the high-speed lines) coexists with the Iberian gauge 1668 mm on the large part of the remaining network. Train length of 740 m is only allowed in France and part of the Hungarian,

Spanish and Hungarian networks. On the rest of the Corridor, various train length restrictions apply, allowing a train length between 400m and 700m. The Corridor's railway infrastructure allows the required axle load of 22.5 t on all of the sections in Spain, Italy and Croatia, while in France, Hungary and Slovenia[1] limitations still exist on some sections. As regards the parameter “Motorway or Express roads” only a few sections are not motorways such as the Hungarian section close to the Ukrainian border.
All **ports** are reported to be fully compliant with Regulation (EU) 1315/2013, which requires the connection to the rail network by 2030. Nevertheless, it shall be highlighted that several ports are further improving the rail connection with a view to improving the rail hinterland connection and thereby increasing possibilities for modal shift.
About 80% of the **IWW** network of the Corridor meet the Regulation (UE) 1315/2013 minimum requirement for the inland waterways of international importance this requirement.
According to EU prescriptions, only **airports** having direct rail services linking the airport with high-speed lines or long distance TEN-T railway lines shall be considered as properly “connected with rail”. Local or regional/suburban rail connections, although improving accessibility, are not sufficient for the full compliance with the Regulation. Under such assumption, only Lyon airport can be considered currently as directly connected to heavy rail.

Transport market analysis

The Corridor Study, which has been published end of 2014[2] contains a detailed transport market Study (TMS) which analyses the transport flows along the Corridor by assessing the capacity and traffic flows on the respective parts of the infrastructure.

Based on the **GDP growth assumptions**, the total freight flows (except maritime traffic) of the market area have been **forecasted** for 2030; the following tables summarize the forecasting results:

Total Market area	**2010**	**2030 trend (do-nothing)**	**2030 (Corridor implemented)**	**2030 Corridor implemented (including accompanied rolling motorway)**
Road	129 623	228 647	195 131	186 431
Rail	22 206	38 958	72 474	81 174
Total (except sea)	**151 829**	**267 605**	**267 605**	**267 605**
Rail share	**14,6%**	**14,6%**	**27,1%**	**29,4%**

Total market area (1000 pax/year)	**2010.**	**2030 Trend scenario**	**2030 With Corridor implementation**	**Diff. Corridor-trend**
Road	46 261	63 539	61 125	- 2 413
Rail	3 001	4 061	10 011	5 950
Air	79 659	110 179	108 153	- 2 026
Total	**128 921**	**177 779**	**179 289**	**1 510**
Rail share	**2,3%**	**2,3%**	**5,6%**	

[1] Axle load of 22.5 tons/axle is provided on 88.1% of the railway network on the MED corridor in Slovenia.
[2] http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/Corridors/Corridor-studies_en.htm

These forecasts show that there is a strong **potential** for international **rail** freight traffic development on the Mediterranean corridor until 2030 and that implementing the corridor could increase the international rail traffic by nearly 6 million passengers / year in 2030.

The transport market study also helped drawing both general and specific conclusions on several **bottleneck** issues. In particular, the following findings arise:

1. The implementation of the Mediterranean corridor represents a major opportunity to shift important volumes of freight from road to rail, with a potential shifting of 40 million tons of goods from road to rail by 2030. Nevertheless, the realization of this objective needs a fully upgraded and interoperable infrastructure with adapted services and rail-road terminal.
2. The connections to the ports are a key element for the success of the corridor. All ports of the corridor have great ambitions of development in the 10-20 coming years, with various projects especially regarding the improvement of capacities for container traffic and rail connections. In fact, intercontinental container traffic in Europe is still handled above all in the ports of the north range, generating very long-distance hinterland flows. The development of the ports of the Mediterranean, together with an efficient rail connection of these ports to the core network, could help reaching a better balance between north and south range and an enhanced sustainability (reducing the costs in time and fuel as well as the related emissions) of Europe's international trade with other continents. The short sea services between European countries or with northern Africa is also a strong and growing element of the maritime dimension of the corridor.
3. Even if they have relatively low traffic for the moment, IWW could play an important role in the future for the Mediterranean corridor. By connecting major industrial zones to seaports, they could offer an interesting alternative to road or rail transport for certain types of goods, which is important to develop as road and rail networks will increasingly suffer from congestion in particular around seaports and urban nodes. In Italy, the IWW system could reach a completely different dimension if Milano and Piacenza were properly connected to the network; in France, the development of the traffic on the Rhône, which is growing rapidly in the last years, is a major opportunity for the port of Marseille/Fos and for enhancing multimodality along a very congestioned valley, supporting strong container traffic growth.
4. Corridor development is also likely to significantly improve the competiveness of rail for international passenger traffic, with a potential increase of 6 million passengers per year by 2030, 2 million of which shifted from air traffic. Corridor implementation could also have important effects for national and regional traffic, improving travel time on sections with strong national flows (Nîmes–Montpellier-Perpignan, Lyon–Chambéry/Grenoble, Milano–Venezia-Trieste, etc.) and creating opportunities for new performing regional services where congestioned nodes are relieved.

What has still to be done

Below are summarized what has still to be done in terms of infrastructure implementation by 2030 in parallel with the need of ensuring a sustainable, smart and innovative European transport system in line with related EU Policies (see also next paragraphs).

Cross-border projects: These projects are crucial for the establishment of direct links between MSs and typically have a high European added value, but may have lower direct economic effects compared to purely national projects. Such projects should be the subject of priority intervention by the Union in order to ensure that they are implemented.

Rail and ERTMS: By comparing infrastructure quality standards, with the current status of the Mediterranean rail core sections, the following key critical issues could be highlighted:

- With regards to speed standards, the Corridor shows limitations in Slovenia and Croatia, specifically on the core sections linking the national network to the ports of Koper and Rijeka,
- Lack of compliance in terms of electrification on several lines is shown in Spain and Slovenia,
- Lack of compliance in terms of axle load is present in the east part of the Corridor alignment, mainly in Slovenia and Hungary,
- Track gauge non-compliance found on several Spanish sections part of the Corridor alignment,
- Train length limitations on the majority of the Corridor alignment with the exception of French lines,
- ERTMS signalling system to be deployed on the majority of Corridor railway lines.

Maritime: With regard to the impact on KPI, all MED ports obviously already meet the basic requirement of TEN-t Regulation (EU) N. 1315/2013, art. 41.2, stating that all core ports need to be connected with rail. Nevertheless, the completion of these planned works will allow an improvement of these technical parameters, enhancing modal shift for freight transport.

Road: With regards to the express road/ motorway parameter, only 2% of the sections, (i.e. the Hungarian section close to the Ukrainian border) are not compliant yet.

Last mile projects: Rail connection to ports is available but should be upgraded in order to meet the full interoperability. However, airport rail connection is mainly unavailable. Needless to say, European legislation requires that last mile connections are ensured by 2030, with the exception of last mile railway connections to airports; in the sense that only main airports shall be directly linked with heavy TEN-t Core Rail Network (HS or Conventional) by 2050.

Urban nodes: Effective integration of urban nodes in the corridors is an urgent key issue. The importance of a global and integrated strategy from the Regions, aligned with the Member States and EU policies, to effectively address bottlenecks within urban nodes is accentuated.

Innovation: This high level overview on past and existing European transport initiatives shows that innovation is of paramount importance for the achievement of the different strategic goals set for the transport sector in Europe, across all modes. Only 40% of innovation projects have a direct contribution to transport decarbonisation. This results in a total of 52 innovation projects. It is worth mentioning that these figures represent only those projects that are considered to have a direct impact on transport decarbonisation but there are many other that also contribute to a lesser extent or in a less evident way.

Climate change & Environmental issues: The implementation of the TEN-T Mediterranean Core Network Corridor will provide a significant contribution to the necessary mitigation of environmental impacts of transport in Europe. The reduction of GHG emissions is primarily linked with modal shift from road to rail, in particular for international freight transport. The Corridor also contributes to a more efficient rail transport, with total electrification and higher load factors thanks to the implementation of the TEN-T standards. The Corridor also mitigates other environmental impacts such as noise and air pollution. While the environmental impacts of the Corridor should be globally very positive, some negative impacts, often local or limited in time, need to be addressed and reduced. Among others, one can mention:

- The construction of new infrastructure, which can have impacts on biodiversity, land use, hydric resources. This needs to be addressed by a detailed EIA for each project, implementing the appropriate measures to avoid or mitigate / compensate these impacts. The GHG emissions in construction phases should also be reduced to a possible minimum, encouraging sustainable construction techniques;

- The modal shift towards rail could lead locally to an important development of traffic on existing rail lines, often crossing urban nodes and dense population areas. Appropriate measures should be taken in order to protect the population of the consequences of this development of traffic, in particular noise exposure.

The positive impacts of the Corridor could also be maximized through a set of measures at European, national or local level, for example:

- Implementing the TEN-T core network as a hole with good interconnections between corridors, as we have seen how they are interdependent;

- Encouraging innovation for improving energy efficiency and decarbonisation of all transport modes;

- Lowering the level of CO2 emissions for the production of electricity by encouraging the development of renewable energy sources: this would make the modal shift to rail more efficient for GHG emission reductions;

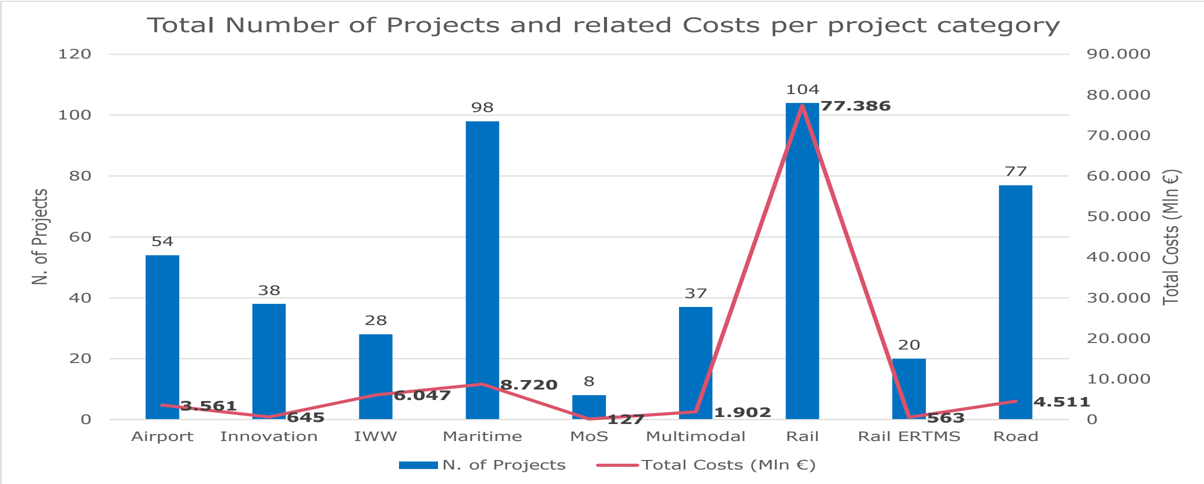
- Promoting modal shift for local and regional transport.

Programme of measures – general statistics

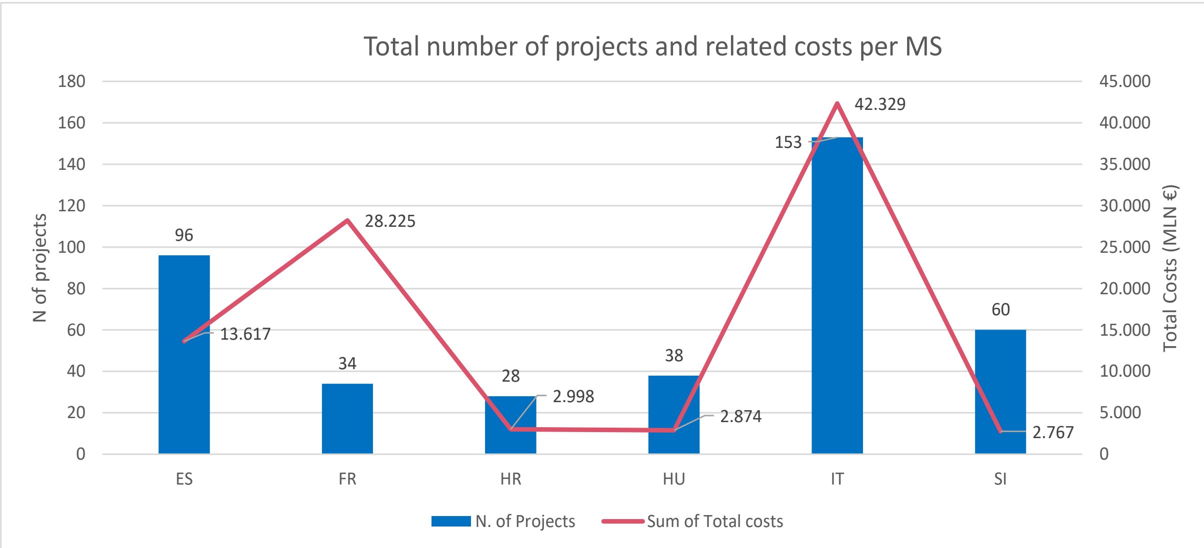
The Mediterranean Project list represents the implementation plan of the Corridor, comprising all those interventions (hard and soft measures) needed in order to meet TEN-t requirements set by Reg. (EU) N° 1315/2013.

The Final project list is composed of 462 projects, whereas this overall amount does not take into account 23 cross corridor/horizontal projects, nor it includes 29 concluded projects.

The required funds for its implementation are approximately €104 billion. Nevertheless, it is worth mentioning that this overall amount shall be considered as underestimated, since there is no available information on the total costs for 41 out of 464 projects. The following figure presents the total number of projects and the associated cost per each project category.



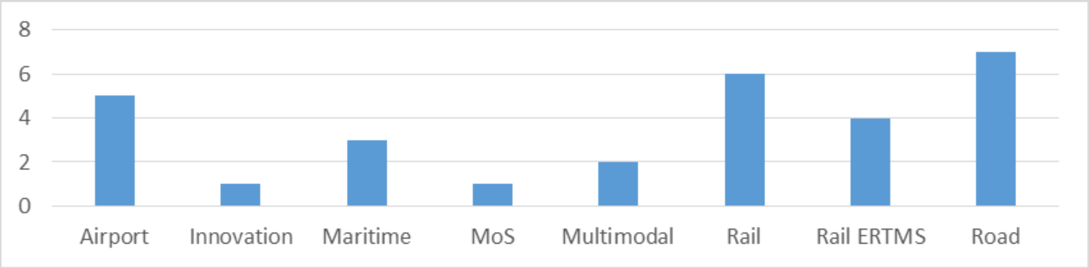
Furthermore, the majority of interventions needed in order to meet TEN-T technical requirements are capital intensive, characterised by high investment costs (i.e. realisation of new railway lines, upgrading of technical parameters relevant for freight traffic, improving last mile connections etc.). Evaluations of projects per MS by total number of projects and associated costs (with the exclusion of cross border projects and multi-country ones) are presented below.



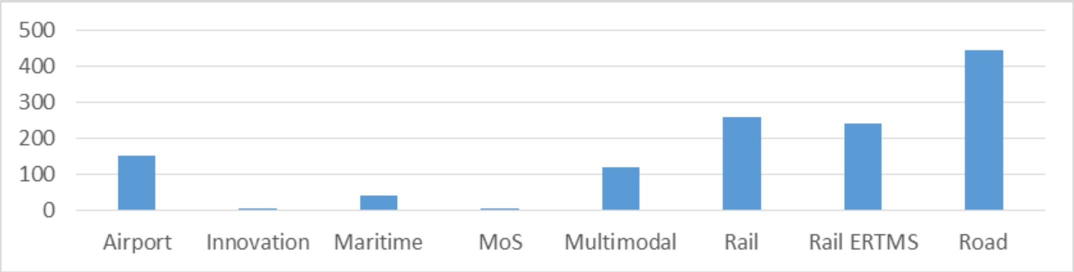
After the update of the project list, Italy, France and Spain still record the highest costs (respectively, €42.3, €28.2 and €13.6 billion), while Hungary, Croatia and Slovenia follow with lower amounts. The repartition of costs and number of projects among MSs also reflects the different number of nodes belonging to each country, as set out in Annex II of Regulation (EU) N. 1316/2013, as well as the extension of the corridor within the State, in terms of km of road, rail and IWW sections.

The completion time represents a crucial factor for evaluating the maturity of projects belonging to the Mediterranean projects list: the large majority of projects (247 out of 462) will be completed by 2020, and this is especially valid for Maritime, Rail and Road projects (as clarified by the figure below). A significant bulk of projects (135) will be finalized by 2030, i.e. the longest time-horizon foreseen by the Regulation (EU) N. 1315/2013, except for airport rail connections.

The following figures give a view on the totality of MED accomplished actions in the period 2014-2016, under both the total number of projects and the total investment per mode.



Accomplished MED projects – Total number of actions



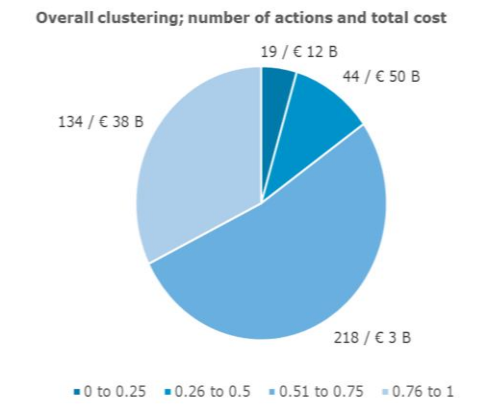
Accomplished MED projects – Total cost in million €

Programme of measures – focus on mapping

The mapping of investments has been based on the analysis of common defined KPIs, the projects' data previously gathered and the relative analysis carried out concerning the update of the Work Plan.

The suggested methodology is based on the evaluation of all the projects and their 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). This methodology enables both quantitative and qualitative criteria to be considered resulting in a final project score.
The figure below indicates the overall mapping of the 415 work-related projects. As explained in the methodology, the 49 actions involving only a study were not included in the analysis.

It is evident from the pie chart that the great majority of the projects falls in the high end of the mapping, i.e. the range in which values assigned to each action span from 0.51 to 1. Furthermore the total number of projects mapping a full 1 is 59 clearly reflecting the importance of the MED CNC project list. In order to implement the projects within the highest ranking cluster, an amount of €38 billion is necessary, equivalent to 33% of the total cost required for the implantation of the MED CNC project list.



Programme of measures – focus on the wider elements

Innovation

The Mediterranean project list contains **a total of 129 projects that can be considered as innovation projects** according to the Regulation (EU) N. 1315/2013. The following figure shows the total number of innovation projects affecting the Mediterranean corridor and their associated cost, when available:

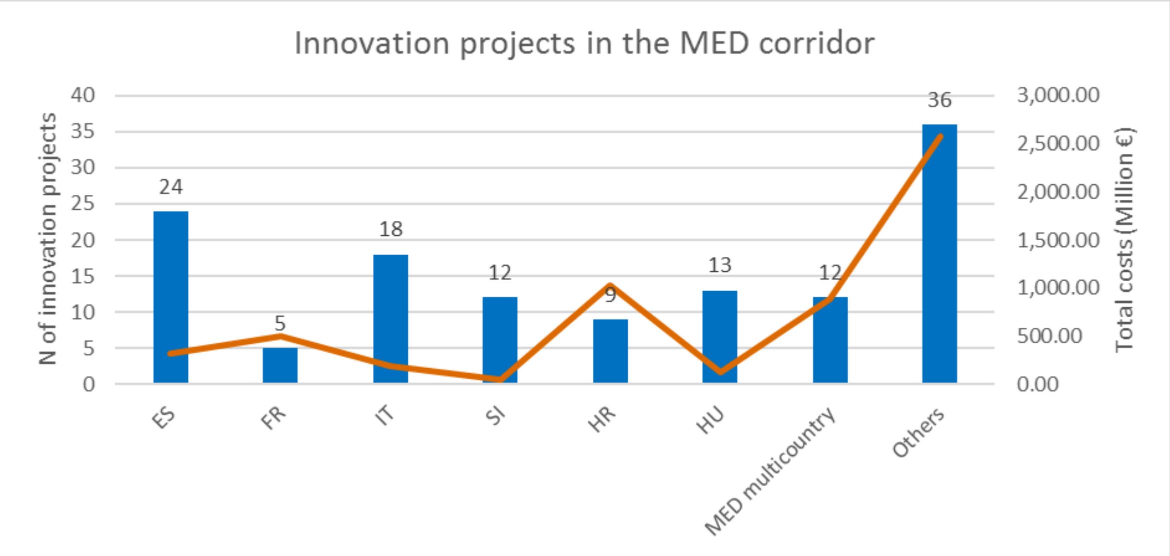


Figure 1 - Number of innovation projects

The total cost of all innovation projects is more than 5.600 M € and the incremental and catch-up innovation categories represent 87% of the total cost accumulated by the innovation projects. This shows that, as expected, the number of radical innovations is low compared to the total of innovation projects.

Among mode-specific strategies, there are common priorities for the whole sector that can be summarised as follows:

- A greener transport through the adoption and implementation of alternative fuels that contribute to the decarbonisation of transport.
- Development and adoption of technology-based solutions such as ITS, C-ITS and other telematics applications as a means to achieving a better information exchange that contributes to a more efficient management of transport networks.
- Encouragement of multimodal transport and efficient and sustainable freight logistics.

Climate change and mitigation of environmental impact

The implementation of the TEN-T Mediterranean Core Network Corridor will provide a significant contribution to the necessary mitigation of environmental impacts of transport in Europe. The full implementation of the Corridor will result in the avoidance of 2-3 million tons of CO2 eq. emissions per year after 2030, according to the above-mentioned assumptions. The reduction of GHG emissions is primarily linked with modal shift from road to rail, in particular for international freight transport. The Corridor also contributes to a more efficient rail transport, with total electrification and higher load factors thanks to the implementation of the TEN-T standards.

Furthermore, the Corridor also addresses other environmental concerns such as noise and air pollution. The total avoided external costs (GHG emissions, air pollution and noise) thanks to the Corridor sum up to a present value of about 10 billion euros, using a 3% discount rate.

Nevertheless, the climate change represents also a risk for the corridor which requires the following actions

- New infrastructure : identify the risk in early design phases, integrating climate change in EIA studies
- Existing infrastructure : review maintenance strategy, protection measures, procedures in case of extreme events / service interruption

Conclusions

Within the context specified above, and based on the analysis of the Corridor and on the wide consultation with stakeholders in the Corridor Forum, a few considerations shall be given, which represent the areas where efforts to develop the Corridor shall be primarily concentrated.

Continuity of the Corridor alignment

The continuity of the corridor alignment should be guaranteed in terms of long-distance or cross-border flows. In this respect, it is very important to encourage projects with the highest added value aiming at solving bottlenecks constraints as well as improving or maintaining the quality of infrastructure in terms of safety, security, efficiency and sustainability.

In particular, the Corridor crosses some of the most developed region of Europe (Cataluña, Rhone-Alpes, Northern Italy), but nevertheless all its territories suffered considerably during the economic crisis of last years as shown by socio-economic data. The re-launch of the growth of the economic potential of the Corridor's regions will certainly be boosted by better connections between them and to other European market areas. This will also improve the function of ports as essential links for the longer distance exchanges with other continents.

Advanced technological and operational concepts allowing interoperability, tracking & tracing of goods, better intermodal integration are among the accompanying measures to be implemented in order to achieve such targets.

This continuity can be implemented only if the works along the Corridor will be coordinated and harmonized, especially at cross-border sections and in the urban nodes.

In particular, the fulfilment of an agreed time table for cross border projects should be ensured in order to avoid serious delays in the expected benefits arising from the investments made.

As a consequence, the importance of bilateral Working Groups and coordination meetings for the development of the Mediterranean Corridor should be promoted.

Furthermore, without the adequate financing for the development of the infrastructure, only slight progress can be achieved. Three of the six Member States are beneficiaries of the Cohesion Fund. A good financing mix between the different available funds will be necessary to ensure that the available means are used in the best possible way, providing the highest European added value.

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Priority to inland navigation, railways and crossing-borders improved practices

Given the socio-economic characteristics of the territories involved, the Corridor is especially relevant for the international trade of goods, given the strong economic relationship between the Countries of its Western part and the development – in perspective – of the ones with the Countries on the Eastern part.
Due to the crossing of environmentally sensitive areas, such as the Pyreneens and the Alps, the objectives of "low-carbon and clean transport, and environmental protection" can be met only by developing efficient rail or maritime freight transport supply (in terms of both services and infrastructure), well interconnected by efficient "last mile" links with relevant freight transport nodes (sea and IWW ports, intermodal rail-road terminals). The latter shall provide sufficient capacity and efficient operations, in order to avoid that the removal of bottlenecks at network level will create new ones on nodes.
Removal of existing localised bottlenecks on the infrastructure, as well as the alignment of it to suitable technical standards for freight (e.g. 7540 m allowed length for trains, maximum gradients for new lines 12,5 mm/m, 22,5 axle load, loading gauge UIC C) appears also key Corridor development measures.

Coordination of the transport development plans
In order to ensure a harmonized development of the Mediterranean Corridor, transport development plans of the MS affected by the Corridor shall be coordinated and harmonised.
Member States eligible for co-funding from the cohesion funds should use these financing instruments towards the logic of the transport core and comprehensive networks development aiming at an efficient inter-modality approach.

Maintain a multimodal transport network
The maintanance and promotion of multimodal transport infrastructures for people and goods shall be seen as a primary objective for evolving the demand for mobility in highly populated and intense economic developped areas of the Corridor.
A much better integration of the various modes remains a challenge for many ports, industries and airports along the corridor. In particular the combination of high numbers of short distance passenger rail services and freight services remains a major challenge mainly in the urban nodes, hampering the development of freight transport in these sections of the Corridor.

Projects evaluation
The evaluation of projects should focus more on their viability and should also incorporate cost-benefit assessments and economic impacts.
The project maturity is relevant as well and should be evaluated in terms of:

- Project Identification (objectives, investment type)
- Technical readiness (Spatial Planning and technical documentation)
- Institutional readiness (institutional framework and capacity)
- Financial/Economic maturity (coverage of costs)
- Social/Environmental maturity (EIA, social/environmental impacts)

Operational and administrative bottlenecks

Special attention should also be paid to the operational and administrative barriers that can have a negative impact on the profitability of the investment and on the efficiency of the Corridor on the whole.
In particular, a specific study of these bottlenecks on the borders and along the corridor should be carried out and focus especially on the following items:

- Harmonising national procedures regarding authorisation and certification of rolling stock,

- Traffic management,
- Management of terminals.
- Access to the market and services

Links to third countries
The corridor shall provide economically efficient and clean transport options to the flows of passengers and goods between those territories as well as the other Countries that will take benefit from the Corridor's development for their international flows (e.g. Balkan countries, Ukraine etc. on the Eastern side).
Especially in relation to Western Balkans regions, but also considering Northern African and Eastern European countries, the Corridor should include the links with third countries.
The important growth potential of these territories, where the transport connections remain still very weak, requires a particular attention in terms of development of transport infrastructure as well as of regulatory reforms and convergence.
After the adoption of the work plan a better understanding of the needs to connect the different parts of the Mediterranean Corridor will be obtained.

Communication and promotion
It is important to continue the multilateral, cross-border cooperation between Member States. For the main missing links, Lyon-Turin and Trieste-Divača, this cooperation should be intensified.
Synergies will be sought with the Rail Freight Corridor 6 (RFC6), notably in addressing the administrative and operational barriers on the historic lines, especially on sections where new cross-border projects are being developed and the historic lines need to serve still as main line in the medium term.
The cooperation with the RFC6 should be strengthened on a regular basis.
Finally, as foreseen by the TEN-T Regulation, the following working groups will be proposed on:

- urban nodes useful to have a local or regional point of view
- ports and RRT.

Due to the maritime dimension of the corridor the working group for ports should be institutionalised and organized on regular basis and focused on last miles investments as well as non-infrastructure nature issues (i.e. administrative and custom procedures).

Importance of the cross-border cooperation
A common Corridor methodology should address those cross-border challenges, including for other Corridors, without prejudice for existing particularities of specific cross-border sections.
Meetings related to specific cross-border issues should be organized on regular basis. This process would help to achieve a smoother implementation of the Corridor.
Importance of investing not only in new infrastructure and upgrades but also in maintenance of the networks to keep them efficient and reliable
The investments foreseen for the Corridor shall also be oriented at the ordinary and extraordinary maintenance of the networks, in order to guarantee efficient and reliable functioning of the Corridor axes. Accordingly, maintenance strategies and associated financial costs shall be considered when defining the future financial needs for Corridor implementation.

Introduction

The present report constitutes the Final Report of the 2nd Phase of the Mediterranean Core Network corridor (MED CNC) Study, and, in accordance with the tender specifications, it describes the progress of the Contractor's work during the contract period.

The report is structured as follows

Chapter one summarises the basis for the development of the study.

Chapter two of this report describes the Corridor compliance with respects to the Regulation (EU) N° 1315/2013, with a focus on each of the transport modes. Chapter three lists the critical issues in terms of potential administrative and operational barriers impeding its full development, including sub-chapters on cross borders sections, per country analysis and urban nodes.

Chapter four shows the results of the transport market analysis, followed by a chapter on capacity issues along the Corridor.

The Report then follows describing the major statistical figures for the project list in chapter five, and proceeds to highlight the results of the mapping exercise in chapter six. Chapter seven is instead centred on the actions already accomplished in the development of the Corridor since 2014.

In chapter eight the results of the financial sustainability analysis have been reported, while chapter nine is devoted to the analysis of the wider elements: Innovation and Climate Change.

Jobs and growth are the main topic of chapter ten, while chapter 11 describes the main figures of the CNC through the use of Corridor Fiches.

Chapter twelve is intended to give an highlight of the impact of the cooperation between the Mediterranean CNC and the Rail Freight Corridor 6. Chapter 3, finally, is devoted to the conclusions and recommendations from the Coordinator.

1 Information on the MED 2014 Study

Adopted by the EU in 2013, the new TEN-T Regulation 1315/2013 forms the current legal basis for the development of the Trans-European Networks (TEN-T). In order to organize efficiently the future development of the Core Network towards its 2030 key completion milestone, nine multimodal Core Network Corridors (CNCs) 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.

In 2014, the first MED CNC Study was published. The Study analysed very thoroughly the infrastructure elements of the corridor and explored the transport markets along it. That analysis led to the preparation of the first corridor Work Plan that was presented by the European Coordinator to the Member States in December 2014 and approved in February 2015.

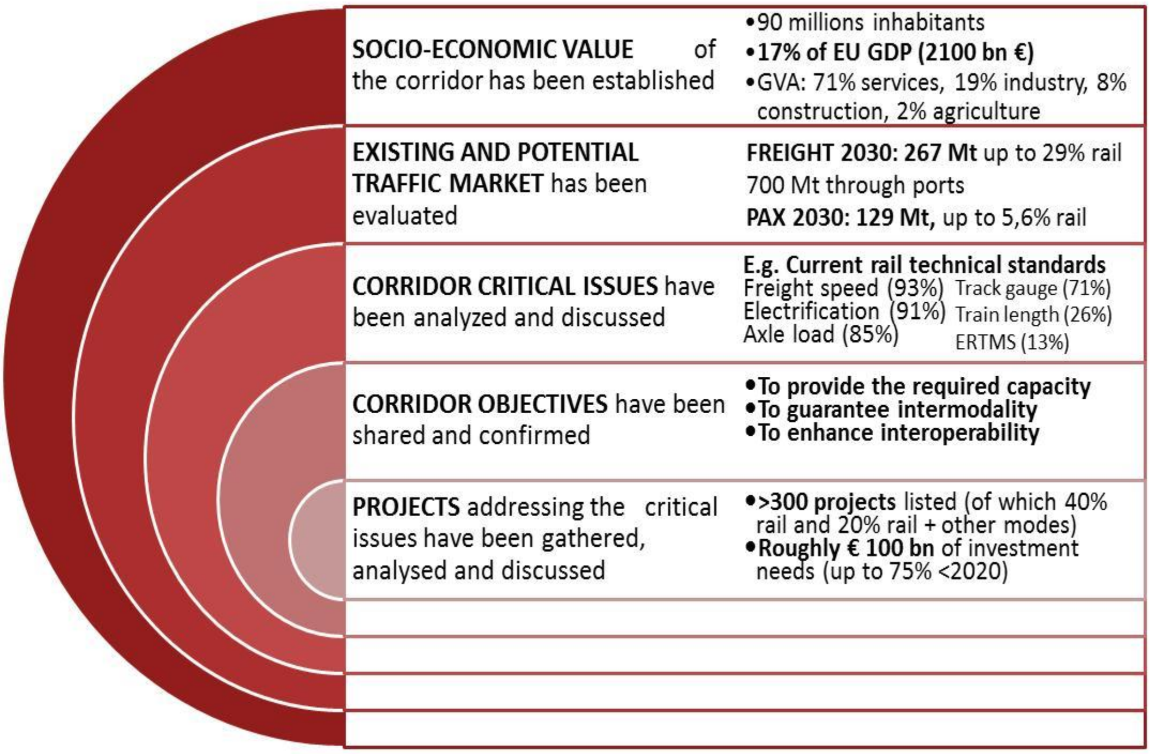

Figure 2: Main outcomes of the Mediterranean corridor Study carried out in 2014

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, at the time, hindered 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 results of the study established the basis for the European Coordinator for the MED Corridor, Laurens Jan Brinkhorst, to draw up the Corridor's Work Plan by the 22nd of December 2014 and issue its finalised version in May 2015. The Work Plan paid particular attention to the priorities of the guidelines: cross border bottlenecks, interoperability and multimodality. It also 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.

Given its one calendar year duration, several aspects of the Corridor were not entirely developed in this first stage of analysis. To this end, DG MOVE of the European Commission published an invitation to tender on the 17th of April 2015 entitled "Studies on the TEN-T core network corridors and support of the European Coordinators".

This Final Report is largely based on the Study of the Mediterranean Corridor (the 2014 Corridor Study) carried out in 2014 and on the on-going analysis of the new Study for 2015-2017 (the 2015-2017 Corridor Study). It is the result of the collaborative efforts of the Member States, the European Commission and external consultants chaired by the European Coordinator.

2 Corridor compliance

TEN-T Regulation defines the transport infrastructure requirements for the Core network, contextually stating that the objectives need to be met by 2030 at the latest. Key Performance Indicators (KPIs) are being used within the 2015-17 CNC study to assess and monitor the evolution of the corridors and the potential effects of individual projects or groups of projects. A common or "generic" KPI framework has been developed for all nine corridors, in order to allow for a cross-corridor comparison.
A summary of this compliance check is given below, based on the updated information provided by the on-going MED Corridor Study.
The current state of the Corridor compliance in 2017 underlines the need to increase Corridor performances for some rail parameters mainly, as shown in the following figure, presenting a selection of the most important requirements for the Corridor implementation.

As shown above, the Corridor compliance is about 100% for road and ports main parameters (i.e. respectively express/motorways, ports connection to rail and CEMT class IV), while airport connectivity to rail and some rail KPIs (e.g. ERTMS, axle load and track gauge) are not yet fully compliant.

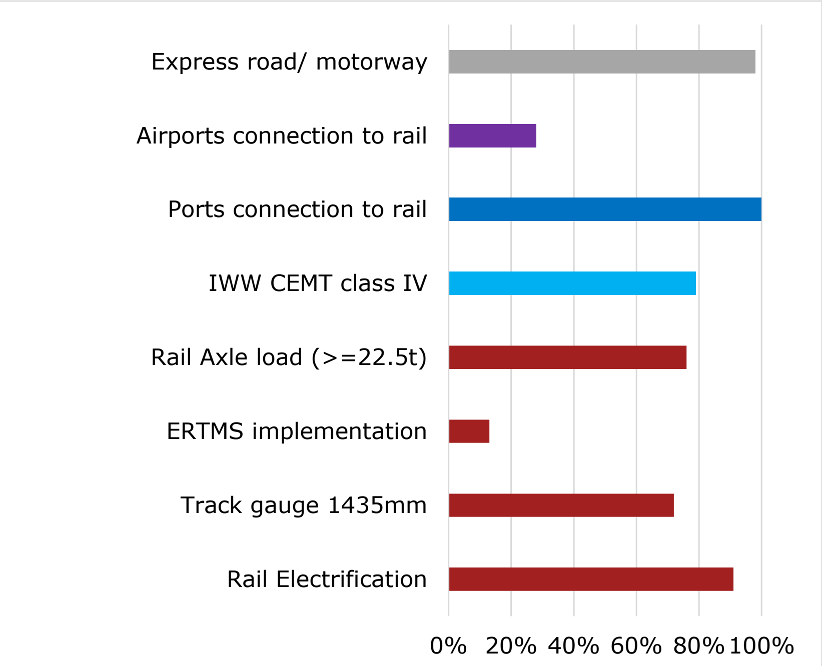

Figure 3 - Corridor KPI 2017 (selection)

In conclusion, the following main issues arise per mode:
For **rail**, electrification is needed in some sections in southern Spain as well as track gauge adaptation in the Spanish network. Yet, ERTMS deployment on the Corridor sections has to be implemented, as well as 740 train length that is not always ensured. Axle load is an obstacle to railway interoperability in Hungary and freight train speed limitations exist on the FR/IT border, and on sections in Croatia, Slovenia and Hungary.
For **IWW**, from Cremona Westward, CEMT IV class and full RIS are not available along the entire section and Sète IWW section is limited by CEMT class < IV[3].

[3] Several projects are in course of implementation to increase the capacity of the Padania-Veneto river axis, such as (among others) the RIS II and the INIWAS.

As regards last miles, rail connection to ports is available but should be upgraded in order to meet the full interoperability; at the contrary **airport** rail connection is mainly not available.

A detailed analysis of this compliance check per mode is given below.

Rail

Electrification is ensured on 92% of the Corridor's railway lines; it is only lacking on some sections in Spain. On the rest of the Corridor three different voltages are in use, raising the issue of interoperability: 1.5kV DC (on conventional lines in France), 3kV DC (on conventional lines in Spain, Italy and Slovenia), 25 kV AC (on high-speed lines in France and Spain; conventional lines in Croatia and Hungary).
One of the main challenges of the Corridor are the different **track gauges**. France, Italy, Slovenia, Croatia and Hungary feature the 1435 mm standard UIC gauge, whereas in Spain, the standard gauge (used on the high-speed lines) coexists with the Iberian gauge 1668 mm on the large part of the remaining network. During the coming years, Spain is expanding the UIC gauge along the Rail Freight Corridor 6 (RFC6) as well.
In Spain, several projects listed in the Spanish implementation plan aim at solving this issue on most of the conventional lines of the Corridor, mainly by upgrading to mixed gauge, either through a third rail or a new track (e.g. Valencia-Port of Tarragona-Castellbisbal), and partly by establishing new UIC gauge lines.
In addition, several Spanish projects have been proposed in order to provide standard gauge access to some logistics and rail freight facilities along the Corridor. Among these projects are the project "Barcelona Port land accessibility and connections" (code 3806), the project "Developing and upgrading freight rail road terminal in Barcelona Can Tunis Terminal" (code 3830). Additional projects aim at providing the standard gauge for rail sections, such as the global project "Implementation of the standard track gauge between Castellbisbal (Barcelona) and Almería" and the project "Bobadilla - Villaverde Bajo - Implementation of UIC track gauge".
In this case, the adaptation to UIC of the related rail connections will allow an increase of the share of freight rail vis-à-vis road in the short term all along the two main sections of the Mediterranean corridor.
The Corridor's railway infrastructure allows the required **axle load** of 22.5 t on all of the sections in Spain, France, Italy and Croatia, while in Hungary and Slovenia[4] limitations still exist on some sections.
A **train length** of 740 m is only allowed in France and on half of the Hungarian network as well as and on small part of Spanish and Slovenian networks. On the rest of the Corridor, various train length restrictions apply, allowing a train length between 400m and 700m.
The Corridor's railway infrastructure allows the required **axle load** of 22.5 t on all of the sections in Spain, Italy and Croatia, while in France, Hungary and Slovenia[5] limitations still exist on some sections.
In France, on some sections the axle load is restricted to 17 t, but these sections are used for passenger services only. In Hungary and Slovenia, several interventions on rail sections are planned which aim at resolving these physical bottlenecks.
The required minimum **line speed** of 100 km/h for freight lines is achieved in Spain, France, Italy (except on the existing cross-border sections), Hungary, on about 41% of the rail sections in Slovenia and in some sections in Croatia.
The table below gives an overview of the compliance rate as regards rail.

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[4] Axle load of 22.5 tons/axle is provided on 93 % of the railway network on the MED corridor in Slovenia.

[5] Axle load of 22.5 tons/axle is provided on 93% of the railway network on the MED corridor in Slovenia.

Parameters	Requirement	2017
Electrification	Electrified rail network km as a proportion (%) of CNC rail network km	92%
Track gauge 1435mm	Standard (1435mm) track gauge as a proportion (%) of CNC rail network km	72%
ERTMS implementation	Length of Permanent Operation (excluding operational test lines) of both ERTMS and GSM-R on rail network, as a proportion (%) of CNC rail network km	16%
Line speed>=100km/h	Length of freight and combined line with allowing for a maximum operating speed greater than or equal to 100 km/h, as a proportion (%) of CNC rail network km without load restriction	92%
Axle load (>=22.5t)	Length of Freight and combined line with a permitted axle load greater than or equal to 22.5 tonnes, as a proportion (%) of CNC rail network km	76%
Train length (740m)	Length of freight and combined line with a permitted train length greater than or equal to 740m, as a proportion of CNC rail network km	23%

Table 1 – Rail technical parameters (source TENtec)

Road

The total length of the road network included in the Mediterranean Corridor is about 5500 km, with Spain covering more than 50% of the entire Corridor.
As regards the parameter "Motorway or Express roads" only a few sections are not motorways such as the Hungarian section close to the Ukrainian border.
The table below shows the compliance rate of the Mediterranean Corridor's roads.

Parameter	Requirement	2017
Express road/ motorway	Road network km classified as motorway or express road, as a proportion (%) of CNC road section km.	98%
Availability of clean fuels (stations)	Number of fuel stations offering plug-in electricity, hydrogen, liquid biofuels, LNG/CNG, bio-methane or LPG along CNC road sections or within 10km from its junctions.	NA

Table 2 – Road technical parameters (Source TENtec)

Besides the requirements described in the previous paragraph, Regulation (EU) 1315/2013 also requires Member States improve the availability of clean fuels along the roads of the Core Network.
In this respect, the tables below show the number of refuelling points offering LPG and CNG (together with the density per country and Corridor) as well as the Corridor compliance with Art 39 of Regulation 1315/2013, which sets specific indications for parking space for commercial road users that shall be available approximately every 100 km, in order to guarantee an appropriate level of safety and security.

Country	Length (km)	N. of clean fuels LPG	N. of clean fuels CNG
ES	2855	43	19
FR	503	47	1
IT	848	86	31
SI	433	38	1
HR	293	20	0
HU	596	45	0

Country	Length (km)	N. of clean fuels LPG	N. of clean fuels CNG
MED CNC	5528	279	43

Table 3 – Refuelling points offering LPG and CNG along the Corridor

Parameters	ES	FR	IT	SI	HR	HU	MED CNC
Km of road	2855	503	848	433	293	587	5503
Number of parking	25	19	15	51	1	3	87
Number of parking per 100 km	0,88	3,78	1,82	11,78	0,34	0,50	1,58
compliance with TEN-t requirement	88%	100%	100%	100%	34%	50%	79%
Target (n. of parking to be compliant)	29	5	8	4	3	6	55

Table 4 – Corridor density of safe and secure parking areas for commercial road users

Ports

Ports represent the main gateways for passengers and especially freight transport to core network Corridors.
There are 12 core ports in the Mediterranean Corridor, mainly located in the western part: Bahía de Algeciras, Sevilla, Cartagena, Valencia, Tarragona, Barcelona, Marseille/ Fos-sur-Mer, Ravenna, Venezia, Trieste, Koper and Rijeka. For ports, Regulation (EU) 1315/2013 requires the connection to the rail network by 2030.
All ports are reported to be fully compliant. Nevertheless, it shall be highlighted that several ports are further improving the rail connection with a view to improving the rail hinterland connection and thereby increasing possibilities for modal shift. The improvement of the rail connection is very important for those ports in Spain which are still connected only with Iberian gauge (exception: Barcelona port).

Inland Waterways (IWW)

The Inland Waterway system belonging to the Mediterranean Corridor consists of:

- 9 inland ports (Sevilla, Marseille/Fos-Sur-Mer, Lyon, Cremona, Mantua, Venice, Trieste, Ravenna and Budapest);
- the Rhône river, between Lyon and Fos sur Mer, with extensions to the Port of Sète (by the "canal du Rhône à Sète") and to the north (outside the Corridor) with the Saône river until Chalon-sur-Saône;
- the Po river and the IWW system of northern Italy, connecting the inland ports of Cremona and Mantua to Ferrara / Porto Garibaldi and Venice / Porto Nogaro / Monfalcone.

The Regulation (UE) 1315/2013 states the minimum requirement for the inland waterways of international importance: CEMT IV class, which means the fulfilment of the following parameters:

Class IV CEMT	Maximum length	Maximum beam	Draught	Tonnage
Motor vessels and	80-85	9.5	2.5	1000-1500

Class IV CEMT	Maximum length	Maximum beam	Draught	Tonnage
Barges				
Pushed convoys	85	9.5	2.5-2.8	1250-1450

Table 5 – IWW class IV CEMT

About 80% of the IWW network of the Corridor meet this requirement. The 20% not complying correspond to the sections Pavia-Casale Monferrato and Piacenza –Pavia covering about 150 km, where the minimum width is about 8 m instead of 9.5 m and a short IWW section to Sete.

Airports

The Mediterranean Corridor comprises 17 core airports: 6 are located in Spain (Valencia, Alicante, Sevilla, Malaga, Barcelona, Madrid – Barajas); two airports are in France (Lyon Saint-Exupery and Marseille-Provence); 6 in Italy (Bergamo-Orio al Serio, Milano – Malpensa, Milano – Linate, Venezia – Tessera, Torino – Caselle, Bologna – Borgo Panigale); and one each in the capitals of Slovenia, Croatia and Hungary.
Out of these 17 airports, six are considered main airports in the meaning of Regulation (EU) 1315/2013, and thus subject to the provisions of Art 41(3), which requires the connection to the trans-European transport network by 2050: Madrid, Barcelona, Lyon, Malpensa, Linate and Budapest.
According to EU prescriptions, only airports having direct rail services linking the airport with high-speed lines or long distance TEN-T railway lines shall be considered as properly "connected with rail". Local or regional/suburban rail connections, although improving accessibility, are not sufficient for the full compliance with the Regulation. Under such assumption, only Lyon airport can be considered currently as directly connected to heavy rail.

Last mile interventions

Recalling article 30 of Regulation (EU) N. 1315/2013, all those projects whose scope refers to the development of the comprehensive network in urban nodes (that are the starting point or the final destination for passenger and freight moving on the TEN-T network) could be considered last mile interventions. In this respect, last mile projects could be classified through the following categories:

- **Corridor multimodal last mile connections:** projects aiming at improving the standards and the performance of the last mile connections to core transport nodes (ports, airports and rail road terminals),
- **Urban nodes projects:** projects focused on the upgrading last mile connections in urban areas (including rail/road bypasses or interconnections between different transport modes),
- **Other urban nodes projects:** horizontal initiatives in core urban areas to promote interconnection between different transport modes and sustainable transport solutions for both passengers and freight.

Needless to say, European legislation requires that last mile connections are ensured by 2030, with the exception of last mile railway connections to airports; in the sense that only main airports6 shall be directly linked with heavy TEN-t Core Rail Network (HS or Conventional) by 2050.

Consequently, by taking into account last mile connections linking core transport nodes (excluding urban nodes) with national railway and road networks, the overall expected total costs amounts to € 6 billion.

Concerning last-mile interventions, 66 out of 464 projects (i.e. approx. 14%), are belonging to that category with a total cost of € 5.4 billion. The following figure shows last mile interventions both in terms of number of projects and in terms of project category costs. More specifically, when focusing the analysis only on on-going or planned interventions, the project list contains 68 out of 464 projects related to last mile connections.

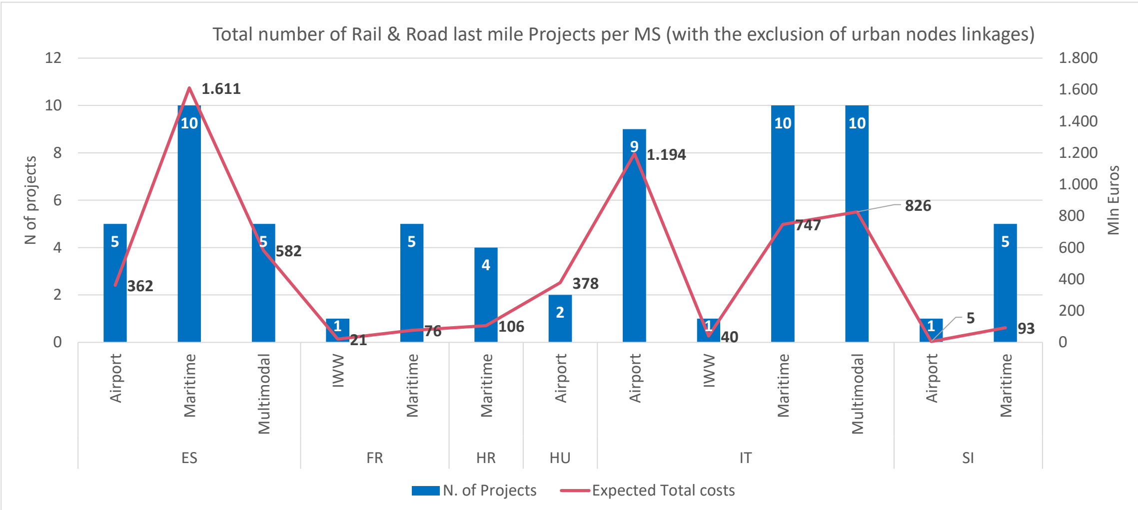

Figure 4: Last mile rail/road Projects per MS (excluding urban nodes interconnections)

[6] Reg. (EU) N. 1315/2013 art. 41.3 and Annex II part II

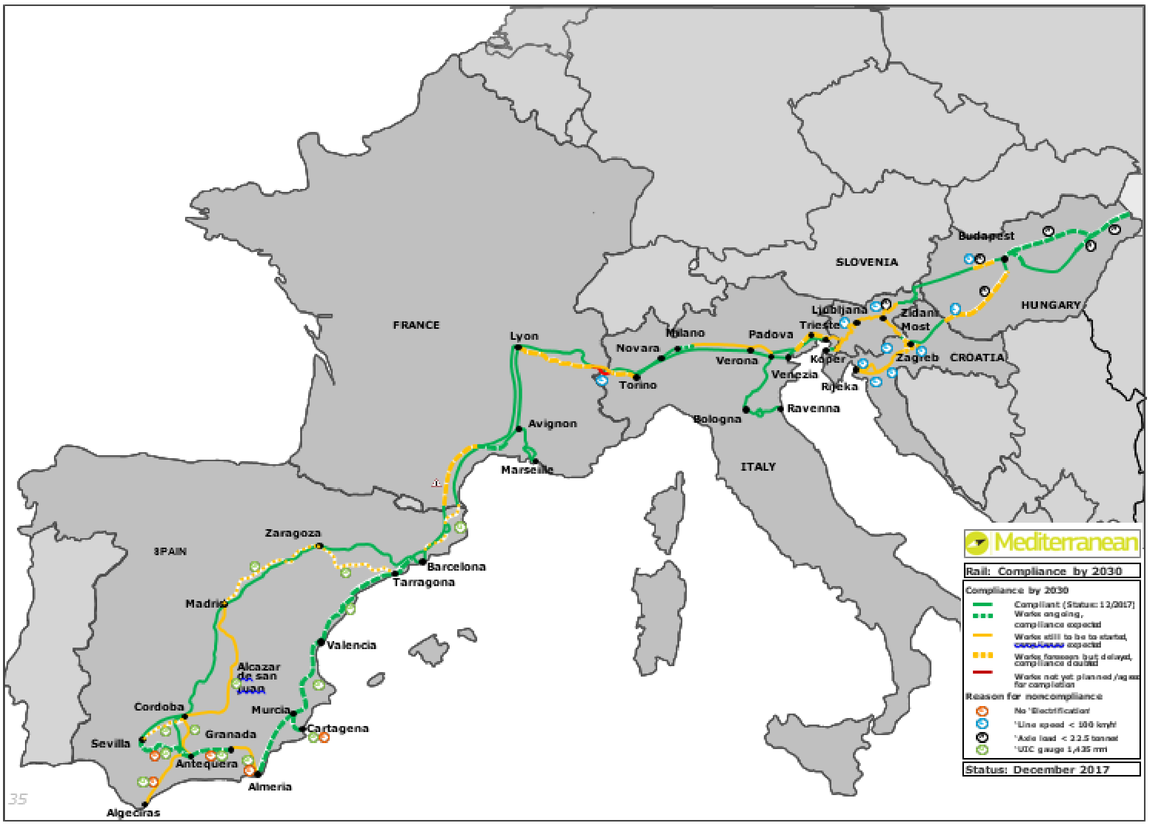

Figure 5: Corridor compliance map 2030 (rail)

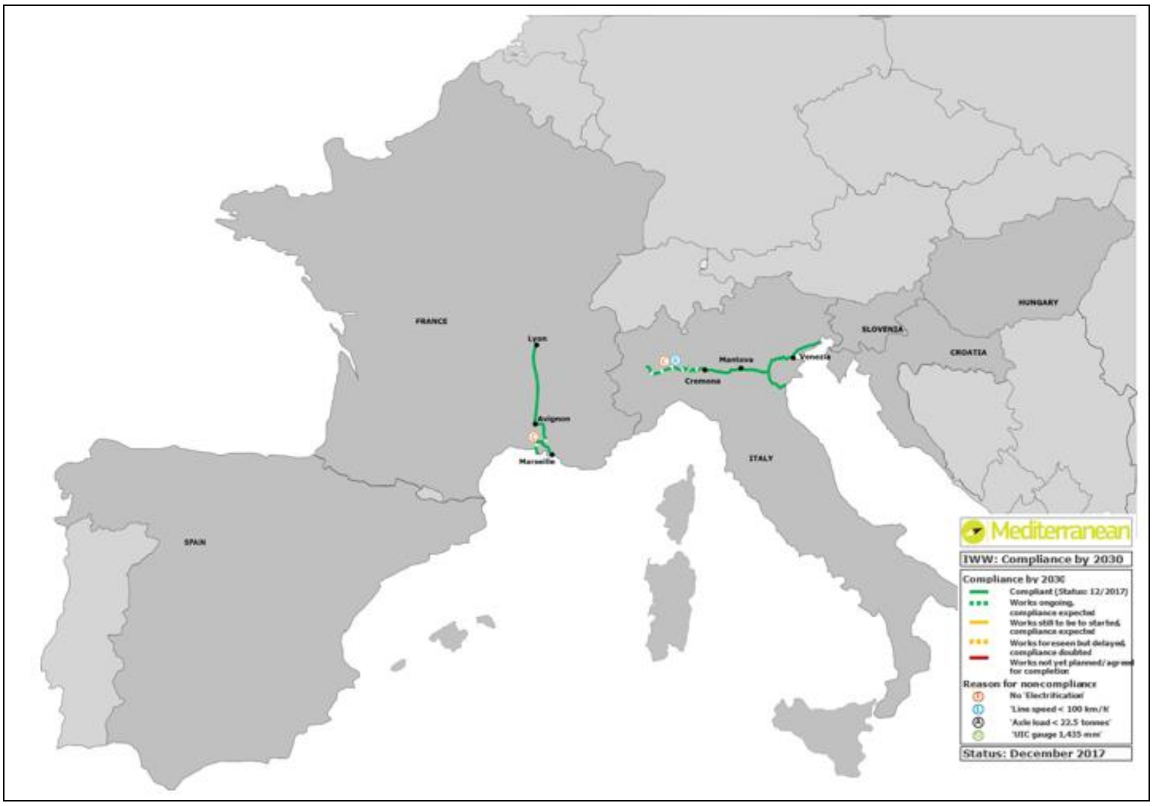

Figure 6: Corridor compliance map 2030 (IWW)

3 Critical issues, potential administrative and operational barriers

This chapter presents per country analysis of the administrative and operational barriers that could have a negative effect on transport activities in the MED corridor. The analysis was conducted per MS and mode of transport.

Cross Border sections

Cross border sections are here considered as the most representative issues connected with the persistence of the bottlenecks along the Mediterranean Corridor. All of the other problems hampering the full development of the Mediterranean CNC are listed in the following sections, taking into account both the administrative and the operational aspects.

Specific rail sections affected:

- **Spain-France**: The new HS line between **Figueres** and **Perpignan**, which opened on 1 January 2013, offers capacity, fluidity and safety; although traffic has significantly grown since then, it is still underutilized. On that specific topic, the Coordinator launched a meeting was held in March 2016 with the stakeholders to address the different issues. Main problems identified concern: lack of UIC gauge connectivity in ES (with last mile issues to main generators other than the port of Barcelona), three signalling systems and voltages required for long-distance trains running through the line[7], and night-time closure at Le Pertus, reducing the number of commercially attractive slots. All these issues are being tackled, mainly by actions listed in the Corridor's Project list.

- **France-Italy**: the steep gradient of the existing railway line on the French side of the border requires double push locomotives for regular sized freight trains (single loco trains are limited to 650 tons). In addition, the existing sidings and passing tracks restrict further the train lengths making the line uncompetitive. The **new railway link Lyon-Turin** with a 57km base tunnel as its main part is the main project of the whole Mediterranean Corridor. It is highly strategic, because it is the main missing link in the Corridor which aims at connecting south-western Europe with central and eastern European countries. Failing this high performance connection transport relations especially between Italy and France, Italy and Spain, Spain and Italy, and Spain and central and Eastern Europe are hampered. As a consequence freight flows are confined to road transport and deviated to other routes causing congestion and creating additional costs. **Renewed commitment of both governments has been announced** for the completion of the cross-border section by 2030, while reflexions are on-going to optimize the projects of the access lines. Still, it is important to ensure that the potential of the new basis tunnel will not be diminished by bottlenecks on nearby sections of the Corridor.

- **Italy-Slovenia**: the existing line between Trieste/Aurisina and Divača needs to be up-graded to meet TEN-T standards. However, recent traffic forecasts

[7] This leads to a lack of available locomotives capable of running on the HS line.

suggest that the capacity of the up-graded line will be sufficient to accommodate traffic beyond 2030[8]. After 2030 both sides will reconsider justification for new high-speed line.

- **Slovenia-Croatia**: on both sides of this cross-border section, which is part of the line connecting the two capitals Ljubljana and Zagreb, the line suffers from speed limitations as well as limitations on train length. The line is not in conformity with TEN-T standards and needs up-grading. On the Slovenian side the line is expected to be upgraded to TEN-T standards by 2030. Slovenia is also in the final stages of construction of the new highway connecting Maribor and the Croatian border towards Zagreb, which will be finished by the end of 2018. In addition, the Dobova – Zagreb section suffers from the following limitations: train speed for freight (<100km/h) and train length limitations (400-500m.)

- **Croatia - Slovenia**: on the Croatian side of this cross-border section, which is part of the line connecting the two capitals Ljubljana and Zagreb, the line suffers from speed limitations as well as limitations on train length. The line is not in conformity with TEN-T standards and needs upgrading.

- **Slovenia-Hungary:** an improvement of the HU rail section Bajánsenye-Boba(-Hodos, SI) (installation of ETCS2 on a 102-km line) is to be concluded in the 1st half of 2018. The development of M70 expressway section Letenye - Tornyiszentmiklós (HU-SI border) into a full 4-lane motorway to be concluded by the end of 2019 will improve traffic safety significantly on this road section. Furthermore, routine and extraordinary road maintenance issues should be discussed between the competent authorities of SLO and HU. An up-grading of this cross-border section has been recently completed with the Pragersko-Hodoš railway line project, which is fully compliant with the TEN-T standards and no particular bottleneck exists.

- **Croatia-Hungary**: this cross-border section (Botovo- Gyékényes) is part of the main railway line connecting Zagreb and Budapest. As most of this important connection the cross-border section requires up-grading to TEN-T standards. Croatian rail infrastructure manager HŽ Infrastruktura has signed a EUR 241 million grant agreement with EU's INEA- Innovation and Networks Executive Agency for the upgrading of the existing track and the construction of a new second track of the 43.2 km long Križevci-Koprivnica-Hungarian state border railway section. HŽ Infrastruktura continues the modernisation of the Mediterranean Corridor with works on Zagreb-Hungarian state border railway section. The new line will generally follow the existing route, except in the section between Carevdar and Lepavina. Works will include reconstruction and construction of four rail stations and six stops, upgrade/removal of removal / upgrade level crossings, the removal of one existing bridge over the river Drava and the construction of a new one. These activities will increase the line

[8] The Slovenian Government has not abandoned the plans to build a fast track in the future. Indeed, the new Trieste-Divača high speed line is considered as a priority project by the Government, since it would constitute Slovenia's only link to the high-speed railway networks of Europe.

capacity, enable speeds of up to 160 km/hour, shorten travel times, allow usage of interoperable trains, and increase the level of safety.

- **Hungary–Ukraine**: three HU road projects aim at constructing the cross-border road section between Hungary and Ukraine, which is a main missing road link of the corridor crossing an EU external border. The works foreseen will extend the Hungarian M3 motorway up to the border. In terms of prioritisation, the realisation of the HU/UA road missing link is one of the important cross-border projects ensuring the smooth functioning of the corridor.

Specific road sections affected:

- **Expressway M3 between Vásárosnamény and Beregdaróc/Déda HU/UA border**. Being the last mile (27 km long) and main border crossing section of motorway M3 (as well as MED CNC in Hungary) this is a missing link. Existing narrow two-directional roads are carrying serious accident risk. According to government decision 1833/2016. (XII. 23.), it is planned to build a 2x1 lane first carriageway by 2020 (financed from the State budget), suitable to be upgraded later into a full 2x2 lane M3 motorway. Preparatory works in this respect are under way.
- **Expressway M34 between Vásárosnamény and Záhony/Cop HU/UA border (39km).** This a missing link and an additional border crossing section of motorway M3 (as well as MED CNC). Although the currently observed and expected volume of traffic does not justify yet economically its construction, preparatory works are under way, aiming to elaborate an officially approved design related to a 2x2 lane motorway. It is planned to build a 2x1 lane first carriageway by 2020 (financed from the State budget), suitable to be developed later into a full 2x2 lane M34 motorway.

- **Expressway M70 between Letenye (Interchange M7/M70) and Tornyiszent-miklós at HU/SL border.** Due to lack of resources and low traffic forecast, 2x1 and 2x2 lane sections alternate on this 21 km long road constructed between 2002-2005), causing frequent and serious accidents following its opening. Although safety level is improved since 90 km/h speed limit has been introduced and strictly enforced on the 2x1 lane sections (totalling 12 km), constantly increasing traffic volume justifies the reconstruction of the existing expressway into a standard 2x2 lane motorway. An approved CEF project (2015-HU-TM-0107-W; ID 3157) started already aiming to upgrade the M70 expressway by 2019 to a full 2-lane dual-carriageway motorway, with emergency lanes, a central reservation and a maximum speed of 130 km/h. The technical characteristics will be in compliance with the TEN-T requirements and will match the standards of the adjacent A5 motorway in Slovenia and M7 motorway in Hungary.

Country analysis

France

Railways[9]
As shown below, the most relevant critical issues are related to:

- **the Lyon rail bottleneck**, where trains suffer every day from delays due to intensive and mixed use of the infrastructure inside one of the most important railway hubs in Europe, preventing further development of regional or freight traffic. Project addressing this issue: 3100, 3110

- **the link between Spain – Perpignan – Montpellier and Nîmes**, where mixed traffic and limited passenger speed could affect the development of international freight trains and high-speed passenger trains. The new section of HSL between Nîmes and Montpellier will be operational by the end of 2017. It will be equipped with ERTMS and has been designed to accept also freight trains; another line is in project between Montpellier and Beziers, then to Perpignan, where the existing line is a bottleneck both in terms of capacity and standards (level crossings, low speed and mixed traffic). Project addressing this issue: 3099, 3107.

- the rail bottleneck of Marseille and the **rail linkage of the port of Marseille**, which suffers from insufficient standards and complexity which affects the productivity of freight trains[10]. Project addressing this issue: 3112

Roads
The most relevant critical issues are related to:

- the Fréjus tunnel (assessed in the Italian section),

- road congestion around Lyon and in the Rhône Valley, Montpellier and between Perpignan and the Spanish border,

- road access to the port of Marseille.

Ports
The rail and road accesses to the port facilities of Fos and Marseille are penalized by the inadequacy of the infrastructures to the freight exploitation modes in the conditioning of the containers and in the volumes to be handled. The port authority has several projects to overcome this issue:

- On Fos terminal projects concern the automation of the signalization and the creation of a supplementary crossing zone;

- In Marseille the program includes three independent functional phases, including the reopening of the Mourepiane link, and the update to the high and low gauges in the link Avignon-Mourepiane.

These projects will increase by 60% the rail tonnage capacity at all Marseille / Fos Port facilities.

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[9] Also see paragraph on cross border issues.
[10] the port became recently manager of the railway system inside the port area and plans important investments

In addition, two rail-road terminals (one in Fos and the other in Mourepiane) and one rolling motorway terminal (in Marseille) are also being projected, with the objective of improving rail system productivity by putting together the port's container and ro-ro flows and the flows from the surrounding industrial zones.
The IWW link between the port of Fos and the Rhône is also insufficient because the container terminal of Fos is not directly connected to the IWW system; therefore a project of direct IWW link between this terminal and the Rhône is under study.
The port must also adapt to increasing maritime traffic and vessel sizes, therefore it has several projects to improve capacity and adequacy of both maritime terminals in Fos and Marseille, including improvement of facilities for the motorways of the sea. Project addressing this issue: 3123

Road rail terminals

The most important technical bottleneck regarding rail road terminals on the corridor is the length of the tracks, which often prevent train assembly from making 740m long trains, therefore affecting productivity and competitiveness of combined transport. For example, the maximum available track length at rail road terminals on the corridor is:

- 400 m. at Avignon – Courtine,
- 320 m. at Le Boulou,
- 400 m. at Perpignan,
- 320 m. at Marseille – Canet,
- 350 m. at Lyon – Venissieux.

Improvements of capacity and access to the Lyon-Venissieux terminal are foreseen in the framework of the Lyon Railway Node program. Project addressing this issue: 3110
Two rolling motorway terminals locate on the corridor, in Perpignan and in Aiton (Aiton is connected with Orbassano in Italy). They are both dedicated to the Modalohr system. The realization of a new terminal near Lyon is still under discussion. New rolling motorway lines are in project, Paris - Barcelona and Calais – Northern Italy.

Inland waterways and inland ports[11]

The Rhône river between Fos-sur-Mer and Lyon is efficient and allows the navigation of large vessels. However, ports and terminals along the river can be described as insufficient and lack of intermodal facilities:

- The container terminal of Fos sur Mer is not directly connected with the Rhône,
- The Port of Lyon (Edouard Herriot) needs improvement of its rail and road access: rail access in particular is not electrified and generates complex train manoeuvres. Its situation in the heart of the city of Lyon is an asset but makes further development of port facilities difficult,
- Improvements of the rail access to the port of Lyon are part of the Lyon Railway Node program.

A further way of improving the use of the Rhône as major freight transport infrastructure would be to create new intermodal facilities. In fact, two projects along the Rhône have the objective of linking new or extended industrial zones with intermodal terminals combining road, rail and waterway: the Salaise-Sablons platform (just south of Lyon) and the Avignon – Courtine platform.

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[11] Although the French inland waterways are not part of the Mediterranean corridor, they have been analysed because included in the scope of the study.

The canal linking the Rhône near Fos-sur-Mer and the port of Sète is also part of the TEN-T core network. Several improvement works are on-going on this canal, to reach TEN-T standards (from CEMT class III to IV) and to increase its performances.

Projects addressing this issue: 8200, 3098

Airports

Two French core network airports are situated in the corridor. The Lyon Saint-Exupéry Airport is connected by rail directly on the Paris - Marseille high-speed line. It has also a tram-train connection with the city centre since 2011. Works to enhance the terminal for low cost airlines are over and the new terminal 1 is under construction. The airport has an ambitious long-term development program aiming at a capacity of 20-25 million passengers per year, with a third runway and a freight zone connected with the future railway bypass of Lyon.
The airport of Marseille - Provence has recently opened a second terminal, dedicated to low cost airlines. The terminal is connected to the regional trains between Marseille and Miramas - Avignon but the train station is not directly situated near the terminals (5min with bus shuttle); the high speed trains can be reached at Aix-en-Provence TGV station (12 min with bus shuttle).

Italy

Railways
The most relevant critical issues are related to:

- The western part of the corridor, from the Italian/French border up to Pioltello (conventional line), where the standard for the loading gauge is limited to PC45 50 whereas on eastern sections after Pioltello the available loading gauge is up to PC80;

- The urban nodes (Venezia, Torino, and Milano) are characterized by a high promiscuity of rail traffic due to overlapping of metropolitan, regional, long distance and freight traffic.

The careful planning and renewal of infrastructure (including a rationalization of traffic management for Milano and the deployment of new lines to separate passenger from freight traffic by limiting as much as possible interference in case of Milano Lambrate or Venezia Mestre “linea dei bivi”) is aiming to solve such issue.
Concerning the node of Torino, the main critical issue is the infrastructural organisation of the node, which hampers the capacity of the node and the smooth functioning of rail freight transport.

- the connection Venezia-Trieste that is affected by low performance for freight (maximum train length) and passenger (speed) trains,

- the railway infrastructure of Trieste port that shows a capacity lack.

Project addressing this issue: 3298, 3232

Roads
As shown below, the most relevant critical issues are related to:

- **Fréjus tunnel:** currently with a single tube accommodating both traffic directions creating potential safety concerns as it happened in 2005 when an accident in the tunnel caused two fatalities. However, the increase of capacity, as it could be generated by the opening of the second tube, is also source of concern as unsuitable improvement of road capacity,

- **In Northern Italy**: the high population density coupled with many small firms and residences spread all over the territory generate a large amount of transport demand that gives rise to congestion problems.

Airports
The critical issues of the Italian airports can be mainly clustered in three different categories of infrastructures: airside, landside and intermodal connections.

- **Airside infrastructures**: the growing traffic expected in the next ten years will lead to airport capacity shortage; therefore, the expansion of infrastructures is mandatory in order to avoid congestion in peak hours. In the two airports of Milan Malpensa and Venice the realization of a new runway is foreseen, indicating the constraints to handle the growing traffic with the current runways endowment. This intervention is also linked to the enlargement of others airside facilities such as terminals, aprons and taxiways. If present in the airport, the upgrade of freight facilities is generally expected too. In the other airports, terminal enlargements are expected in order to cope with the growing passenger and freight demands of the following years; in some cases, such as Turin and Bergamo, the specialization of the available infrastructures is expected in order to manage freight, passengers, etc. In Brescia (specialized airports for freight only), the extension of the existing runway is expected to cope with the wide body plane used for freight activities. Funding of the proposed interventions are often uncompleted, indicating potential constraint in their realisation;

Projects addressing this issue: 3617, 3615, 3601, 3604

- **Landside infrastructures:** previous air-side interventions are related to the enlargement of the landside infrastructures in few airports (within the corridor only in Malpensa and Turin). In particular:
    - Bergamo airport: the rail link is currently unavailable (a feasibility study has been carried out),
    - Milano Malpensa: the rail connection is available;
    - Turin Caselle: rail connection existing;
    - Venice airport: the rail link is currently unavailable, but it is planned.

Projects addressing this issue: 1119

Offering new connections which seriously challenge road transport on travel time is mandatory. For main airports, such as Milan and Venice, to realise the metropolitan connection (to easily reach the airport from the city) is important; long distance connections further enlarging the airport catchment area and finally increasing the potential airport passengers are important too.
Therefore, the further development of the connections of Malpensa with the existing High Speed rail and the realisation of the new intermodal connection in Venice Tessera airport is a priority.

Ports
The list of physical bottlenecks, low technical standards (compared to TEN-T Regulation) and lack of interoperability issues along the MED Ports network include, but do not limit to, the following points.

- **The limited available draughts** of **Venice port** (due to the lagoon) pose some limitations for certain types of traffic (requiring vessel of big dimensions). Projects addressing this issue: 1278

- **The freight traffic for Trieste port** is served by distinct rail transport facilities interconnected and connected to the external international network (in the port area there are about 70 km of tracks). However the freight traffic flow is inadequate in comparison to the available draught (deep enough to allow huge ships to dock). Projects addressing this issue: 1852

- A critical issue of the **Ravenna port is the limited draught** (structural problem since Ravenna is a canal-harbour). Yet, Ravenna’s port physical bottlenecks would require several works for the upgrading of port infrastructure. Projects addressing this issue: 1858

- **Need of improved traffic management Systems.** For many Italian ports (Trieste and Ravenna included), a consistent issue concerns the adopted IT platforms and the absence of a common platform for all Players/entities. Projects addressing this issue: 1272

Rail road terminals
As shown below, the most relevant critical issues are related to:

- the **Orbassano node,** that is now facing a lack of accessibility to HS rail (the access to conventional rail exists); this will be solved with the new Lyon - Turin line and the related works in the node of Turin. The project foresees a dedicated connection of the rail road terminal with the new line. The direct access from the HS line would enhance capacity on the existing conventional rail line where it is expected to be increased a metropolitan rail service. Some critical voices indicate that to fully use the access along the HS line it would be necessary to use dual voltage locomotives (not so common among the rail freight undertakings). Otherwise, in case of old locomotives it would be used the conventional line (thus may lead to manage priorities between metropolitan and freight trains using the same line;

Inland waterways
As shown below, the most relevant critical issues on inland waterways are related to:

- **limited draught of waterways** subject to seasonal variations (only in the summer season),

- **lack of direct transhipment** between inland and sea ports,

- **lack of a direct rail connection** up to the quay in the main inland ports (i.e. Cremona),

- **accessibility** of the western part of the corridor (between Cremona Milan and Casale Monferrato) is limited to main vessel due to **a missing lock**; the channel linking Milan with the existing IWW is currently under construction;

- **low navigability reliability:** the low rate (60%) is due to the constant variations in hydraulic conditions. This constraint provokes a limited draught and the consequent reduction of the transported tonnes per vessel. In particular, about twenty critical points have been identified, five of them are along the Cremona- Mincio section;

- **inadequate fleet:** the current Italian fleet is not sufficient in terms of units and qualitative standards because there are no vessels which meet Class V requirements; on the contrary, the majority of the convoys follow Class IV standards because of the infrastructural constraints such as limitation of lock measure.

Projects addressing this issue: 3196, 3186, 3254

Croatia

Rail

The most relevant critical issues are listed below:
Entire Croatian section equipped with **single track** except Dugo Selo -Zagreb section, which is double track. Section Dugo Selo -Zagreb suffers from overlapping of traffic flows, bottleneck. Moreover, all sections are not equipped with **ERTMS**, suffering from **train length** limitations (average train length allowed is in the range of 400-700m.) and **train speed** limitations for freight. Projects addressing this issue: 3140, 3174
About **safety** equipment the auto stop device (AS) of the INDUSI (I 60) type is in use on the entire network.
About Gabarit: loading gauge PC 80/410 (UIC Type: C) except Dreznica-Rijeka and Ostarije-Dreznica which have a class A (UIC type).
Max admissible **axle load** for all sections permits to exploit 22.5 ton. About **electrification** System: all sections are equipped with 25kV, 50 Hz

Zagreb Main Station – Rijeka line was built 135 years ago, it has unfavourable route (hard shapes etc.), completely contrary to the modern traffic requirements, especially the section Karlovac-Rijeka (70% of its length is in curves) that is the direct connection to Rijeka port. Projects addressing this issue: 3138

Zagreb node suffers from a lack of capacity in the short – medium run (by pass for freight trains needed). Barring any large and radical efforts, Zagreb railway node shall not have sufficient capabilities to receive planned increased railway transport (inner suburban passenger transport and local cargo transport, inbound or outbound long distance passenger and cargo transport, transit passenger and cargo transport). Projects addressing this issue: 3144

Inland Waterways

The list below summarises the identified barriers concerning inland waterways in Croatia, although no projects are part of the Mediterranean corridor.

- **RIS implementation.** RIS is implemented on all rivers (Danube, Drava and Sava) but there still exist a problem with lack of staff due to non-employment for RIS centre.
- Shortage of **Workforce** in public sector.

Seaports

Concerning the seaports in Croatia, the following issues can be listed as problems affecting the network.

- **Rijeka**: Container storage area is rather small, and space is limited, so that is a severe bottleneck of the port of Rijeka. Increasing of container transhipment requires the construction of dry ports in the port hinterland and efficient railway connections. In addition, research has shown that equipment in port of **Rijeka** is technologically old, and 80% of its historic cost is written off, which means that this kind of equipment is not reliable for attracting new amounts of cargo, and it is not possible to bid a competitive price for port – transport services. Projects addressing this issue: 3514
- **Long vessel waiting times** re-scheduling due to port congestion: In peak times, vessels have to wait offshore before they are unloaded, which is related to capacity bottlenecks. Projects addressing this issue: 3517

- Insufficient **mooring space**: a capacity bottleneck that has to be eased by (costly) extensions or through shortening of berth time. Projects addressing this issue: 3137

- Not flexible infrastructure to increasing **ship size**.

- Low level of **information integration** among port community: a port encloses a high number of stakeholders.

- Lack of **common integrated development strategy** of the seaports and atomised market.

- **Insufficient integration** among transport modes**.** At the container terminal in Rijeka, there are no conditions for achieving a higher significant usage of railway -short range gauge that goes through the city.

Roads

Lack of efficient and sustainable traffic management system of Rijeka – Zagreb Motorway. Among the proposed measures to solve the problem:

- increasing fluidity of transport flows
- reduction of bottlenecks
- modernize the system for traffic management and accident prevention
- investments in guard rails for motorways
- ensure environmental protection by construction of noise barriers
- reconstruction of the existing lighting system and transfer to energy-efficient lighting system.

Airports

One of the identified physical bottlenecks in traffic in Croatian airspace is high seasonality, with the main flows running in SouthEast - NorthWest stretch. The volume of traffic in the period May-October is almost double than the volume in the rest of the year. This seasonality of traffic provides challenges in achieving a balance between the required capacity and use of resources throughout the year.
Other critical issues are mainly identified with the:

- Low **technical standards**
- Need of improved traffic management systems
- Administrative procedures
- Insufficient integration among transport modes

Projects addressing this issue: 3135, 3509

Slovenia

Railways

In the 2014-2020, the orientation given by the EC gives high importance to the development of rail transport (especially for cargo) in order to reduce environmental impacts.

Additionally, the general orientation is to invest into rail service because of possible ecological issues. Rails should take over most of the imported cargo; otherwise the roads will be over occupied and the emissions above acceptable levels.

Thus, the removal of existing bottlenecks for upgrading of existing infrastructure concerns: Divača – Koper (new line); Divača – Trieste (in progress); Divača – Ljubljana (upgrade of the current infrastructure); Ljubljana node (short-term solution: track deepening, Tivoli arc); Zidani Most – Celje (increase in capacity); Pragersko – Hungarian board (project in progress, electric traction); Šentilj –Maribor (upgrade of the existing track).

As far as passenger transport is concerned, only 5% of the population is using rail service as a mean of transport. It should be pointed out that adequate infrastructure and good rail connections are of great importance to attract foreigners to Slovenia, in particular tourists during the summer period. There is a relatively poor connection with Italy, although the direct train between Ljubljana – Trieste – Venice will start to operate in June 2018. In 2018 INTERREG program SI-IT will finance project called CROSSMOBY with the aim to improve environmentally friendly cross border passenger traffic between two countries. and apparently limited interests to improve it. Projects addressing this issue: 1906 (Identification of additional measures for upgrading (increase abilities) of the existing line Divača-Koper), 1941 (Upgrading the railway line between Ljubljana and Divača, 1. Phase).

Roads

Concerning passenger transport, Ljubljana has already established a park&ride (P&R) system, Maribor is going to establish P&R in 2019. According to recent studies, however, no more than 25% of the population will be using public transport.
In addition, high traffic volumes are observed during the rush hours in Ljubljana node. So, the Ljubljana ring road could be considered as the main bottleneck, suffering from capacity limitations, especially during peak hours. At the moment, a specific action in order to reduce noise pollution on the Ljubljana bypass is going to be addressed by the road infrastructure manager (DARS, a state-owned company), which is studying possible changes to the traffic regime (a reduction of the speed limit from 100 to 80 km/h). Measures are also directed at diverting transit traffic from the very busy northern towards the eastern bypass, which has fewer residential buildings in its direct vicinity.

Ports

Luka Koper's main planned infrastructural activities are the extension of the existing piers, the deepening of waterways and the construction of a third pier, which would allow the reorganization of works and improved operational flexibility. One of the priority projects is also an increase in the capacity of cargo transferred from the port to rail. In order to maintain the 60% modal split, a second track on the track Divača-Koper needs to be implemented. Projects addressing this issue: 1143 (Construction of the 2nd track Divača-Koper)

Road rail terminals

Railway intermodal terminal located in Ljubljana (operated by Slovenske Železnice) needs more capacity (new investments have been programmed in 2013). Projects addressing this issue: 1391 (Upgrading and modernization of Ljubljana container terminal infrastructure for improvement of intermodal transport services and logistics centre)

Airports

The most important planned activity in the near future for the country's main airport (Letališče Jožeta Pučnika, Ljubljana) is the construction of a new passenger terminal (EUR 17m of European, funds obtained, project currently on stand-by). Meanwhile, the key point regarding the unification of infrastructure would be to connect the airport to rail service and to improve road infrastructure around the airport and in the region (planned in 2040, local roads between Štajerska and Gorenjska. It needs to be taken into account that Aerodrom Ljubljana is currently sold, hence its development heavily depends on its new owners (investments on passenger and freight terminals are needed). Projects addressing this issue: 1934: Renovation and modernization of airport infrastructure, 1921 (Airport Ljubljana - Development of airport infrastructure - In the context of the National Spatial Plan will set area for the location of the airport and other infrastructure) 1922 (Reallocation of the main road)

Hungary

Railways

Before moving to the detailed description of the critical issues, it is important to underline that MAV plans to eliminate bottlenecks on several sections belonging to the corridor. The related investments are under preparation and cover:

- **Track alignment** (lifting slow-down signs);
- **Energy supply system of catenary** (sub-stations and catenary);
- **Renewal of old bridges**;
- **Station reconstruction**, in particular the renewal of the three Budapest head-stations;
- **Intermodal investments** in Kaposvár and Debrecen in order to increase the quality of services as detailed below.
  - Debrecen plays an important role in its Euro-region and the Eastern part of the country. Its integration into transport systems should be developed accordingly. Part of the efforts is the creation of an intermodal node serving the city's population and its visitors. The main railway station in the centre of the town will be reconstructed.
  - Kaposvár sees the following investments: interconnection of the railway station, the local and inter-city bus terminals, PR, BR, joint platforms, information system, passenger facilities and other functions; two-level separation of roads and railways, separation of pedestrian movement and bike traffic. The related feasibility study is completed.

Projects addressing this issue: 3905, 3908

Roads

Main critical issues along the Hungarian road network can be summarised in:

- **Low density of clean fuel stations** alongside and in the vicinity of MED CNC road sections
- **Congestion on various sections** due to lack of resources, low traffic forecast, high rate of trucks and shortage of 2x2 lane sections. This of course also affect the traffic, making it rather difficult to calculate the expected travel time.

Projects addressing this issue: 3919, 3916

Road Rail terminals

Trans-loading rail terminal at Záhony (HU/UA border). The international market position of the trans-loading terminal is worsened due to the sharp decline of international trade with Ukraine and substantial decrease of international transit traffic, due to the war-like situation in the Eastern part of the country.

METRANS RRT Csepel Island – Budapest. This new privately financed RRT has been built and opened recently (14.06.2017) by METRANS (the intermodal subsidiary of Hamburger Hafen und Logistik AG). Its capacity is 250 000 TEU/year. The length of its 8 tracks, however, doesn't allow to handle 750 m long trains and its railway connection is not electrified yet. For the time being it is not freely accessible by third parties.

Csepel Freeport, Budapest. The capacity of the trimodal terminal operated by Budapest Freeport Logistic Co. doesn't allow to handle 750 m long trains and its deteriorated railway connection is not electrified yet. The renewal of the railway line connecting the terminal to the MÁV main line No.150 at Soroksár (including upgrading of the Gubacsi Bridge across the Danube branch) is under preparation (see approved CEF project 2015-HU-TM-0365-S listed in RD CNC Project List 2017 as ID 9732).

Projects addressing this issue: 9841

Airports

Railway connection of Budapest Airport is missing yet, hampering further development and increase of capacity of it. Connecting the freight handling areas of Budapest airport to the main Budapest-Arad railway line is under way. Projects addressing this issue: 9904

Urban nodes

According to the Regulation (EU) N° 1315/2013, Urban node means "an urban area where the transport infrastructure of the trans-European transport network, such as ports including passenger terminals, airports, railway stations, logistic platforms and freight terminals located in and around an urban area, is connected with other parts of that infrastructure and with the infrastructure for regional and local traffic".
The following table lists the 13 Core Urban Nodes derived from the Regulation (EU) N° 1315/2013, Annex II along the MED corridor.

Countries	Urban Node	CNC affected	Involved modes		
			Rail	Road	IWW
ES	Sevilla	MED – ATL	x	x	x
ES	Madrid	MED – ATL	x	x	
ES	Valencia	MED	x	x	
ES	Barcelona	MED	x	x	
FR	Marseilles	MED - NS	x	x	x
FR	Lyon	MED - NS	x	x	x
IT	Turin	MED	x	x	
IT	Milan	MED - RALP	x	x	
IT	Bologna	MED – SCANMED - BA	x	x	
IT	Venice	MED - BA	x	x	x
HR	Zagreb	MED	x	x	
SI	Ljubljana	MED - BA	x	x	
HU	Budapest	MED – OEM - RD	x	x	x

Table 6: Overview of MED corridor urban nodes

Sevilla

The following figure depicts the Sevilla Urban node in terms of relevant MED Core corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Sevilla port (inland and maritime port),
- Sevilla airport.

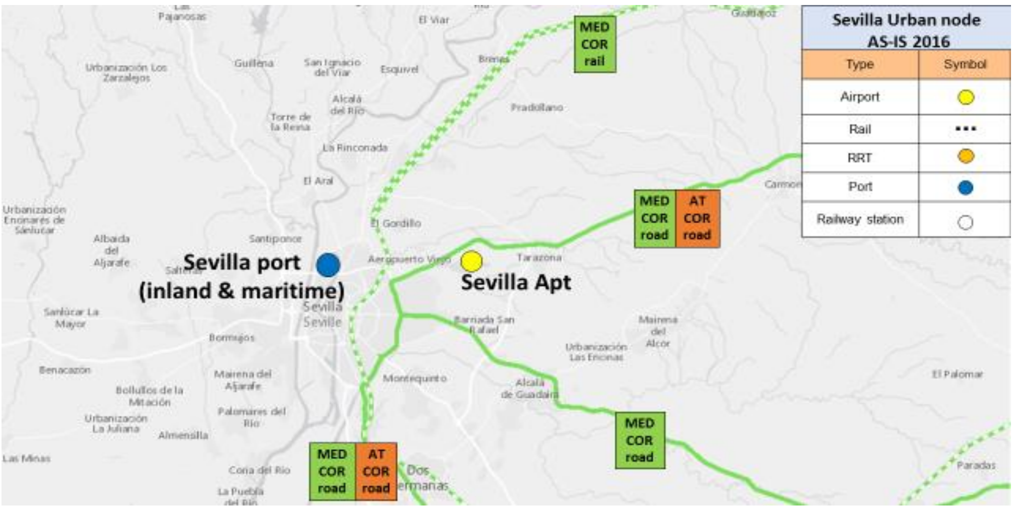

Figure 7: Sevilla Urban node

As shown in the above figure, the Sevilla node shares the sections of roads N-IV and A-4 with the Atlantic corridor.
The Sevilla Urban node is characterised by the following main issues:

- Rail access to Port of Sevilla interferes with the passengers railway line Sevilla-Cádiz, as freight trains need to make crossing moves along the passenger line to enter the port. This affects negatively the capacity of the railway access, possibly creating a bottleneck in the near future with the extension of the port rail facilities (Cuarto y Verde docks).
- SE-40 ring road suffers from traffic congestion, which negatively affects primarily medium and long distance traffics through the Sevilla node.
- The need for several developing and upgrading interventions on the maritime port infrastructures.
- Sevilla port accessibility, and its connection to the hinterland, is hampered by current infrastructures.

Madrid

The following figure depicts the Madrid Urban node in terms of relevant MED Core corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Adolfo Suarez – Madrid Barajas airport,
- Norte y Sur Madrid RRT.

It is worth mentioning that the picture depicts the Madrid RRT as shown in the TEN-Tec System and the Regulation contains a single RRT in Madrid. However, Madrid actually articulates rail freight traffic mainly through four different RRT, each in a different geographical location.
These are as follows:

- Coslada dry port,
- Abroñigal RRT,
- Vicálvaro RRT,
- Villaverde Complex RRT (Villaverde – San Cristóbal).

ADIF manages additional rail facilities in Madrid (Aranjuez, Santa Catalina and others), though they are used only as technical installations, not for train loading/unloading. Dry port of Azuqueca, which is located in Guadalajara (Region of Castilla La Mancha), is functionally linked to the RFC Madrid-Barcelona despite not belonging to the Madrid node.

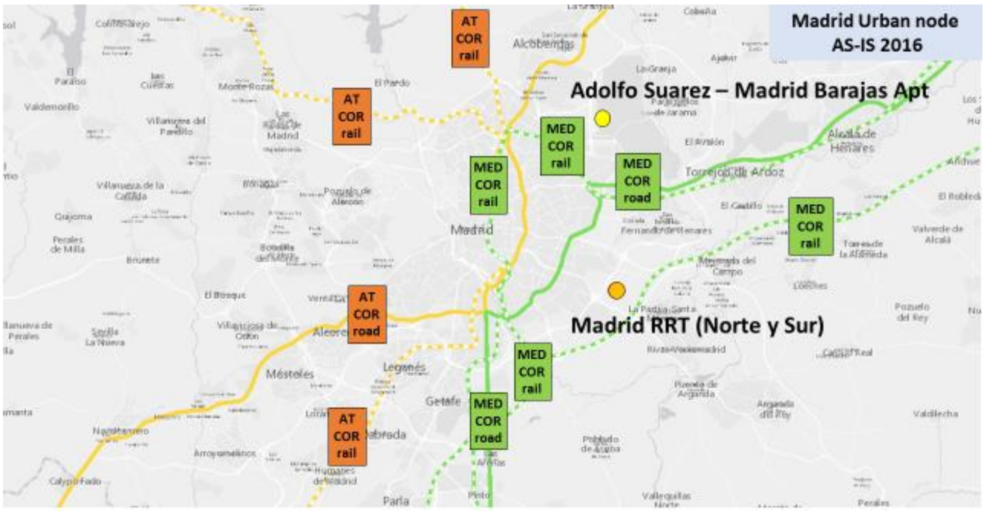

Figure 8: Madrid Urban node

As shown in the above figure, the Madrid node shares sections of roads and rail infrastructure with the Atlantic corridor.

Madrid Urban node is characterised by the following main issues:

Strong heterogeneous rail traffic sections due to overlapping of metropolitan, regional, long distance and freight traffic. This mixed use of infrastructure negatively affects node performance requirement for freight traffic, especially during higher commuter train frequencies periods, and might constitute a bottleneck to the smooth functioning of the corridor.

In regard to the high speed rail network, there is a lack of connectivity in UIC gauge between north (Madrid Chamartín) and south (Madrid Puerta de Atocha) stations , which prevents direct services connecting the regions in the north-west/north with the regions in the north-east/east/south through Madrid.

Madrid rail freight traffic is mainly articulated through the dry port of Coslada and the RRTs of Abroñigal (containers) and Vicálvaro / Villaverde (conventional freight). These facilities lack of capacity to absorb the expected rail freight traffic demand mainly due to limited number of tracks and usable track lengths. Additionally, the lack of UIC gauge may reduce rail competitiveness in the future transport market.

Main access roads suffering from traffic congestion in Madrid are the M-30 and M-40 ring roads. M-30 problems are specially located at the eastern arch, on the section between the A-2 (Madrid-Barcelona) and A-3 (Madrid-Valencia) radial accesses; and M-40 problems are located at the eastern and southern arches, were traffic congestion on peak hours is mainly related to accessibility to the economic areas located in these city sectors (Ribera del Loira, Villaverde, Julián Camarillo, etc.).

In terms of last mile connection, Madrid airport is not connected to long-distance rail, which impedes the realisation of journeys from other Spanish cities connected with Madrid by HS rail. This means that at present, passengers travelling by train to Madrid to catch a flight from Madrid airport need to change at either Madrid Chamartin or Madrid Puerta de Atocha HSR stations. According to recent studies about HSR – aeroplane complementarity in Madrid, passengers doing these changes would add up to 600,000/year.

Valencia

The following figure depicts the Valencia Urban node in terms of the relevant corridor infrastructure that are (according to Regulation (EU) N° 1315/2013):

- Valencia Port;
- Valencia Airport

Figure 9: Valencia Urban node

The Valencia Urban node is characterised by the following main issues:
The existing rail line must be updated in order to increase its speed, freight capacity and sharp slopes, as well as enhancing the metropolitan lines.

- Valencia port has just one access for heavy vehicles located on the south side. That means the vehicles coming from north have to do a surrounding of more than 20 km for entering into the node. There is also a significant bottleneck in the corridor in terms of road lines caused by the Serreria tunnel.

- Several rails sections for the lines surrounding the city need upgrades in order to be compliant with TEN-T requirements,

- For last mile connection, Valencia port accessibility and connection with the hinterland need to be upgraded. Road connection to the Airport shall be improved too. There is also a future need of rail connection to the port because of the potential demand caused by the new ZAL Valencia and Fuente San Luis Station,

- Valencia - Barcelona connection does not allow competitive commercial speeds. Few port connections, which are basic for economic activity and to make possible the transatlantic connections.

- Valencia suffers from road traffic congestion, especially in the V-30 access to the port and in the metropolitan area. The bottleneck caused by the insufficient rail capacity between Valencia and Sagunto is also significant, as more than 100 journeys are performed every day.

Barcelona

The following figure depicts the Barcelona Urban node in terms of relevant MED Core corridor infrastructure, that are (according to Regulation (EU) N° 1315/2013):

- Barcelona Port,

- Barcelona Airport,

- Barcelona La Llagosta Terminal.

Figure 10: Barcelona Urban node

The Barcelona Urban node is characterised by the following main issues:

- The rail access to the Port of Barcelona has a temporary and deficient connection in UIC, producing important operation problems and reducing load capacity,

- The main necessity for the city would be finishing the construction of the Intermodal Rail Terminal La Sagrera (this will provide high speed, long and short distance to the surrounding areas).Similarly, the implementation of UIC gauge in the La Llagosta terminal would allow a better connection to the corridor,

- A rail connection with the airport is needed as well, especially with T1 Terminal, the most used one, since the lack of accessibility limits its usability,

- An enhancement of ring roads and accesses of Barcelona is necessary in order to lighten traffic,

- Logistic installations of Castellbisbal and Montcada have very limited space, and the access is difficult in one of the two directions,

- Road circulation around the node would need the realisation of a fourth ring road for smoother traffic management,

- Some rail connections with freight terminals and sidings are built at the same level of the roads of the Port (4 level crossings). This fact supposes that freight trains interfere with other surface traffics of the Port, with consequent risk of accident for vehicles and pedestrians at the level crossings.

Marseille

The following figure depicts the Marseille Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Marseille - Provence airport,
- Marseille and Fos-sur-Mer Port,
- Fos-sur-Mer RRT
- Marseiile RRT
- Miramas RRT and rail freight terminal.

We have also shown on the map the RRTs in development in direct relation with port facilities: in Marseille (Mourepiane terminal) and in Fos-sur-Mer.

Figure 11: Marseille Urban node

The core infrastructure in Marseille presents an overlap between North Sea Mediterranean and Mediterranean corridors. The port is located on two sites: Marseille (mainly for European and north-African freight traffic, MoS, passenger traffic) and Fos-sur-Mer for large and intercontinental vessels.

The Marseille Urban node is characterized by the following main issues:

- A need for improving accesses to the Port facilities. There is a lack of quality rail connections and terminals in both Marseille and Fos-sur-Mer. The road access to Fos-sur-Mer presents last mile issues with large portions of non-express roads to reach the terminal facilities, causing safety and congestion issues. The IWW connection of Fos sur Mer port terminal is also incomplete, as one of the major docks (darse 2) in not directly connected to the Rhône River.
- Important bottlenecks in rail traffic due to overlapping of metropolitan, regional, long distance and freight traffic, and the configuration of the St-Charles station as “end station”,
- The Miramas RRT is characterized by an unsufficient train length acceptancy and limited capacity.
- As most of major cities in Europe, Marseille is also affected by road congestion. This situation affects in particular the accessibility of the port facilities situated in the heart of the urban area of Marseille.

Lyon

The following figure depicts Lyon Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Lyon airport,
- Edouard Herriot Inland Port,
- Venissieux RRT.

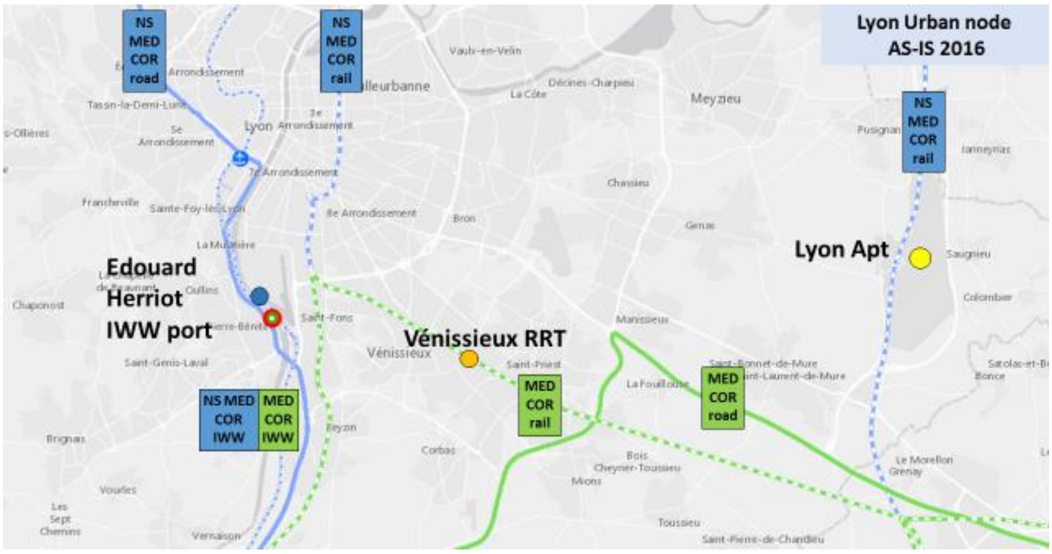

Figure 12: Lyon Urban node

As shown in the above figure, the Lyon node is also intersected by the North Sea Mediterranean corridor, which follows a North-South axis. The Mediterranean corridor overlaps with NSMED along the Rhône Valley between Lyon and Marseille, and shifts towards East (Torino) precisely in Lyon, while NSMED continues to the North.

Most relevant issues on the Lyon Urban node are the following:

- An intense congestion in rail traffic due to overlapping of metropolitan, regional, long distance and freight traffic, most of them passing on an infrastructure of limited capacity in the heart of the city. This congestion causes delays, operating issues and prevents any significant future development of rail traffic. The sections with major capacity issues are Lyon St – Clair – Guillotière (north-south crossing of the city including the Lyon Part-Dieu Station) and St-Fons – Grenay, of particular relevance for MED corridor since it is the initial section of the major rail axis from Lyon to Torino,
- Lyon Venissieux RRT is characterized by an unsufficient train length acceptancy and lack of capacity if we are aiming at a significant increase in rail traffic by 2030. Therefore, it represents a major bottleneck for the MED corridor,
- The Edouard Herriot inland Port is located in the city centre of Lyon, in a very densely populated area. Its rail accesses in particular need an upgrade as they present incomplete electrification and demand complex train manoeuvres,
- Like most major European cities, Lyon is also affected by road congestion. Its specific configuration with a motorway crossing the city centre (A6/A7) calls for solutions enhancing bypasses for long-distance traffic.

Turin

The following figure depicts the Turin Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Caselle airport,
- Orbassano RRT.

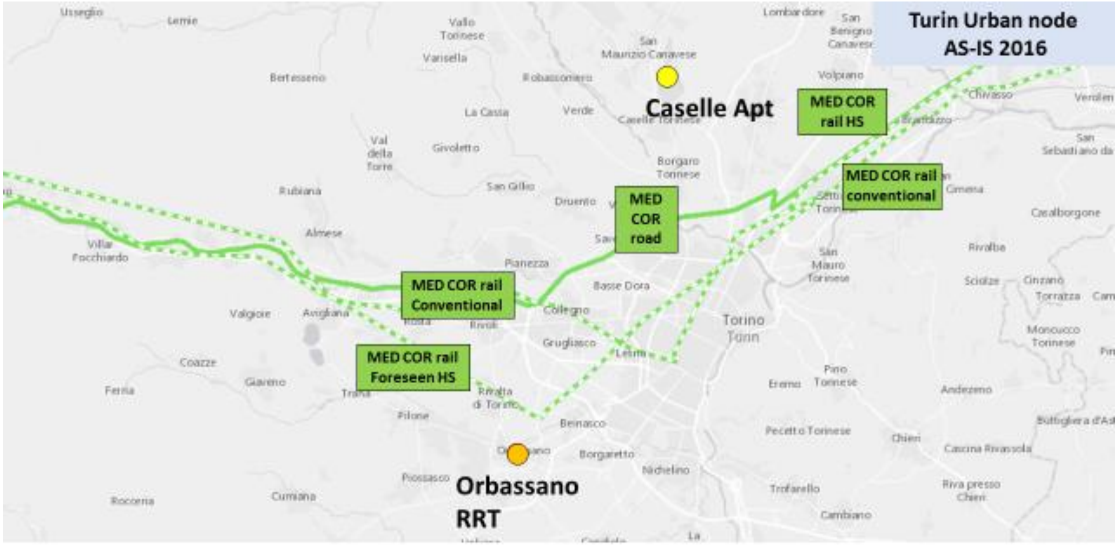

Figure 13: Turin Urban node

As shown in the above figure, even though Turin has no interconnection with other CNC, it still represent a strategic node for the Mediterranean corridor because of its proximity to the FR/IT border and the fact that it is the starting point of the new cross-border Lyon-Turin High speed section.
The Turin Node is an essential point of the national railway system, concerning both its function as a node for the HS/HC system and the Turin-Lyon corridor and its metropolitan mobility value. The planned interventions for the node, both infrastructural and technological, are essential in order to increase its capacity and enhance the intermodal integration.
The following main issues currently affect the Turin Urban node:

- The current infrastructural organisation of the node does not permit to exploit its potential capacity in terms of rail traffic, as assessed by the publication realized by the Lion-Turin Observatory (i.e. "I quaderni dell'Osservatorio ferroviario Lione-Torino"),
- Some infrastructural upgrades are needed in the section Bussoleno-Avignana for train length and maximum gabarit,
- The planned interventions for the Turin Node need to be completed with specific projects to allow the capacity and punctuality increase, due to the overlapping of different types of rail traffic (metropolitan, regional, long distance and freight).
- Technological upgrade is being completed on the rail section Torino – Padua conventional line.

Milan

The following figure depicts the Milan Urban node in terms of relevant MED Core corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Linate airport,
- Malpensa airport,
- Milano Smistamento RRT

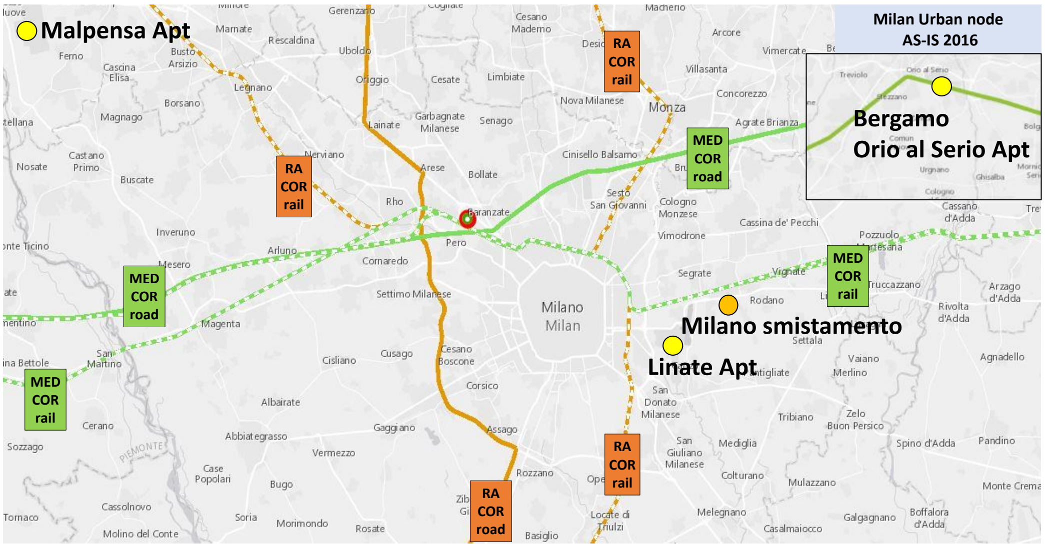

Figure 14: Milan Urban node

As shown in the above figure, the Milan node is intersected by Rhine Alpine corridor, which follows a North-South axis, connecting Genoa port to Northern European Regions.
The following main issues concern the Milan Urban node:

- Rather high promiscuity of rail traffic due to the overlapping of metropolitan, regional, long distance (both standard and HS services) and freight traffic. This mixed use of infrastructure negatively affects node's performance requirement for freight traffic and represent a potential harm to the smooth functioning of the corridor,
- With respect to the node general accessibility, it is worth to underline that the high population density coupled with many small firms and residences spread all over the territory generate a large amount of transport demand that gives rise to congestion problems (especially road-related ones).
- Improved rail accessibility is required for Milan Malpensa airport (located in the intersection between two different Ten-t corridors),
- Insufficient integration among transport modes and IWW channels is also to be underlined, due to the lack of last "mile" connection to Milan to Italian IWW system.

Bologna

The following figure depicts the Bologna Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Borgo Panigale airport,
- Bologna Interporto RRT

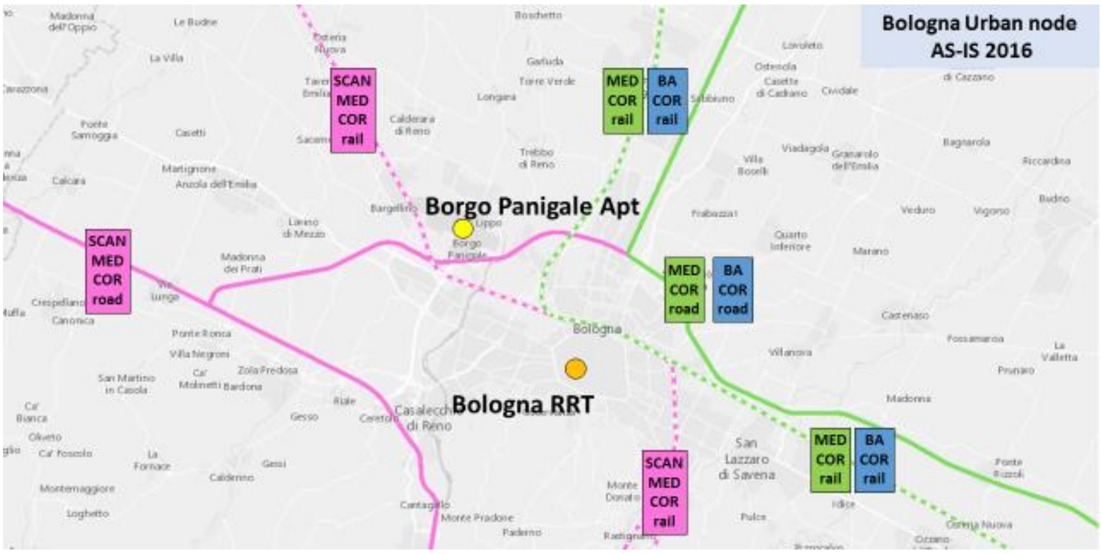

Figure 15: Bologna Urban node

As shown in the figure above, Bologna is an essential node for three of the four CNC crossing Italy (i.e. Mediterranean, Scandinavian Mediterranean and Baltic-Adriatic CNC). While for MED and BA CNC there is a perfect overlapping in the node, SCANMED corridor follows a different South-North trajectory.
Main issues of the Bologna node are outlined below:

- The node suffers from severe road sections capacity shortage (e.g. A14 Motorway between Bologna and Castelbolognese and A13 Motorway between Bologna and Ferrara),
- Technological upgrading with a new management system are needed in the railway sections Bologna-Padua and Bologna-Rimini,
- The intermodal rail connection with the Bologna airport is currently unavailable,

Venice

The following figure depicts the Venice Urban node in terms of relevant MED Core corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Tessera airport,
- Venice IWW/Maritime port.

Figure 16: Venice Urban node

As shown in the above figure, the Venice urban node is characterized by the presence of an IWW/Maritime port and the total overlapping of Mediterranean and Baltic-Adriatic CNC.

The Venice Urban node features the following main issues:

- For passenger intermodality, lack of rail connection with the airport,
- For intermodal integration, reduced rail accessibility to port areas, due to single track rail connection to Venice port causing traffic flow restraint. Additionally, the railway traffic from/to the port has to pass through Venezia Mestre, thus reducing the available capacity of the station,
- Rail sections going eastward are being upgraded; preferably by enhancing the conventional line in order to allow a maximum speed up to 200 km/h,
- Infrastructure and technological/signalling upgrading of the existing lines are necessary (station traffic control and management system) in order to increase the available capacity and to separate passenger traffic from freight traffic by limiting possible interferences and increasing the quality of the railway services,
- The limited available draughts of Venice port (due to the lagoon) limits certain types of traffic (requiring vessel of big dimensions).

Ljubljana

The following figure depicts the Ljubljana Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Ljubljana airport,
- Ljubljana RRT.

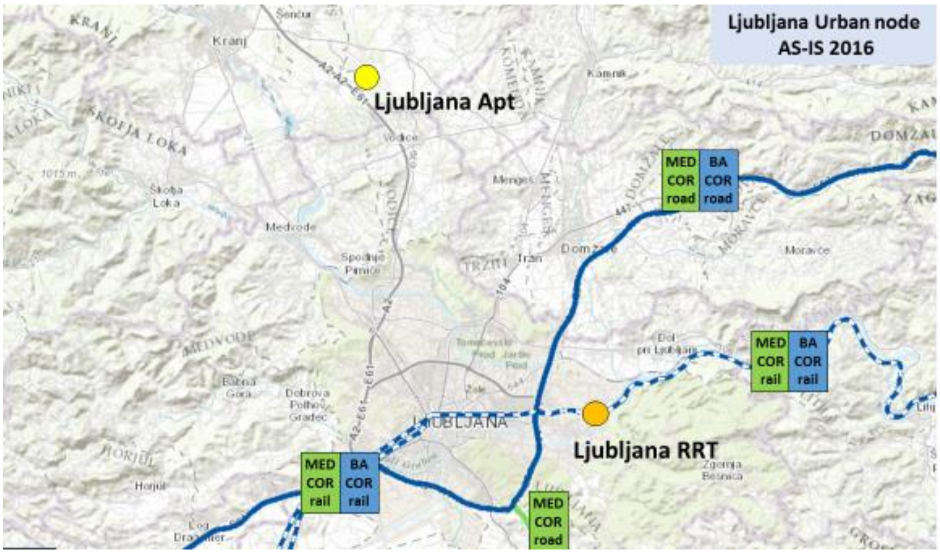

Figure 17: Ljubljana Urban node

As shown by the above table, the Ljubljana urban node presents a total overlapping between the Mediterranean an**d the Baltic-Adriatic corridor.**
The following main issues affect the Ljubljana Urban node:

- There is a limitation of capacity due to high traffic volumes on roads and RRTs.
- Lack of capacity for rail lines,
- Lack of connection between Ljubljana airport and railway network,
- Cargo traffic from the city centre should be reduced, if not eliminated at all, through a bypass of Ljubljana railway hub,
- N° direct connection between railway section Primorska and Gorenjska region – all train compositions must be directed to the train station in Ljubljana, stop and change the direction and continue on the other section,
- Ljubljana ring road could be considered as the main bottleneck, as it suffers from high capacity limitations especially during peak hours.

Zagreb

The following figure depicts the Zagreb Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Zagreb airport
- Zagreb RRT

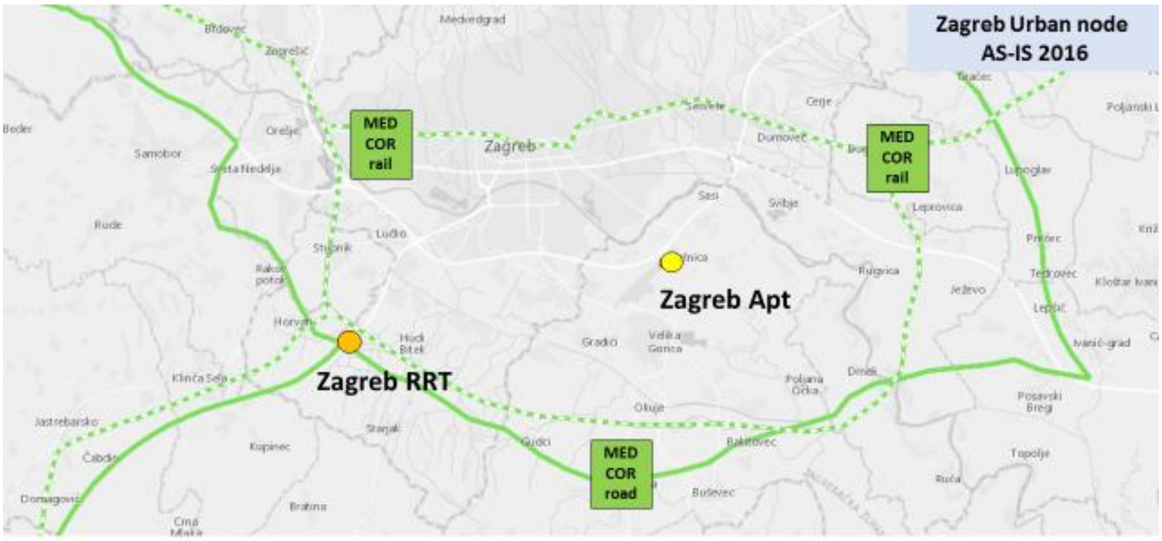

Figure 18: Zagreb Urban node

The Node is facing capacity problems related to the following bottlenecks:

- Physical bottleneck in railway system,
- Need for electrification and compliance with Core Network standards,
- Additionally to railway, Air control system is facing certain issues which are being resolved with planned projects.

Budapest

The following figure depicts the Budapest Urban node in terms of relevant corridor infrastructure, which are (according to Regulation (EU) N° 1315/2013):

- Budapest airport,
- Budapest RRT,
- Budapest IWW Port.

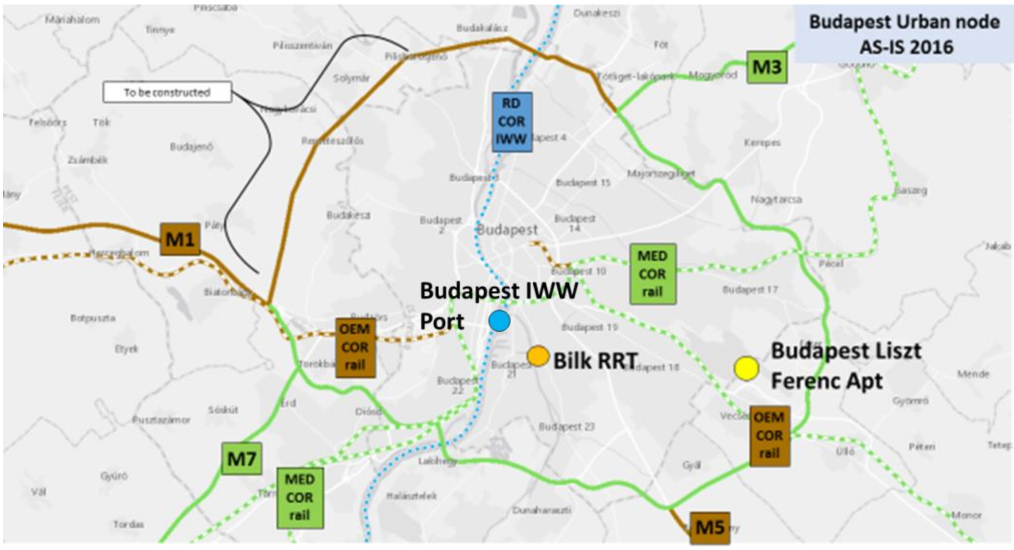

Figure 19: Budapest Urban node

As show in the figure above, Budapest is indeed a crucial node in the European transport framework, as three CNC crossing Hungary in its capital city (i.e. Mediterranean, OEM and R-D CNC).
The Node is particularly affected by the following concerns:

- Missing rail link between Budapest Liszt Ferenc International Airport and MED/OEM/R-D CNC railway lines penetrating into the capital city area,
- Non-compliance of some MED/OEM/R-D CNC rail sections (between Budapest-Kelenföld and Budapest-Keleti railway stations) with requirements of Reg. 1315/2013; limited capacity of the Southern Danube Railway Bridge,
- Lack of capacity of the road link between the Airport and the city centre within the urban area,
- Missing North-Western section of the ring motorway M0.

4 Transport market analysis

Results of the multimodal transport market study

The Corridor Study, which has been published end of 2014[12] contains a detailed transport market Study (TMS) (cf. chapter 4.2.2) which analyses the transport flows along the Corridor by assessing the capacity and traffic flows on the respective parts of the infrastructure.
The results of the TMS presented in this chapter have been inserted in the Work Plan in order to illustrate the traffic flows, demands and future prospects. The base year for market analysis is the year 2010, which is the last year where a global set of data for the whole Corridor is available, in particular for OD matrices). Recent evolutions of traffic, in particular for ports and cross-border flows, are presented where available. These evolutions show that traffic on the corridor remains quite dynamic despite a context of weak economic growth between 2010 and 2015. Therefore, long-term projections made in 2014 can still be considered valid.

Current flows in the Corridor's market area

In the 2014 Corridor Study, a "market area" for international flows of goods and passengers on the Corridor has been defined, based on origin-destination pairs that cross at least one common border of two Corridor countries. Then, a forecast for the year 2030, target date for the completion of the core network Corridors, was made on this basis (NB: due to the difficulty in obtaining origin-destination data for maritime transport, this mode is dealt with separately from the modes road and rail).

Goods

As shown in the table below, international freight flows in the corridor's market area represent about 150 million tons in 2010. The overall modal split is about 85% for road and 15% rail. In addition to these terrestrial flows, it should be noted that about 40 million tons are exchanged between Corridor countries by Sea, in particular between Spain and Italy.

Mode	1000 tons / year (2010)	%
Road	129,623	85%
Rail	22,206	15%
Total (except sea)	151,829	

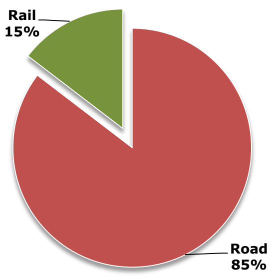

Figure 20 –Freight flows in the Corridor's market area in 2010 (1000 tons / year)

An analysis of the trade flows shows that:

- Corridor countries have strong cross-border exchange flows at regional level, with each other and with the rest of Europe; in particular Catalonia and Lombardy appear as the predominant generators of trade flows;
- Road is the dominant mode for flows between Corridor regions, and rail share remains at a relatively low level when compared for example with cross-Alpine freight flows in a north – south direction.

[12] http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/Corridors/Corridor-studies_en.htm

Over the recent period, cross-border flows on the Corridor were still growing. At the Mediterranean SP-FR border, freight flows represent 48 million tons in 2015, compared to 42 million in 2010, with an annual average growth of 2,8%. Rail share is still low, but rail flows have grown from 1,6 to 2,3 million tons (+40%) with help of the new UIC gauge rail link between Perpignan and Figueras. On the FR-IT border (including coastal flows at Ventimiglia), traffic has remained stable (about 41 million tons) in a difficult economic context for France and Italy. Rail share seems to be slowly growing again after having decreased a lot in the previous decade (3,7 million tons in 2015 compared to 3,2 in 2010, +15%).

Another source of major international flows on the Corridor are the freight flows generated by the **seaports**. The total volume of commodities passing through the sea ports of the Corridor amounted to nearly 400 million tons in 2010, of which about 100 million tons concerned goods shipped between EU countries. 327 million tons (80%) of goods generate flows to and from the hinterland, the rest being transhipped. The traffic of the ports of the Corridor is growing rapidly: in 2015, their total traffic reaches nearly 450 million tons, showing an average annual growth rate of 2,7% between 2010 and 2015. For container traffic specifically this growth is even higher (about 5% per year).

The map below shows the total volume of goods treated in each port and the rate of EU-internal flows.

Figure 21 –Volume of total goods handled by ports and rate of EU-internal flows (1000 tons / year)

As regards **inland waterways**, in 2010, freight traffic on the two waterways of the Corridor amounted to:

- 5.8 million tons on the Rhône;
- 1.6 million tons in northern Italy, from which 0.4 million on the Po river and 1.2 million between Venice and Porto Nogaro.

The main inland port on the Rhône is the Port Edouard Herriot of Lyon, which accounted for 1.3 million tons in 2010.

In Italy Mantua had 0.2 million tons, Cremona 0.08 million tons and Rovigo 0.09 million tons of IWW traffic in 2010. Porto Nogaro had 1.2 million tons. It is to note that IWW traffic in Italy has known a severe decrease between 2008 and 2010. In 2007 the port of Cremona had an IWW traffic of nearly 0.5 million.

Passengers

The total international passenger traffic between the six Corridor countries is 81 million passengers per year. The two main flows are between France and Spain, and France and Italy: these two relations represent 80% of the international traffic considered. The overall modal split is 64% for road, 33% for air and 3% for rail transport.

The Spain – France and Italy – France relations are characterized by strong road traffic, consisting mainly of short-distance trips around the respective border points of Le Perthus (ES-FR) and Ventimiglia (IT-FR). Regarding air traffic, the first country per country relation is between Italy and Spain, with almost 10 million passengers per year. France – Italy and France – Spain have both similar air traffic volumes (7.5 million).

The rail market share is generally weak, in particular for flows with Spain; flows between Hungary and Slovenia / Croatia have significantly higher rail market shares (15-20%) than the other flows, but on relatively small volumes of demand (200 000 and 400 000 pax per year respectively).

Mode	1000 pax / year (2010)	%
Road	51,687	64%
Rail	2,514	3%
Air	26,627	33%
Total	80,828	

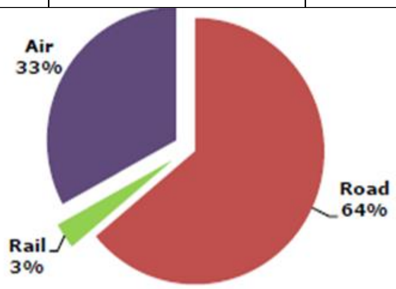

Figure 22 – Total passenger demand between Corridor countries

Passenger flows in the "market area" of the Corridor (i.e. based on origin-destination pairs that cross at least one common border of two Corridor countries) can be summarised as follows:

Total market (area 1000 pax / year)	2010
Road	46,261
Rail	3,001
Air	79,659
Total	128,921

Total market (area 1000 pax / year)	2010
Rail Share	2.3%

Figure 23 – Total passenger flows in the marker area of the Corridor

These international passenger flows in the Corridor's market of about 129 million passengers per year in 2010 are concentrated mainly in the western part of the Corridor. The low rail share can be explained by the fact that a large part of these passenger movements are short-distance cross-border trips, which are still carried out more efficiently by road than by rail.

The other important flows are the flows between major cities and to touristic zones of the Corridor countries or neighbouring countries ; the distance between these major nodes is generally really high (over 1000 km in most of the cases), which gives the air transport a tremendous market advantage for these type of flows.

Forecast of the overall transport demand

Freight

In order to assess the potential future traffic on Corridor rail infrastructure, in particular for cross-border sections, an assessment of the potential rail freight matrices at 2030 has been performed, considering Corridor implementation.

This assessment takes into account:

- The traffic growth derived from the analysis of the international flows on Corridor market area;
- The traffic generated by the ports, according to the consortium's forecasts;
- The traffic growth of national traffic on Corridor sections, estimated with a simplified assumption linking traffic growth and GdP.

The result of this assessment is shown on the map below:

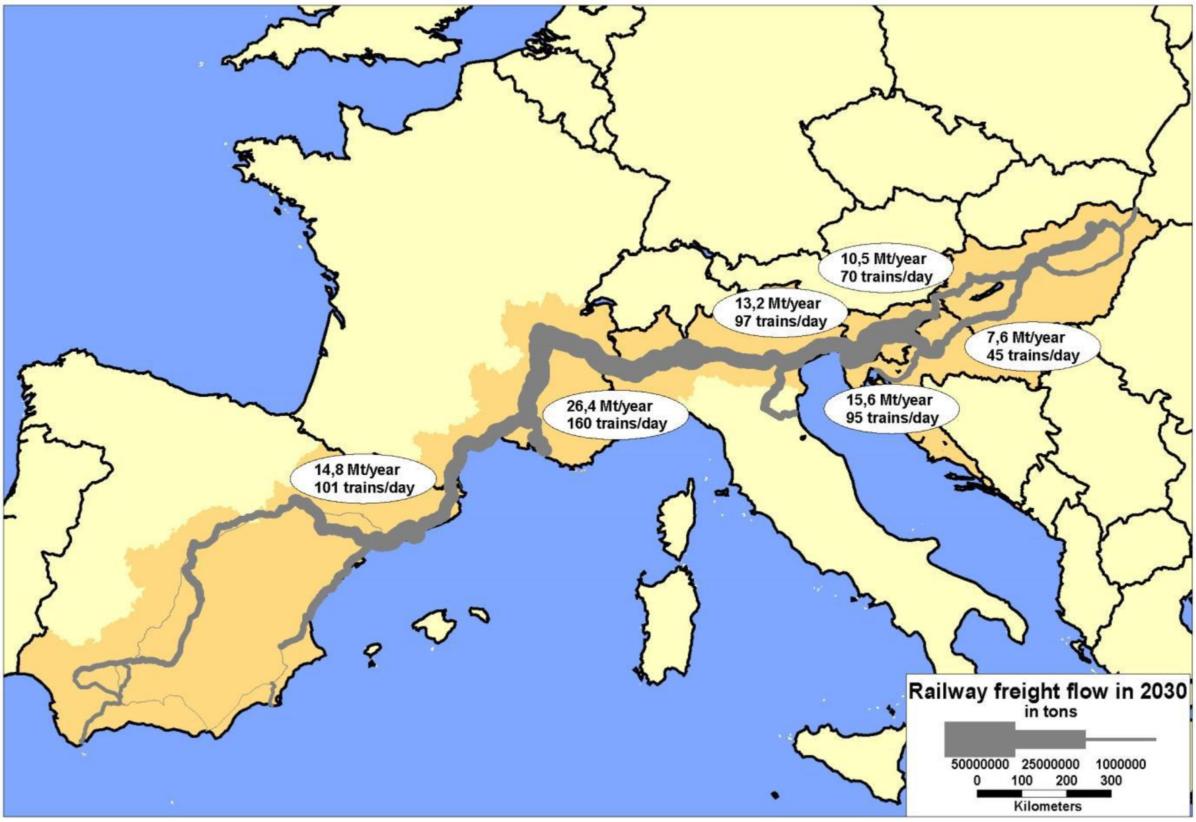

Figure 24 – Potential rail traffic on cross-border sections of the Corridor in 2030

According to the Study the total demand in the market area of the Corridor would increase from 151 million tons in 2010 to 267 million tons in 2030, with an average annual growth rate of 2.9%.
With the full implementation of the Corridor, the rail market share could potentially increase up to 27%, reaching about 72 million tons a year.
The table below summarizes the forecasting results for the Corridor's market area:

Mode	2010	2030 Trend (do-nothing)	2030 Corridor implemented	2030 Corridor implemented (+ accompanied rolling motorway)
Road	129,623	228,647	195,131	186,431
Rail	22,206	38,958	72,474	81,174
Total (except sea)	151,829	267,605	267,605	267,605
Rail share	14.6%	14.6%	27.1%	29.4%

Table 7 – Forecast for freight (thousand tons)

The forecasts in the 2014 Corridor Study show that there is a **strong potential** for international **rail traffic** development on the Mediterranean Corridor.

- The global demand can be expected to have a solid dynamic if GDP growth in Europe turns back to "normal" rates (as is expected in EC projections) on a long term average. It is particularly the case for the exchanges of goods with countries of Eastern Europe.

- Starting from a relatively low base in 2010, the final rail shares given by the forecasting model (between 20% and 30% for most of the relations considered) are not excessively high for international continental rail transport as long as it offers competitive performances; they remain below observed rail shares in Europe on the north – south direction.

- Thus, implementing the Corridor could potentially shift about 33 million tons per year from road to rail (about 2.3 million trucks/year equivalent) or even 41 million tons / year (3 million trucks) if we include accompanied combined transport (rolling motorway) on the Lyon – Turin axis[13].

- However, these forecasts express the *potential* market of the Corridor, meaning that reaching these effects imply the complete implementation of the Corridor with fulfilment of the TEN-T standards and the absence of bottlenecks, and imply also the creation of appropriate transport services along the infrastructure, particularly in combined transport.

As regards **maritime traffic**, all ports and all commodity types are expected to grow in the period 2010-2030, in particular container traffic (about 4% per year) without assuming shifts between ports and without specific growth of the transhipment traffic.
It is reasonable to expect that the level of rail traffic generated by the Corridor's ports could double by 2030 as compared to 2010 levels, even taking into account an increase of train length. The most important effects can be expected at the ports of Algeciras, Valencia and Barcelona, resulting of traffic growth and important modal shift

[13] The introduction of the rolling motorway could also consistently increase the environmental benefits associated with combined transport.

expectations, as a result of the expected improvements of the ports' rail connections. Although to a lower scale, this can also be expected on the other ports along the Corridor, particularly ports of Sevilla, Tarragona and Cartagena (Dársena de Escombreras).
Taking into account potential additional growth from shifting traffic from the Northern European ports, this rail traffic increase could be even more important.
The maritime dimension of the Corridor is also expressed by a strong traffic of short sea shipping and RoRo services between the Corridor's countries or between Europe and northern Africa. This traffic is also expected to grow rapidly in the coming years with the further development of the motorways of the sea and with the economic and demographic growth of Africa.

Passengers

Implementing the Corridor will significantly reduce rail travel time, and consequently increase frequency of train services on various international relations along the Corridor, therefore generating shifts from road or air to rail but also, as already mentioned, traffic induction.
The Corridor's full implementation would **increase rail shares** in particular for traffic between France and Spain (from 2% today to 12% in 2030) and between France and Italy (from 4% to 8%).
The table below summarizes the forecast for the whole market area:

Mode	2010	2030 Trend (do-nothing)	2030 Corridor implemented	Corridor gain with respect to do-nothing
Road	46,261	63,539	61,125	- 2,414
Rail	3,001	4,061	10,011	+ 5,950
Air	79,659	110,179	108,153	- 2,026
Total (except sea)	128,921	177,779	179,289	1,510
Rail share	2.3%	2.3%	5.6%	

Table 8 – Forecast for passengers (thousand pax)

Implementing the Corridor could thus increase the international rail traffic by nearly 6 million passengers/year in 2030. This increase would come from modal shifts from air (2 Mpax), modal shifts from road (2.4 Mpax) and traffic induction (1.5 Mpax). Rail share would go from 2.3% to 5.6% on the overall market area, which represents more than a doubling of the rail traffic with respect to the do-nothing scenario.

Conclusions drawn from the transport market Study

The implementation of the Mediterranean Corridor represents a major opportunity to **shift important volumes of freight from road to rail**, with a potential shifting of 40 million tons of goods from road to rail by 2030. Nevertheless, the realization of this objective needs a fully upgraded and interoperable infrastructure with adapted services and rail-road terminals.
Developing the Corridor will also lead to an increased competiveness of rail in the international passenger traffic, with a potential increase of 6 million passengers per year by 2030, 2 million of which shifted from air traffic. This would more than double the rail share.
The connections to the ports, including their hinterland link with RRTs and dry port, are a key element for the success of the Corridor.
The IWW can play an important role in the future for the Mediterranean Corridor, despite the current low traffic volumes. Especially by connecting major industrial zones to seaports, they could offer an interesting alternative to road or rail transport for certain types of goods.
The Corridor developments also likely to improve significantly the competiveness of rail for international passenger traffic, with a potential increase of 6 million passengers per year by 2030, 2 million of which shifted from air traffic.

The Corridor implementation will also have important effects for national and regional traffic, improving travel time on sections with strong national flows (Valencia – Barcelona, Nîmes – Montpellier - Perpignan, Lyon – Chambéry / Grenoble, Milano – Venezia - Trieste…) and creating opportunities for new performant regional services where congested nodes are relieved.

Capacity issues along the Mediterranean Corridor

The main problems relating to capacity and line saturation along the Corridor lie in the large urban areas and are summarised below.

- The realization of the new railway link **Lyon – Turin** aims at developing efficient passenger and freight services and contributing to modal shift from road to rail. Beyond the completion of the cross-border section including the 57 km base tunnel by 2030, the rest of the line needs to be implemented depending on the evolution of the passenger and freight traffic, in order to benefit fully from the capacity offered by the new base tunnel. There is an important reflection process going on, both on French and Italian side, in order to optimize phasing, effectiveness and costs of the access lines.

- The **Lyon node** is already critical today and its situation prevents any significant development of rail traffic coming from Spain or from the port of Marseille to northern Europe, Switzerland or to Italy. An alternative path to Switzerland or Italy might be available in the short term via the newly electrified line between Valence, Grenoble and Chambéry but with quite limited capacity.

- The **Turin Node** is an essential point of the national railway system, both concerning its function as a node for the HS/HC system and for the Turin-Lyon Corridor and its metropolitan mobility value. The planned interventions for the node, both infrastructural and technological, are essential in order to increase its capacity and enhance the intermodal integration. In particular, rail projects are foreseen in order to allow better track occupancy and increase the capacity of the node.

- The **Brescia-Verona-Venezia** rail section is affected by punctual capacity limitations due to traffic promiscuity and to the high existing transport volumes, expected to increase in the future

- In relation to **other urban nodes** (i.e. Madrid, Barcelona, Valencia, Marseille, Milano, Venice, Ljubljana, Zagreb and Budapest), bottlenecks exist due to the overlapping of different types of rail traffic (metropolitan, regional, long distance and freight). The planned investments are necessary to relax such constraints. For example, once all major generators are connected, there could be some capacity issues in the urban area of Barcelona, with about 100 – 150 freight trains per day on some sections having to share tracks with heavy commuter rail traffic; this issue would require a more in-depth analysis of local traffic.

- Regarding **Zagreb node**, the critical bottleneck is lack of capacity in the short – medium run, since the most intensive long-distance cargo and passenger transport takes place along this sector, as well as the most intensive suburban area in the Republic of Croatia. Barring any large and radical efforts, Zagreb railway node shall not have sufficient capabilities to receive planned increased railway transport (inner suburban passenger transport and local cargo transport, inbound or outbound long distance passenger and cargo transport, transit passenger and cargo transport). In response to the necessary measures, Study of framework possibilities of modernization of the node Zagreb is in preparation, in which HŽI planned to do conceptual design of solution of modernization of this railway line according to TSI and other EU regulation. This project was applied on 3rd CEF call.

- The need for a new line is also clear in the **central part of Slovenia**, where freight traffic could reach over 200 trains a day. Such traffic does not appear to be easily mixed with the passenger traffic in the Ljubljana area. In particular, Ljubljana ring road could be considered as the main bottleneck, suffering from capacity limitations especially during peak hours.

- Regarding Budapest node, main issues derive from the missing rail link between Budapest Liszt Ferenc International Airport and MED/OEM/R-D CNC railway lines, the limited capacity of the Southern Danube Railway Bridge and the missing North-Western section of the ring motorway M0 around Budapest.

- Between **Montpellier and Perpignan** capacity issues could become critical at the latest once all connections to Spanish seaports, industrial plants and the other logistic terminals will be upgraded at UIC gauge. The new line, beginning with a first section between Montpellier and Beziers, will become necessary to realize the potential demand of the Corridor, clearly aiming at a strong development of rail freight transport on this axis.

- Given the present traffic and its potential development, the upgrade of the line between **Divača** and **Koper** is an absolute priority: there are 82 trains/day on this single-track line, with an expected increase to and 142 trains per day by 2030. In light of this projected increased traffic, the Slovenian government has passed the bill to build a second rail between Koper and Divača that has already been confirmed by the public on the referendum in September 2017. The construction is set to begin in the end of 2017, while the project is expected to be finished by the end of year 2025. Studies for the construction of the second track on the line Koper – Divača have been recently finalised. A special purpose vehicle company (Second Track Koper- Divača - 2TDK) has been established which will act as a promoter of this initiative. The works are planned for implementation in the period 2017-2025 in support of the planned expansion of the port terminal infrastructure (960.1 € million).

The issues presented above, are being currently faced by Mediterranean Stakeholders and, in large majority, taken into due consideration in the definition of the Corridor Project list.

5 Project List Extension and Updates 2016 – 2017

The Mediterranean Project list represents the implementation plan of the Corridor, comprising all those interventions (hard and soft measures) needed in order to meet TEN-t requirements set by Reg. (EU) N° 1315/2013. In this respect, this chapter aims at summarising the content of the project list, showing general statistics about number and overall cost of planned interventions per MS.

Nonetheless, specific statistics on the most relevant project dimensions have been produced: i.e. identification of last mile, cross border and pre-identified projects, as well as identification of project breakdown per transport mode (rail, maritime, air, road, IWW, rail/road terminals). The time horizon for the implementation of the Project list is 2030, in order to match the project timing with the provision of Regulation (EU) N. 1315/2013. The Project list is analysed on the basis of its own main categories -i.e. mode of transport, cost classes, project typologies (i.e. bottlenecks, cross-borders and last-miles).

The Final project list is composed of 462 projects, whereas this overall amount does not take into account 23 cross corridor/horizontal projects, nor it does include 29 concluded projects.

The required funds for its implementation are approximately €104 billion. Nevertheless, it is worth mentioning that this overall amount shall be considered as underestimated, since there is no available information on the total costs for 41 out of 464 projects. The following figure presents the total number of projects and the associated cost per each project category.

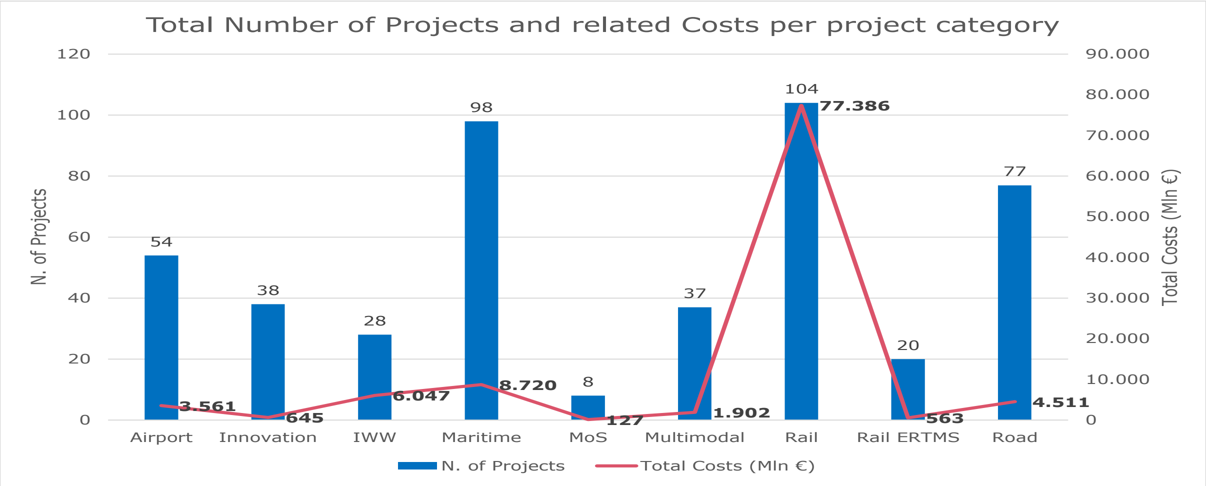

Figure 25: Total number of projects and related cost per each project category

Furthermore, the majority of interventions needed in order to meet TEN-T technical requirements are capital intensive, characterised by high investment costs (i.e. realisation of new railway lines, upgrading of technical parameters relevant for freight traffic, improving last mile connections etc.). Evaluations of projects per MS by total number of projects and associated costs (with the exclusion of cross border projects and multi-country ones) are presented below.

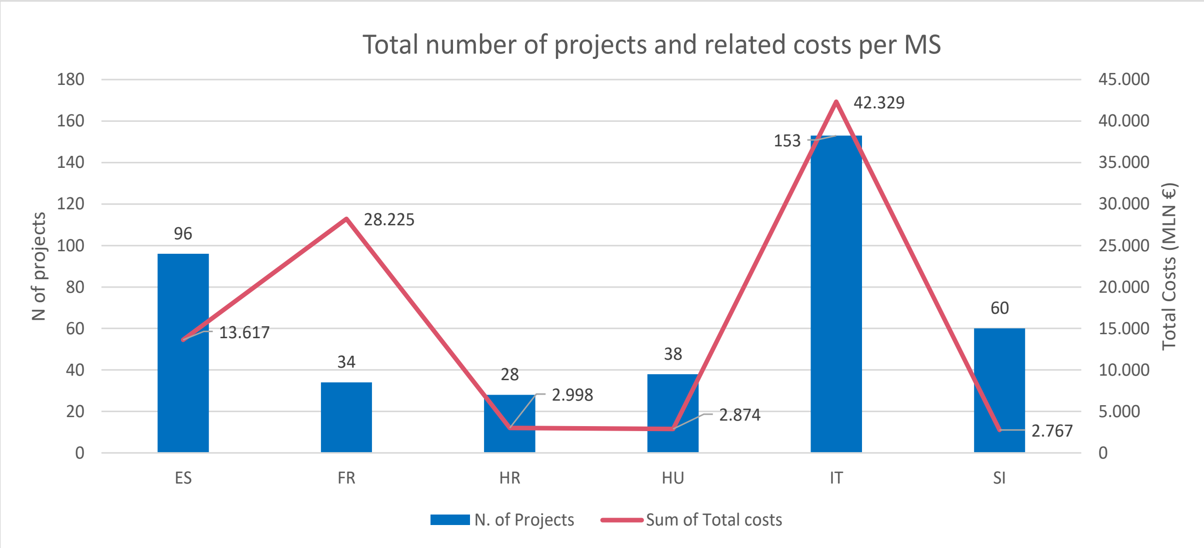

Figure 26: *Total number of projects and related cost per each MS*

After the update of the project list, Italy, France and Spain still record the highest costs (respectively, €42.3, €28.2 and €13.6 billion), while Hungary, Croatia and Slovenia follow with lower amounts. The repartition of costs and number of projects among MSs also reflects the different number of nodes belonging to each country, as set out in Annex II of Regulation (EU) N. 1316/2013, as well as the extension of the corridor within the State, in terms of km of road, rail and IWW sections.

The completion time represents a crucial factor for evaluating the maturity of projects belonging to the Mediterranean projects list: the large majority of projects (247 out of 462) will be completed by 2020, and this is especially valid for Maritime, Rail and Road projects (as clarified by the figure below). A significant bulk of projects (135) will be finalized by 2030, i.e. the longest time-horizon foreseen by the Regulation (EU) N. 1315/2013, except for airport rail connections.

Analysis per mode

5.1.1.1 Rail & RRT including ERTMS deployment plan

The analysis of the Project list regarding contributions to rail KPIs (electrification, track gauge, ERTMS, axle load, train length and line speed) shows a good progress to be expected possibly by 2030. Although the only KPI reaching full compliance is the electrification, positive results can be achieved in terms of:

- Track gauge 1435mm (90% in 2030);
- ERTMS implementation (77% in 2030);
- Axle load (>=22.5t) (84% in 2030);
- Train length (740m) (64% in 2030).

Looking to the rail big picture, it is possible to underline that the targets for 2030 will nearly tend to the full compliance. Nevertheless, although ERTMS implementation is the KPI with a higher progress, only 77% of the rail network will be equipped with this signaling system. Limitations to train length will penalize about 65% of the Corridor sections.

Rail KPI	Forecast 2030
Electrification	100%
Track gauge 1435mm	90%
ERTMS implementation	77%
Line speed>=100km/h	94%
Axle load (>=22.5t)	84%
Train length (740m)	64%

Table 9: Expected progress in the rail network until 2030

5.1.1.2 IWW & inland ports including RIS Deployment Plan

For inland waterways, the identified projects contribute to reach the full compliance for all the infrastructure requirements set by the Regulation

5.1.1.3 Maritime Ports & MoS

Bottlenecks identified for seaports will be solved by 2030. The provision of alternative fuels for maritime transport as well as the deployment of operational single window/e-maritime services in order to achieve interoperability will be further investigated in the coming months.
All inland ports will be connected by rail as required by the Regulation (EU) N 1315/2013. The connection by CEMT Class IV waterway will be achieved by projects solving this bottleneck by 2030.

5.1.1.4 Road transport (including ITS deployment)

The road network was already very near to the compliance for all countries in 2015, with the selected projects expected to increase the relative share of motorway/express road sections to 100% of the total Corridor length. Constant improvements seem yet to be a concern of the road infrastructure managers; therefore, some projects for this are presented in the Project list in terms of secure parking, availability of clean fuels as well as the deployment of intelligent transport system.

5.1.1.5 Airports

The connection of main airports with rail network is fundamental to achieve the intermodality objective set by the Regulation. In order to provide a detailed analysis of airports requirements (distinguishing for core and main airports) and airport projects, the following subparagraphs deal with issues related to current and expected connectivity of corridor airports.
Connection to road and rail network
The physical and technical parameter compliances of the airports situated on the MED corridor were analysed using the Regulation (EU) N° 1315/2013 as a benchmark. Particularly, articles 24, 26, 28 and 41 describe the conditions that need to be met by 2050.
A key condition to ensure interoperability of the airports is their connection to the railway network. This, together with the availability of clean fuels, are the KPIs that are taken into consideration in the Project List.
There are 17 core airports along the MED corridor (Sevilla, Malaga, Alicante, Valencia, Madrid, Barcelona, Marseille, Lyon, Turin, Milano Linate, Milano Malpensa, Milano Orio

al Serio, Bologna, Venice, Ljubljana, Zagreb, Budapest,). Out of these airports, six Airports (marked with *) are the main airports that have to be connected to TEN-T "heavy rail" (preferably the high-speed rail network) and road by 2050 according to Art. 41 of the Regulation.
The following table provides detailed information on current airport connectivity (both for connection with conventional rail and "heavy rail", when required) and on 2030 compliance.

- C = Compliant
- NC = Not compliant
- NR = Not required

Table 9 - Core airports of the Mediterranean corridor (rail connection)

Core airports	AS IS 2015			TO BE		
	Motorway/ Expressway connection	Conventional rail[14]	Heavy rail	Conventional rail by 2030	Heavy rail by 2050	Foreseen projects
Sevilla	C	**NC**	NA	**NC**	NA	-
Malaga	C	C	NR	C	NR	
Alicante	C	**NC**	NR	**NC**	NR	none
Valencia	C	**NC**	NR	**NC**	NR	none
Madrid*	C	C	**NC**	C	C	3863
Barcelona*	C	C	**NC**	C	C	3033
Marseille	C	C	NR	C	NR	
Lyon*	C	C	NR	C	C	
Turin	C	C	NR	C	NR	
Milano Linate*	C	**NC**	NR	NR	**NC**	none
Milano Malpensa*	compliant	compliant	**not compliant**	compliant	compliant	6812
Milano Orio al Serio	compliant	**not compliant**	not required	compliant	not required	6808
Bologna	compliant	compliant	not required	compliant	not required	3274, 1367
Venice	compliant	**not compliant**	not required	compliant	not required	1119

[14] "Conventional rail" includes conventional rail connection, long distance trains and people mover links. Heavy rail connection is expected by 2050 for "Main airports" only, according to the Art. 41.3 of Regulation (EU) N° 1315/2013.

Core airports	AS IS 2015 Motorway/ Expressway connection	Conventional rail[14]	Heavy rail	TO BE Conventional rail by 2030	Heavy rail by 2050	Foreseen projects
Ljubljana	compliant	**not compliant**	not required	**not compliant**	not required	none[15]
Zagreb	compliant	**not compliant**	not required	**not compliant**	not required	none
Budapest*	compliant	**not compliant**	**not compliant**	compliant	compliant	4424

** Main airport ex. Annex II Regulation (EU) 1315/2013*

As shown in the above table, out of the 6 main airports of the corridor, only one (Lyon) is currently considered compliant to the characteristics of "Main airports", according to Annex II of the Regulation (EU) N° 1315/2013,
For other Main airports, the following information can be summarized:

- **Madrid Barajas airport**: the airport is currently connected with conventional rail in one of its terminals but lacks of heavy rail connection. Project 3863 will provide the airport with high speed rail connection by 2030,

- **Barcelona airport**: the airport is currently connected with conventional line in one of its terminals (out of two) but has no connection to heavy rail. Project 3033 will extend conventional rail to the second terminal by 2030 but no project for connecting the airport to the high speed rail network is foreseen in the project list,

- **Milano Linate**: the airport is not currently provided with the connection with conventional and/or heavy rail. A project is foreseen to connect the airport by underground to be linked to the conventional rail line. No project is foreseen by 2050 for heavy rail connection.

- **Milano Malpensa**: the airport is connected by conventional rail from Milano with Ferrovie Nord and with Trenitalia (via Gallarate). Heavy rail connection, not currently provided, is expected to be compliant in 2050 by means on the realisation of the project 6812 ("Milano Malpensa Airport - South Access") aiming at establishing a new high speed railway connection between the airport and the high speed rail line Turin-Milan,

- **Budapest airport**: Budapest Liszt Ferenc International Airport is not connected to the main Hungarian railway network. The project "Connection of the railway line Budapest-Arad to the multi-modal hub at Budapest Airport" (ID 4424) is expected to eliminate this bottleneck. Compliance in this respect will be achieved by 2030. The airport is directly linked to common road section of

[15] Currently the railway connection to the airport will be subject to examination in the context of the development of regional routes, particularly linking Ljubljana - Kamnik with connection to the Ljubljana airport. Analysis is being performed to analyse the current status and review of the pre-made studies and technical solutions.
It is envisaged that the measures can be justified on the analysis of the current status, real and verifiable traffic needs and also taking into considerations the economics of the project.
Slovenia is following and will continue to follow the requirements of the EU Regulation regarding the development of the TEN-T network wherever possible, except when due to physical limitation such connection will not be possible (according to Article 41 of the Regulation (EU) N° 1315/2013).

OEM/R-D/MED CNC (M0 Eastern Section) via RN4 (2x2 traffic lanes). However, the capacity of the road connecting the airport directly to the city centre is inadequate (2x1 traffic lane), thus frequent congestions or accidents often hamper passengers to reach or leave the airport in due time. Urban public transport between the airport and city centre is assured by an express bus line and a Metro line (from Kőbánya-Kispest Metro Terminal station).

Clean fuel availability for aircraft
In terms of availability of clean fuels for aircraft, Mediterranean airports do not currently fulfil the KPI, as shown in the following table.

MS	Core airports	Current availability of clean fuels	Availability of clean fuels by 2030	Projects to meet 2030 compliance
ES	Sevilla	no	no	none
ES	Malaga	no	no	none
ES	Alicante	no	no	none
ES	Valencia	no	no	none
ES	Madrid*	no	no	none
ES	Barcelona*	no	no	none
FR	Marseille	no	no	none
FR	Lyon*	no	no	none
IT	Turin	no	no	none
IT	Milano Linate*	no	no	none
IT	Milano Malpensa*	no	no	none
IT	Milano Orio al Serio	no	no	none
IT	Bologna	no	no	none
IT	Venice	no	no	none
SI	Ljubljana	no	no	none
HR	Zagreb	no	no	none
HU	Budapest*	no	no	none

Table 10: Core airports of the Mediterranean corridor (clean fuels availability)

*stands for Main airport ex. Annex II Reg 1315/2013
As shown above, the 17 airports of the corridor are not currently equipped for providing clean fuel to aircraft and this situation will not probably change by 2030, since no project for ensuring clean fuels availability has been submitted for the project list.
This situation for the airports is an example of domains where "missing projects" can be identified and where infrastructure gaps exist in corridor development plans.

5.1.1.6 Urban nodes

Please see chapter 5.

6 Mapping of projects

Methodology

The mapping of investments has been based on the analysis of common defined KPIs, the projects' data previously gathered and the relative analysis carried out concerning the update of the Work Plan.

The suggested methodology is based on the evaluation of all the projects and their 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). This methodology enables both quantitative and qualitative criteria to be considered resulting in a final project score. However, it should be emphasised that the MCA does not provide a definitive solution, but rather a rational and structured basis to guide decision-making. The application of the MCA ensures that the economic characteristics of the project are not the only rating criterion, while other critical aspects, such as regional cohesion, environmental impacts, policy, etc. can also be considered. The MCA provides a logical approach, where any criteria (both quantitative and qualitative) and their relative importance can be taken into account.

The analysis will evaluate two main aspects:

- **Project maturity:** analysed by assessing the level of progress ("not started" / "in progress" / "concluded") on specific project steps, such as (1) Planning stage / pre-feasibility studies / Strategic Environmental Assessment (SEA) (2) Preliminary project analysis/ Feasibility studies (3) Environmental Impact Assessment (EIA) / Detailed Design / Detailed Implementation Plan / Administrative Permits and Licences.
- **Project relevance:** basically related to the purpose of the intervention and its capacity to meet **TEN-t and EU** priorities, as set by Regulation (UE) N. 1315/2013 and 1316/2013 (reflected by the technical parameter and bottlenecks tackled by the intervention).

The above-mentioned criteria have been evaluated through the analysis of data currently available in each CNC Project list. Furthermore, it shall be underlined that already completed projects as well as projects only dealing with studies have been excluded from this assessment.

Results

The following section summarises the project mapping analysis.

The figure below indicates the overall mapping of the 415 work-related projects. As explained in the methodology above, the 49 actions involving only a study were not included in the analysis.

It is evident from the pie chart that the great majority of the projects falls in the high end of the mapping, i.e. the range in which values assigned to each action span from 0.51 to 1. Furthermore **the total number of projects mapping a full 1** is 59 clearly reflecting the importance of the MED CNC project list. In order to implement the projects within the highest ranking cluster, an amount of €38 billion is necessary, equivalent to 33% of the total cost required for the implantation of the MED CNC project list.

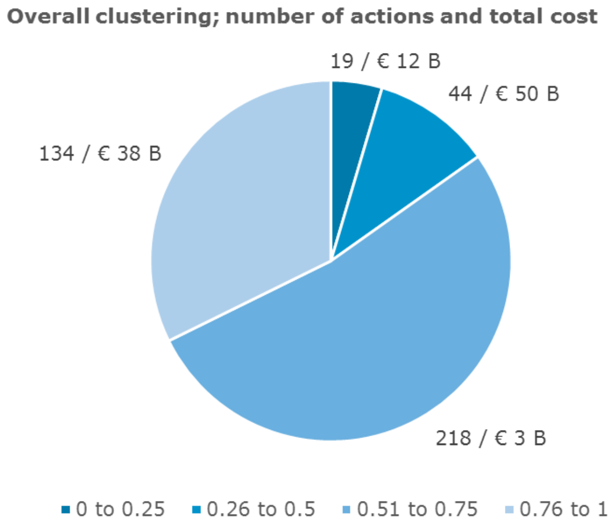

Figure 27: Overall mapping of Mediterranean corridor projects

Here below details on the breakdown per transport mode is provided. From the graph, it is evident that Rail and ERTMS projects, which are the priority at European level, have a very high ratio. Among the categories with a ratio higher than the mean, there are also Innovation, IWW and Maritime projects, reflecting their importance in terms of positive impact on the environmental sustainability.

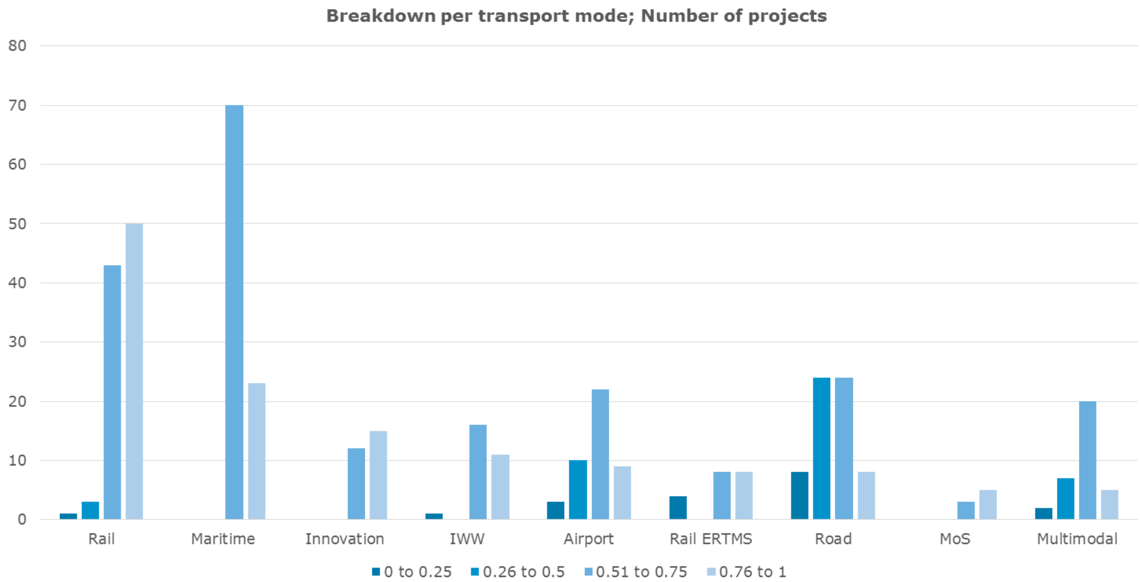

Figure 28: Mediterranean projects mapping: breakdown per transport mode

Since the mapping exercise is the result of two different indicators, namely relevance and maturity, a more in-depth look into the singular mapping of these two indicators is hereby provided.

Figure 29 illustrates, in the same way used for the overall mapping, the number of projects falling into each one of the clusters: this time though, the only value accounting for the mapping is the maturity.

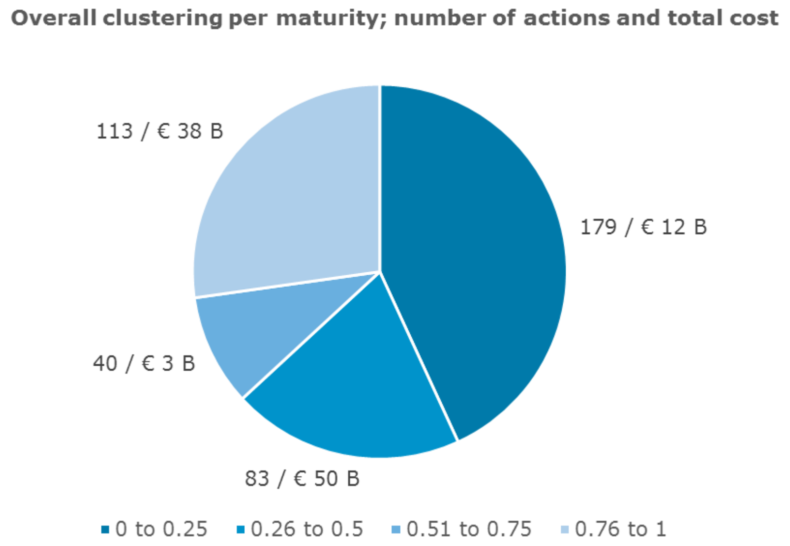

Figure 29: Mapping of MED projects per maturity

The results, as presented in the pie charts, are not in line with the overall mapping proposed in the previous page. This is due to the fact that the project maturity only accounts for the 40% of the overall mapping, hence the impact of the maturity indicator could not be enough weighed to be reflected as a trend in the overall mapping.

The breakdown per modal category is presented in Figure 30, with rail (including for the purpose o this calculation also rail ERTMS) accounting for the greatest share of mature actions: out of a total of 117 actions, 41 score between 0.76 and one full point, of which 25 score a full 1.

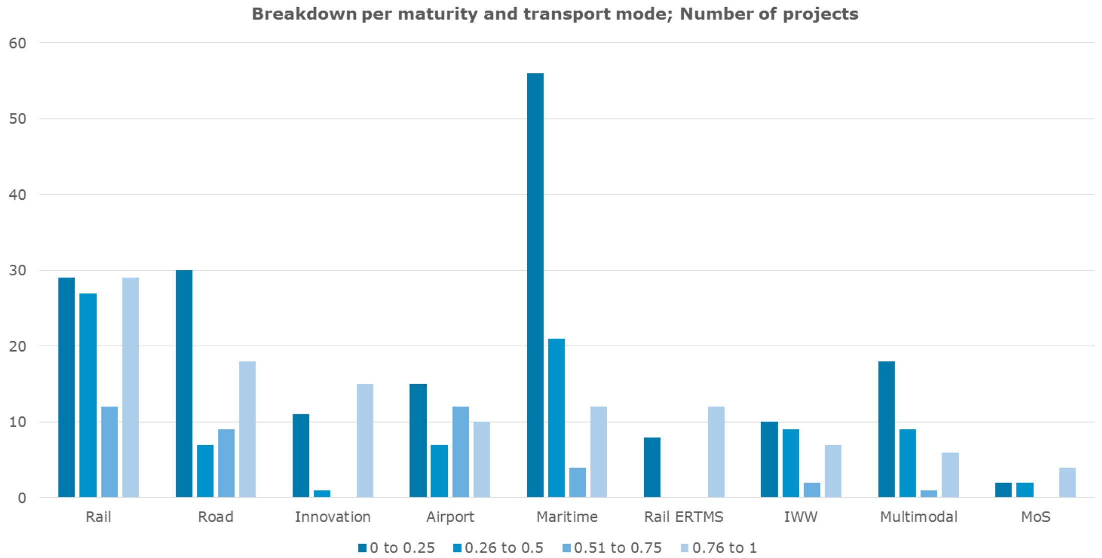

Figure 30: Breakdown of overall mapping per maturity indicator and transport mode

Concerning the relevance indicator, which determines 60% of the overall mapping, the figure below illustrates in the usual way the distribution of actions among the 4 clusters.

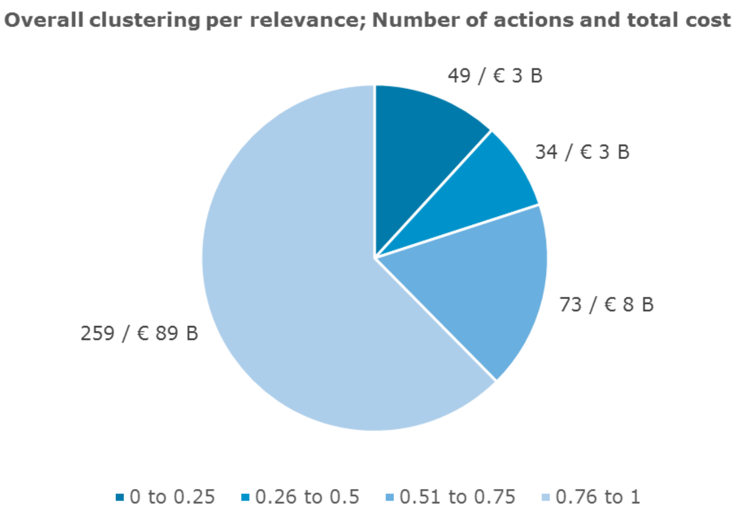

Figure 31: Breakdown of overall mapping per relevance indicator

As already mentioned, relevance is the more important criterion taken into consideration when doing the mapping analysis: this assumption is easily verifiable as the trend here is much more similar to the overall one. As previously done for the maturity indicator, Figure 32 below indicates the modal share of the entire set of 415 actions.

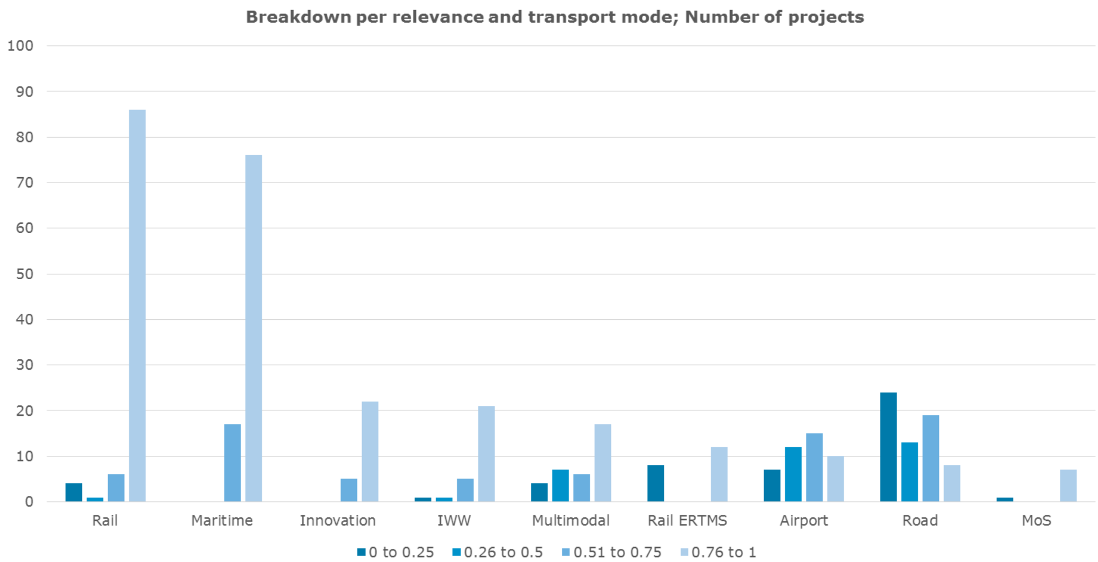

Figure 32: MED projects mapping: breakdown per transport mode, relevance indicator and number of projects

Focus on maturity: possible delays on the completion of the works

Venezia-Trieste rail line

The original 2010 AV / AC project with the full variant track included an investment of € 772 million for the first tranche - 10 kilometers between Mestre and the airport. From Marco Polo to Portogruaro, 61.5 kilometers, the expected cost was € 2,683 million. In Friuli Venezia Giulia, the estimated value of the investment was nearly four billion: 2,246 for Portogruaro-Ronchi and 1,745 for the Ronchi dei Legionari - Trieste. A total of about 7.5 billion euros.
According to the needs expressed by the Government, RFI has therefore studied a "speedying" solution of the current line, based on few variants of the track and a technological modernization of the entire line, of the estimated cost of 1.8 billion Euros. The intervention is capable of eliminating singular points and paths that affect the overall performance level of the line, with phase-realization.
In addition, the latest generation technology systems will be installed for the safe management and control of rail traffic, which will improve the performance of rail transport companies.
In detail, the interventions are broken down as follows:

- Suppression of 18 level crossing in Veneto
- Suppressing 7 level crossing in Friuli Venezia Giulia
- Variant of Portogruaro
- Extended Latisana version of 4 km including new deck on Tagliamento
- Ponte Isonzo variant
- Ronchi-Aurisina variant (20 kilometers)
- Technological adjustments
- Infrastructure intervention to increase the axial maximum load of the line, in favor of freight traffic

These operations will allow for a speed of 200km / h with a 65' journey time on the Venice - Trieste route (against a cost of 7.5 billion euros and a journey time of 55').
The project "Enhancement Venice - Trieste" is included in the existing RFI Program and the Ministry of Infrastructure and Transport, with a total cost of 1,800 million Euro, of which 200 million Euros are available for the design of the interventions and the realization of a first phase of the same.
The interventions can be carried out by phases also in order to facilitate the financing and to work while the line is operating, and have been articulated in the following time scenarios:

1. **Short-term interventions**. Interventions financed by the Decree "Sblocca Italia" and already being implemented (timely interventions on track geometry and civil works, TE adjustments and IS modifications)

2. **Medium-term interventions.** Trajectory variations in Portogruaro, Latisana and Isonzo river, upgrading the Latisana plant, technological enhancement and suppression n. 21 level steps;

3. **Long-term interventions:**

   Realization of new AV / AC line between Ronchi and Aurisina (1st phase - Bivio S.Polo - Aurisina section, including interconnection with the historical line and the variant Gorizia - Trieste line)
   Restoration of the "line of bivouacs": Interventions at the Monfalcone and Quarto d'Altino / Portogruaro plants
4. **Further long-term phase**

Fourth track on Ronchi - Bivio S. Polo (2nd Phase of the new AV / AC Ronchi - Aurisina line).
This project review framework does not exclude the possible, future doubling of the historic line, or the high speed itself, which could be programmed following the saturation of the current line.
To this end, in the current Program Agreement between RFI and the Ministry of Infrastructure and Transport, the projects "New AV / AC Venice - Trieste: Venezia - Ronchi dei Legionari" and "Nuova AV / AC Venice - Trieste: Ronchi dei Legionari - Trieste", are included among the programmatic interventions, that is to start beyond the horizon of the Plan (Section 4 - Financial Needs beyond the Plan)

Montpellier Perpignan rail line

In France, most of the projects experiencing delays have been labelled as "second priorities", meaning that they will be implemented after 2030, in the framework of the national plan *Mobilité 21,* that was issued in 2013.
This plan confronted total projects costs with financial capacity of the State and Regions, and shifted priorities to "everyday mobility" (local and regional transport) so that several projects, especially long-distance and high-speed rail, were programmed to be implemented after 2030. The *Mobilité 21* plan is expected to be updated in the beginning of 2018, after an important public debate and the relative consultation process, called "assises de la Mobilité", which has been launched by the prime Minister and the Minister of transports on September 19th. and is going to last until December.
No major shift in priorities is expected after this debate and "everyday mobility" should remain the major theme. Focus will be put on innovation, digitalization and decarbonisation of transport. The outcome of the process should be a programming law in spring 2018, detailing and securing pluri-annual funding for the selected investment projects in the next 5-10 years.
The new train line between Montpellier and Perpignan is covered by project 3099 on the Mediterranean CNC Project List[16]: this project has been considered as "second priority" in the *Mobilité 21* plan, although the possibility that some of the works might start before 2030 exists. In the meantime, project-phasing has been clarified and the first section will be a mixed freight and passenger line between Montpellier and Beziers. This first section might be implemented around 2030; the exact dat of the implementation will be clarified in the upcoming programming law.

[16] Name of the project: "New railway line between Montpellier and Perpignan (LNMP)"

7 Summary of the accomplished actions

The following figures give a view on the totality of MED accomplished actions in the period 2014-2016, under both the total number of projects and the total investment per mode.

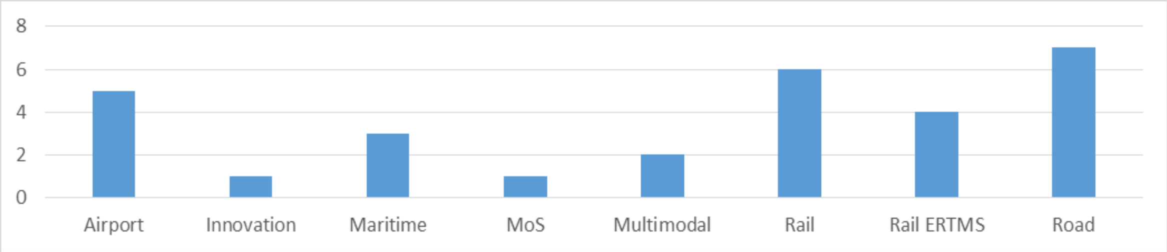

Figure 33 – Accomplished MED projects – Total number of actions

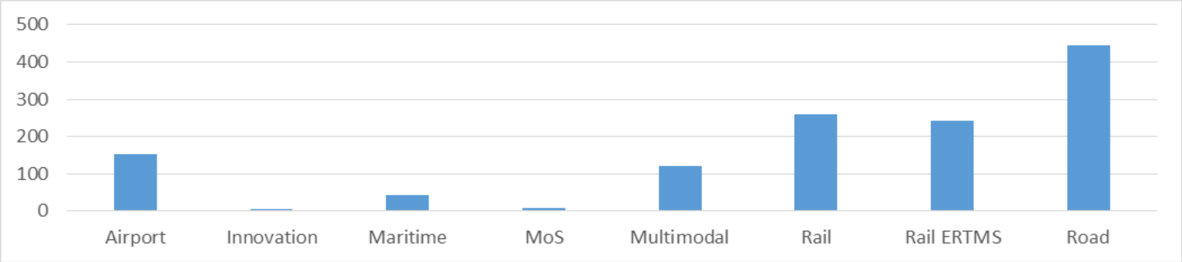

Figure 34 - Accomplished MED projects – Total cost in million €

Here follows a focus on two of the most significant completed projects, including details on the modal category, timing and financing.

Reconstruction of the existing line on the section Divača-Koper

The railway line is used for passenger transport between the coast and the hinterland and is an important transport route for the import of goods and source material and for the export of goods produced by Slovenian companies. With the improvement of the line's capacity, the project will bring most benefit to the users of the railway infrastructure, as it will provide fluent freight flows from and to the port of Koper.The transfer of goods transport from road to rail will have a positive impact on the environmental and increase traffic safety. The modernised railway line will also contribute to interoperability.

Project Category: Rail

Country: Slovenia

Project end date: 01/01/2016

Total Cost: 194 million Euro

MXPT2 (Railink)-UP

Rail accessibility to Malpensa airport had an important improvement following the 2017 connection between Terminal 1 and Terminal 2, which has made it possible to significantly expand the potential user base. Over 6 million passengers a year now find rail services to reach the T2 economically more advantageous compared to other modes of transport.

The project consists of the construction of the rail link between Terminal 1 and Terminal 2 of Malpensa. The design of the project is divided into two lots:

- lot 1 concerning the construction of the underground railway station;

- lot 2 concerning the continuation of the railway line for approximately 3.4 km long double-track tunnel and trench, and includes the design of railway facilities all along the railway link and within the T2 station.

Project Category: Airport

Country: Italy

Project end date: 01/09/2016

Total Cost: 115 million Euro

8 Identification of projects financing tools for the MED Corridor

The Connecting Europe Facility (CEF Transport) supports Trans- European networks and infrastructures in the sectors of transport, telecommunications and energy. Under the CEF, € 26.25 billion are made available from the EU's 2014-2020 budget to co-fund TEN-T projects in the EU Member States (of which €11.3 billion is earmarked from the Cohesion Fund and therefore applies to eligible Member States only).

From a transport point of view, besides allocating part of its budget to the CEF for the development of the TEN-T transport networks, the Cohesion Fund supports transport projects which clearly benefit the environment and/or develop and rehabilitate comprehensive, high quality and interoperable railway systems, and promote noise-reduction measures. Under this context, the projects listed in the Mediterranean project list have benefited from the results of the latest 2015 CEF call.

Definition of the methodology

The analysis aims to identify the funding sources of projects listed within the MED WP pipelines. The rationale behind this is to leverage the information provided in the project list and determine the presence of funding gaps and the potential for other-than-public-grants forms of support.

Before the analysis was performed, the data was reviewed and corrected. Once the data was cleaned and unique categories of funding sources names for all the projects were defined, the analysis could be performed.

To summarize, it was necessary to cluster the funding sources used to cover investment costs, linking every recurring funding source name to a specific pre-determined tag:

- *Macro-level tag*: in which the different "funding sources" were related to macro categories (i.e. MS/ public; EU; Private/own resources),
- *Detailed tag*: where, specifically for the EU support, a further break down was made to categorise the EU funding sources (i.e. CEF, ESIFs and Other/unspecified),
- *Data analysis*: once the data was cleaned and the categories of funding sources names for all the projects were given in a unique way, the analysis was performed, following a specific procedure,
- *Identification of the overall investment requirement for the CNC WP:* summing up all the investments costs of each project on the Corridor,
- *Identification of the share of investments for the analyses' elaboration:* taking into account only the projects that presented complete information (total cost equals to the sum of the amounts listed in the funding sources),
- Analysis *of the funding sources identified to cover the investment cost:* considering the "potential" and "approved" share of funding and identifying the EU funding already approved;
- *Application of the ratios to the overall investment cost:* carried out to assess if the EU share of the investment costs of the whole Corridor WP can be financially sustained by the identified sources, keeping fixed the rate of the EU grants approved.

Comments on the results for the MED Corridor

The MED Corridor is composed of 433 projects[17], accounting for a total of € 103 billion. Of these, 90 projects, 21% of the total, present complete financial information and hence are eligible for the analysis. The corresponding amount, approx. € 6.8 billion, is divided in the following financial sources:

- *MS/ Public grants*: €2.6 billion, or 39% of the total,
- *EU Grants (CEF, ESIF)*: about €2.2 billion, or 32% of the total,
- *Private/own resources:* nearly €1.9 billion, or 28% of the total,
- *EIB/Bank loan & others:* about €0.1 billion, or 2% of the total.

The EU grants share of the total is further divided in subcategories related to their origin:

- CEF/ Ten-T: €1,7 billion, or 76% of the total,
- ESIF: €0,3 billion, or 17% of the total,
- Other: €0.1 billion, or 7% of the total.closing

This analysis is further broken down considering the "potential" and "approved" share of funding, when available (e.g. when not specified, funding has been considered as potential).

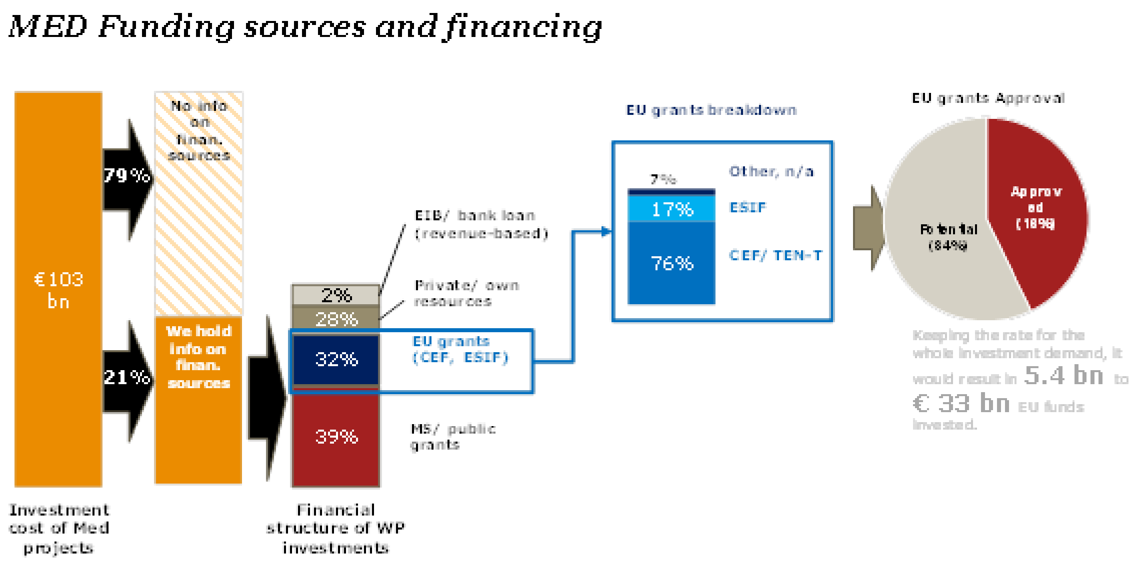

Figure 35: MED Corridor funding sources and financing

Approved funding accounts for almost 42% of the total, while the remaining 58% of the total is still potential.

The results of the analysis show that fixing the rate to 42% throughout the whole investment demand, would result in €13.7 B-€32.3 B of EU funds deployed. The inclusion of private investors and the use of financing (properly favoured through financial instruments, when necessary) can strongly contribute to providing the resources the market needs.

[17] Study-only interventions were excluded from the analysis.

Mediterranean Corridor financial sustainability assessment

Following the analysis of financially sustainable projects in the Mediterranean Corridor list, 152 projects (or 35%) resulted not financially sustainable, 172 (or 40%) potentially financially sustainable and 109 (or 25%) financially sustainable.[18]

The total value of the financially sustainable projects is € 41 B, therefore implying that if 15% of CAPEX was financed with private capital/loans, the reduction in grand expenditure would be equal to € 6.1 billion.

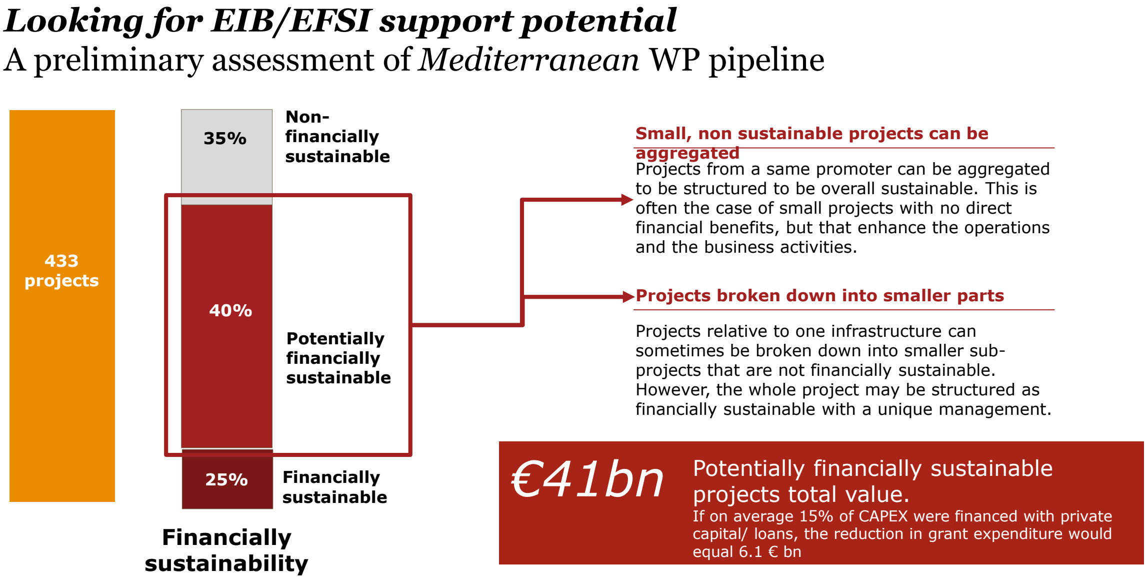

Figure 36: Mediterranean Corridor analysis of financial sustainability of projects

[18] Please note that as for the previous analysis studies-only interventions were not considered within the analysis.

9 Wider Elements

Innovation

The main objective of this task was to analyse how the projects part of the Mediterranean project list contribute to the deployment of innovation projects in the corridor.

In order to ensure that the evaluation is done in a consistent way across all CNCs, a common methodology was developed by the representatives of all corridors. A series of web meetings were held over a period of four months to encourage the exchange of ideas and refinement of the methodology. This common methodology was agreed upon and shared with DG MOVE.

The Mediterranean project list contains **a total of 129 projects that can be considered as innovation projects** according to the Regulation (EU) N. 1315/2013. The following figure shows the total number of innovation projects affecting the Mediterranean corridor and their associated cost, when available:

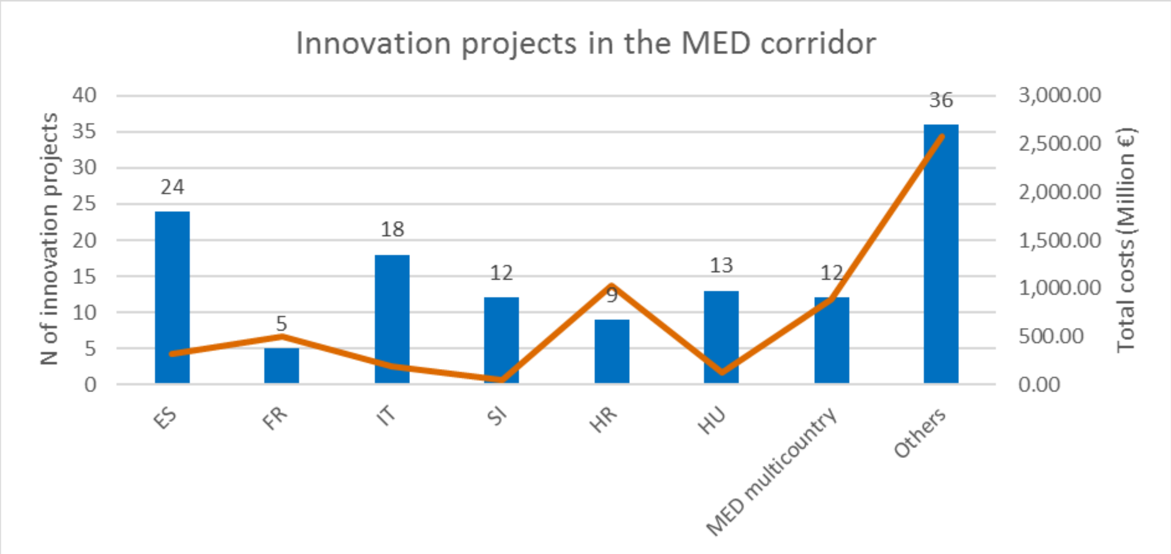

Figure 37 - Number of innovation projects

The gap analysis is aimed at identifying those innovation areas or objectives set by the Issues Papers not covered by the projects in the list of the Mediterranean Corridor. In order to do so, a set of innovation categories were defined using the content of Articles 31, 32 and 33 of Regulation (EU) N. 1315/2013 as a guideline:

- Telematic applications,
- Sustainable freight transport services,
- Other new technologies and innovation.

It is important to notice that most innovation projects do not contribute to a single innovation category but several at the same time.

The assessment of the innovation projects in the project list was undertaken by analysing a series of common features. This section summarises those features and the main results obtained.

9.1.1.1 Type of innovation

Innovations have been divided in three different types for the purposes of this study:

- Catch-up innovations
- Incremental innovations
- Radical innovations

Catch-up innovations mostly refer to initiatives that are directly transposed or transferred from other sectors or regions where they had already been implemented.
Incremental innovations are those that provide additional functions, applications or improvements to an existing idea.
Radical innovations can occur through the introduction of new technologies or procedures that can generate a step-change and provide unexplored solutions.

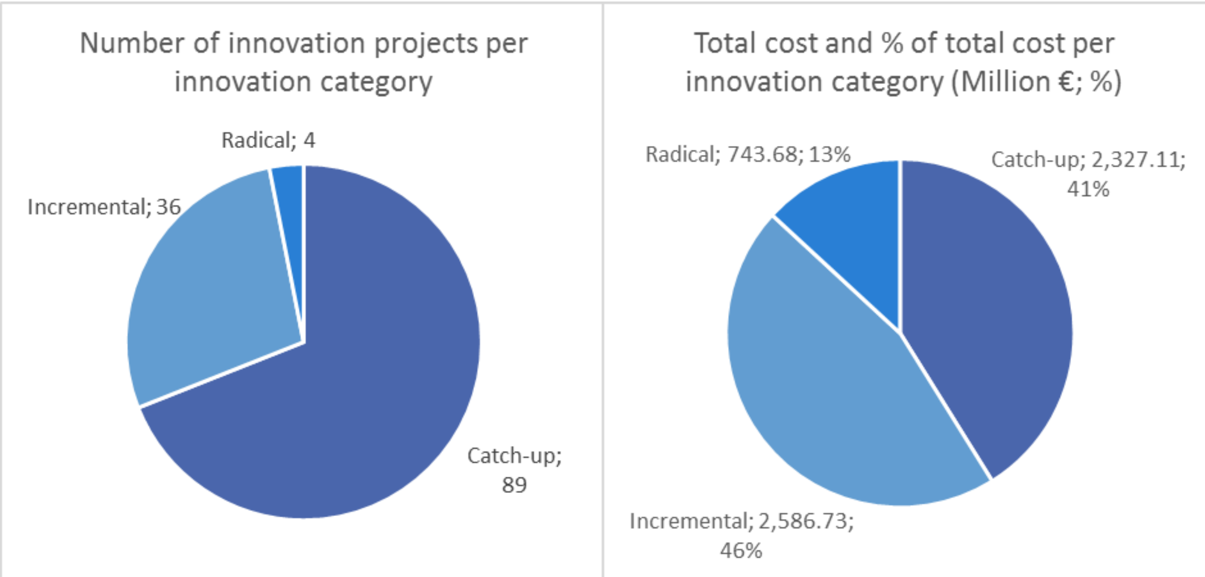

Figure 38: Number of innovation projects and total cost per innovation category

As shown in the figure above, the majority of innovative projects in the project list are classified as catch-up innovations: a total of 89 projects out of 129. The number of incremental and radical innovations projects is 36 and 4, respectively.
From Figure 38, it is clear that incremental and radical innovations have a higher average cost per project than catch-up innovations.
The following table highlights the radical innovation projects developed in the Mediterranean corridor:

Table 11: List of radical innovations in the MED corridor

ID	Project title	Project promoter	Project description	MS	Cost (M€)
3871	Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)	Fundación Valenciaport	The Action prepares engineering studies, engineering plans, construction drawings of 4 LNG retrofitted prototype vessels, 7 LNG bunkering stations at core ports (5 prototype stations in Koper, Genova, La Spezia, Livorno, Venezia, and 2 fully operational LNG break-bulking stations in Nantes-St Nazaire, and Fos-Marseille). The Action is part of the GAINN Global Project. Activities: Final engineering projects of prototypes and pilots; Prototyping; Real life trials and pilots; Building two LNG break-bulking stations in Nantes-St Nazaire and Fos-Marseille; Communication and coordination. Successful completion of the Action will advance the Global project, and will act as leverage for launching other mature, technically and socioeconomically viable implementation actions for LNG bunkering in the Mediterranean by 202	ES/ FR/ HR/ IT/ PT/ SI	41.37
7060	LNG Technologies and Innovation for Maritime Transport for the Promotion of Sustainability, Multimodality and the Efficiency of the Network (GAINN 4 SHIP INNOVATION)	Fundación Valenciaport	Retrofit a high-speed craft (HSC) ropax vessel so that it will be fuelled by a mix of 75% LNG and 25% diesel. The prototype will be the first case in the world of a retrofitted HSC ropax vessel that maintains all the features needed in the liner service where the ship is deployed whilst increasing service quality	ES	15.03
NEW-2017	Joint Application for PDP Implementation	SDM	The project entails 13 initiatives under AF1 "Extended Arrival Management (AMAN) and	Multicountry	643.80

ID	Project title	Project promoter	Project description	MS	Cost (M€)
	- Cluster 1		Performance Based Navigation (PBN)" and 14 initiatives under AF5 "System Wide Information Management (SWIM)"		
3887	STM_MONALISA 3.0 - STM Validation Project	Swedish Maritime Administration	Further test and validate the concept of Sea Traffic Management (STM). This pilot action with wider benefits, will impact all core corridors. It is part of a larger project aiming at ensuring successful deployment of STM. The following activities will be implemented: Voyage Management; Flow Management and Port Collaborative Decision Making. The validation will be carried out through test-beds	Multicountry	43.48

Projects 3871 and 7060 are considered to be radical innovations since both of them entail the development of LNG retrofitted prototype vessels, hence contributing to the development of a totally new product, despite applying a known and tested fuel technology.
The other two projects deal with the testing of new traffic management or navigation functions. These can be classified as radical innovations as they are not fully developed, tested and deployed yet.

9.1.1.2 Impact

Since the impact of a given innovation can be wide, a set of generic measures were established to ensure homogeneity in the analysis across projects and TEN-T corridors. These impact type were inferred from the scope of the project provided by the project description.
The following table summarises how many innovation projects can be expected to generate each type of impact:

Table 12: Number of innovation projects attached to each type of impact

Impact type	Number of innovation projects with this impact expected
Transport digitalisation	62
Safety improvement	51
Transport decarbonisation	54
Transport efficiency improvement through data sharing	68
Contribution to development of European technological industry	63
Others	8

The number of innovation projects generating each type of impact is fairly balanced. Transport efficiency through data sharing is the most frequent result, closely followed by contribution to the development of the European technology industry and transport digitalisation.
A small selection of projects is attached other relevant results such as data harmonization, rail infrastructure compatibility in cross border sections, dissemination of good practices or increase in airspace capacity. The latter is relevant for some SESAR-related projects.
As shown below, about 70% of innovation projects are expected to generate more than one of the types of impact in the list. In particular, 25% of those projects contribute to four different impacts simultaneously.

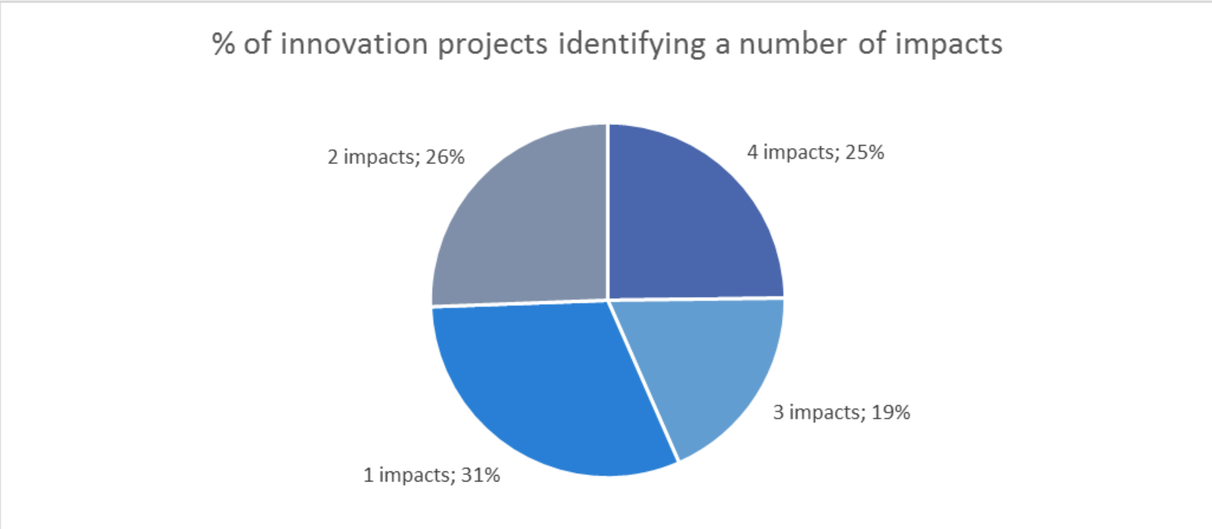

Figure 39: Percentage of innovation projects with one or more impacts expected

9.1.1.3 Barriers and enablers

A set of barriers and enablers were defined as a way to identify the main reasons hindering or facilitating the deployment or the market uptake of innovations in the corridor. It is worth saying that the selection of each of these elements is highly dependent on the level of detail provided by each project description and also subject to a certain degree of subjectivity.
The set of **barriers** analysed are the following:

- Insufficient standardisation and regulation,
- High investment costs,
- Lack of sufficient public funding support.

Judging whether high investment costs is a barrier or not is particularly challenging since there is no standard definition of when an investment can be said to be high. This is something that cannot be directly inferred from the project cost and rather it depends on the relative perception of that cost, influenced by elements such as the financial strength of the project promoter or the number of entities involved in the project.
For example, a project requiring a great level of investment that is shared amongst a large number of entities or promoters might not perceive high investment cost as a

barrier. However, another project with the same numeric cost but promoted by a single entity subject to budgetary constraints might find the cost as the main barrier for the development of the project. For this reason, it is important to mention that this part of the analysis was built on the consultants' local knowledge of the projects and their professional judgement.

In relation to the lack of sufficient public funding support, the analysis has been systematised by selecting this barrier for the cases in which the project information does not specify potential or committed funding from either national budgets, CEF calls or other non-own sources.

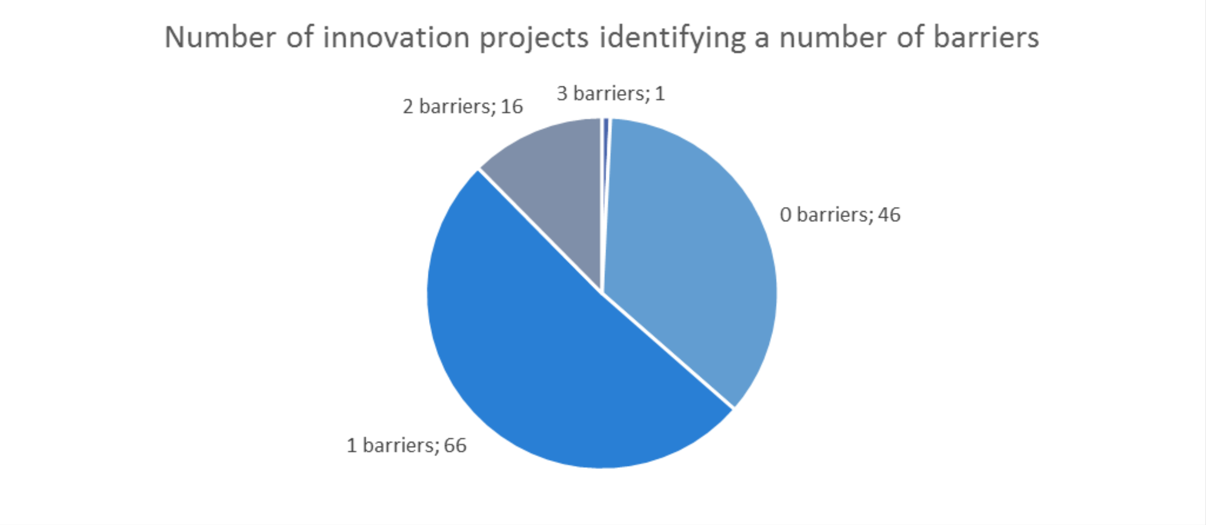

Figure 40: Number of innovation projects with a varying number of barriers

High investment costs is the most frequent barrier (cited in 54 innovation projects) followed by the lack of sufficient public support and insufficient standardisation and regulation. From the 129 innovation projects in the Mediterranean project list, a total of 29 does not have either awarded or expected funding from a public source, which represent 22% of the innovations.

In contrast, as suggested by the figure above a total of 46 innovation projects are not considered to be affected by any of the pre-identified barriers, whereas a total of 66 (representing more than 50% of the total) are affected by one of them. In some cases several barriers are associated with the same project: 16 projects present two barriers and 1 project three barriers at the same time.

Similarly, a set of **enablers** were defined to identify the most common factors facilitating the deployment of innovative projects in the corridor:

- Research and industrial sectors coordination
- Joint initiative from the Transport and Energy sectors
- Existing public/private funding for real implementation of the innovation idea

Research and industrial sector coordination is a particularly relevant enabler because it tackles one of the reasons why some innovations are not adopted by the market: the so-called death-valley risk. A joint initiative from the research and industrial communities ensures that the innovation is led by a market or industrial interest, hence increasing the probability of the innovation to mature and reach full deployment stage.

Similarly, a joint initiative from both the transport and energy sector may tackle more effectively carbon reduction or the introduction of alternative fuels. This is the reason why this factor is considered another important enabler to be taken into account.

Funding availability is a more evident enabler of innovation deployment but not less important than the other two in the list. The following graph shows the number of innovation projects benefited by zero, one or more than one enabler:

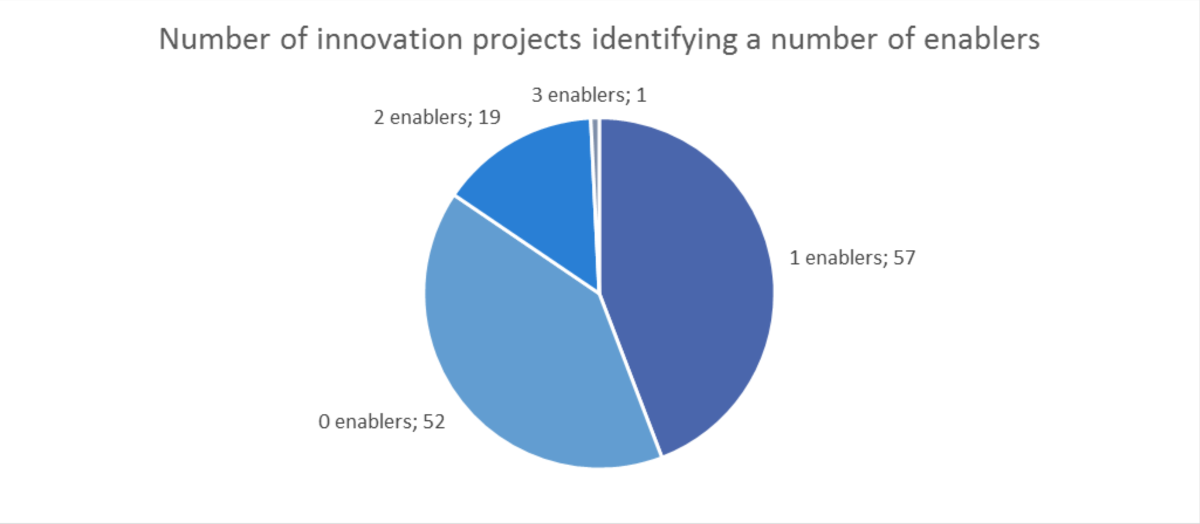

Figure 41: Number of innovation projects with a varying number of enablers

Existing public or private funding is the most frequent enabler (cited in 65 innovation projects) followed by research and industrial sector coordination and joint initiative from the transport and energy sector.

Diagram in shows that a total of 52 innovation projects are not benefited by any of the pre-identified enablers. Contrarily, there are 57 innovation projects benefited by one enabler only, 19 projects boosted by 2 enablers and 1 project affected by all 3 enablers at the same time.

9.1.1.4 Scalability and transferability

Scalability refers to the capacity to *do more* with a given product or innovation. For example, investments in physical infrastructure are usually not scalable, in the sense that adding capacity or *features* requires massive new investments. On the other hand, investments in control systems or intelligent transport systems usually present some scalability, as small investments may allow to better exploit the opportunities these systems bring.

The following diagram shows that 69% of innovation projects are considered to be scalable.

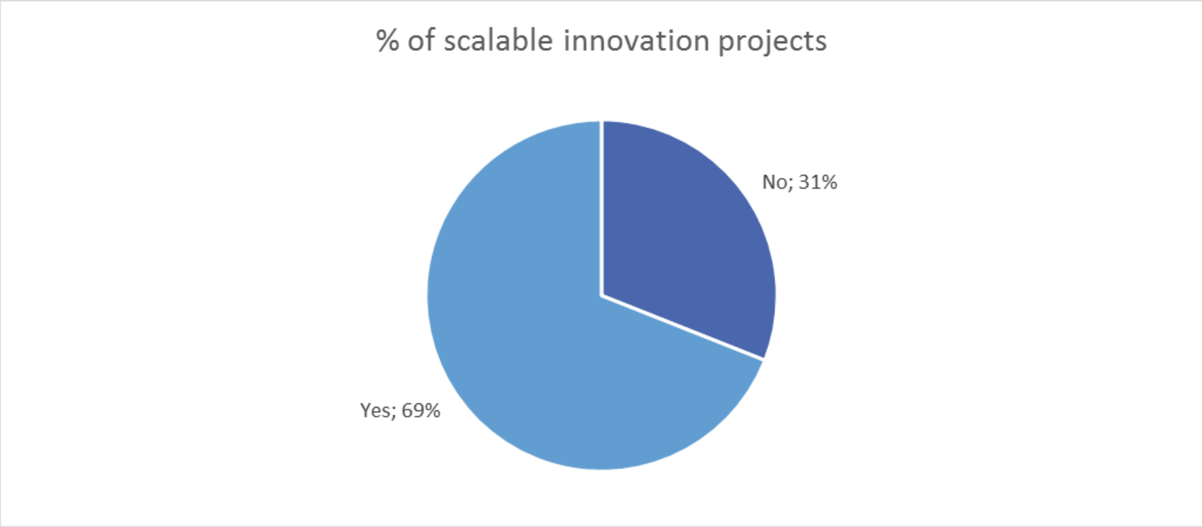

Figure 42: Percentage of scalable innovation projects

Transferability refers to the capacity to apply the outcomes and technical skills of one project in different locations. In general, skills in projects which address very specific local problems or that exploit local circumstances are difficult to transfer to other locations. For example, investments on technologies with high levels of standardization – e.g. electric vehicles – are usually highly transferable, while investments strongly related to specific business models or conditions usually have a lower level of transferability.

9.1.1.5 Contribution to decarbonisation

The contribution of innovations to transport decarbonisation is one of the key elements of this analysis. It complements the assessment of the overall contribution of the corridor to transport greening and climate change abatement.
To some extent, many projects may contribute to transport decarbonisation. However, the aim of this analysis was to identify those projects with a direct or larger contribution. In particular, the contribution of innovation projects has been evaluated in terms of:

- The deployment or facilitation of alternative fuels (electricity or hydrogen)
- The deployment or facilitation of alternative fuels (natural gas or biofuels)
- Efficiency improvement in propulsion technologies
- Modal shift, in particular through the introduction of innovative transport services such as MoS (Motorways of the Seas), rolling highways, etc.

The following diagrams show the percentage of innovation projects contributing to decarbonisation and the type of decarbonisation from those contributing to it.

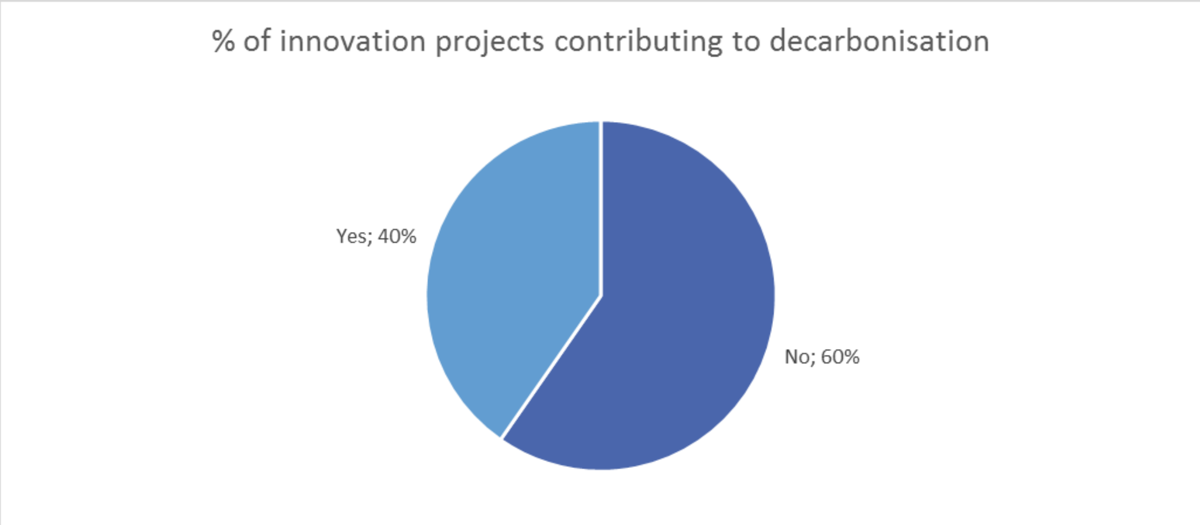

Figure 43: Percentage of innovation projects contributing to decarbonisation directly

The figure above shows that only 40% of innovation projects (i.e. 52 projects) have a direct contribution to transport decarbonisation. It is worth saying that thoese figures only represent those projects that are considered to have a direct impact on transport decarbonisation but there are many other that also contribute to a lesser extent or in a less evident way.

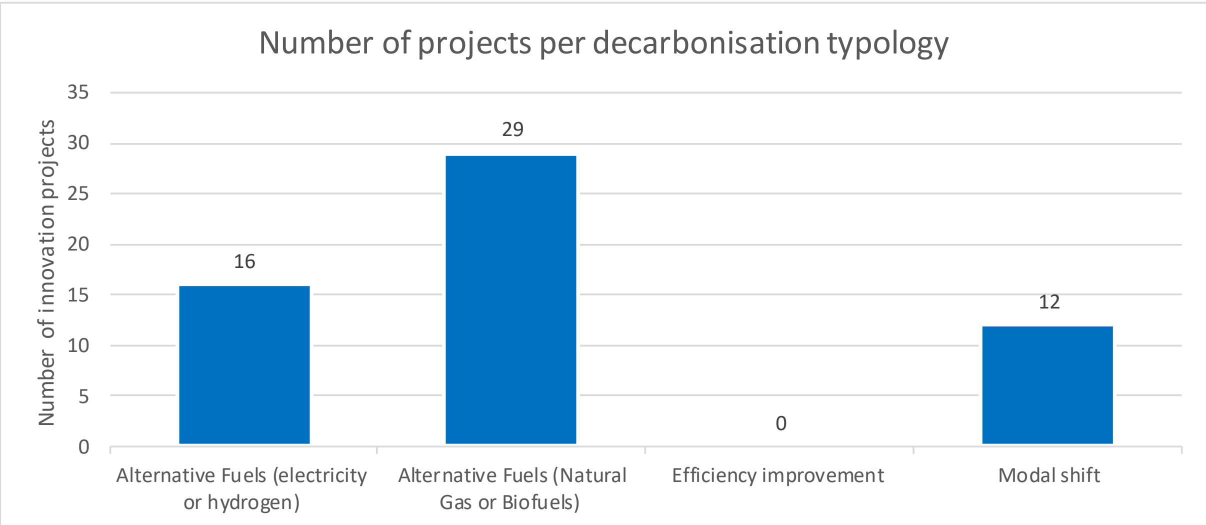

Figure 44: Number of innovation projects per decarbonisation typology

Figure 44 shows that the majority of innovation projects that contribute directly to decarbonisation do this through facilitating the use of alternative fuels. None of the projects focus on the efficiency improvement of engine or propulsion solutions (although there are a few examples of retrofitting existing vessels with LNG-fuelled engines) and 12 of them contribute to decarbonisation by means of modal shift.

The amount of innovation projects that encourage the deployment of natural gas or biofuels almost doubles the amount of those aimed at encouraging the use of electricity or hydrogen as alternative fuels. In the first case, most of the projects entail the deployment of LNG or CNC refuelling stations for freight vehicles or the installation of bunkering facilities in ports. In the second case, the majority of projects focus on the deployment of charging facilities for electric cars followed by a mix of other types of projects.

Contribution to decarbonisation through modal shift is achieved by means of introducing of MoS and rolling highway services in most of the cases.
There are 5 projects that contribute to decarbonisation in more than one of the above-mentioned ways. Of these projects, 4 focus on encouraging the use of electricity/hydrogen and natural gas/biofuels simultaneously. The remaining project contributes to decarbonisation through the use of electricity and modal shift. This project (ID 1946), CarEsmatic, promoted by Luka Koper d.d. is aimed at facilitating the transport of electric cars through a MoS between the ports of Barcelona (Spain) and Koper (Slovenia).

9.1.1.6 Identification of case studies

Following the criteria stated in the methodology, a potential list of projects that could be further analysed as case studies is as follows:

Table 13: Pre-selection of potential case studies

TEN-T ID	Project title	Project promoter	MS	Cost (M€)
3871	Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)	Fundacion Valenciaport	ES/ FR/ HR/ IT/ PT/ SI	41.37
7048	CIRVE Project	"IBIL, Gestor de Carga de Vehiculo Electrico, S.A."	ES/FR/PT	3.52
7062	Boosting Energy Sustainable fuels for freight Transport in European motorWays (BESTWay)	Gas Natural Servicios S.D.G, SA	ES/FR	7.71
7432	Med-Atlantic Ecobonus	Puertos del Estado	ES/FR/IT/ PT	1.54
3704	Calais / Paris - North Italy Rail motorway	VIIA	FR/IT	-
NEW-2017	NEXT-E	MOL, E.ON, Nissan	HU/ SK/ CR/ CZ/ SL/ RO/ AU	4.70
3659	FLEX-E- Overall Project	ENEL SpA	IT/DE/FR/ES/AT	12.40
3883	CHAMELEOM. Creation of LNG road HAulage MArket in a smart & quick way	HAM Criogenica	Multicountry (SI/ES)	2.67
3530	SiLNGT Small Scale TRANSPORT	BUTAN PLIN druzba za distribucijo plina	SI/HR	3.30

This list of projects is preliminary and subject to the agreement across corridors to avoid the duplication of case studies. The three or four case studies have to be selected from the table above.
The following tables contain examples of potential case studies from the innovation perspective:

Table 14: Innovation case studies 1

Project title	**Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)**
Node/Section	Koper, Genova, La Spezia, Livorno, Venezia Nantes-St Nazaire, and Fos-Marseille ports
Project promoter	Fundación Valenciaport (coordinating applicant)
Countries involved	ES/ FR/ HR/ IT/ PT/ SI
Project description	The Action prepares engineering studies, engineering plans, construction drawings of 4 LNG retrofitted prototype vessels, 7 LNG bunkering stations at core ports (5 prototype stations in Koper, Genova, La Spezia, Livorno, Venezia, and 2 fully operational LNG break-bulking stations in Nantes-St Nazaire, and Fos-Marseille).
Project start/end dates	Start: 01/01/2015 End: 30/09/2019
Total cost in Million Euro	44.37 (19.22 recommended CEF funding in 2014)

The Action is part of the GAINN Global Project. Its activities include: final engineering projects of prototypes and pilots; prototyping; real life trials and pilots; building two LNG break-bulking stations in Nantes - St Nazaire and Fos - Marseille; communication and coordination.

Successful completion of the action will advance the Global Project, and will act as leverage for launching other mature, technically and socio-economically viable implementation actions for LNG bunkering in the Mediterranean by 2020.

Its **contribution to the innovation deployment** is to facilitate the use of LNG as an alternative fuel for ships and maritime transport, contributing in turn to transport decarbonisation. The most innovative aspect of this project probably lies on the development of LNG retrofitted prototype vessels, a type of vehicle not easily accessible on the market currently. The break bulking facilities aim to split up large-scale LNG shipments into smaller parcels. This will enable the distribution and use of LNG as a cleaner fuel alternative for maritime vessels, ferries, trucks and other industrial applications, hence contributing to widespread the use of LNG as a reliable alternative fuel.

In case the prototype vessels are successfully developed, it would be the first step to a possible mass manufacturing of those new vehicles in mass, which might have a positive impact on the **development of the European technological industry.**

The **main barrier constraining the deployment** of this innovation is the high investment costs required for the development of the prototypes and the investment required to build the bulking and break bulking facilities in ports. However, in the case of this particular project those barriers are partly offset given the availability of European funding obtained through 2014 CEF call.

Regarding the **scalability** of the project, the development of the prototype vessels can be considered as scalable since marginal adjustments or modifications to the design might bring additional functionalities or an improved performance. However, the infrastructural side of the project is not scalable, since subsequent facilities expansions require proportional investments.

The project is completely **transferable** to other ports of the corridor, to other corridors and other world regions. In principle the prototype vessels could operate at any port and the bulking facilities technology can be applied elsewhere with minor adjustments to the physical restrictions of each port.

Table 15: Innovation case studies 2

Project title	**SiLNGT Small Scale TRANSPORT**	
Node/Section	Several core sections in Croatia and Slovenia	
Project promoter	BUTAN PLIN druzba za distribucijo plina	
Countries involved	HR/SI	
Project description	Deployment of natural gas refuelling stations (LNG/LCNG, LPG) in Slovenia and Croatia	
Project start/end dates	Start: 01/10/2016	End: 01/09/2019
Total cost in Million Euro	3.30 (50% funding from 2015 CEF call)	

The Action will be implemented on the roads of the Core Network in Slovenia and Croatia, on the Mediterranean Core Network Corridor.

It aims at developing LNG availability and use in these two countries. This will be achieved through the deployment of four natural gas refuelling stations (LNG/LCNG, LPG) in Slovenia (3) and Croatia (1) along with one demonstration vehicle that will be a trailer equipped with a cryogenic container and LNG refuelling station.

Its **contribution to the innovation deployment** is to facilitate the use of LNG as an alternative fuel in road transport, contributing in turn to transport decarbonisation. The most innovative aspect of this project probably lies on the demonstration part of the project, which might constitute a key element to the adoption of the technology from the users.

The **main barrier constraining the deployment** of this innovation is the high investment costs required for the deployment of the refuelling stations. Although the project obtained funding from the 2014 CEF call, the deployment of such refuelling stations at country level or even corridor level would require a large investment.

ON the one hand. regarding the **scalability** of the project, it cannot be considered scalable since the construction of additional refuelling stations require proportional additional investment. On the other hand, the project is 100% **transferable** to other parts of the corridor, other corridors and other world regions.

9.1.1.7 Conclusion

This in-depth overview on past and existing European transport initiatives shows that innovation is of great importance for the achievement of the different strategic goals set for the transport sector in Europe, in all the different ways.
Among mode-specific strategies, there are common priorities for the whole sector that can be summarised as follows:

- A greener transport through the adoption and implementation of alternative fuels that contribute to the decarbonisation of transport.
- Development and adoption of technology-based solutions such as ITS, C-ITS and other telematics applications as a means to achieving a better information exchange that contributes to a more efficient management of transport networks.
- Encouragement of multimodal transport and efficient and sustainable freight logistics.

The total cost of all innovation projects is more than 5.600 M € and the incremental and catch-up innovation categories represent 87% of the total cost accumulated by the innovation projects. This shows that, as expected, the number of radical innovations is low compared to the total of innovation projects.

The pre-selected case studies in Table 6 are innovation projects that contribute to transport decarbonisation to some extent. The lack of data availability might be a liability when analysing such projects as case studies, since in many cases only the information in the CEF fiches is publicly available. Other innovations submitted their proposals for the 2017 CEF call (which is currently under evaluation) so no public information can be found on these projects yet. The majority of projects pre-selected to be case studies deal with the use of alternative fuels.

Climate change and decarbonisation

Climate change is in action. Several consequences can already be seen and they will increase in the future. These disturbances are inevitable because of the inertia of the climate system and for this reason, they require adaptation. This adaptation is an indispensable addition to the mitigation actions (reduction of emissions of greenhouse gases) already committed.

Transport is responsible directly and indirectly (energy, infrastructure, etc.) for about 25% of CO_2 emissions, which contribute to global warming and to changes in climate that have major impacts on those same transports. It is recognized and scientifically proven that climate change hazards can affect the life-span and effectiveness or even destroy infrastructure in the transport sector with serious social and economic consequences.

The 2015 Paris Climate Conference (or COP21) was held from 30th November to 12th December 2015. Each year, the participants of this conference come together to discuss and deliberate on the measures to be implemented, with the aim of limiting global warming. This international summit in France brought together 195 countries that have validated an international agreement on climate, applicable to all countries, which set the goal of limiting global warming between 1.5 °C and 2 °C by 2100. The European Union was strongly involved in the success of this event.

Infrastructure and network managers are among the first economic players to question the consequences of climate change on their business. The life cycle of the decisions that characterize their installations corresponds to the typical timeframe of these changes: infrastructures built or modernized in the next 5 to 10 years will shape economies and territories until the second half of the 21st century. The technological and organizational choices that will be made in the short and medium term will strongly influence the energy, planning, mobility and communication flows of the period to come. They will also characterize their adaptability and resilience to climatic conditions different from those experienced in the past.

In this context, the various stakeholders involved in the development of the TEN-T core network corridors will have to integrate the assessment of the impacts of climate change on the resilience of their infrastructures, whether terrestrial, air, river or maritime, and must adapt design and renovation to these impacts that have far-reaching consequences.

The scope of this analysis in the Mediterranean Corridor study is to identify the most important risks that the infrastructure of the Corridor will have to face in the coming years related to climate change. The methodology has been shared among all TEN-T corridor teams. It should help stakeholders to raise the level of awareness of these issues and take the appropriate measures to enhance the resilience of the transport infrastructure during design phases or in operation.

9.1.1.8 Identification of major risks related to climate change for corridor infrastructure

The analysis started with the identification of major climatic threats on a country level, based mainly on IPCC documentation and national plans. Then, looking more in detail by mode and corridor section these threats were confronted to the level of exposure and vulnerability of the infrastructure, in order to assess a qualitative risk level.
This analysis resulted in a risk assessment table covering all sections of the corridor and modes. The major risks identified for the Corridor with this process are the following:
In Spain, average temperatures in summer are expected to increase by about 6 ° C, while precipitation will be reduced by 30%. These changes will be accompanied by periods of intense drought and extreme temperatures, which will have a significant impact on transport infrastructure. The risk of rail buckling and the weakening of the structures that support infrastructure and pavements will be a decisive factor in the risks associated with the operation of the infrastructures and maintenance costs. The energy supply might be disrupted during these extreme circumstances, and the risks of electrical failure will increase.
Although rainfall is moderately reduced by global warming in corridor regions, extreme rainfall events can increase flash floods in frequency and intensity. These phenomena are accentuated by droughts and cause significant material damage to infrastructures, in addition to the risks incurred by the users of these infrastructures. All the terrestrial infrastructures in the corridor are concerned, particularly the railways, which are more sensitive as there is no possibility of alternative routes. This risk concerns particularly Spain, France, Italy and Hungary, and more specifically infrastructures located in large river valleys intersected by tributaries (Rhone valley, Po valley, etc.).
All maritime ports and infrastructure will be affected by maritime flooding as well as extreme flooding. Storms will also affect navigation and thus the commercial capabilities of ports. All the countries in the corridor, except for Hungary, will be concerned.

9.1.1.9 Case studies

No project of the Mediterranean Corridor project list directly addresses the challenges of infrastructure resilience to climate change. Nevertheless, this factor is taken in consideration in the design and building techniques of new infrastructure, being part of the environmental impact assessment (EIA) studies.
As an example, studies on project No. 3099 "New railway line between Montpellier and Perpignan (LNMP)" highlighted the risks of maritime submersion, and the consultation studies raised concerns about the risks of flooding of the new line. Indeed, the existing railway line, located in some points very close to the sea and at a very low altitude is constantly subject to weather conditions (spray, winds, etc.) that may cause traffic disruption and accelerate the corrosion of the installations. Sea levels rise and the increase of extreme weather events could amplify those risks.
This has been taken into account in the design of the future line, but climate change could ultimately alter the risks identified in the studies carried out for this project, and the new line, which is at some point located at the edge of sub-flood risk areas, may also face unidentified risks, which would have significant economic impacts on the operation and repair of the line.

9.1.1.10 Conclusion and recommendations

Transport infrastructures are very long-term facilities. Transport systems will need to adapt both to changes in average climate conditions and to the higher likelihood of occurrence of extreme events. To ensure the continuity and security of the transport of people and goods, measures must be taken to improve the resilience and adaptability of the infrastructures. To the best of our knowledge, on vulnerability and risk, it is difficult to establish a scale of priorities for actions and an acceptable level of risk, but broadly the main risks related to climate change impact on the corridor's infrastructure could be identified.

More than average increases, changes in extreme events are likely to affect transport infrastructures and, more broadly, transport systems. The risk lies not only in brutal phenomena such as the breakdown of an infrastructure, which might lead to the unavailability, definitive or temporary, of part of the transport network, but also on the possibility of extension of a local accident to the entire network.

According to a more in-depth analysis of vulnerability and taking into account the elements currently available, each mode of transport is affected, resulting in different consequence depending on the mode and also on the territory concerned. Lower River flows in navigable rivers, submersion of coastal infrastructures, and damage to structures during extreme events, wind problems for airports, etc.

The recommended adaptation measures must be consistent with the goal of climate change mitigation, particularly with the objective of reducing greenhouse gas emissions.

The following recommendations are made:

- Establishment of crisis management mechanisms revisited to avoid total network cuts, on a scale adapted to climate events and involving all stakeholders.
- The systematic realization of a territorial assessment of transport systems in order to understand the effects of climate change on the corridor and its associated infrastructures.
- Adaptation of technical reference systems for the design, operation and maintenance of infrastructures to climate change. It is necessary to ensure that infrastructures built according to old standards can be adapted to climate change, just as new infrastructure projects are in line with the projected hazards.
- Improved knowledge of the behavior of materials and structures (railway rails, roadways, etc) to new stresses (high temperatures, submersions, wave effects, etc). Climate change will also modify the behavior of the users and the journeys will no longer be carried out according to the same considerations as today. The training of people affected by climate change, whether they are infrastructure managers or users, is also essential.
- Define the responsibility of the actors. Climate change and the extreme events that it can cause, with an increase in the occurrence, duration of the events and location concerned, raises the questions of responsibility in strategy and operation.

Mitigation of environmental impact

Climate change adaptation needs to be implemented jointly with the mitigation actions that have to be taken in order to reduce global warming to its minimum level and

achieve the objectives set by the COP21. So first and foremost, this analysis of the study aims to assess the impact of the Corridor's implementation on GHG emissions and to provide a set of recommendations in order to minimize these emissions deriving from transport along the Corridor sections.
Transport networks and their infrastructures also have other environmental impacts such as air pollution, noise, potential disruption of natural habitats and biodiversity, agriculture, water resources etc. All these impacts cannot be tackled at Corridor level and require a detailed environmental impact assessment (EIA) for each project to take the appropriate measures to avoid, mitigate or compensate the identified impacts.
Nevertheless, the issues of noise and air pollution are addressed here at a very broad level, along with the GHG emissions, using commonly accepted factors to assess their "shadow price", the underlying cost for society. The factors used are derived from the European guidelines and studies such as the EC Handbook on external costs of transport (update 2014), the TREMOVE database and the i-TREN project.
The methodology is based on two main pillars:

- estimating impacts of the Corridor on modal shift,
- estimating the contribution of the Corridor on transport and energy efficiency, through the implementation of the TEN-T standards or from particular projects, notably those related with innovation deployment that are looking at transport decarbonisation.

9.1.1.11 CO_2 emissions savings on the Corridor through modal shift

Basing on the results of the Transport Market Study of 2014 for international traffic, and on TENTec data with reasonable evolution assumptions for national and local traffic, we have estimated the amount of GHG emissions from transport along the various sections of the Mediterranean Corridor in three different situations:

- for the base year 2010;
- for 2030 in a "do-nothing" scenario, thus keeping modal shares as they were in 2010;
- for 2030 with implementation of the Corridor, taking into account the expected modal shift

The resulting estimated traffic volumes (in ton/km and passenger/km) on corridor sections are the following:

Table 16: Total traffic on corridor sections, in million ton.km and passenger.km

Total freight traffic Corridor sections (million ton.km / year)	2010	2030 trend scenario	2030 with corridor implementation	Diff. Corridor - trend
Road	211,916	315,983	288,772	-27,211
Rail	16,225	26,180	53,253	27,072
IWW	2,245	3,024	3,931	907
Total	**230,386**	**345,187**	**345,956**	
Rail share	***7.0%***	***7.6%***	***15.4%***	

Total passenger traffic Corridor sections (million pax.km / year)	2010	2030 trend scenario	2030 with corridor implementation	Diff. Corridor - trend
Road	153,192	189,714	182,452	-7,262
Rail	21,360	26,225	38,803	12,578
Air	46,078	63,778	62,256	-1,522
Total	**220,630**	**279,717**	**283,512**	
Rail share	***9.7%***	***9.4%***	***13.7%***	

Subsequently, by applying the emission factors recommended in the EC Handbook, we obtain the following figures for GHG emissions (in ton CO_2 eq.) on the Corridor:

Table 17: GHG emissions on corridor sections

Total GHG emissions on corridor sections (million ton CO2eq / year)	Mode	2010	2030 trend scenario	2030 corridor implemented	diff. Corridor - trend
Total Freight international		5.7	7.73	6.44	-1.29
Total Freight national		13.5	13.88	13.56	-0.32
Total Passenger international		8.8	10.94	10.76	-0.18
Total Passenger national		18.8	17.83	17.19	-0.64
Total Corridor		**46.8**	**50.38**	**47.95**	**-2.43**

According to this calculation, the implementation of the Mediterranean Corridor in 2030 would lead to a global reduction of about 2.4 million ton CO2 eq. per year with respect to the trend scenario. Given the level of uncertainties, particularly in evaluating the effects of the Corridor on national and regional traffic, **a possible order of magnitude between 2 and 3 million ton CO2 eq. per year** should be considered.
Despite the expected significant growth of transport along the Corridor, the GHG emissions should remain around their level of 2010, thanks to the progress of energy efficiency of transport and to the modal shift allowed by the implementation of the Corridor.
The main source of GHG emission reduction when implementing the Corridor is the modal shift for international freight, resulting in around 1.3 million tons of CO2 emissions avoided (-17% compared to the trend scenario).

We have also calculated the cumulative CO_2 emissions saved until 2080, considering the reasonable assumptions of traffic growth and stability of emission factors after 2030. Under these assumptions the comulative CO_2 emissions avoided between 2010 and 2080 would be **175 million tons CO_2eq**, of which 95 million in international freight traffic. Using the recommended value of 90 € / ton for the "shadow price" of the GHG emission and other recommended unitary costs for air pollution and noise from transport, we have estimated the total reduction of external costs derivating from these three environmental factors:

Table 18: Value (million € 2010 at prices) of the avoided external costs with the implementation of the Corridor

	Total present value - 3% discount rate	**Value for 2030**
Total avoided external costs (million € - 2010 prices)		
Total Freight international	**5,415**	183.3
Total Freight national	**1,560**	51.9
Total Passenger international	**562**	20.4
Total Passenger national	**2,538**	91.5
Total corridor	**10,075**	347.1

In 2030, the total socio-economic value of avoided external costs thanks to the modal shift allowed by the implementation of the Mediterranean Corridor is about 350 million € per year (at 2010 prices). **The present value of the avoided costs over the whole period is about 10 billion euros, considering a 3% discount rate**. Over these 10 billion €, the value of avoided GHG emissions is the most important contributor with 6.2 billion €; air pollution avoided costs represent 3.3 billion € and avoided noise costs are about 0.5 billion €.

9.1.1.12 Project effects and case studies

These estimates present the overall global effect of the Corridor on CO2 emissions through modal shift. At the same time, it is also important to look at the various projects on the Corridor and try to assess their impact not only on modal shift, but also on transport efficiency and promotion of more sustainable fuels and energies for transport.

As mentioned in the innovation part of the study, there are 52 innovative projects along the Corridor that have the clear objective of participating in transport decarbonisation, most of them by encouraging the deployment of new fuels like LNG or electricity. A good example of this is the "GAINN4MOS" project (Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions) which will contribute to LNG deployment in several ports of the Corridor, with the creation of new refillment facilities but also retrofitting existing vessels. It is nevertheless difficult to quantify the impact of such projects and measures since a global network effect is needed, both on the corridor and elsewhere, to obtain a significative market uptake for alternative fuels.

Innovation contributes also to modal shift with new types of freight transport services like MoS or rolling motorways. There are several types of rolling motorways foreseen on the Corridor:

- Long-distance unaccompanied service routes like Calais - northern Italy or Paris – Barcelona;

- Short or medium distance routes providing both unaccompanied and accompanied[19] service like the existing one between Aiton and Orbassano or the future one between Lyon and Turin foreseen with the new line.

These services have the advantage of functioning with the existing rolling stock of trucks and trailers, so no adaptation is needed from the road transport companies. Furthermore, some systems do not need any vertical manipulation of the trailers.
Existing services between Perpignan and Luxembourg or between Aiton and Orbassano are successful, with 3 to 4 return services per day and high occupancy rates. Developing this system requires at least 750m long trains allowed everywhere, improved interoperability, sufficient capacity on the rail network and, of course, new terminals like the ones projected in Barcelona and in the Paris region.

If we take the example of the two projects promoted by VIIA on the Corridor's project list (Calais – Northern Italy and Paris – Barcelona) they are estimated to save about 125 000 tons CO_2 eq. per year[20]. More services could be proposed on the long term, especially with the Lyon-Turin line in operation, such as services between Barcelona and northern Italy.

Finally, going back to classic infrastructure projects, we analysed the "carbon balance" of the new Lyon – Turin railway line, as studied by LTF in 2011. An important aspect of this "carbon balance" analysis, as developed by the French Agency for Environment and Energy (ADEME), is the comparison of CO_2 emissions during design and construction phases with CO2 emissions (and savings) during operation phase. The main results of this analysis, carried out for the complete Lyon-Turin program (including access lines in France and Italy) were as follows:
GHG emissions during design and construction phases: 13 million tons CO_2 eq.
GHG emissions saved during operation phase (until 2080): -97 million tons CO_2 eq.
The project is thus globally saving about 84 million tons of CO2 eq. emissions over a period of 70 years. The project becomes "carbon positive" from 2038 onwards.
In the operation phase, the yearly saving of CO2 emissions are about 1,5 million tons per year in 2040 and up to 2,7 million tons after 2050. It is assumed that about 25% of these avoided emissions concern network sections of the Mediterranean Corridor.
These emissions savings derive mostly from modal shift. But in the case of the Lyon-Turin, there are also other factors at play that improve transport efficiency and decarbonisation, such as:
The new Lyon-Turin line is shortened, thanks to the base tunnel: between St-Jean-de-Maurienne and Bussoleno, the new line will be about 20 km shorter than the existing one, as well as shorter than the road itinerary. Additional distance will be saved with the access lines.
The project will contribute to rail transport efficiency on the corridor by allowing longer and heavier trains, contrarily the existing line which is a major bottleneck in terms of train length and weight limitations. An increase of up to 25% of net weight of goods transported on each train can be expected.

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[19] Accompanied services embark full lorries with their drivers; unaccompanied services embark only the trailer
[20] Based on 5 daily services for Paris – Barcelona and one daily service for Calais – northern Italy, 40 trailers / service.

Finally, the new line will save energy by avoiding the sharp ramps of the existing line, which climbs up to an altitude of 1300 m with a maximum gradient of 3,5% ; the future line will have a maximum altitude of 700m and a maximum gradient of 0,75%.

9.1.1.13 Conclusion and recommendations

The implementation of the TEN-T Mediterranean Core Network Corridor will provide a significant contribution to the necessary mitigation of environmental impacts of transport in Europe. The full implementation of the Corridor will result in the avoidance of 2-3 million tons of CO_2 eq. emissions per year after 2030, according to the above-mentioned assumptions. The reduction of GHG emissions is primarily linked with modal shift from road to rail, in particular for international freight transport. The Corridor also contributes to a more efficient rail transport, with total electrification and higher load factors thanks to the implementation of the TEN-T standards.

Furthermore, the Corridor also addresses other environmental concerns such as noise and air pollution. The total avoided external costs (GHG emissions, air pollution and noise) thanks to the Corridor sum up to a present value of about 10 billion euros, using a 3% discount rate.

Beyond this calculation based on the 2014 TMS and standard emission factors, a number of additional effects of the Corridor only partially quantifiable at this stage, are worth mentioning:

- The reduction of ramps and distances through major projects like the Lyon-Turin;
- Additional modal shift provided by new freight transport services like rolling highways;
- Projects contributing to decarbonisation of road transport by promoting electromobility and alternative fuels.

Another important effect is the investment in ports connections and facilities. Our global calculation takes into account the expected growth of traffic through the Mediterranean ports and the expected modal shift to rail for hinterland distribution, as described in the 2014 TMS. However, the improvements in the Mediterranean ports could also lead to a better balance between ports of the north range and ports of the south range in Europe. This can avoid a great amount of GHG emissions by reducing both maritime and terrestrial distances. Other important reductions in GHG can be expected with the development of LNG facilities in ports and short-sea services like Motorways of the Sea. International on-going studies at European level, such as the study on the assessment of the potential of the maritime and inland ports or the study on MoS, will shed light on these topics.

While the environmental impact of the Corridor should be positive overall, the reduction of other negative factors, often local or limited in time, ought to be addressed. Among these, it is worth mentioning:

- The construction of new infrastructure, which can impact biodiversity, land use, hydric resources. This needs to be addressed by a detailed EIA for each project, implementing the appropriate measures to avoid or mitigate / compensate these impacts. The GHG emissions in construction phases should also be reduced to a possible minimum, encouraging sustainable construction techniques.
- The modal shift towards rail can lead locally to an important development of traffic on existing rail lines, often crossing urban nodes and dense population areas.

Appropriate measures should be taken in order to protect the population from the consequences of this traffic development particularly noise exposure.

The positive results of the Corridor can be maximized through a set of measures at European, national or local level, for example:

- Implementing the TEN-T core network as a hole with good interconnections between corridors, as we have seen how they are interdependent;
- Encouraging innovation to improve energy efficiency and decarbonisation of all transport modes;
- Lowering the level of CO_2 emissions for the production of electricity by encouraging the development of renewable energy sources: this would make the modal shift to rail more efficient for GHG emission reductions;
- Promoting modal shift for local and regional transport.

10 Jobs and Growth analysis

We carried out an analysis of the growth and jobs impact of our corridor applying a multiplier methodology based on the findings of the study *Cost of non-completion of the TEN-T*[21]. For the analysis we classified the projects contained in our project list as of May 2017 into three mutually exclusive categories:

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

The three categories also present a hierarchy. If a project is marked in the project list as cross-border it belongs to that category. If not, it is checked if it falls under an innovation category. If that is not the case, it will be treated as average project. Mixed rail and ERTMS projects are counted with 10% as an innovation project and the reminder as average project. Only those projects were considered that were not completed before 2016. For each of the three categories we aggregated the investments related to the projects of the category and thus obtained the investments planned for the period 2016 until 2030.

The multipliers in table 36 have been applied to estimate the total growth and job impacts of the corridor over the period 2016 to 2030.

Table 19: Multipliers used for the growth and jobs analysis derived from the study of Cost of non-completion of the TEN-T (2015)

	Type of investment			
Categories	**Average**	**Cross-border**	**Innovation**	**Unit of measurement**
GDP-Multiplier	**4,35**	**16,8**	**17,7**	bn€-GDP / bn€-INV
JOB-Multiplier	**16.300**	**37.000**	**38.700**	FTE-JobY / bn€-INV

The projects for which cost estimates are available and that are planned to be implemented over the period 2016 until 2030 amount to an investment of 88.5 B $€_{2015}$. The implementation of these projects will lead to an increase of GDP over the period 2016 until 2030 of 540 B $€_{2015}$ 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 1,702,000 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.

[21] 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.

11 Mediterranean Corridor Fiches

The Mediterranean Corridor Fiche included the main information on the corridor categorised under the following topics:

- Jobs and Growth
    - The cost of the non-completion of the Corridor would mean 97 million job-years less between 2015 and 2030 in the EU;
    - 622 billion EUR of GDP's accumulated loss for 2015-2030.
- Connectivity
    - 6 Member States: Hungary, Slovenia, Croatia, Italy, France, Spain;
    - 17% of EU's GDP generated by the Corridor's regions;
    - 13% of EU's population living in the Corridor's regions.
- Funding needs
    - 462 projects identified;
    - 123 projects concerning rail & ERTMS;
    - 28 projects concerning inland waterways;
    - €104 B of estimated investment;
    - €77,7 B for rail;
    - €6,0 B for inland waterway.
- Efficiency
    - The Lyon-Turin Transalpine link on both sides of the Alps, is the only east-west mass freight corridor in Southern Europe, able to carry flows from both the north and south of France to Italy. It facilitates the establishment of a network using 5,000 km of existing lines, from the Iberian Peninsula to Central-Eastern Europe, passing through the Po Valley; it represents a counterbalancing axis of prosperity to the south of the Alpine Arc.
- Success stories
    - The Madrid-Barcelona high-speed line: it reduced the journey time between the two cities from 5 hours in 1996 to 2 hours 38 minutes today
    - Avignon node – RRT & IWW: Creation of a tri-modal platform IWW-rail-road by upgrading and integrating existing port facilities on Courtine area and RRT of Champfleury
- Climate impact
    - The targets for rail for 2030 tend to reach full compliance. For IWWs, the identified projects contribute to reach the full compliance for all the infrastructure requirements set by the Regulation.

Flagship projects

Flagship projects are 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.
Such projects should be backed by the **commitment of actors** involved and have a genuine chance of being implemented and generating benefits in the shorter run (about 3 to 4 years).
The topic of the projects must be linked to the **issues papers, or ensuring compliance** with relevant EU transport policy objectives.

Along the Mediterranean Corridor there are 6 Flagship projects, which are hereunder listed. Full description and related fiches can be found in Annex.

- ITS for Roads
- CORE LNGas hive
- MEDTIS 3
- LNG for Ports – GAIN4MOS
- LNG for Ports – GAIN4SHIPS Innovation
- Cross border section of the new Lyon-Turin rail link Mont Cenis base tunnel

12 Impact of cooperation with RFC

Objective

All the multimodal core network corridors bring together different corridor concepts, which are complementary to each other: Rail Freight corridors, ERTMS corridors, RNE corridors, etc. In this regard the CNCs are much more extensive in scope and nature than the other corridor instruments which preceded them, even though these others types of corridors will be adapted over time to fit with the new European transport policy (TEN-T).

On the other hand, the other corridor concepts concern the development of the railway network in order to stimulate the increase of international traffic flow, thus creating a single European railway area. More specifically, Rail Net Europe addresses timetabling and allocation issues, while the core Task of ERTMS corridor is the deployment of the European Train Control system and the promotion of interoperability. Finally, the main purpose of the Regulation (EU) N. 913/2010 establishing the Rail Freight corridors is to increase the international rail freight attractiveness and efficiency, thus improving rail competitiveness and market share.

Table 20: Alignment of different corridor concepts (source: Mediterranean corridor Study, 2014)

	Spain							France			Italy		Slovenia		Croatia	Hungary		
MED*	Algeciras - Almeria	Almeria-Valencia	Valencia	Algeciras - Madrid	Madrid-Zaragoza-Barcelona	Valencia-Barcelona	Barcelona (ES/FR border)	(ES/FR border) Avignon-Lyon	Avignon-Marseille	Lyon – IT border	(FR/IT border) Turin-Milan-Verona-Padova-Venezia-Trieste	Padua-Bologna-Ravenna	(IT/SI border) Ljubljana	Ljubljana- HR border	SI border-Zagreb- HU border	Ljubljana- HU border - Budapest	HR Border Budapest	Budapest-Zahony
RFC 6		X	X		X	X	X	X	X	X	X		X			X		X
RFC 4				X														
ERTMS D			X			X	X	X	X	X	X		X			X	X	
PP 06										X	X		X			X	X	
PP 03		X	X	X	X	X	X	X										
RNE 06			X			X	X	X	X									
RNE 08										X	X		X			X	X	X

The alignment of the Rail Freight Corridor 6 – Mediterranean is mostly the same of the railway alignment of the Mediterranean CNC. It stretches over more than 7.000 km through the route Almería – Valencia/Algeciras/Madrid - Zaragoza/Barcelona - Marseille – Lyon – Turin – Milan – Verona – Padua/Venice –Trieste/Koper – Ljubljana – – Budapest – Zahony (Hungarian-Ukrainian border).

Figure 45: Alignment of the Mediterranean Rail Freight corridor (RFC6)

Accordingly, there is the opportunity and the need of cooperating, taking into account the specific roles and responsibilities of the two entities: the RFC 6 management office and board, on one side, and the CNC Coordinator and Forum, on the other.

Cooperation model and forms of interaction

Given this general framework, a permanent and fruitful collaboration has been set up from the beginning of the Forum's activity, in 2014. The management office of RFC 6 participated in all the Forum meetings and in several working group session, presented its contribution and shared with the CNC Coordinator and the supporting consulting team the results of the works carried out at the RFC level (such as the annual reports, the synthesis of the market study and the customer satisfaction surveys).

Such continuous communication and interaction allowed the Coordinator and the supporting consulting team to have a deeper understanding of the status of the interoperability along the railway section of the Mediterranean CNC. At the same time, this common effort supported the identification of the most relevant projects for the achievement of full interoperability for freight, as well as the needs in terms of connections between the railway corridor and the Core intermodal terminals and ports. Finally, the positive performances of the RFC6 activities in terms of promotion of an integrated commercial offer have also been shared with the Forum, helping its Members to become aware of the operational results that can be achieved by an integrated corridor management.

We would like to emphasize that this collaboration is improving the development of the CNC Work Plan, especially thanks to the RFC6 management office and board for the active and timely participation and support in the CNC Forum and study. The coordination between Corridor's infrastructure development and its commercial role for international rail freight is absolutely crucial to achieve the ambitious modal shift target for the freight flows along this Corridor - from 15% in the “do-nothing” scenario to 27% with the full Corridor implementation.

Finally, in providing input to the update of the Mediterranean corridor Work Plan, it is important to consider the success factors for rail freight corridors such as the adoption of the following soft measures:

- Enhancing and speeding up train handling (and customs) procedures in border stations,
- Harmonisation of operational rules,
- Harmonised quality and performance monitoring across corridors.

13 Conclusions and recommendations

Continuity of the Corridor alignment

The continuity of the corridor alignment should be guaranteed in terms of long-distance or cross-border flows. In this respect, it is very important to encourage projects with the highest added value aiming at solving bottlenecks constraints as well as improving or maintaining the quality of infrastructure in terms of safety, security, efficiency and sustainability.

In particular, the Corridor crosses some of the most developed region of Europe (Cataluña, Rhone-Alpes, Northern Italy), but nevertheless all its territories suffered considerably during the economic crisis of last years as shown by socio-economic data. The re-launch of the growth of the economic potential of the Corridor's regions will certainly be boosted by better connections between them and to other European market areas. This will also improve the function of ports as essential links for the longer distance exchanges with other continents.

Advanced technological and operational concepts allowing interoperability, tracking & tracing of goods, better intermodal integration are among the accompanying measures to be implemented in order to achieve such targets.

This continuity can be implemented only if the works along the Corridor will be coordinated and harmonized, especially at cross-border sections and in the urban nodes.

In particular, the fulfilment of an agreed time table for cross border projects should be ensured in order to avoid serious delays in the expected benefits arising from the investments made.

As a consequence, the importance of bilateral Working Groups and coordination meetings for the development of the Mediterranean Corridor should be promoted.

Furthermore, without the adequate financing for the development of the infrastructure, only slight progress can be achieved. Three of the six Member States are beneficiaries of the Cohesion Fund. A good financing mix between the different available funds will be necessary to ensure that the available means are used in the best possible way, providing the highest European added value.

Priority to inland navigation, railways and crossing-borders improved practices

Given the socio-economic characteristics of the territories involved, the Corridor is especially relevant for the international trade of goods, given the strong economic relationship between the Countries of its Western part and the development – in perspective – of the ones with the Countries on the Eastern part.

Due to the crossing of environmentally sensitive areas, such as the Pyreneens and the Alps, the objectives of "low-carbon and clean transport, and environmental protection" can be met only by developing efficient rail or maritime freight transport supply (in terms of both services and infrastructure), well interconnected by efficient "last mile" links with relevant freight transport nodes (sea and IWW ports, intermodal rail-road terminals). The latter shall provide sufficient capacity and efficient operations, in order to avoid that the removal of bottlenecks at network level will create new ones on nodes.

Removal of existing localised bottlenecks on the infrastructure, as well as the alignment of it to suitable technical standards for freight (e.g. 7540 m allowed length for trains, maximum gradients for new lines 12,5 mm/m, 22,5 axle load, loading gauge UIC C) appears also key Corridor development measures.

Coordination of the transport development plans

In order to ensure a harmonized development of the Mediterranean Corridor, transport development plans of the MS affected by the Corridor shall be coordinated and harmonised.
Member States eligible for co-funding from the cohesion funds should use these financing instruments towards the logic of the transport core and comprehensive networks development aiming at an efficient inter-modality approach.

Maintain a multimodal transport network

The maintanance and promotion of multimodal transport infrastructures for people and goods shall be seen as a primary objective for evolving the demand for mobility in highly populated and intense economic developped areas of the Corridor.
A much better integration of the various modes remains a challenge for many ports, industries and airports along the corridor. In particular the combination of high numbers of short distance passenger rail services and freight services remains a major challenge mainly in the urban nodes, hampering the development of freight transport in these sections of the Corridor.

Projects evaluation

The evaluation of projects should focus more on their viability and should also incorporate cost-benefit assessments and economic impacts.
The project maturity is relevant as well and should be evaluated in terms of:

- Project Identification (objectives, investment type)
- Technical readiness (Spatial Planning and technical documentation)
- Institutional readiness (institutional framework and capacity)
- Financial/Economic maturity (coverage of costs)
- Social/Environmental maturity (EIA, social/environmental impacts)

Operational and administrative bottlenecks

Special attention should also be paid to the operational and administrative barriers that can have a negative impact on the profitability of the investment and on the efficiency of the Corridor on the whole.
In particular, a specific study of these bottlenecks on the borders and along the corridor should be carried out and focus especially on the following items:

- Harmonising national procedures regarding authorisation and certification of rolling stock,
- Traffic management,
- Management of terminals.
- Access to the market and services

Links to third countries

The corridor shall provide economically efficient and clean transport options to the flows of passengers and goods between those territories as well as the other Countries that will take benefit from the Corridor’s development for their international flows (e.g. Balkan countries, Ukraine etc. on the Eastern side).

Especially in relation to Western Balkans regions, but also considering Northern African and Eastern European countries, the Corridor should include the links with third countries.
The important growth potential of these territories, where the transport connections remain still very weak, requires a particular attention in terms of development of transport infrastructure as well as of regulatory reforms and convergence.
After the adoption of the work plan a better understanding of the needs to connect the different parts of the Mediterranean Corridor will be obtained.

Communication and promotion

It is important to continue the multilateral, cross-border cooperation between Member States. For the main missing links, Lyon-Turin and Trieste-Divača, this cooperation should be intensified.
Synergies will be sought with the Rail Freight Corridor 6 (RFC6), notably in addressing the administrative and operational barriers on the historic lines, especially on sections where new cross-border projects are being developed and the historic lines need to serve still as main line in the medium term.
The cooperation with the RFC6 should be strengthened on a regular basis.
Finally, as foreseen by the TEN-T Regulation, the following working groups will be proposed on:

- urban nodes useful to have a local or regional point of view

- ports and RRT.

Due to the maritime dimension of the corridor the working group for ports should be institutionalised and organized on regular basis and focused on last miles investments as well as non-infrastructure nature issues (i.e. administrative and custom procedures).

Importance of the cross-border cooperation

A common Corridor methodology should address those cross-border challenges, including for other Corridors, without prejudice for existing particularities of specific cross-border sections.
Meetings related to specific cross-border issues should be organized on regular basis. This process would help to achieve a smoother implementation of the Corridor.
Importance of investing not only in new infrastructure and upgrades but also in maintenance of the networks to keep them efficient and reliable
The investments foreseen for the Corridor shall also be oriented at the ordinary and extraordinary maintenance of the networks, in order to guarantee efficient and reliable functioning of the Corridor axes. Accordingly, maintenance strategies and associated financial costs shall be considered when defining the future financial needs for Corridor implementation.

Specific recommendations by mode for the Mediterranean Corridor

Railway network improvements

Completion of missing key sections

The new railway link Lyon-Turin is the key section on which the optimal functioning of the whole Corridor hinges. Without this new link the Corridor will not be able to perform its role of the major east-west axis south of the Alps.

Similarly, the Montpellier-Perpignan section will become crucial to utilise the full potential of the newly built railway connection in UIC gauge between France and Spain. The further development of this section will be looked at in the light of the traffic evolution in order to avoid that the section becomes a bottleneck in the medium term, at the latest once all connections to Spanish seaport, industrial plants and the other logistic terminals will be upgraded at UIC gauge.

Several cross-border rail and also road connections in the eastern part of the Corridor need to be addressed under this heading as well.

Implementation of ERTMS

In order to reach our final target to achieve an interoperable and competitive railway network, three conditions need to be fulfilled along the Corridors: sufficient infrastructure quality, harmonisation of national rules throughout Europe and introduction of ERTMS. To speed up this process and to show tangible results in the railway sector, we need to accomplish quick wins through implementing short-term and less costly projects. Implementation of interoperability actions, such as the 740m train length standard, harmonisation of operation and authorisation rules would have a direct impact on productiveness.

Detailed ways how to accelerate ERTMS equipment along the core network shall be evaluated according to the current European Deployment Plan and the related strategy for ERTMS equipment by 2030, as laid down in Regulation (EU) 1315/2013.

Ensuring full interoperability

The completion of the new HS line between Figueres (Spain) and Perpignan (France) was a historic event, creating the first interoperable link with the Iberian Peninsula. However, for the above explained reasons, this interoperability, in practice, appears to be only partial. To overcome this situation, the structured cooperation between the two Member States should be intensified.

In general, the realization of the rail potential international traffic in Spain can only be achieved by a full UIC gauge connection from the main traffic generators to the border. But also on the remaining railway sections of the Corridor, delivering interoperability means agreeing on the full deployment of the UIC gauge.

In order to enhance the modal shift, a substantial improvement of the overall interoperability of the Corridor has to be ensured by removing the remaining restrictions in particular in terms of train length, axle load and signalling system needed to meet the market needs (especially on the Eastern part of the Corridor). While this effort can only be made gradually, this kind of issue is only solved when the whole Corridor has reached the common standards, and even a very small section remaining with lower standards in the central part of the Corridor has enormous negative effects on its potential.

Maritime ports improvements

Ensuring full connectivity of maritime ports

Major investments have been made over the last few years, all resulting in a significant growth in the use of ports and of their influence areas (hinterlands). In order to complete the hinterland connections and therefore achieving the highest returns from the measures implemented, it is necessary to complete the pending road and railway accesses.

In particular, as regard rail, proper connections with hinterland are the most relevant critical issue. Rail connection should be addressed in terms of: (1) developments inside the port in order to connect the different terminals with the port rail access; (2) connection between port and rail network (i.e. "last mail connection"); (3) long distance connections because of their bottlenecks and missing sections affect the development of services with origin and destination in the port.

Inland waterways improvements

Ensuring full reliability of IWW
Full reliability for inland waterways sections is very important for Corridor implementation, both in terms of 365 day navigability and absence of physical constraints. Furthermore, the considerations presented for ports full connectivity can be extended to inland ports.

Airport intermodality improvements

Increasing rail connections to the airport
The development of heavy rail connection to the airports shall be set as primary objective for airport intermodality, both for passenger and freight. Specific projects presented in the Mediterranean Project list go to that direction (e.g. rail connection to Venice airport, People Mover construction in Bologna airport and Rail connection to T1 Terminal of Barcelona airport).

Road projects improvements

Reaching the TEN-t targets
Road network needs to be fully compliant with the criteria set by the Regulation (EU) No 1315/2013 both for the establishment of express road or motorway and the availability of clean fuels along the Corridor. This is very important in cross-border sections.
In this respect, the project Vásárosnamény - Beregdaróc (HU-UA border) will permit to upgrade the Eastern road section of the Corridor to the desired standards. Similar road projects exist (e.g. IT-SI road cross border section) and others shall be supported.

Urban node projects improvements

Development of urban nodes
It became quite apparent in the Corridor Study that the main urban areas along the Corridor constitute sometimes serious bottlenecks for rail hampering not only local and regional traffic but also restricting severely international traffic. Attention must not only be given to passenger services but equal treatment should be given to freight services using the same infrastructure. While the general problem is similar in all urban nodes, the specific situations of the various urban nodes differ and need to be studied individually.
Particular attention needs to be paid to urban nodes which form the crossing points with other core network Corridors, in order to allow a seamless flow of high-speed passengers and freight flows. This concerns first of all the major nodes like Madrid, Lyon and Milan, but also Verona, Venice and Budapest.