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The Results and Efficiency of Railway Infrastructure Financing within the European Union

STUDY

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DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT D: BUDGETARY AFFAIRS

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Abstract

Upon request by the Committee on Budgetary Control (CONT) this study analyses the results, efficiency and effectiveness of the EU investment in rail infrastructure with a special focus on cross border rail projects. Beginning with a discussion of the reasons for the moderate success of EU railway policy it investigates four case studies with a focus on effectiveness of funding schemes and success of removing bottlenecks, particularly at border crossings, to improve attractiveness of the railway mode. Recommendations are given for a more efficient joint development of a European rail network by the Member States and the EU and a further development of funding schemes tailored to railways.

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This document was requested by the European Parliament's Committee on Budgetary Control. It designated Mr Markus Pieper, MEP, to follow the study.

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LIST OF ABBREVIATIONS

AG	Aktiengesellschaft (stock exchange company)
AT	Austria
ATL	Atlantic (core network corridor)
ATM	Air Traffic Management
AWP	Annual work programme
BCR	Benefit Cost Ratio
BE	Belgium
BG	Bulgaria
CBA	Cost Benefit Analysis
CEF	Connecting Europe Facility
CF	Cohesion Fund
CNC	Core Network Corridors
CO2	Carbon dioxide
CTRL	Channel Tunnel Rail Link
CZ	Czech Republic
DB	Deutsche Bahn AG
DBF	Design-Build-Finance PPP model
DBFO	Design-Build-Finance-Operate PPP model
DE	Germany
DK	Denmark
DG-MOVE	Directorate General for Mobility and Transport
DG-REGIO	Directorate General for Regional Policy

EAV	European Added Value
EC	European Commission
EERP	European Economic Recovery Programme
EESC	European Economic and Social Committee
EFSI	European Fund for Strategic Investments
EIAH	European Investment Advisory Hub
EIB	European Investment Bank
EIPP	European Investment Project Portal
EPEC	European PPP Expertise Centre
ERA	European Railway Agency
ERDF	European Regional Development Fund
ES	Spain
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
EUR	Euro, European Currency
FOB	Funding Objectives
FR	France
GDP	Gross domestic product
GR	Greece
HSR	High speed rail
HU	Hungary
Hz	Hertz
ICE	Inter-City Express (of Deutsche Bahn AG)

IM	Infrastructure Managers of railway networks
INEA	Innovation and Networks Executive Agency
ITF	International Transport Forum, OECD organisation
ITS	Intelligent Transportation Systems
KPI	Key performance indicator
kV	Kilovolt
LGTT	Loan Guarantee Instrument for TEN-T Projects
LGV	Ligne à Grande Vitesse (high speed line)
m	Metre
MAP	Multi-annual work programme
MED	Mediterranean (core network corridor)
MFF	Multi-annual financial framework
MoS	Motorways of the Sea
MS	Member State
NGO	Non-governmental organisation
NL	Netherlands
OBK	Øresundsbron Konsortiet
OEM	Orient East Mediterranean (corridor)
p.a.	Per annum
PBI	Project Bond Initiative
PBKAL	Paris-Brussels-Cologne-Amsterdam-London (priority project)
pkm	Passenger kilometres
PP	Priority Project
PPP	Public private partnership

PSO	Public Service Obligations
PT	Portugal
RD	Rhine-Danube (corridor)
RFC	Rail Freight Corridor
RFF	Réseau ferré de France
RIS	River Information System
RO	Romania
RU	Railway undertaking responsible for railway operations
SCNF	Société nationale des chemins de fer français
SE	Sweden
SESAR	Single European Sky ATM Research
SF	Structural Funds
SK	Slovakia
TEN-T	Trans-European Transport Networks
TEN-TEA	Trans-European Networks – Transport Executive Agency
TGV	Train à grande vitesse
TINA	Transport Infrastructure Needs Assessment
tkm	Ton kilometres
UIC	International Union of Railways
UK	United Kingdom
VPD	Vehicles per day

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EXECUTIVE SUMMARY

The Committee on Budgetary Control (CONT) of the European Parliament has requested a study to analyse the results, efficiency and effectiveness of the EU investment in rail infrastructure with a special focus on cross-border rail projects.

Background

Railway policy and fostering railway infrastructure as part of the development of the Trans-European Transport Networks (TEN-T) has been a prominent issue of European transport policy. The European objective to shift transport to more environmental friendly modes, that was a cornerstone of the policy during the decade after the year 2000, placed emphasis on developing a better and more integrated European railway system that would be able to service a higher modal-share of transport demand for both passenger and freight transport. Railway network investments also benefitted from European co-funding via structural funds (European Regional Development Fund, ERDF and Cohesion Fund, CF) and the TEN-T funds.

Aim

This study intends to answer the question of whether the EU financing of railway infrastructure is an efficient and effective way of achieving European objectives to ensure the smooth functioning of the internal market and to strengthen the economic and social cohesion of Member States. Can this be done by eliminating transport bottlenecks and improving the mobility of goods and persons between the Member States? The objective of this study is to assess four case studies of proposed TEN-T projects for their impacts, efficiency and effectiveness of implementation. This assessment is accompanied by the analysis of benefits and overall impact of the investment in cross-border projects including their impacts on regions and economies of the countries involved.

Methodology

The study begins with an overview of European railway policies and investment strategies. Funding instruments are analysed, including new schemes, and suggestions made by advisory groups. Four case studies are presented to investigate the efficiency of rail investment strategies including the funding schemes applied. The impacts on border crossings are the focus of analysis. Based on the findings the study presents conclusions with regard to the efficiency of rail investments and their finance, together with their European added value. Finally it provides recommendations for streamlining European financial support in order to accelerate railway investments, in particular to remove bottlenecks at border crossings. The research is carried out as a desk study completed by selected interviews and data analysis provided by the European Commission, in particular DG Regio and INEA.

Findings

Efficiency of European railway reform

European railway reform policy began with Directive 1990/440/EG which aimed to overcome the technical and organisational fragmentation, and create a common free and competitive rail transport service sector, increasing the attractiveness of railways. Directives 2001/12-14 and three railway packages in 2001-2004 followed and the EU Commission has prepared a proposal for a fourth railway package in 2013 which is still under discussion. Following the Treaty of Maastricht 1993, Trans-European Networks were defined in 1996 and updated in 2004 and 2013. Railway investments have played a major role in this.

Substantial changes have been achieved in the past 25 years. Infrastructure management has been separated from railway undertakings so that competition could grow within the railway service sector. Interoperability has improved after the establishment of the European Railway Agency, the common control system ERTMS is developing on new and upgraded links, and the problems of licensing new technology for international transport operations are on the way to being solved. Last but not least Trans-European Networks for Transport (TEN-T) have been defined and partly implemented, including a big financial effort to improve the rail infrastructure as a precondition for revitalising the European railways.

Despite this, the prime political goal, as expressed in the White Papers of 2001 and 2011, to substantially increase the passenger and freight transport share of the railway market, has not yet been achieved. The modal shares of railways in the passenger transport market have not changed much and have actually decreased in the freight transport market over the past 25 years. The difficulties arising over this long process of restructuring the railways are caused by a number of factors: the technological and organisational fragmentation of EU railway organisations; the long life and high fixed costs of railway technology; the long time needed for migration of new technology and regulations; the national railway policies protecting their state companies; the resistance of trade unions against competitive structures; and low market pressure because of high national protection and subsidy.

In the future a continuation of the railway friendly EU policy can be successful as soon as Member States, technology and organisation will allow. The expectations for the future is for Europe-wide transport without major bottlenecks and border delays, standardised technology, low operation costs and convenient transport times on modern infrastructures along the core network corridors. Rail transport can become competitive, particularly on long distance international corridors, if rail passengers expect low travel time and high comfort and shippers/forwarders use synchronised and reliable freight services at reasonable costs. A full internalisation of external costs will be an essential precondition for the market success of railways.

Efficiency of Rail Funding Schemes

More than 50% of railway infrastructure investments have previously been funded by national budgets. EU co-funding added an average of 12%. The remainder was financed by concessions, PPP, loans, equity capital or, to a lesser extent, by rail track charges. European co-funding can be provided by CF, ERDF, CEF, EIB (mainly loans) and in the future by EFSI. CEF is the main EU funding instrument for TEN-T investments, from which EUR 24.05 billion can be used for the programming period 2014-20. EUR 11.3 billion have been transferred from the CF to CEF for use in transport investments in the former cohesion and accession countries under the conditions of CF funding (max. 85% co-funding). About one half of the available CEF budget has been allocated to TEN-T projects in the first call in September 2014. From this it follows that the forthcoming calls will be much smaller in volume.

In the past two funding periods, from 2000 to 2013, transport co-funding by ERDF and CF had roughly ten times the budget of the TEN-T funds. Although this budget was also partially used to invest into TEN-T infrastructures it was still less focused than the TEN-T funds. Further, cross-border multi-national projects were largely ignored by the ERDF and CF funds, while they played an important role for the TEN-T funds, particularly from 2007 to 2013. With the increase of TEN-T funds now available via CEF,for the funding period 2014 to 2020 substantially higher co-funding budgets will go to the rail mode and these funds will be more concentrated on the cross-border sections than in the previous period.

The EU Commission, together with EIB, has previously tried to develop additional financial instruments to foster private finance. The LGTT instrument aims to reduce the pay-back loads for investors in the ramp-up phase of projects when transport demand has not reached the expected volume. Euro bond finance can be offered to private project companies by attracting liquidity from institutional investors like insurance companies or pension funds.

However, these instruments have not been very successful in previous years. This was initially caused by the low private interest for investment in transport infrastructure after the economic crisis such that the number of PPPs dropped drastically. A second reason is that transport infrastructure projects often cannot provide a sufficient and stable revenue stream to pay back amortisation and interest. This is particularly true for railway projects for which PPPs face two main difficulties. First the expected market revenues generated by a railway project are low and exposed to high political risk. Secondly the usual PPPs and other concession schemes expect the operational management responsibility to be allocated to the private concessionaire. This may cause conflicts with the infrastructure manager who is responsible for availability and integration of the whole rail network.

Against this background the Christophersen group has suggested two additional instruments which can be tailored to the financial needs and possibilities of the railways: “Concession-like finance” and “mixed fund finance”. Concession-like finance can, for instance, be construed in the context of a PPP without revenue streams. The concessionaire has to provide the project and to make it available for the concession period (“availability-based PPP”). The payment of amortisation and interest would be done by the state, the railway undertakings and the infrastructure manager. Mixed funds can be constructed for railway investment and finance for a long-term period (as in Switzerland), while the financial flows can stem from project-related revenues, ear-marked taxes or cross-finance from road transport. As direct cross-financing is not acceptable in some countries the Christophersen group suggests the use of environmental charges from road or air to support the railway investment fund.

When it comes to cross-finance prominent border-crossing projects like the Oeresund, for which the rail part of investments is partly financed by road tolls, can be identified. This type of road / rail combined infrastructure makes it possible to construct private-like concession schemes in a transparent and efficient way. This option exists for a few projects, but has not been used at other places where it is possible as for instance in the case of the Danube bridge between Vidin and Calafat.

Availability-based PPPs can be interesting for border crossing rail infrastructure investments. In such cases the contracts will have to be prepared for the involved countries and the private consortia. Here the new European Investment Advisory Hub (EIAH) should be supporting together with the European Coordinators. Among other considerations it is recommended to define the scope of a project appropriately, e.g. a bridge or a tunnel together with the related access links, to avoid isolated solutions which bring little progress in a network context. Our findings fit together with the recommendations of the Christophersen Group which underlines the need to strengthen the user-pays principle (e.g. by the internalisation of external costs of transport) and to facilitate cross-financing solutions between modes.

Case Studies

Out of the 30 priority projects (PPs) defined by the European Commission under their TEN-T guidelines of 2004, four projects have been selected for a deeper investigation. The case studies consider the efficiency and effectiveness of project implementation with respect to five key issues: (1) effectiveness of planning and construction, (2) transport demand impacts, (3) project assessment, (4) regional impacts and (5) effectiveness of EU co-funding. Cross border sections are of particular interest because they are supposed to create European added value.

The Øresund Fixed Link (PP11) connects Denmark and Sweden via the Øresund with a combination of a tunnel, an artificial Island and a bridge. At both ends of the fixed link there are metropolitan areas: in Denmark the capital city of Copenhagen and in Sweden the cities of Malmö and Lund. The project was opened in the year 2000 and has the following characteristics: (1) It was constructed without delays and cost-overruns of 39% can largely be assigned to additional requirements requested by stakeholders (e.g. environmental mitigation). (2) Demand development was below forecasts in the ramp-up phase but has reached the forecasted trends after 2007. (3) The socio-economic ex-post assessment estimates a BCR of 2.2 for medium growth scenarios. Even in pessimistic scenarios the BCR remains above 1. (4) Regional impacts have been identified in the housing and labour markets as well as the increasing integration of business activities (e.g. ports merger) and education activities (University cooperation). (5) The joint Swedish/Danish project company Oeresund Bro has financed the project almost completely from private loans which were guaranteed by the states. EU co-funding was EUR 127 million. PP11 is a prototype for an economically viable project with high measurable positive cross-border impacts.

The PBKAL high speed rail connection Paris, Brussels, Cologne, Amsterdam and London (PP2) with its four border crossing links is part of the North Sea-Mediterranean Core Network Corridor and became fully operational in 2010. Characteristics are as follows: (1) PP2 includes single national projects in four countries and the Channel Tunnel as a major cross-border project. Cost overruns occurred between 25% and 116% (for the HSR link Cologne-Frankfurt). (2) Actual demand is still below forecasts by about 30% but demand and modal split are now improving after closing major bottlenecks such as the HSR link between Folkestone and London. (3) All ex-ante CBAs are positive while the actual financial figures, although not satisfactory, are improving. (4) There is controversy over Regional impacts. While there is no doubt that PBKAL has positive impacts on the economic development of the connected agglomerations, concern is expressed that the regions in between the HSR stations have not been able to participate in the benefits. (5) The overall costs total EUR 18.8 billion and were financed by various financial schemes according to national preferences: public finance, e.g. in France and Germany, private finance with public support and guarantees in the UK. EU co-finance was about 5%. PBKAL is a positive case for EU cross-border integration of rail networks and cross-border impacts.

South-West European high speed network (PP3) aims to merge Europe's two largest high-speed networks in order to bring Portugal, Spain and Southern France closer to each other and to central Europe. Its features are: (1) Total costs are estimated at 6.8 billion EUR (incl. sections in Portugal), with finalisation envisaged for 2017 (Mediterranean branch) and 2022 (Atlantic branch). (2) Passenger transport demand is expected to develop from about 3 million (2015) to 5.8 million (2050) on the Mediterranean corridor. It is significantly lower on the Atlantic corridor section between Bordeaux and San Sebastian where about 1 million passengers currently use the railways each year. (3) While ex-ante CBAs present positive results, for the Mediterranean sections and the section Tours-Bordeaux in particular, there are upcoming doubts as to whether the traffic volume between Bordeaux and San Sebastian will develop with sufficient speed to reach the forecasted CBA figures. (4) The expected regional benefits in Spain and Portugal are significant but highly uncertain. (5) A mix of financial instruments has been used, including innovative instruments for the section between Tours and Bordeaux. The PPP is constructed through sources of the concessionaire (Vinci), EIB loans, public grants blended according to traffic risk and advanced tools to manage the financial risks. There is no doubt that the project fosters cross-border travel activities between France and Spain while the Mediterranean branch offers higher prospects than the Atlantic branch.

The **South-Eastern European railway corridor (PP22)** of 3575 km length connects the South Eastern Member States Greece, Bulgaria and Romania to the Central and West European countries Hungary, Czech Republic, Austria and South-East Germany. It has the following features: (1) While the northern branch is almost complete the southern branch in Bulgaria and northern Greece is still not ready for construction to begin. (2) In the corridor sections east of Vienna the transport volumes are falling and are very low in Bulgaria and Northern Greece. (3) A CBA for the P22 corridor underlines that the sections along the northern branch where construction has started, are economically sound, while all scenarios including a major upgrade of the southern branch generate a negative CBA result. (4) Positive regional and cross-border effects can be expected for the southern branch, but at a very low level. (5) For the former accession and cohesion countries the CEF funding is about 78% of the eligible investment costs. Total EU co-funding comprises EUR 1.7 billion from CEF and between 1.2 and EUR 1.5 billion (estimated) from ERDF. The planning for the southern branch is not mature and needs reconsideration. An alternative railway route from Budapest to Thessalonica could be explored.

Recommendations

1. Although the EU railway policy, including supporting investments into TEN-T railway projects, have not achieved the goal of substantial shifts from road and air to rail there are indicators to suggest that the policy is on the right track. It has to be continued with increased intensity and consistency to strengthen the market position of railways and foster the sustainable development of the transport sector.
2. The improvement of border crossing rail sections is often ignored by the countries concerned because the national railway companies give little priority to network sections with low traffic volume. The European value of efficient border crossings can be very high and in many cases achieved with a combination of organisational intelligence and modest investments.
3. Improvements to the EU rail network needs high funding efforts from the national budgets and can be supported by private investors. As long as private funding requires high and reliable revenues stemming from project operation, railway investments will have little chance of attracting private investors. Therefore the role of the state will prevail for railway infrastructure finance, either through direct grants or by providing guarantees and taking risk.

4. Nevertheless "private like" financing models can be applied for railway infrastructure finance. An initial example is the construction of a concession model with extensive state guarantees for a combined road/rail project, as for instance a bridge or a tunnel (Oeresund model). This offers the opportunity to finance parts of the rail facility with revenues from road users. Among the case studies analysed there are projects which can be considered for this type of finance, such as the rail access investments for the Danube bridge at Calafat.
5. A second option is to apply "concession like" models which can be constructed as PPPs but define the provision and availability of a project for the concession period as the performance of the concessionaire, instead of delivering revenues. The railway undertakings, the infrastructure manager and the state share in refinancing the capital costs of the project. The French HSR link Tours-Bordeaux gives an example for such a financing scheme.
6. A third example is the construction of funding schemes for which the long-term investment needs are defined on the one hand and the sources of finance on the other hand. The Swiss model provides an extreme case for combining taxes, project revenues and income from road tolling, i.e. a massive cross-finance. A similar scheme could be prepared by changing Directive 2011/76 accordingly and allow mark-ups to support rail. At least the mark-ups for external costs of air pollution and noise could be transferred to more environmentally friendly transport modes such as rail.
7. Some regional studies and European-wide macro-economic analysis have revealed substantial wider economic benefits of cross-border projects. Whether such benefits accrue directly in the border regions depends, of course, on the regional structure, as in the Oresund case where both Copenhagen and Malmo benefit. In the case of PBKAL, London, Paris and Lille receive benefits, while peripheral regions which are poorly connected to the HSR stations, e.g. Kent and Nord pas de Calais on both sides of the channel, do not gain.
8. The analysis of case studies gives rise to streamline the plans for developing the HSR network and complement this backbone infrastructure by regional rail networks which provide good access to the HSR stations and improve the inter- and intraregional interconnectivity.
9. The Oresund case also reveals that intense cooperation between the Member States and their willingness to implement access infrastructures to connect the large scale new infrastructure with the smaller regions is of importance for the success of a project in terms of creating wider regional benefits. Lack of cooperation and missing regional access links hamper the achievement of regional benefits of cross-border infrastructures.

1. INTRODUCTION

The Committee on Budgetary Control (CONT) of the European Parliament has requested a study to analyse the results, efficiency and effectiveness of the EU investment in rail infrastructure with a special focus on cross-border rail projects.

Railway policy and fostering railway infrastructure as part of the development of the Trans-European Transport Networks (TEN-T) has been a prominent issue of European transport policy. The European objective to shift transport to more environmental friendly modes, that was a cornerstone of the policy during the decade after the year 2000, placed emphasis on developing a better and more integrated European railway system that would be able to service a higher modal-share of transport demand for both passenger and freight transport. Railway network investments also benefitted from the European co-funding via structural funds (European Regional Development Fund, ERDF and Cohesion Fund, CF) and the TEN-T funds. Thus it is relevant to enquire into the results and efficiency of such EU railway infrastructure financing.

The topic of the study is whether the EU financing in railway infrastructure is an efficient and effective way of achieving European objectives to ensure the smooth functioning of the internal market and to strengthen the economic and social cohesion of Member States. This should be achieved by eliminating transport bottlenecks and improving the mobility of goods and persons between the Member States. The objective of this study is to assess the proposed TEN-T projects of four case studies for their impacts, efficiency and effectiveness. This assessment is accompanied by the analysis of benefits and overall impact of the investment in cross-border projects including their impacts on regions and economies of involved countries.

To fulfil the objective of the study it is necessary to describe the European railway policy that in the past two decades placed emphasis on transforming the state owned national railway companies into businesses that continuously improve their levels of service and thus successfully compete on the transport markets not only with themselves but also with the other modes. The second element to be understood consists of the railway infrastructure development and the way these infrastructures are funded and planned both at the level of the Member States and of the EU. Finally, it will be relevant to assess the impacts of the policies and the relationship between impacts and policies including the funding policy. This is best performed by analysing case studies.

This study seeks to achieve its objectives by providing an overview of European railway policies, looking particularly at the strategic documents like the Transport White Papers and the policy decisions of the so-called railway packages (I to IV). Secondly, it will look at the instruments in place that enable the development of transport infrastructures and the funding of these infrastructures. The issue of interoperability is related to infrastructures and rolling stock equipment. Due to the system of national railways, several technical and organisational barriers for true European rail transport prevail, and these hamper the efficiency of the European railway systems. Again the efficiency of the European railway funding has to be analysed in the framework provided by the institutional interaction between Member States' railway policies and European supra-national railway policy. This interaction is most prominent at the cross-border connections of the European railway system.

The selection of the four case studies needs to consider this setting. The case studies need to be part of European priority projects and include one or more cross-border railway sections. Further, the projects should cover a variety of different regions and be at different levels of maturity of project implementation to enable ex-post assessment of impacts of the projects. As this also includes regional development impacts that are only revealed over the long run, it is necessary to include some case studies that were completed at least 10 years ago. With these criteria in mind the following four priority projects were selected as case studies:

- The Oresund fixed link crossing between Sweden and Denmark completed in 2000 in Northern Europe (PP11),
- The north-western high-speed rail network between Paris-Brussels-Cologne-Amsterdam-London with parts completed in 1994 (Channel Tunnel) while the final parts at the German border are still under construction in Western Europe (PBKAL PP2),
- The south-western high speed networks from Portugal across Spain to Paris and Lyon with parts completed in 1992 but others still in the planning phase in Southern Europe (PP3), and
- The south-eastern rail corridor from Dresden to Athens and Costanza which is the least completed of the four case studies and is the only case study covering Eastern Europe (PP22).

Based on the findings of these very differently developed projects the study elaborates and presents conclusions with regard to the efficiency and the added value of European railway investments with a focus on cross-border connections.

The study is organised as follows: Chapter 2 introduces the EU railway policy and draws initial conclusions on the achievement of policy objectives on railway market development and modal split. Discussing these general conclusions on rail policy progress within the European Union the scene is set for a more detailed and differentiated look at funding instruments and corridor implementations in the subsequent parts of the study.

Chapter 3 takes a closer look at the various funding instruments applied during the programming periods 2000-2006 and 2007-2013 by EC institutions, EIB and Member States, and at the funding instruments in place for the current period 2014-2020 and potential alternatives or improvements. The weight and importance of the different funding instruments for the development of European railways is of particular concern.

Chapter 4 then delves into the four case studies, which represent a sample of projects in terms of size, progress and success. For each case study the transport impacts, the impact assessment, the funding structure, and the regional economic and cross-border impacts are investigated.

Chapter 5 summarises the findings of the case studies in terms of European added value and takes an extended look at other studies on European added value.

Chapter 6 finally draws conclusions on the efficiency and wider impacts of funding instruments and of cross-border railway investment projects. The conclusions and recommendations build upon the general statements on EC rail funding policy and seek to emphasise positive and negative aspects based on the funding scheme analysis and the case study findings.

2. EUROPEAN RAILWAY POLICY

KEY FINDINGS

- Since the decision of the EU Court of Justice from 1985 the EU has actively followed the objective of developing a common free and competitive European transport service sector under its legal competence. This was rapidly implemented in the area of road freight transport, where free cabotage/free tariffing were introduced in 1988/1994, and the haulage and forwarding companies were well prepared to operate under free market conditions.
- Common railway policy and **railway reform began with Directive 1990/440**. This was followed by Directives 2001/12-14 and three railway packages in 2001-2004. The EU Commission has prepared a proposal for a fourth railway package which is still under discussion.
- The main objectives of these intensive efforts by all EU political bodies are: organisational reform of railway companies, change from state railways towards a competitive regime, **free access to networks and essential railway facilities**, common principles for charging, **interoperability of infrastructure and rolling stock**, common operating control and safety systems.
- **Substantial changes** have been achieved **since 1985**. Infrastructure management has been separated from railway undertakings so that competition could grow within the railway service sector. Interoperability has improved after the establishment of the European Railway Agency, the common control system ERTMS is developing new and upgraded links and the problems of licensing new technology for international transport operations are on the way to being solved. Last but not least Trans-European Networks for Transport (TEN-T) have been defined, starting with the Maastricht Treaty, and TEN-T railway projects in the new MSs have received high co-financing from the EU Commission.
- Despite substantial changes have been achieved, the **prime political goal**, as expressed in the White Papers of 2001 and 2011, to revitalise the railways and to substantially **increase their market shares**, **has not yet been achieved**. The shares of railway in the passenger transport market have not much changed and have decreased in the freight transport market.
- The difficulties arising in this long process of restructuring the railways are caused by a number of factors: the **technological and organisational fragmentation of EU railway organisations**, the long life and high fixed costs of railway technology, the long time needed for migration of new technology and regulations, the national railway policies protecting their state companies, the resistance of trade unions against competitive structures and low market pressure because of high public subsidy.
- In the future a continuation of the railway friendly EU policy can be successful as soon as Member States, technology and organisation allow for Europe-wide transport without major border delays and without changes of locomotives and personnel. Standardisation of technology can lead to lower costs of investment and maintenance of rolling stock; modern infrastructures on the main (Core Network) corridors can increase speeds and lower operation costs; services on passenger trains and synchronisation of freight trains can lead to **better adjustment to market needs**. A full internalisation of external costs will be an essential precondition for the market success of railways.

Chapter 2 introduces EU railway policy and provides an overview on the achievement of policy objectives on railway market development and modal split. Discussing these general issues on rail policy progress within the European Union sets the scene for a more detailed and differentiated look at funding instruments and corridor implementations in the subsequent parts of the study.

2.1. RAILWAY MARKET ORGANISATION AND COMPETITION POLICY

European transport policy became a focal instrument of European integration policy after the decision of the European Court of Justice from May 22, 1985, which stated that the European Council had been inactive with respect to the establishment of a common free and competitive transport service sector. The Council was forced to correct this neglect according to Art. 176 EEC, within a reasonable range of time (see Erdmenger, 1985). Shortly after this decision the European Council decided, on June 29, and the Council of Ministers of Transport on November 14, 1985, to develop a free and competitive transport market by 1992. The principles decided upon have entered the Maastricht Treaty of 1992 which guaranteed the free movement of people, goods, services and capital and gave a new momentum to the common transport policy. It underlined the European competence for regulation and competition policy on the transport market – which could no longer be treated as a special market with national exceptions – and also a European responsibility for a coordinated transport investment policy which is manifested in Article 129 of the Maastricht Treaty through postulating guidelines for Trans-European Networks for communication, energy and transport.

The relevant European legislation is based on the Directives 1990/440 and 2001/12-14. The first Directive 1990/440 initiated the common European railway policy and stated the following principles:

- Clear separation of public and commercial parts.
- Freeing the commercial companies from old publicly induced debt.
- Separating infrastructure managers from railway undertakings, separate bookkeeping and balance sheets.
- Preparation for open access of third parties to the networks.

This framework Directive was supplemented in the year 2001 by Directives 2001/12-14, which specified the steps for opening of the market and the regulations for the companies. These Directives were the base of the so-called railway packages which were issued to specify expected actions in all Member States and for all EU railway companies following the legal framework created.

First railway package (2001):

- Specification of open access, procedures in case of essential facilities.
- Specification of regulatory requirements in the event that the infrastructure manager (IM) and railway undertakings (RU) are governed by a holding company.
- Obligation for Member States to establish fully independent regulatory bodies with the necessary resources, competences and expertise.
- Common principles for charging railway track use on the base of marginal costs plus mark-ups.
- No cross-subsidisation between freight and passenger service.

Second railway package (2002)

- Establishment of a European Railway Agency (ERA) in Valenciennes, France.
- Opening of the market for international freight transport to the entire European rail network as of January 1, 2006.
- Opening of the market for national freight transport ("cabotage") as of January 1, 2007.
- Adoption of a Directive on railway safety.

Third railway package (2004)

- Further opening of the market for international rail passenger transport.
- Regulation of the rights and obligations for passengers in international rail traffic.
- Regulation of rail freight quality.
- Directive for train driver's licenses.

Fourth railway package (proposal)

On January 30, 2013 The European Commission approved the Fourth Railway Package to accomplish the development of a single European railway area. The proposals focus on four key areas (see POLIS Network, 2014):

- **Infrastructure governance**: Institutional separation between Infrastructure Managers (IM) and Railway Undertakings (RU); strengthening the role of IMs and their operational and financial independence, establishment of a European Network of IMs.
- **Opening of the market for domestic passenger transport services by rail**: More competition on regional rail markets, market opening for new entrants from December 2019 onwards, urban mobility action plans, non-discriminatory access to ticketing systems, non-discriminatory access to suitable rolling stock.
- **Interoperability and safety**: Transfer of competences from Member States to the European Railway Agency (ERA) for issuing vehicle authorisations and safety certifications, and removing technical market access barriers.
- **The social dimension**: Safeguarding of jobs after market opening, protecting workers by requiring new contractors to take them on when public service contracts are transferred.

The White Papers from 2001 ("Time to Decide") and from 2011 ("Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system") have prepared the political basis for a fundamental restructuring of the European railway sector to achieve a revitalisation with growing rail modal shares. The 2001 White Paper addresses the necessary steps to revitalise the railways through integrating rail transport into the internal market, making optimum use of the infrastructure and modernisation of services. Market opening, stepping up rail safety and interoperability, new infrastructure particularly in rail freight freeways, are essential elements of the political programme for the ten year period until 2010.

The 2011 White Paper sets a clear vision of a competitive and sustainable transport system to achieve the ambitious goal of reducing the CO_2 emissions of the European transport sector by 60% in the year 2050 compared with 1990. The railways are an integral part of the planned Single European Transport Area and can contribute to the climate goal by attracting considerable parts of transport from road and air to the rail mode. For instance, 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050. This is facilitated by efficient green freight corridors and presupposes a number of changes of the railway sector as they are described in the railway packages. Furthermore, it requires more emphasis to be put on the internalisation of external costs of road and air transport, dramatically reducing accident rates and air pollutant emissions on roads, and minimising climate impacts from road and air transport.

2.2. VARIETY AND REGULATION OF TECHNICAL STANDARDS

Not only regulation, but technical standards chosen by the European countries also hamper interoperability and greatly reduce flexibility and cost efficiency of cross-border rail transport, particularly for freight. These national specificities have either been chosen deliberately for network protection or have emerged as a consequence of industry or energy sector structures. The most relevant network characteristics are listed below:

(1) Power Systems: 6 different power standards for long distance rail traffic exist in the EU. The majority of countries apply 25 kilovolt (kV) / 50 Hz alternating current (Portugal, England, Finland, Denmark, northern France, parts of Eastern and South-East Europe), followed by 15 kV, 16,7 Hz (Ireland, northern UK, rest of Scandinavia, Switzerland, Austria and Germany). Spain, Italy and the rest of Eastern Europe apply the Russian system, while southern France and south-east England apply their own DC-systems. Multiple power systems thus not only appear between larger regions, but also between and within countries (e.g. UK, France, Czech Republic, Slovakia).

(2) Pantograph Profiles: Electric power supply requires standardised shapes and heights of catenary systems. Europe uses four standards, which are not necessarily consistent with power systems.

(3) Track Gauges: The European networks consist of six standards for track width. However, of these, only three (the UIC standard gauge, the Spanish and the Russian gauge) are relevant for long distance transport. There are even differences within countries as the Spanish example shows standard gauge for high speed network and wide gauge for the rest of the network.

(4) Train Lengths: There are more than 20 regulations on maximum train lengths on the European network. These relate to signalling standards, block systems or length of the passing tracks and may even differ within countries (e.g. in Germany with 735 m west and 650 m east). Single projects, such as the 1500 m train tested by the Marathon-Project in France or the 850 m train from Denmark to Hamburg, try to increase and unify train length in rail freight.

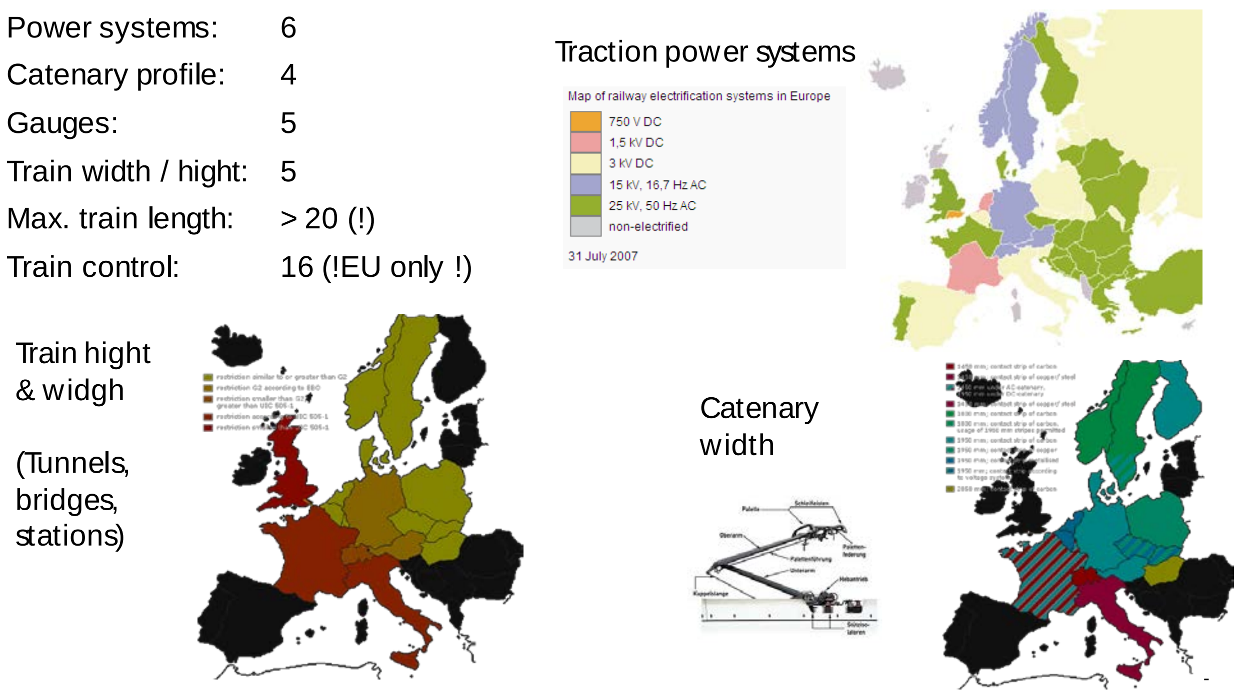
(5) Loading Gauges: European networks cannot cater for double stack container trains and are subject to varying regulations on maximum width and height. Standards are set by UIC regulations 505-1/4/5/6 and 506 as well as by national bodies. A large number of countries use a standard

larger than the German / Austrian national standard (G2; Scandinavia, Eastern Europe and Benelux). While France, Italy and Switzerland (a bit larger) go for the UIC 505-1 standard. Profiles are smallest in the United Kingdom.

(6) Train Control Systems: Train control systems ensure safety in rail transport and have a large impact on track capacity. With the introduction of the European Train Control System (ETCS), EC and UIC have attempted to define a common standard for international train operations. However, although the implementation of its second stage (ETCS Level 2) is slowly progressing, there are already national adaptations (dialects) appearing and Europe still consists of more than 16 different control systems in the EU Member States alone – often several in one country. Given the fact that ETCS or similar systems can increase track capacity by up to 40 % (TOSCA-Project) this slow progress, particularly in the large countries in the European centre, is astonishing. Multiple and incompatible systems make international approval of locomotives and power cars slow and expensive and drastically reduce the number of train sets available for use on international corridors.

The following illustrations give an impression of the scattered picture of the technical regulations in the European railway network. On top of this heterogeneity there exists a multitude of different licensing regulations or rail track access charging systems.

Map 1: Technical standards on the European rail network



Sources: https://en.wikipedia.org/wiki/Railway_electrification_system (upper right), http://www.bueker.net/trainspotting/voltage_map_europe.php (lower left and right)

Some of the characteristics are determined by engineering design alongside the track, such as the tracks themselves, tunnel profiles or curve radii. These will be very difficult and expensive to adapt with existing infrastructures. On the other hand, with new infrastructures, track and loading gauges can be adjusted to common EU standards without impacting the rest of the network. Other parameters are associated with control systems and infrastructure conditions, namely train length depending on block distances and the length of sidings. Power system and catenary profiles are specific elements of the trackside equipment. Adapting these to other standards for a particular corridor segment should be available at moderate costs – but adaptations need to be implemented along the whole network. So the most promising way to start is to harmonise control systems for specific corridors. This is done for major track renewal or new investments along the Trans-European Rail Network.

2.3. INFRASTRUCTURE INVESTMENT POLICY

Following the decision of the European Court of Justice in 1985, the EU Commission began initiatives to co-ordinate national master transportation plans and make the European transport infrastructure interoperable. Decisions on transport investment, however, remained in the domain of Member States. The Maastricht Treaty included the obligation to develop guidelines for Trans-European Networks (TEN) every 8 years, beginning with the year 1996. The first guidelines for the transport sector (TEN-T) – published as decision No 1692/96/EC - included 14 priority projects, the so-called Essen - projects. Ten of these 14 projects included rail investments. The EU Commission also launched an initiative to analyse the needs for transport investments in accession countries which became EU Member States in 2004 and 2006. The results of the "Transport Infrastructure Needs Assessment" (TINA) were included in the first revision of the TEN-T in 2004, which was prepared by the High Level "van Miert" - Group.

The 2004 TEN-T revision, published in the decision No 884/2004/EC of the European Parliament and the Council, suggested 30 priority corridors altogether. Eighteen of these concern the improvement of the rail network and four are combined rail/road projects. In 2006 the TEN-T EA (Executive Agency) was established to support the programming, selection and monitoring for TEN-T projects, to provide technical assistance with financial engineering and administer the budget of the programme. Furthermore, nine coordinators for the most important projects have been charged to identify and help to solve problems, in particular with the cross-border sections of projects.

The 2011 TEN-T revision, which was partly modified in 2013, introduced a dual layer consisting of a comprehensive and a core network. The comprehensive network comprises all major European transport links as defined in 2004 while the core network includes all nodes and links of highest European importance to be realised by the year 2030. The network elements have been structured to form nine core network corridors (CNC, as published in the CNC - brochure of the EU Commission, 2013). All CNC are defined as multi-modal, but as they include the projects of the 2004 TEN-T there is a clear dominance of rail projects. The Rail Freight Corridors exist in parallel with the CNC. They had been defined in Regulation 913/2010/EU, which is largely included in the CNC. The EU Commission has launched comprehensive transportation studies for all CNC and started a communication and governance process. This consists of CNC-forums and other stakeholder information to drive EU infrastructure policy forward and foster initiatives on integrating freight corridors, promote future-oriented infrastructure standards, boost innovative projects (e.g. on the field of clean fuel or traffic management), stimulate synergies with other sectors (e.g. energy or climate protection), advance resource-efficient infrastructure development, and encourage innovative financing solutions[1].

1 Key notes taken from presentations of the EU Commission given at the 1st CNC Forum in Brussels, 2014.

2.4. POLICY ACHIEVEMENTS

Despite the attempts of the EU Commission in the past 25 years to establish an internal market for rail, and improve rail efficiency, the success measured by market performance has been very modest. The introduction to the 4th Railway Package (draft 2013) concludes that although there have been major re-organisations of the railway sector and large sums of money have been spent on railway investment and public service obligations (PSO) by Member States and the EU Commission, the market results achieved are highly unsatisfactory. The following results are shown by comparing the modal split statistics of 2012 with 1995, when EU rail policy began to be reformed (see European Commission, 2014):

- The modal split in passenger transport (in pkm) has been almost stable at 6.5 %.
- The modal split in freight transport (in tkm) has decreased from 20.3 % in 1995 to 17.2 % in 2012 (figures without maritime shipping). However, this is also due to the strong decline of rail transport in the new Member States.

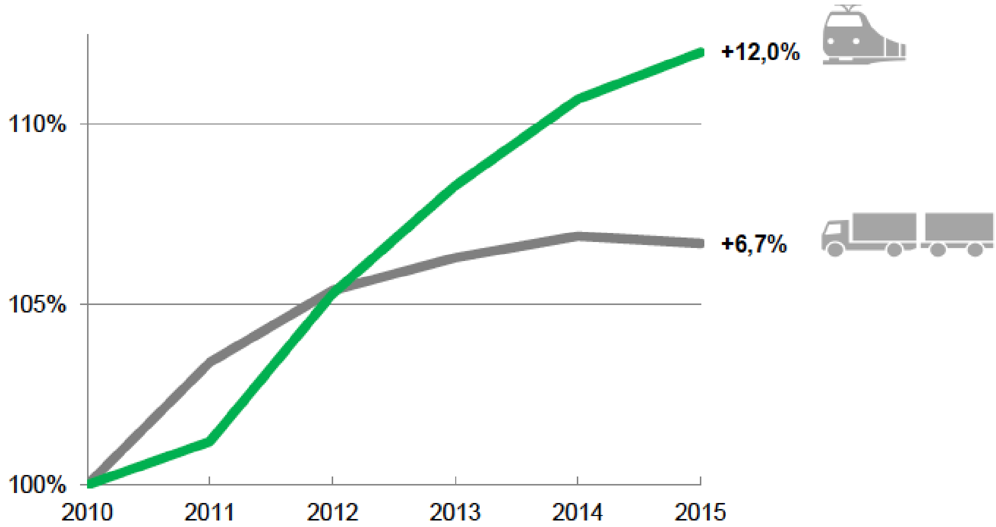
Although some growth was recorded for rail it was not higher than the market average in passenger transport and even lower in freight transport. This indicates that the aim of the EU Commission and of the Member States to shift transport activities from road and air to rail has not been achieved.

However, the EU rail market development has not been uniform. For instance, Sweden reported an increase of rail passenger transport of more than 20% from 2005 to 2010. During the same period the German rail freight transport increased by 12%. These examples show that there are a number of different reasons behind the average figures. Looking at the list of main causes given below one has to bear in mind that they don't apply homogenously across all Member States and their railway companies.

- The railway companies are operating in highly competitive markets and have difficulties in following the market requirements of flexible, synchronised and low-cost door-to-door service. The estimated potential for modal shift in the past has not considered the market dynamics which worked in favour of road and air.
- Higher efficiency of railways with respect to better environmental/climate and safety performance are not translated into competitive advantages because the external diseconomies of road and air have not been internalised. Although Directive 2011/76/EU provides the option of internalising costs of air pollution and noise of heavy goods vehicles on the road, the impacts on road transport costs are negligible.
- Interoperability problems with respect to infrastructure profile, power supply, train control, rail safety, rolling stock and organisational standards persist and the Member States are only interested in migrating to EU standards if they receive sufficient co-funding from the EU.
- The transformation of former national rail companies to commercial railway undertakings has provoked more social resistance than expected. France and Germany are examples of the growing political power of rail labour unions and the ways in which labour conflicts are conducted reduce the reliability of railway transport and their attractiveness to the customer.

While older forecasts, in particular for the EU Commission, present very optimistic prospects for the development of railway competitiveness on long-distance transport, the recent national forecasts look different. The transport forecast for the German Transport Infrastructure Master Plan (BVWP, 2015, p 297) predicts a decreasing modal split for railway freight transport on transit relationships, i.e. the market segment for border crossing freight movements, which should be addressed most intensely by the EU policy. This takes into account only partially the actual development of railway costs compared with competing modes as it is shown in Figure 2. It demonstrates that the costs of rail freight transport have increased in recent years relative to road transport such that the positive achievements reported above are also at risk.

Figure 1: Development of the Price Index for Freight Transport in Germany



Source: Allianz pro Schiene, 2015 (based on Federal Statistical Office)

Based on the empirical evidence of missing achievements and growing market threats the European Economic and Social Committee (EESC, 2013) has published a very critical opinion on the 4th Railway Package, based on more than 20 years of experience. Some essentials are:

- The measures suggested to improve governance and to open domestic passenger services to competition are not all supported by evidence and are disputed by experts (e.g. by the McNulty Report (2011) from the UK). This applies for the Commission's proposal of strict separation between the functions of IMs and RUs.
- The situation for rail freight in a number of Member States is "disastrous". Many players willingly admit that "in a number of Member States, not a single tonne of goods has been transferred to rail as a result of liberalisation." (EESC. 2013, p 8). While the competition has become fierce on the most profitable connections, which has brought improvements for a number of block trains, this is partially at the expense of single wagon load services (which are important for shifting the transport of higher valued final and intermediate goods from road to rail).
- The EESC is not convinced that the proposal of the Commission to foster market entry of new players, which do not have to invest or work on research and innovation (leasing rolling stock from ROSCOs and taking over personnel from companies who have lost tenders) leads to the desired competitive dynamics. Following the UK example, leasing of rolling stock is carried out by banks and financial institutions which are interested in short-term financial profits

while long-term technological development and education of qualified personnel is not their business.

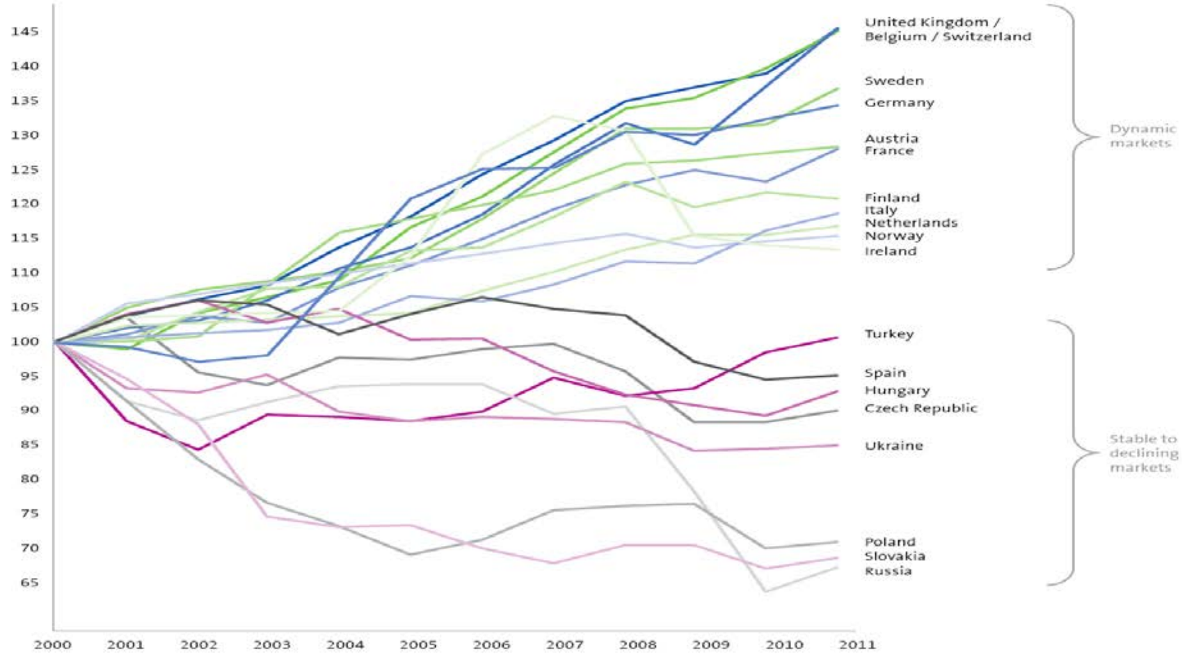
The controversial discussion of the 4th Railway Package by Associations of Public Transport and NGOs –particularly criticising the abolition of direct contracting and the introduction of obligatory tender beginning with January 2023, indicates that some major changes will be necessary before the package might pass the EP and the Council. A solution could be to separate the technical part, which is widely agreed and ready to be introduced, from the organisational/regulatory part, which needs further negotiation.

To bridge the gap between the ambitious European Commission's policy plans and the review of past success/failure stories, the European Commission has issued a number of research and support projects in the 7th framework programme: LivingRAIL, SPIDER PLUS, FOSTER RAIL, TransForum, Marathon, etc. The studies mainly criticise the lack of implementation of policies and investment programmes with sufficient stringency. They identify a lag of co-ordination between EU, Member States and railway companies and call for a change in business and policy cultures. The joint policy brochure of the LivingRAIL and SPIDER PLUS project prioritises measures to be taken for a massive shift of passengers and freight consignments to rail as follows:

- **Investment**: Complete the European high speed and priority freight corridor network. Capacity is of utmost importance as many countries with high rail shares today, already operate at the network utilisation margin. Equally relevant is to close gaps, particularly in border crossing links, and upgrade inter-city main lines to 160 kph. This has to be supported by appropriate funding options (see section 3.).
- **Reforming railways** is then the second biggest endeavour besides capacity provision. Without railways which have incentives and the capabilities to act for their customers rather than to be stuck in system optimisation, no major demand shift will happen in passenger or in freight markets.
- **Inclusive planning**: Europe needs a vision for its transport policy. Once defined, this needs to be broken down into details in conjunction with the Member States and with the railway (and other transport) companies. In that sense the role of corridor co-ordinators need to be strengthened and all parties need to commit to co-operate.
- **Fair market conditions**: Railways have to pay for energy and value added taxes, and purchase of CO_2 certificates or noise reduction for their rolling stock.[2] However, their competitors don't pay for substantial parts of their external costs (accidents, environment, climate change). Internalisation of external costs is a precondition for the success of railway investment and railway reform.
- If these – and a whole series of supporting measures in the areas of land use, urban development, regulation and pricing, mobility services, rail technology – are taken seriously, a major shift to rail is possible. The development of cross-border passenger demand in Western Europe in recent years supports this (see Figure 2).

[2] Note that these conditions vary between the Member States.

Figure 2: Cross-border rail passenger flows 2000 – 2011



Source: Amadeus Research 2013

3. EUROPEAN RAILWAY INFRASTRUCTURE FUNDING

KEY FINDINGS

- Funding **from national budgets contributes more than half of the financial sources for railway infrastructure investment**. European co-funding provides an additional 12% on average. The remaining third of the total funding stems from a variety of sources such as loans, equity capital (in the case of large projects) or rail track charges (only for running costs and parts of maintenance/reinvestment costs).
- As **rehabilitation of the railway networks is becoming a dominant issue** which requires stable financial streams and efficient management of maintenance/reinvestment work, some MSs (e.g. Germany) have established special funding schemes which are supplied partly by government money and partly by the infrastructure management companies and their holding companies. This allows for efficient medium-term planning, scheduling and implementation of works independent of constraining public budget regulations, but is controlled by private and public auditors on the basis of performance indicators.
- **European co-funding** can be provided by CF, ERDF, CEF (mainly grants), and EIB (mainly loans). In the future it could also include EFSI funds and extended instruments which can be combined with the above main sources. The role of TEN-T funding through CEF has substantially increased, particularly through the integration of CF funding which comprises 11.3 out of 26.25 billion EUR for the period 2014-20 (2.2 billion EUR being transferred to EFSI). For railways a slight growth of funding by the structural funds can be expected.
- The main problem of applying new instruments to railway infrastructure investment is that **private investors of a public private partnership (PPP) usually require a revenue stream** which can at least finance the private capital invested (amortisation and interest). In such cases, instruments like LGTT help to overcome financial difficulties in the start-up phase while they assume that the revenue flows will be sufficient in the following periods. In the **case of railways, sufficient revenue flows cannot generally be expected.** Therefore PPPs would have to be based on **achievement or performance indicators** and refinanced by state money.
- Furthermore, **PPPs** are in the first instance instruments which encourage the efficiency of private business cost control, risk management and the sanctioning of success or failure. A positive example is provided by the **Tours – Bordeaux line on PP3 and the Atlantic CNC.** As most railway infrastructure managers claim that they are behaving according to private business rules, conflicts may arise between private project managers of PPP schemes and semi-private infrastructure managers. Such conflicts have to be solved a priori by appropriate contracts and arrangements.
- **Project bonds** appear to be an appropriate instrument for rail funding because institutional investors, like pension funds and insurance companies, could be attracted. Last but not least **mixed funds** can be established which are financed by (earmarked) taxes, road user charges or mark-ups for external costs.
- It would also be possible, in principle, to construct appropriate **bond financed PPPs** which are not based on revenue streams. However, as the state in this case would have to contribute “shadow revenues” to pay back amortisation and interest, legal feasibility is in question because this type of PPP finance could be classified as a hidden public credit which would increase public debt and **create conflicts with the issue of budget consolidation** (Stability and Growth Pact).

3.1. EUROPEAN FUNDING OPTIONS FOR RAIL PROJECTS

3.1.1. National Funding

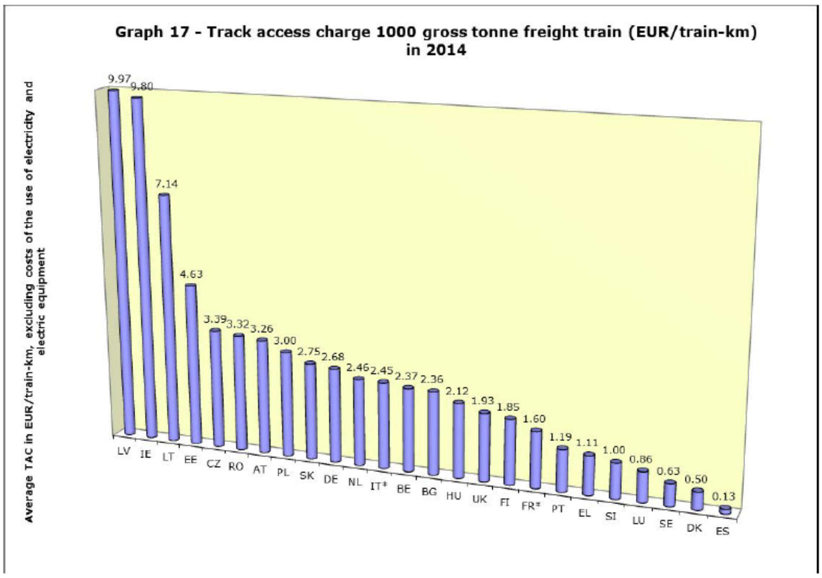
a) Budget funding

National funding from the government's budget is the main source of financing transport investments. Infrastructure for public rail transport does not usually generate revenue streams which are interesting for private investments. While it is possible, in principle, to finance the government's budget through taxes and credits, the latter option no longer attractive because the budget consolidation has first priority in a number of member countries as a consequence of the European Stability and Growth Pact , ratified on March 2, 2012. Federal funding can be generated by co-funding agreements with regional and local (city) institutions, which is, for instance practiced in France for the TGV development and in Germany for the mega-project Stuttgart 21/Stuttgart-Ulm.

b) User charges (Rail track charging)

Rail track charging is regulated by Directive 2001/14 and the railway packages. The charging principle is marginal cost-based but the regulation allows for mark-ups and multi-part charging schemes which apply further differentiations according to technological characteristics, bottlenecks (scarcity) and level of service. The Recast of the first Railway Package and the Proposal for a Fourth Railway Package (see Chapter 2) foresee a differentiation according to noise emission reduction (silent brakes for freight wagons). This is already implemented in Germany, the Netherlands and Switzerland as a non-EU neighbouring country. In many member countries the rail track charges do not cover more than the current running cost and wear and tear. Figure 3 shows the wide variations of rail track charges for freight trains in the Member Countries.

Figure 3: Track access charges for freight trains in 2014



*Source: RMMS questionnaires - no data for Norway; *= for France and Italy, data refers to 2013, as these Member States did not provide data for 2014. – Annex 8 of Staff Working Document SWD(2014) 186*

Source: European Commission, 2014

c) Financing schemes for current maintenance, re-investment and new investment

As can be concluded from Figure 3 the revenues from rail track charging in most countries will not finance more than the running and current maintenance cost (5-10% of total costs). In Baltic states like Latvia, the high charges for rail freight (bulk cargo transport related to the ports at the Baltic Sea) are able to finance the major part of total cost. In other states like Germany, the revenues are substantially higher than the running and current maintenance costs but a long way from covering the total costs. Therefore in Germany a Performance and Funding agreement between the federal government and the Deutsche Bahn AG[3] was set up in 2009 and renewed in 2015. The expected surplus achieved by the infrastructure management company of Deutsche Bahn AG plus a contribution of the holding company make a company contribution of EUR 1.6 billion p.a. This is allocated to a fund for reinvestment and major maintenance of rail infrastructure for a five years period 2015-2019. The federal government pays EUR 4 billion p.a., such that the fund receives payments in an order of magnitude of EUR 28 billion, which can be spent according to private business rules, i.e. avoiding the restrictions of public budget planning. A plan for reinvestment measures associated with quality performance indicators has been set up which is approved by the government and will be checked by private accountants and the Auditor General. The company will have to pay penalties if the performance indicators are not met.

Financing of new rail infrastructure investment is generally a matter of national budget finance and EU co-funding. Exemptions are links with high passenger or freight volume, for example to connect large airports, ports or hubs, for which PPP schemes are feasible. Principally a master plan for transport investments has to be set up and approved by the parliament before projects can be allocated to financial plans. This is generally done within medium-term financial planning. In most countries there is no synchronisation of long-term transport investment with long-term financial planning, with the Czech transport sector strategic plan (2012, Book 9) being a positive exception to this rule.

d) Public Private Partnerships

In PPPs the state is responsible for planning, legal procedures and eventually a share of investment costs, while private investors take responsibility for the construction, maintenance and operational arrangements (in Design-Build-Finance-Operate, DBFO) Parts of the final design are also planned by the private partner. This means that the private sector not only contributes part of the funding but provides a number of functions which are associated with private finance such as cost control, risk management, information/transparency and sanctions (incentives for management success). Obviously the private investor cannot provide the liquidity at better conditions than the state so the capital cost will be higher than that of public finance. Furthermore transaction costs will occur because the contractual arrangements can be complicated, particularly if conflicts are foreseeable and the possibilities of rent seeking and faulty strategies have to be considered. Therefore the World Bank (2012) and several countries (see Reform Commission, 2015) apply public sector comparators (PSC) to check whether PPP is superior to conventional public funding in a life cycle context.

For the railway investments, PPPs are often not a preferred option. The reasons are twofold. First of all a project has to generate a revenue stream which will serve to pay back the capital costs and to generate a profit for the investor. The market revenues from railway projects are generally low and risky in the sense that they are influenced by a government's decisions on investments (e.g. parallel investments in

[3] Performance and Funding Agreement (Leistungs- und Finanzierungsvereinbarung (LuFV). LuFV I: 2009-2013/14. LuFV II: 2015- 2019).

motorways), taxes (e.g.: energy taxes and VAT on rail, no taxes on international air transport) or on rail track charges (social policy arguments in regional and local public transport). Secondly rail investments influence the whole network such that project-specific pricing and management could reduce the network connectivity. This generates a priori conflicts between project and infrastructure managers, as the latter feel responsible for the complete rail network. Many infrastructure managers have signed private sector-type contracts and claim that they integrate the private market functions of finance such that there would not be sufficient efficiency gains through PPPs to outweigh the higher cost of capital procurement and the higher transaction costs. Experiences with PPPs so far in the railway sector are not in any case encouraging (see CE, 2012). It is also affected by the fact that public influence on the public transport sector is bigger than on road or airport investments making it difficult to construct a clear and reliable business case for the private investors.

Several attempts have been made to cope with these difficulties. In Germany PPPs have been constructed for motorway upgrading projects which are based on availability instead of market revenues i.e. in the end the authorities pay for the availability of the infrastructure fulfilling pre-defined performance criteria (authority pay). In France a PPP scheme has been developed for the finance of the HSR link between Tours and Bordeaux as part of PP3 and the Atlantic corridor, which includes "quasi-private" project revenues. The concessionaire contributes 49% of the investment costs while the infrastructure manager gives 13% and the state (federal and regional governments) pay for the rest of 38%. The scheme is reduced to "DBF", i.e. the private concessionaire is only responsible for providing the project but not for its operation. The payments for amortisation and interest for the concession are generated by the railway undertaking SNCF.

3.1.2. EU Funding of transport infrastructure

European funding instruments have been described in detail in the report of CE Delft (2012) for the European Parliament and can be classified into EU grant funding, EIB/EBRD bank financing and innovative financial instruments (see Table 1). The main funding instruments are the Connecting Europe Facility (CEF), which replaces the former TEN-T funding, the European Fund for Regional Development (EFRD) and the European Fund for Strategic Investments (EFSI). These instruments are described in more detail in sections 3.2 and 3.3. In this section we will focus on additional instruments which involve private investors or are constructed like private financing schemes.

Table 1: European Funding Instruments

FINANCING SOURCE / INSTRUMENT	TYPE OF FUNDING	BUDGET 2007 – 2013 BILLION EURO	PROPOSED BUDGET 2014-2020 (BILLION EURO)	MANAGE-MENT	MAX. CO-FINANCING RATE
TEN-T programme	Mainly grants	8	--	EC/INEA	**50%**
CEF	Mainly grants	--	24.05	EC/INEA	**85%**
Marguerite Fund	Equity	1.5	Not known	Core sponsors (banks)/EC	**10%**
LGTT/EU project bonds	Guarantees	1	Not determined yet, will fall under CEF	EIB/EC	**20%**
ERDF	Grants	46.7	Not known ex ante	Member states/EC	**85%**
CF	Grants	35	Not known ex ante	Member states/EC	**85%**
EIB	Loans	53	Demand driven	EIB/Member states	**75%**
EBRD	Loans	Not known	Demand driven	EBRD	**N/a**
SFF	Loans	Not known	Not known	Member states/ EC/EIB	**Max. €300m**
National, regional, local governments	Grants Loans Guarantees	Not known	Not known	National, regional, local government	**100%**

Source: own compilation based on CE (2012)

Originally the proposed CEF funding was EUR 31.7 billion. During negotiations of the MFF this budget was reduced to EUR 26.25 billion from which EUR 2.2 billion have been transferred to EFSI. The CEF budget for transport is now EUR 24.05 billion.

3.1.2.1 Public private partnerships

The EU Commission follows the dedicated objective to develop alternative financial instruments to support public finance by a government's budget. This is becoming increasingly difficult because of the requirements of budget consolidation (see the White Papers on Common Transport Policy from 2001 and 2011). One option is to construct public private partnerships (PPP) for appropriate infrastructure projects as described in section 3.1.1. The EU Commission can add further instruments presented in the following sections to make PPPs more attractive to private investors.

3.1.2.2 EIB-Loans and Loan Guarantee Instrument for TEN-T Projects (LGTT)

The usual EIB-Loans are given to the public investor of a project and paid back at least partly from the revenues induced by the project. Against the background of declining national finance of transport infrastructure projects by PPPs after the financial crisis (the value of project financed infrastructure in Europe declined by more than half from EUR 70 billion in 2010 to EUR 34 billion in 2012, see EY, 2014) the LGTT instrument has been launched by the EIB and the EU Commission in 2008. It aims to promote private sector (e.g. PPP) involvement by helping private investors to overcome the most critical ramp-up phase which is 5-7 years after opening of a project. LGTT provides guarantees against demand risk in this period of up to 20% of total senior debt. It gives EIB the possibility of accepting debt with higher financial risk than normal. A basic condition is that the project is financially viable, which is assessed by EIB, i.e. the financial problem to be overcome by LGTT is expected to be only temporarily.

During 2008 - 2012, the LGTT was signed for five motorway projects, one maritime project and one high speed rail project (LGV Sud in Southern France). However, none of these projects has actually used the guarantee (see: EU Commission, 2014). This indicates that LGTT application has become very narrow and limited. One reason is the change in prospects for transport development after the economic crisis, which has drastically reduced the propensity of banks and other investors to engage in such projects.

As concluded in section 3.1.1, rail projects do not have an affinity with PPP finance, particularly if they are traffic-revenue dependent[4]. But as soon as the revenue dependency is ruled out of the PPP contract, as in the case of availability-based arrangements, the LGTT instrument is not needed. Therefore this instrument is only expected to play a role in the future finance of railway investments, even if it is extended, for instance by project bond constructions (see section 3.1.2).

3.1.2.3 EU Project bonds

The Europe 2020 Project Bond Initiative (PBI), carried by the EU Commission and EIB, aims to revive and expand capital market options to finance large TEN projects for the transport, energy and communication sectors. The Project Bond Credit Enhancement (PBCE) facility has been established. This instrument supports senior project bonds issued by infrastructure project companies. The pilot phase began in 2012 under Regulation No. 670/2012 and is expected to end in 2016. It is regarded as a precursor of the main phase under the CEF for the Multi-annual Financial Framework 2014-2020 for which the CEF can allocate EUR 24.05 billion to the transport sector. The testing phase is supported

[4] This is underlined by the EPEC (2015) Review on the European PPP Market. Although transport projects make about two thirds of the total PPPs in 2014 there is no railway project among them.

by EU budgetary resources which stem from unused funds. On this basis the initial phase of four motorway projects have been supported.

Against the background of difficulties of integrating private finance into the funding schemes for transportation projects, particularly for the railway sector, the EU Project Bond Initiative has developed a concept to make project bonds for transport infrastructure attractive to large investors, particularly institutional investors like pension funds or insurance companies. The EU would contribute up to 20% altogether of the project costs and provide about one third of the risk guarantee. This would broaden the scope of the LGTT by extending it from bank lending to the larger capital market.

With this objective the EU project bonds could also co-finance PPPs which are funded by availability or performance-based payments of the state, i.e. independent of market revenues of the project. But this instrument is not free of risk. For instance, moral hazard risk may occur in the sense that financially unviable projects are promoted. The effect would be that the basic functions of PPP of introducing better management, cost and risk control, would not be automatic and would have to be introduced into the scheme by appropriate performance indicators in the contracts. Therefore the EIB will have to adjust their assessment criteria, in particular the financial soundness and economic viability, in a wider context.

Three pilot projects were started to test the instrument, one of these being the Belgium motorway project A11 which was the first greenfield PPP using this instrument. A recent example for application is the German A7 motorway project Hamburg-Bordesholm. The availability (or authority-pay) based PPP consists of a mix of public and private financial sources including EIB loans constructed by the new PBCE instrument.

The intended leverage effect is estimated to be between 15 and 20. In presentations and documents of the EIB or of the Commission (e.g. EY, 2014) even a leverage factor of 19 is discussed. This factor has obviously been derived from a German motorway extension project, for which the EU contribution from LGTT was EUR 30 million for a total cost of EUR 562 million, which makes 1/19 of the total costs. But it can be doubted that the LGTT support was the critical factor which has brought the project to life. Contrasting with this example, the mid-term evaluation report of the Commission (2014) highlights a highway project in the Netherlands for which the PBCE was successful: the highway extension project N33 was financed 38% by normal bank loans while 62% of the debt was secured by the Dutch pension fund.

3.1.2.4 Developing new schemes for European Infrastructure Projects

A high level group consisting of H. Christophersen (former Vice-President of the EU Commission), K. Bodewig (former Minister of Transport of Germany) and C. Secchi (both TEN-T Coordinators) delivered an interim report on this challenge to the Transport Ministers' Council in December 2014 and a final report in June 2015 (Christophersen et al., 2014; 2015)[5]. It starts with pointing out the high investment needs for transport infrastructure which could not be satisfied in previous decades. The group has started to collect information on future investment needs from the Member States with the interim result that more than EUR 600 billion will be needed in the period between 2014 and 2030. In principle there is enough liquidity on the capital market to be directed to infrastructure

[5] This high level group is further on named "Christophersen Group".

finance, for instance the OECD (2014) cites assets of pension funds (20.4 trill. US $), insurance companies (24.3 trill. US $) and investment companies (28.8 trill. US $) worldwide for the year 2010.

The group concludes that a better environment for private investments in transport has to be created. Under this condition new financial instruments as they have been presented above have to be developed further. Furthermore it is important to give support to project managers and public administrators in using such instruments. When it comes to areas of transport investments, which could be considered for application, the group mentions – among a number of other areas – the deployment of ERTMS on-board trains.

The group reports a total of EUR 127 billion for projects which will be ready for implementation by 2017, among them being EUR 30 billion for railway projects. Projects of highest EU added value are identified, particularly cross-border projects, major bottlenecks and other cross-border sections, giving priority to greener modes of transport such as railways or inland waterways. Such priority projects could be financed by a combination of EU grants, long-term loans and national co-funding, i.e. a combination of private and public funding. The group suggests an appropriate pooling and blending of these instruments.

When it comes to details of rail finance the group is well aware of the basic difficulties, particularly with revenue-based financing schemes, and suggests two additional business models: a concession-like scheme, and a dedicated transport fund. Concession-like schemes can be constructed without generating revenues from the operation of a project, as for instance in the case of PPPs based on availability or performance indicators (see section 3.1.1). Appropriate contracts have to be developed to describe the obligations of private contractors while trying to avoid conflicts with the rail infrastructure managers. Another example of a concession-like scheme is the joint finance of road and rail investments as in the case of the Oeresund project. In this case a major part of the revenues is generated from road user charges which also benefit rail. The concessionaire is a public enterprise (Sund and Belt) and the risk is absorbed by public guarantees (see Öresund case study).

Dedicated mixed transport funds would collect money from different sources. The Swiss "FABI" investment and finance scheme for instance applies the funding concept in a most extensive way. It is based on a long-term infrastructure investment plan and the estimated total costs for its realisation. The revenue sources to finance these life cycle costs include revenues from rail track charges, payments for service obligations, mark-ups for fuel taxes, motorway vignettes from passenger cars and road user charges from heavy goods vehicles, i.e. a massive cross-finance from road to rail. Contrasting this extensive funding scheme the German concepts, suggested by Advisory Committees[6] avoid cross finance and focus on a mix of public budget payments (eventually ear-marked taxes) and payments of railway undertakings. A fund for financing reinvestments for the rail infrastructure was established in 2009, as presented in section 3.1.1 c).

It is widely agreed that the transfer of payments of road users for external costs are not classified as cross finance such that this tool can also be applied in countries which refuse cross financing. Presently the only possibility of applying this instrument is provided by Directive 2011/76 EU, which allows Member States to add a mark-up for external costs of air pollution and noise to the infrastructure costs to design the road user charges for heavy goods vehicles on motor- and expressways. To develop this tool in a way that it generates substantial volumes of funds it would be necessary to extend it to all producers of external costs of transport, to complete the list of external costs (presently only including air pollution and noise), to make external cost charging technically

6 Daehre Commission, 2012 ; Bodewig Commission, 2013.

easy (it currently requires a highly differentiated charging scheme for noise which does not yet exist) and to charge the real full external costs (presently "cap values" are limiting the charges).

3.2. PAST EU RAILWAY FUNDING 2000 – 2006 AND 2007 – 2013

This section presents the relevance of the different European funds in with respect to the national funding and the relationship between the different European funds.

3.2.1. Expenditures in the funding period 2000 – 2006

Structural and Cohesion Fund

Following a rather scattered selection of transport projects funded by the EU up to the late 1990s, the multi-annual financing framework 2000 to 2006 has devoted 30% of funds to cross border projects (Steer Davies Gleave, 2011).

According to the ex-post assessment study of the RTD and cohesion funds for the period 2000 to 2006 by the European Commission (Steer Davies Gleave, 2010), ERDF funds were allocated equally across the Union and amounted to 3% of total transport investments in Old and New Member States. In contrast, cohesion funds were naturally more directed to New Member States with 1.5% of transport investments. EC contribution to transport investments ranged from 36% to 48% (Baltic countries, Poland and Portugal), down to zero for some western European countries.

Steer Davies Gleave (2010) find that the funds are largely designed for new road constructions. Railway and intermodal transport projects, which anyway exceed the management capacities of several Member States and project promoters, only took a share of 21% in the respective period, and just 11% in the 10 new Member States.

ERDF support for rail by country is very different. The highest shares in ERDF funding for rail investments are reported for Slovenia (36%), Italy (34%), Spain (28% Austria (27%) and Greece (25%). ERDF for rail projects of the big western European economies ranges between 16% (Germany) and 4% (France). However, given the relatively low share of ERDF and cohesion funds in national expenditures, these figures do not characterise the structure of total transport expenditures in these countries. Compared with the total co-funding of TEN-T infrastructure coming from the TEN-T funds of EUR 2.8 billion, the budget provided by the ERDF for transport is about tenfold and by the CF is about fivefold.

Table 2: ERDF and Cohesion Fund Expenditures 2000 - 2006 for Transport (all modes, EUR million)

Country *	National budget	ERDF	Cohesion Fund	Private funding	TOTAL	EIB loans	% Rail of ERDF
Austria	13 894	3		n.a.	13 897	871	27%
Belgium	4 699	27		n.a.	4 726	516	2%
Czech Rep.	9 371	95	546	n.a.	10 012	2 039	16%
Germany	147 326	2 953		n.a.	150 279	4 080	16%
Denmark	8 271	3		n.a.	8 274	1 705	0%
Estonia	414	20	213	n.a	647,6	8	2%
Spain	83 968	9 523	4 814	8 618	106 923	15 403	28%
Finland	15 422	23		n.a.	15 445	410	0%
France	109 481	774		n.a.	110 254	5 934	4%
Greece	n.a.	4 185	1 490	5 676		4 286	25%
Hungary	63	145	724	n.a.	976	1 516	1%
Ireland	15 335	1 096	294	n.a.	16 725	681	0%
Italy	134 071	2 652		n.a.	136 722	7 638	34%
Lithuania	727	82	126	n.a.		935	23%
Luxembourg	1 024	2		n.a.	1 026	386	0%
Latvia	439	56	353	n.a.	848	52	13%
Netherlands	74 155	27		n.a.	74 182	624	6%
Poland	11 046	539	2 694	n.a.	14 279	2 389	13%
Portugal	4 903	2 592	1 635	n.a.	9 130	5 987	6%
Sweden	13 304	63		n.a.	13 367	1 277	0%
Slovakia	3 036	100	381	n.a.	3 523	275	0%
Slovenia	n.a.	4	122	n.a	n.a.	829	36%
UK	158 182	416		n.a.	158 599	4 259	12%
Total EU10	**26 398**	**1 041**	**5 071**	**1 255**	**33 819**	**6 438**	**11%**
Total EU15	**784 035**	**24 344**	**8 355**	**8 618**	**825 225**	**19 016**	**22%**
Total EU25	**810 433**	**25 385**	**13 426**	**9 873**	**859 044**	**61 324**	**21%**

* Cyprus and Malta disregarded in the country enumeration, but are considered in the respective totals.

Source: Steer Davies Gleave (2010), Tables 4.1 and 4.4

The main point of criticism with the ERDF and Cohesion funding programmes was the strong bias towards road transport. This is contrary to the official policy of the European Union, which was laid down in the 2001 transport White Paper "Time to Decide" (European Commission 2001). In this, as in previous and succeeding communications, the concepts of co-modality and the strengthening of the rail sector were advocated.

The International Transport Forum (ITF) estimates that in developed economies in 2008, investments account for about 20% of GDP, where infrastructure investment make up a share of 2.8% and transport infrastructure of 1.3% (ITF 2013). The European investment into transport infrastructures are presented in Table 2. The table shows that for the period 2000 to 2006 the total transport investment in EU25 countries amounted to EUR 859 billion. Out of these, ERDF funds for transport reached EUR 25.4 billion and Cohesion Funds (CF) EUR 13.4 billion. The share of rail investments is not provided for the same period. Figures of the International Transport Forum limited for the period 2004 to 2006 indicate rail investment of EUR 112 billion, the largest amounts being invested in Italy (EUR 28 billion), UK (EUR 19.1 billion) and Spain (EUR 16.5 billion).

The ERDF spending is further categorised by the ex-post evaluation of the funding period 2000 to 2006 (see Table 3). The detailed analysis of the data reveals an ERDF transport spending of EUR 29.1 billion of which road including motorways (58.1%) and rail (21.6%) receive the highest share of funding.

Table 3: Transport investment by mode supported by ERDF in 2000 to 2006 (EUR million)

	Rail	Road	Motor-way	Air-ports	Ports	Urban Transport	Multi-modal	Others	Uncate-gorized	Total
Initial allocation	7,136	13,534	3,821	782	1,515	1,948	1,163	602	675	31,176
Allocation	7,670	14,594	4,217	898	1,702	2,204	1,163	604	791	33,843
Actual spending	6,291	13,410	3,525	808	1,320	1,745	993	375	657	29,124
Share of modes at ERDF spending	**21.6%**	**46.0%**	**12.1%**	**2.8%**	**4.5%**	**6.0%**	**3.4%**	**1.3%**	**2.3%**	**100%**

Source: own analysis based on SDG (2010)

The support provided by the Cohesion Fund is more focused on rail transport. As Table 44 reveals: out of EUR 16.9 billion spent on transport from the CF, about EUR 7.8 billion is dedicated to rail transport, which is close to half of the CF funds. In general the share of the CF funds on the total investment that receive co-funding by CF is substantial reaching up to 85% in Ireland and 77% in Poland, Portugal and Spain. On average the CF fund contributes two third to both rail projects receiving co-funding from CF and transport projects in general.

However, the countries place different emphasis on funding rail projects in relation to the CF. E.g. Estonia did not invest at all into railways, while Latvia spent half of their CF related transport investments on railways.

Table 4: Transport investment supported by CF in 2000 to 2006

EUR million	Project	No of projects	Net committed	Total paid	Cohesion fund	National funds	Other funds	Total spent	%CF on Total
Bulgaria	Rail								
	Transport total	5	334.81	327,81	327,21	367,17	0	716,44	45,7%
	Total	38	748.39	690,1	783,12	544,99	0	1359,19	57,6%
Czech Republic	Rail	5	218.80	218,8	225,49	81,04	48,52	382,44	59,0%
	Transport total	15	597.53	567,1	604,22	460,59	48,52	1148,06	52,6%
	Total	58	1213.92	1183,22	1234,93	656,52	111,96	2070,4	59,6%
Estonia	Rail	1	1.16	1,16	1,35	0,45	0	1,8	75,0%
	Transport total	14	213.11	208,49	214,39	48,21	30,91	293,82	73,0%
	Total	37	424.13	406,21	430,56	106,56	35,82	575,8	74,8%
Greece	Rail	6	636.14	564,66	658,78	534,35	0	1193,13	55,2%
	Transport total	27	1716.97	1637,38	1823,48	1223,67	216,6	3263,75	55,9%
	Total	121	3342.62	3176,99	3700,37	1780,13	327,96	5808,46	63,7%
Spain	Rail	48	4366.10	4366,1	4430,26	567,96	725,84	5724,05	77,4%
	Transport total	80	6280.85	6231,35	6376,06	1742,67	784,31	8903,04	71,6%
	Total	407	12609.64	12554,71	13023,45	3303,99	935,84	17263,29	75,4%
Ireland	Rail	1	67.47	67,47	66,04	11,65	0	77,7	85,0%
	Transport total	6	330.70	314,33	336,87	189,87	0	526,75	64,0%
	Total	10	619.98	602,24	628,83	272,29	0	1030,49	61,0%
Latvia	Rail	6	163.18	163,18	159,71	83,69	0	253,43	70,2%
	Transport total	18	356.50	356,5	353,93	136,37	0	504,24	70,2%
	Total	46	674.37	674,37	710,8	239,24	14,24	992,85	71,6%
Lithuania	Rail	4	103.11	99,39	103,56	102,69	0	206,66	69,5%
	Transport total	17	404,44	400,71	407,5	173,62	0	586,62	69,5%
	Total	51	820,72	806,48	825,11	323,06	12,36	1185,31	69,6%
Hungary	Rail	8	348,23	327,57	356,84	269,26	0	626,11	62,7%
	Transport total	14	691,17	670,51	734,69	410,36	0	1172,48	62,7%
	Total	47	1432,71	1323,76	1483,19	829,5	0	2348,37	63,2%
Poland	Rail	14	679,91	679,91	718,65	229,47	0	957,15	77,4%
	Transport total	35	2709,42	2479,13	2663,09	769,66	0	3442,88	77,4%
	Total	130	5473,79	5174,55	5478,17	2076,44	113,25	7703,79	71,1%
Portugal	Rail	11	809,45	809,45	868,22	258,92	0	1127,14	77,2%
	Transport total	34	1529,99	1529,53	1640	484,26	0,11	2124,36	77,2%
	Total	109	3346,65	3325,44	3534,63	1307,22	79,09	4920,94	71,8%
Romania	Rail	0	0	0	0	0	0	0	
	Transport total	12	940,19	808,02	945,84	327,3	0	1564,73	60,4%
	Total	63	1978,18	1803,67	2000,57	716,98	2,21	3018,08	66,3%
Slovenia	Rail	5	52,45	52,45	52,45	49,25	0	115,54	56,1%
	Transport total	8	122,14	122,14	122,14	81,86	0	217,84	56,1%
	Total	28	250,64	250,64	254,31	171,24	0	443,68	57,3%
Slovakia	Rail	4	209,75	209,75	209,83	188,03	0	417,34	55,8%
	Transport total	8	380,48	380,48	380,62	263,51	0	682,32	55,8%
	Total	39	762,91	762,91	766,5	446,29	5,1	1295,94	59,1%
TOTAL CF countries	Rail	113	7655,77	7559,91	7851,17	2376,78	774,36	11082,47	67,3%
	Transport total	293	16608,27	16033,49	16930,03	6679,14	1080,44	25147,31	67,3%
	Total	1184	33698,66	32735,29	34854,53	12774,45	1637,82	50016,58	69,7%

Source: own analysis based on data provided by EC DG Regio

3.2.2. Expenditures in the funding period 2007 – 2013

TEN-T work programmes

For the seven year multi-annual financial framework period (MFF) 2007-2013 the EC concluded on co-funding the Trans-European Networks with a budget of EUR 8 million, which was actually increased to EUR 9.6 billion by means of the European Economic Recovery Programme (EERP). TEN-T funds, however, constitute only 20% of the support for transport project granted by total EU expenditures for transport, including ERDF and the Cohesion Fund. It is targeted to a specific set of strategic links in the European transport networks by the priority projects. 65% of the TEN-T programme in the period 2007 to 2013 were targeted to the 30 priority projects (PPs) including the Galileo satellite navigation system (PP15). Of these, EUR 5.2 billion were fixed in the first year of the programme and EUR 1.1 billion were added in 2012.

Table 55 presents a snapshot of actually finalised or on-going projects under the TEN-T programme by type of expenditure. Out of the 656 projects 35% go to rail, but these ask for 58% of budget. The average cost of rail projects thus are nearly double the average project costs. In contrast projects of the European Rail Transport Management System ERTMS are just about half the costs of an average TEN-T project. In addition, 20 projects with a total budget of EUR 103 million and expected total costs of EUR 205 million have been cancelled during their lifetime, of which 17 were ERTMS activities. These projects are not considered in Table 5.

Table 5: TEN-T projects and expenditures 2007-2013 by category (sample)

MODE	Number of projects ongoing or closed	Share of projects	Actual TEN-T funding (EUR million)	Share of funding
Rail	231	35%	3,867.6	58%
ERTMS	59	9%	324.1	5%
Road	82	13%	298.8	4%
Airport	11	2%	48.4	1%
ATM	25	4%	470.1	7%
IWT	55	8%	453.1	7%
RIS	19	3%	32.6	0%
Port	63	10%	131.5	2%
MoS	46	7%	351.6	5%
Multimodal	51	8%	283.6	4%
ITS	13	2%	272.5	4%
Galileo	1	0%	190.0	3%
Grand Total	**656**	**100%**	**6,724.0**	**100%**

Symbols: ERTMS: European Rail Traffic Management System; ATM: Air Traffic Management; ITS: Intelligent Transport Systems; MoS: Motorways of the Sea; RIS: River Information System; IWT: Inland waterway transport

Source: Data provided by INEA

Funding share of TEN-T projects related to their negotiated budget averages at 35% across the Union and several project types. National funding rates, however, show a large divergence, ranging between 11% (Belgium, Portugal) and 100% reported for many new Member States and countries with structural difficulties, such as Greece and Ireland. Cost overruns of those projects which have not been cancelled remain at 27% across countries and project types. For the ERTMS projects cost overrun is even close to 100%.

The 449 projects assessed in Table 6 provide a sufficiently large sample of all TEN-T funded activities in the funding period 2007 – 2013, covering 90% of the envisaged programme budget of EUR 8.0 billion.

Table 6: Project costs and TEN-T funding for rail and ERTMS in MFF 2007-2013

Country	EUR million 2007 – 2013 *			Share of TEN-T funding
	Budget	Total costs	TEN-T funding	
FR	3 889.9	4 529.2	948.0	24%
ES	1 588.8	1 914.9	848.0	53%
DE	3 126.5	3 748.0	621.4	20%
IT	1 323.5	1 768.0	444.5	34%
AT	2 221.4	2 550.2	328.8	15%
SE	1 105.6	1 336.8	240.2	22%
DK	293.6	426.9	133.3	45%
FI	866.7	979.9	113.3	13%
NL	149.6	256.1	106.6	71%
PT	878.3	981.2	102.8	12%
BE	821.1	911.1	90.0	11%
UK	429.2	510.6	81.4	19%
CZ	76.8	153.5	76.8	50%
LT	139.6	201.4	61.8	44%
SI	49.4	98.8	49.4	50%
PL	39.2	78.4	39.2	50%
EL	31.5	63.0	31.5	50%
LV	40.9	58.4	17.5	43%
LU	61.1	76.7	15.6	26%

Country	EUR million 2007 – 2013 *			Share of TEN-T funding
	Budget	Total costs	TEN-T funding	
EE	31.3	46.7	15.4	49%
HU	14.3	28.5	14.3	50%
IE	12.0	23.9	12.0	50%
SK	2.5	5.0	2.5	50%
BG	1.6	3.1	1.6	50%
Multi-National	**3 093.3**	**4 940.8**	**2 777.2**	**90%**
TOTAL	**20 287.5**	**25 691.2**	**7 172.9**	**35%**

* Data restricted to the publicly accessible project fiches on the INEA website
Source: Fraunhofer ISI with data from http://ec.europa.eu/inea/en accessed 12.7.2015

In the 2010 mid-term review of the TEN-T programme, the European Commission (2010) reported on 92 trans-European infrastructure projects, which together made up two thirds (EUR 5.3 billion) of the TEN-T funds. The review should bring more accountability into EU spending and go as far as to identify each project for which funding cuts and re-allocations are needed. While half (48) of the projects have been found to be on track for completion by 2013 or considered credible with a prolongation of funding until 2015 (29 projects), the budget for 15 projects has already been partly or completely cut at this stage. A review of the entire MFF 2007-2013 is being prepared at the time of writing this report.

In the ex-ante assessment of the TEN-T funding period 2007 – 2013, ECORYS (2007) estimates a social benefit cost ratio with improving cross-border and bottleneck links for the programme of 1.6, i.e. every euro invested would generate EUR 1.60 of social benefits. But the report also mentions that the envisaged budget might not be sufficient to complete the TEN-T by 2020. Further obstacles are poor project preparation and promotion and inefficient cross-border operations due to conflicting national and EU needs.

In 2006 the European Commission set coordinators for the priority projects as the TEN-T programme showed considerable delays against the investment calendar. Endowed with only a limited annual allowance plus travel costs their mission was to support implementation by coordinating national agencies and project promoters particularly for the cross-border section of the priority projects. A review by Steer Davies Gleave (2014) concludes that without the coordinators, progress-to-date would have been far more limited. Given the limited resources spent on their work, the benefit cost ratio was considerable.

Cohesion and Structural Funds

Table 7 explains the contribution of ERDF and CF to fund railway projects that belong to the TEN-T network and to other rail networks. The share of railway co-funding from the Structural Funds (SF) decreased to less than 10%. However, the absolute value of co-funding for railways increased from EUR 14.1 billion (EU27) to EUR 23.4 billion (EU28). TEN-T investment roughly accounts for three quarters of the total rail co-funding by the SF. However, amongst the multi-national projects to which cross-border transport projects belong, only minor funds were invested into the rail cross-border projects (about 1%).

Table 7 : Transport investment supported by ERDF and CF in 2007 to 2013

Member States	ERDF & CF co-funding	ERDF & CF Rail infrastructure	TEN-T rail infrastructure	ERDF & CF Mobile rail assets	TEN-T mobile rail assets	Total rail co-funding	Share rail on SF
AT	667	0	0	0	0	0	0.00%
BE	987	0	0	0	0	0	0.00%
BG	5 435	0	341	0	0	341	6.28%
CY	493	0	0	0	0	0	0.00%
CZ	22 455	398	2 159	125	38	2 720	12.11%
DE	16 100	52	715	0	0	766	4.76%
DK	255	0	0	0	0	0	0.00%
EE	3 012	22	133	0	30	185	6.15%
ES	26 596	199	3 938	0	0	4 137	15.55%
FI	977	0	10	0	0	10	1.04%
FR	8 052	193	6	0	0	199	2.48%
GR	15 846	16	669	0	0	684	4.32%
HU	21 281	0	1 720	0	0	1 720	8.08%
HR	706	40	182	0	0	222	31.40%
IE	375	17	0	0	0	17	4.46%
IT	20 992	1 663	555	30	0	2 248	10.71%
LT	5 747	23	549	8	0	580	10.10%
LU	25	0	0	0	0	0	0.00%
LV	3 947	141	115	0	0	256	6.49%
MT	728	0	0	0	0	0	0.00%
NL	830	0	0	0	0	0	0.05%
PL	57 178	1 294	3 593	387	193	5 468	9.56%
PT	14 558	12	364	0	0	376	2.58%
RO	15 374	453	1 139	100	0	1 692	11.01%
SE	935	11	0	1	0	12	1.24%
SI	3 345	0	450	0	0	450	13.44%
SK	9 999	33	905	242	0	1 180	11.80%
UK	5 387	85	0	2	0	87	1.61%
Multi-national	7 975	64	17	10	5	95	1.19%
EU28 incl. multi-national	**270 258**	**4 715**	**17 560**	**904**	**266**	**23 446**	**8.68%**
EU 15	**112 584**	**2 247**	**6 256**	**33**	**0**	**8 536**	**7.58%**
EU 13	**149 700**	**2 405**	**11 287**	**862**	**261**	**14 815**	**9.90%**

Source: own analysis based on data provided by EC DG Regio

Structural funds (namely the ERDF) and the cohesion fund play a decisive role in transport funding in the MFF 2007 – 2013. Co-funding rates differ widely: up to 85% for the Cohesion Fund and up to 75% for ERDF. Structural funds target project implementation; it is frequently argued that during the funding period from 2000 to 2013, the TEN-T budget triggers the projects, while the cohesion budget builds the projects (Steer Davies Gleave, 2010). In the programming period 2007 – 2013, the ERDF and the Cohesion fund will together contribute EUR 81.9 billion for transport, of which EUR 44.2 billion go to TEN-T projects, and out of these EUR 18 billion go to rail. So even in TEN-T projects themselves TEN-T funds that amounted to EUR 9.6 billion played a minor role (Steer Davies Gleave, 2010).

The total amount available for rail by the structural funds during this period was EUR 23.4 billion. Current planning of structural funds for 2014 to 2020 foresees about EUR 68 billion for transport plus some EUR 2 billion for cycling. This means a reduction of about EUR 12 billion compared with the previous period. For railway the planned budget amounts to about EUR 19 billion, i.e. about EUR 4.4 billion less. However, it should be noted that the CF additionally comprises EUR 11.2 billion that are ring-fenced to CF as part of the CEF. Thus the budget for transport of the structural funds has been roughly maintained in total for the period 2014 to 2020. For railways even a slight growth of funding by the structural funds can be expected.

Management and monitoring differs between the funds. The ERDF and Cohesion funds, run by DG-REGIO, only monitor projects above EUR 50 million (this will be changed to EUR 75 million in the next funding period 2014 to 2020), while the TEN-T fund of DG-MOVE applies a stricter project management and closer co-ordination of activities.

3.3. TEN-T AND CEF FUNDS FOR 2014 TO 2020

Funding of TEN-T infrastructure projects for the period 2014 until 2020 is governed by two regulations dating from the end of 2013: The second revision of the TEN-T Guidelines [EU REG 1315/2013] and the newly established funding mechanisms for the TEN-T, in particular the Connecting Europe Facility (CEF) [EU REG 1316/2013]. The process of setting up this new regulation commenced in 2009. The following paragraphs explain the main rules of the regulation, while the process is described in detail by Schade et al. (2014).

The new TEN-T planning concept establishes a two layer network: the top layer is made up of the TEN-T core network that comprises infrastructure of particular European interest serving the long-distance and cross-border flows of passenger and freight transport. This network is structured into nine so-called core network corridors (CNC) that make-up about 75% of the TEN-T core network. Any CNC crosses at least three Member States and connects both different markets within Europe and European markets with international markets. Ports and airports are seen as gateways to Europe such that the CNCs usually start and/or end at a port. Apart from connecting important markets the CNC also represent a planning instrument able to solve the problems of implementing large cross-border infrastructures and of setting-up and efficiently managing transport operations across Member States. The TEN-T core network is designed by a combined normative and analytic approach such that European urban nodes of a certain size as well as the large ports and airports handling a minimum share of European traffic should become part of the network and should be connected. Annex II of the TEN-T Guidelines [EU REG 1315/2013] define the list and types of nodes belonging to the core network. The bottom layer is defined by the strategic networks designed by each of the Member States and is called comprehensive TEN-T network.

Two important observations have shaped the design of the funding rules for the period 2014 to 2020. The European Commission concluded that cross-border projects and bottlenecks relevant for long distance European traffic are often not sufficiently supported by the Member States, both financially and politically. On the other hand these were expected to generate the highest European added value. Therefore the TEN-T co-funding rates for such infrastructures were increased to (1) provide a stronger incentive for Member States to invest into them, and (2) increase the European added value of the co-funded infrastructure. In particular, the European co-funding share of cross-border projects can reach 40% of investments into works for rail and waterway, and 30% for the removal of railway bottlenecks and to support motorways of the sea (MoS). Studies and ERTMS investments can receive European co-funding of 50% of their eligible cost. All EU TEN-T co-funding shares are specified by the regulation on the CEF (EU REG 1316/2013). It should be noted that the regulation on the structural funds provides for different co-funding shares.

Railway projects on the core network have to comply with technical standards set by the legislation to ensure interoperability. The following list presents the technical standards to be fulfilled by railway infrastructure of the core network:

- Two tracks with electrification;
- Equipment with ERTMS;
- Axle load: at least 22.5t;
- Line speed for freight trains: at least 100 km/h;
- Train length: at least 740m;
- Track gauge: 1435mm.

To achieve these standards and improve interoperability, implementation of technologies can be co-funded by the CEF. Such innovative technologies can be co-funded by up to 50% of the whole investment. This holds for instance for the European Rail Traffic Management System (ERTMS). Measures to reduce the noise impact of rail transport are also eligible for co-funding (20% co-funding rate).

The TEN-T funding made available via the CEF roughly tripled compared with the previous funding period 2007 to 2013. However specific rules apply. CEF is stocked with EUR 24.05 billion to co-fund TEN-T projects. Of this, EUR 11.3 billion was taken from the Cohesion Fund (CF) and ring-fenced for TEN-T investment in cohesion countries.

The European Commission has decided to assign a large share of the CEF budget to the first call for proposals in September 2014 arguing that the investments should also work as a stimulus to the weak European economy. The EC is dividing the call into a multi-annual programme (MAP), in which the very large projects like the Brenner Base Tunnel or the Fehmarn-Belt Fixed Crossing usually receive co-funding over several years, and into an annual work programme (AWP). The MAP was assigned EUR 11 billion and the AWP EUR 930 million. The budget is planned to be assigned to the four funding objectives (FOB) in the following way:

- FOB1: Removing bottlenecks and bridging missing links, enhancing rail interoperability, and, in particular, improving cross-border section: EUR 6 billion.

- FOB2: Ensuring sustainable and efficient transport systems in the long run, with a view to preparing for expected future transport flows, as well as enabling all modes of transport to be decarbonised through transition to innovative low-carbon and energy-efficient transport technologies, while optimising safety: EUR 250 million.
- FOB3: Optimising the integration and interconnection of transport modes and enhancing the interoperability of transport services, while ensuring the accessibility of transport infrastructures: EUR 750 million.
- FOB4: Funding for Cohesion Countries from the ring-fenced budget of the Cohesion Fund: EUR 4 billion.

The funding decision of the call was published on July 10th 2015. It reveals an increase of the actual funding. The 681 proposals received by INEA eligible for funding asked for a budget of EUR 32.66 billion, which means 170% more budget was requested than available. Only 452 proposals were recommended by external experts for funding and the internal evaluation by the EC was passed for 276 proposals. The EC recommended projects for funding with a co-funded investment of slightly above EUR 13 billion. The distribution of the different funding objectives and calls is presented in Table 8.

Table 8: TEN-T funding summary of first call 09/2014 – decided 07/2015

Programme	Objective	Funding Objective	Planned budget EUR million	Decided budget EUR million	No of co-funded projects
MAP	FOB1	Cross-border, bottlenecks, missing links	6,000	7,147	99
	FOB2	Decarbonised and innovative transport	250	146	28
	FOB3	Integrated, interconnected, interoperable transport	750	799	67
	FOB4	Cohesion countries – ring-fenced budget	4,000	4,739	48
AWP	FOB1-3	Cross-border, bottlenecks, innovation, interoperability, etc.	930	186	34
		Total call	**11,930**	**13,017**	**276**

Source: EC (2015a)

In total the first call consumed more than EUR 13 billion, which is more than half of the budget of the CEF for transport. This means the further six calls, assuming that calls will actually take place annually, will have to be much smaller. As will be explained in the next section the setting-up of the European Fund for Strategic Investment (EFSI) is further affecting the balance between the size and the funding objectives of this first call and the other calls.

The MAP under the funding objective 1 (FOB1) roughly foresees a co-funding budget of EUR 4.9 billion for railway infrastructures from this first call, amongst which the Brenner Base Tunnel receives EUR 878 million for works and EUR 302 million for studies, the Lyon-Turin Base tunnel EUR 813 million and the railway line between Stuttgart and Ulm EUR 1,026 million (European Commission 2015a). This means that for this funding objective about 70% would be dedicated to railway infrastructure. We estimate that for the whole first CEF call more than 70% of the budget goes to the rail mode. Rail mode accounts for about half of the projects receiving co-funding in this call.

3.4. THE ROLE OF EFSI AND CEF

In November 2014 the European Commission and their new President Jean Claude Juncker acknowledged the European weakness for generating investments and proposed an investment plan for Europe (European Commission 2014b). At the centre of the plan is the so-called European Fund for Strategic Investment (EFSI) that is equipped with EUR 21 billion and is supposed to have a leverage effect of 15 to generate investments of EUR 315 billion. The initial funds for the EFSI (1) are to be taken from the European budget of the Multi-annual Financial Framework (MFF) with EUR 16 billion, and (2) are provided by the European Investment Bank (EIB) with EUR 5 billion.

In January 2015 the EC then tabled the proposal for a regulation to establish the EFSI (European Commission 2015b). According to the proposal, transport should be one of the priority areas of investments. However, the focus is defined as "development of infrastructure, including in the areas of transport, particularly in industrial centres" (page 16), which thus seems to place an emphasis on urban centres and not on cross-border sections as envisaged by the TEN-T and CEF regulations. The proposal also suggests shifting a budget of EUR 2.7 billion from the CEF transport to the EFSI. In total the CEF budget would be reduced from EUR 33.24 billion to EUR 29.94 billion.

The EFSI regulation was adopted in June 2015 (European Commission 2015c). The budget shift from CEF to EFSI was maintained but the amount reduced from EUR 2.7 billion to EUR 2.2 billion. The total CEF budget was set at EUR 30.44 billion. The transport support objective of the EFSI was brought in line with the TEN-T and CEF regulations: "EFSI support to transport infrastructure should contribute to the objectives of Regulations (EU) No 1315/2013 and (EU) No 1316/2013" (page 4). Without the adoption of the objective the budget shift from CEF to EFSI probably would have weakened the European policy objective to close the gaps in the European core TEN-T network by focusing CEF budget on these projects, in particular at border crossings between Member States.

It remains the fact that with a reduced CEF transport budget of EUR 24.05 billion and a spending decision of EUR 13 billion in July 2015 more than half of the CEF budget has been assigned with the first call such that about EUR 11 billion remain for the six following calls. This could weaken the achievement of the CEF objectives. However the final outcome depends (1) on the projects to be selected under EFSI, and, even more (2) on the success of EFSI to crowd in private money for infrastructure investments. If successful, i.e. if the proposed EFSI multiplier of 15 can be achieved for transport infrastructures it would strengthen the CEF objectives. However, for transport infrastructures this would only be feasible if such infrastructures generated revenues making a point of enhancing the user-pay-principle for transport infrastructures, and possibly also considering the examples of Switzerland where road user charges are used to cross-fund railway infrastructure. Our findings strongly fit together with the recommendations of points 7 and 8 of the Christophersen Group Report which underlines the need to strengthen the user-pays principle and to facilitate cross-financing solutions between modes.

The EFSI is one element of the Investment Plan for Europe. It comes as a package together with the European Investment Advisory Hub (EIAH) and the European Investment Project Portal (EIPP). While the EFSI is providing funds to mobilise finance and to finance investments the EIAH is providing expert advice on project development and project finance both for existing and new financial instruments. The advice will come from EIB experts and national experts recruited for the purpose of the EIAH. The third element, the EIPP, should work similar as a crowd-funding platform though at different levels of funding by collecting projects, checking their viability and via the EIPP making them public to investors looking for large scale investment opportunities.

We expect that the EFSI could promote European railway infrastructure projects e.g. as part of multi-modal terminals or as railway connections to ports and airports. However, the effect might be limited, if not also other actions follow which increase the financial viability of railway projects as mentioned in sections 3.1 and 6.4.

4. CASE STUDIES

KEY FINDINGS

- **Transport impacts and bottlenecks** deliver a mixed picture. For the Oresund crossing and the Paris-Brussels link within PBKAL, traffic volumes have developed according to expectation, while Channel Tunnel demand is below plan by a factor of two. Reasons for this are manifold: besides the economic crisis, infrastructure charges, prices and privileges of competitors, initial poor access and border controls on the UK side compete with politically driven demand expectations. The remaining links between France, Spain and Portugal in PP3 and along PP22 are still not open to traffic.
- **Project assessment and funding** point in a similar direction. Construction times went according to plan for most of the finalised northern-European projects, although construction time nearly doubled for some access links in PBKAL (High Speed 1 in the UK, Brussels-Amsterdam or Frankfurt-Cologne). Cost overruns range between 8% and 25% for the French and Spanish main lines in PP3, 39% for the Oresund crossing, 63%-69% for the Channel Tunnel to 116% for Frankfurt-Cologne. Besides geological uncertainties the most relevant cost drivers are changes in project design often motivated by political arguments during the construction phase.
- **Regional and cross border impacts** appear to be difficult to measure directly. The positive example of the Oresund fixed link crossing, where imbalances in housing and labour markets were reduced as envisaged, is counterbalanced by other projects which deliver more scattered messages. Although the regions on both sides of the English Channel cooperated by forming a joint development region, impacts after opening of the Eurotunnel are not measurable. While impacts for the regions directly served by new infrastructures are usually positive in terms of accessibility and employment, regions with poor access to the new infrastructures, so-called "shadow areas", may even lose out. However, it is widely acknowledged that positive impacts take time to unfold and that they can be stimulated by providing good regional access to the new facilities and by implementing accompanying regional economic stimulation policies.

4.1. CASE STUDY SELECTION AND DESIGN

Out of the 30 priority projects defined by the European Commission under their TEN-T guidelines from 2004, four priority projects were selected for a deeper investigation. The case studies summarised in this section will consider the efficiency of project implementation as well as their efficiency in achieving the policy priorities in terms of regional development and cohesion. Of special interest are the cross-border sections of the Priority Projects, i.e. those with particular European added value.

The case studies selected by the Terms of Reference are:

- PP11 - Oresund fixed link crossing between Denmark and Sweden;
- PP2 - High-speed railway axis Paris-Bruxelles/Brussels-Köln-Amsterdam-London: PBKAL;
- PP3 - High-speed railway axis of southwest Europe and
- PP22 - Railway axis Athens–Sofia–Budapest–Vienna–Prague–Nuremberg/Dresden.

The four case studies are very different in nature concerning geographical dimensions, transport markets affected and status of implementation. While the Oresund (PP11) and the PBKAL northern European high speed corridor have been operational for several years, the south-western European high speed network (PP3) is in progress and the south-eastern railway corridor has not yet passed the planning phase in many critical parts. The latter three priority projects represent wider multi-national networks.

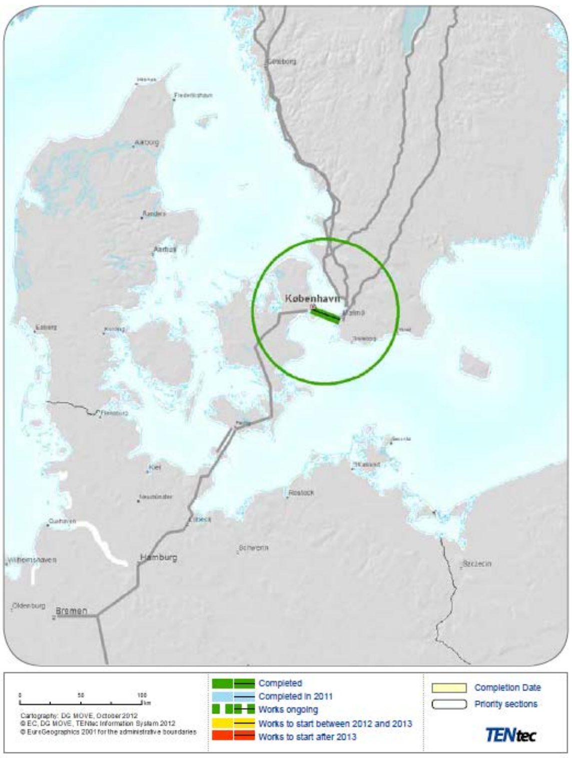
The actual status of the priority projects, future activities and their potential for economic and regional development have been documented by the status reports of the Commission and individually for each corridor by the former priority project coordinators[7]. Since the establishment of the core network corridors (CNC) the priority projects on these corridors now form an integral part of the progress reports and work plans on the CNC[8] and background studies on these add to the official documentation used in this study. However, as the measurement and the underlying drivers of economic and regional development are complex and subject to debate, we acknowledge the findings of contemporary research in the field.

The summaries of the four case studies presented hereinafter provide the most relevant information for the three key issues (1) transport impacts, (2) project assessment and (3) regional impacts. Of these, the latter is of most concern for judging the efficiency of railway funding for the achievement of European development and cohesion goals.

4.2. PP11: ÖRESUND FIXED LINK

The Øresund Fixed Link connects Denmark and Sweden via the Øresund with a combination of a tunnel, an artificial Island and a bridge. It essentially constitutes a cross-border project. Metropolitan areas are located at both ends of the fixed link: in Denmark the capital city of Copenhagen and in Sweden the city of Malmö, and adjacent to which is the city of Lund. The Øresund Fixed Link was constructed between 1995 and 1999 and opened in 2000.

Map 2: PP11 with construction progress



4.2.1. Transport impacts and bottlenecks

The first decade after opening of the infrastructure, traffic roughly doubled, as expected by the forecasts published at opening. The economic crisis of 2008/09 dampened the growth for both passenger and freight rail transport and

7 For the reports see: http://ec.europa.eu/transport/themes/infrastructure/ten-t-policy/priority-projects/annual-reports_en.htm .

8 For the workplans see http://ec.europa.eu/transport/themes/infrastructure/news/2015-05-28-coordinator-work-plans_en.htm .

caused road passenger transport to stagnate. However, the operators of the Øresund Fixed Link expect further moderate growth of transport demand in the future.

4.2.2. Impact assessment and funding

The ex-post socio-economic assessment of the Øresund Fixed Link reveals a benefit cost ratio (BCR) of 2.2 and a financial internal rate of return of 9.9% over an assessment period of 50 years. The infrastructure was largely funded by private loans raised by the project promoter and operator Øresundsbron Konsortiet (OBK) at low interest rates facilitated by guarantees from the Danish and Swedish States. The loans are expected to be paid back by 2033 and from 2017 onwards a dividend is expected to be paid.

4.2.3. Regional and cross-border impacts

The Øresund Fixed Link is an example of how a cross-border infrastructure enlarges markets of business, labour and housing and thus stimulates economic development in the regions served by the infrastructure. A particular impact is the significant reduction of unemployment amongst young Swedes in the Malmö region by providing them job opportunities in Copenhagen. Pressure on the Copenhagen housing market has also been reduced by allowing people to move easily to Sweden while keeping their jobs in Denmark.

4.2.4. Conclusions

The Øresund Fixed Link can be seen as a success story of a large European cross-border infrastructure project. It was constructed without delays. Cost-overruns occurred but could largely be assigned to additional requirements requested by stakeholders (e.g. environmental mitigation) and the project management was sufficiently flexible to adjust to such requirements. The traffic forecasts are largely met so the financial figures give rise for optimism that the loans will be paid back after 33 years of operation. The socio-economic ex-post assessment estimates a BCR of 2.2 for medium growth scenarios, but even in pessimistic scenarios the BCR remains above 1. It should be highlighted that the foundations of such a successful project were laid by a sound Treaty that was concluded between Denmark and Sweden in 1991, at the initial phase of the project.

4.3. PP2: THE PBKAL NORTHERN EUROPEAN HIGH SPEED NETWORK

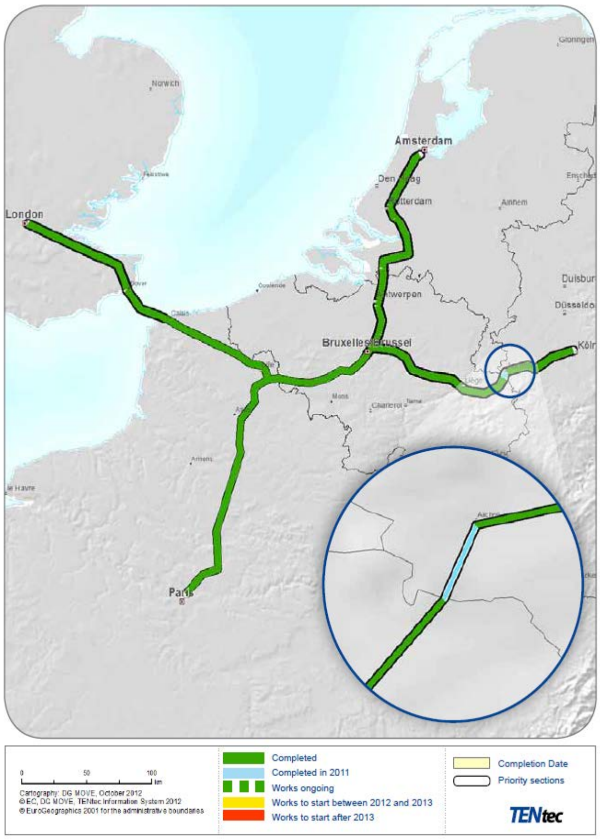
The high speed rail connection between Paris, Brussels, Cologne, Amsterdam and London is part of the North Sea-Mediterranean Core Network Corridor and became fully operational in 2010. Within this high speed rail network there are four cross-border links: the Channel Tunnel, and the connections between Paris-Brussels, Brussels-Amsterdam and Brussels-Cologne.

The overall length of this project is 932km. The major part was completed before 2010, leaving only a small share of the cross-border section between Belgium and Germany (Liège and Aachen) for completion in 2011. The important high speed link from Frankfurt to Cologne was completed by 2002 solely using national funds. Due to the importance of this link for the PP2 and due to the prominence of the Frankfurt – Cologne high speed project, this section is included in the subsequent corridor analyses.

The Channel Tunnel total cost of the project amounted to EUR 5.8 billion, EUR 3 billion of which was a public sector contribution. The contribution of the TEN-T budget amounted to £138 million (European Commission, 2012). The journey time from London to the Tunnel is 35 min, to Paris

2h15min and to Brussels 1h51 min. The high speed rail connection between Paris and Brussels began its service in 1997 and reduced travelling time from Paris to Brussels to 1h22min. It also appreciably shortened rail journeys between Paris and Lille. With the high speed train the travel times between these cities are thus below that of air travel, resulting in a considerable modal shift from air to train transport.

Map 3: PP02 with construction progress



Source: European Commission, 2012

4.3.1. Transport impacts and bottlenecks

The Priority Project 2 can be claimed a success story, since three international operators (Thalys, Eurostar and ICE trains) share these connections. Eurostar is the dominant operator in the Channel Tunnel and a large segment of Thalys' total sales stems from the connection between Paris and Brussels. Both connections are faster than airline travel times. Between 1995 and 2010 Eurostar passengers have doubled, while Thalys passengers have risen by more than 300%. For comparison: The ICE international by Deutsche Bahn AG carried 2.2 million passengers on the Amsterdam-Frankfurt line and 0.8 million passengers on the Brussels to Amsterdam route.

Table 9 : Eurostar and Thalys yearly passengers (figures in millions)

Operator	1995	2000	2005	2007	2009	2011	2013	Δ95-13
Eurostar	4.9	7.1	7.45	8.26	9.2	9.7	10.1	+106%
Thalys	1.54	5.5	6.19	6.2	6.08	6.65	6.69	+334%
ICE Int.*							3.0	n.a.

* Frankfurt–Amsterdam and Frankfurt–Brussels. national and international passengers

Source: European Commission (2012) and press releases by Thalys and Eurostar

The journey time between Paris and London decreased from 5:12 (in 1989) to 2:15 (in 2007) after the Channel Tunnel was finished. Similar travel time gains are prevalent at the other cross-border sections. Thus, the PBKAL is the number one success story in the North Sea-Mediterranean Core Network Corridor. It is one of the few Priority Projects which is fully operational, and besides some bottlenecks regarding signalling problems between Belgium and the Netherlands and between

France and Belgium and the north-south junction in Brussels, which are mainly due to high congestion in peak times, there are no major bottlenecks left on the PBKAL.

4.3.2. Impact assessment and funding

The completion of the project, leading to a great reduction in travel times, had a strong impact on modal shift. Flight travel demand between the major cities has drastically diminished. Thus, the objective of a more environmentally-friendly modal shift has been accomplished with this project. Eurotunnel reduced its greenhouse gas emissions by 44% between the start of its operations and 2008 and by an additional 20.5% between 2008 and 2010.

Naturally, cross-border sections are the most difficult network sections to implement and are the last choice of investment for rail infrastructure companies. Capacity bottlenecks will always appear as new infrastructure induces new demand but bottlenecks across geographical barriers prevent the implementation of an effective network. Currently there is no definition of bottlenecks with cross-border effects and this need to be clearly addressed in order to drive the investment needed for the greatest improvement in EU added value (Steer Davies Gleave, 2011).

Perhaps the greatest barrier to project implementation of the Channel Tunnel and its access links to Paris, Brussels and London was differing models of funding rail services. While the UK follows the philosophy of full cost coverage of infrastructure investments by fares and access charges, France is ready to grant more subsidies. In particular for the Channel Tunnel project the UK government refused to grant any direct subsidy. Accordingly, the infrastructure coverage by access charges in the Eurotunnel is 90% in contrast to 60% on the UK access link and only 20% in France (Vickerman, 2015, Thomas and O'Donoghue, 2013). Moreover, the continuing tax free sales on cross Channel ferries and flights and the rise of low cost airlines have hampered business opportunities of the Eurotunnel rail link. A rather devastating assessment is presented by the UK Strategic Rail Authority (Anguera 2005): "The cost benefit appraisal of the Channel Tunnel reveals that overall the British economy would have been better off had the Tunnel never been constructed, as the total resource cost outweighs the benefits generated". However, profitability of the project increased after the channel tunnel rail link (CTRL or High Speed 1) became fully operational in 2007.

Chevrolet et al. (2011) conclude that three projects along the extended PP2 face cost overruns from 25% (Paris – Lille) to 69% (Eurotunnel) and 116% (Frankfurt – Cologne). The major reasons cited were significant changes in specification and design during the projects' life time. In particular, in the case of the Frankfurt – Cologne section, extensive construction problems together with a poor project and demand assessment are deemed responsible for the more than doubling of implementation costs. Given that the Channel Tunnel Rail Link (CTRL) connecting London to the Tunnel, has undergone two restructurings due to funding reasons, a cost overrun of only 40% appears moderate.

An ex-post evaluation of the French Northern high speed line (TGV Nord) by RFF (2005) finds that the socio-economic rate of return of the line is around 5% with a 20 year discount period, which is below the 8% threshold set out by the General Planning Commission for Public Investments based on 40 year discount periods. Besides the accounting period the report highlights that these results ignore time savings of foreigners using the line, i.e. the European added value. Planning, regional development and tourism effects are also ignored in the assessment.

Total investment costs for the period from 2007 to 2013 in this corridor are estimated to be EUR 1.86 billion against EUR 16.95 billion before 2007 (European Commission, 2008). As the development and construction time of PPKAL spans more than two decades there is no comprehensive source on the total share of TENT-T-funding for PP2. For on-going works, project fiches by INEA on feeder lines into the main PP2 corridor report a TEN-T-funding share of around 5-6%. An exception is Cologne-Aachen with a TEN-T-share of 25%. The work in those areas is typically in regions which are not eligible for the Structural Fund as PP2 stretches over countries exceeding 90% of the average EU GDP per capita (European Commission 2012, Steer Davies Gleave, 2011).

4.3.3. Regional and cross-border impacts

The development of the North-west Europe HSR has been largely driven by the objective of joining the major metropolitan areas involved. Besides positive impacts on these metropolitan areas, both levels of service and potential economic impacts have been much less pronounced in intermediate areas between major hubs. (Vickerman, 2015). Since regional accessibility to HSR stations is lacking, the project has not led to the reduction in inequalities in accessibility in the regions. Long-term impacts on regional development need accompanying policies, but local governments are often not sufficiently prepared to stimulate this, resulting in underinvestment in the regions. However commuting patterns have clearly adapted.

An overview of large projects by the EVA-TREN (2007) project and Cascetta et al. (2010) concluded that for Paris-Lille TGV, one third of all commuting and business were affected by the introduction of the high speed rail and 6000 fixed jobs were created, although this is difficult to verify and allocate to the investment. Despite this there are positive economic effects for local actors, e.g. through the location of international companies in Nord Pas de Calais, 90% of enterprises identified no impact on their overall activity (Vickerman, 2006). Even where cross-border integration objectives are seen as a priority by the regions themselves, problems of jurisdictional segregation, competence and competition prevent the creation of new services which could transform regional performance.

The English Channel is a unique case for regional integration due to the physical barrier of the Channel, differences in currency and language, the non-compliance of the UK with the Schengen agreement and the British Euro-scepticism (Thomas and O'Donoghue, 2013). The regions on both sides of the English Channel, Nord Pas de Calais and Kent, are peripheral in their countries, face declining industries due to closure of coal mines in 1989 / 1990 and therefore have a negative external image. High hopes to overcome these were put into the single European market. However, what was achieved through a partnering of the two regions and the opening of the Channel Tunnel was a rise in leisure and shopping trips (including access to Eurodisney in Paris), but not an establishment of a common labour market. Poor timetables and high fares through the Eurotunnel prevent a lively commuter market.

4.3.4. Conclusions

The PBKAL is a good example of a successful cross-border implementation of a railway infrastructure project. However, it has to be admitted that the prerequisites were quite favourable; the region is rather densely populated with a GDP per capita that is well above the EU average. Furthermore, there is a high demand for connections between the cities. But despite these positive starting conditions, regional effects outside the metropolitan areas remain limited. The reasons for this failure are listed as follows by Vickerman (2015):

- Choice of location of intermediate stops: for technical, cost and timetabling reasons these are often far from nearby cities providing only poor access of these regions to the HSR services.
- Little integration with regional and local transport, failing to compensate the poor geographical accessibility of remote regional HSR stations with good access services.
- Poor service levels at intermediate stations as additional stops increase headline times and thus reduce the overall travel time between the metropolitan areas.
- Missing regional development policy including complementary social investments.

The corridor clearly demonstrates that highly developed transport infrastructures and frequent services alone cannot guarantee the achievement of European integration and cohesion targets. Nevertheless they can support these targets with carefully defined transport projects.

4.4. PP3: HSR southwest Europe

Priority project 3 (PP3) aims to merge the two largest high-speed networks, in order to bring Lisbon, Porto, Madrid, Barcelona, Valencia, Paris, Lyon and Bordeaux closer to each other and to central Europe. The corridor connects the Iberian Peninsula with central Europe. Therefore, a high-speed network of 3656 km length (Secchi, 2013) is part of the rail networks of Portugal, Spain and France.

The network consists of three branches which partly overlap with two of the newly defined TEN-T Core Network Corridors: the Atlantic (ATL) and the Mediterranean (MED) corridor. While the Spanish high speed network, being the second largest in the world after China, is close to completion, the border crossing links between the three countries and / or their access routes are still awaiting finalisation. The status of construction works is as follows (Compare Map 4):

Map 4: PP03 with construction progress

Source: Secchi (2013)

- The Mediterranean branch, connecting Madrid with Paris via Barcelona: The border crossing link from Perpignan to Figueras has been in operation since December 2013, providing direct TGV high speed services (6:28 h) from Paris to Barcelona. However, at the French access route from Montpellier to Perpignan construction works are envisaged starting in 2015/2016 with an opening of the line planned for 2020. The final missing link between Montpellier and Nimes (40 km) should open for traffic in 2017 (Secchi, 2013).
- The Atlantic branch, connecting Madrid with Paris via Bilbao/Bordeaux: The more direct connection from Paris to Madrid would run via Bordeaux and Bilbao in the North of Spain. The

main cross border link between Bordeaux and San Sebastián is still pending and opening is not expected before 2022. Only the access links on both sides, from Tours to Bordeaux in France and the Basque-Y connecting Bilbao to the Spanish high speed network, are in progress and are expected to open for traffic in 2017.

- The Iberian branch, linking Madrid, Lisbon and Porto: This is essentially at an explorative stage. The entire Portuguese high speed network is not expected to be complete before 2020 as works were suspended in 2011 by the Portuguese Government.

4.4.1. Transport impacts and bottlenecks

Mediterranean branch: Current passenger demand on the Perpignan – Figueras line between France and Spain is at around 2 million passengers per year or 6700 passengers per day. Of this, one third is multi-national traffic coming from or going to third countries. The strong growth rate of 2.8% between 2005 and 2010 on the link dropped to 1.9% after 2010. If this growth rate is applied to the decades to come, 3.6 million passengers in 2025 and 5.7 million passengers in 2050 can be expected. The Paris – Barcelona line served by TGV trains since December 2013 already takes more than 10% of the international traffic between France and Spain (200,000 passengers) (PWC et al., 2014). However, when compared to Barcelona – Madrid (annual average 2008 – 2014: 6.5 million passengers) these figures appear moderate.

Atlantic branch: Passenger traffic between Bordeaux in France and San Sebastian / Bilbao in Spain at the Atlantic coast line is reported to be 35 million passengers trips per year, of which around 27 million (77 %) are done by car, 7 million by air and only one million (3 %) are done by rail (TIS et al., 2014). The low rail share is remarkable as the route is already now served by TGV from Bordeaux-St-Jean via Dax and Irun 3 hours 17 minutes against 2 hours 30 minutes by car (without congestion). Current demand volumes by rail amount to around 3300 passengers per day, which is around half the demand estimated on the mediterranean branch of PP3 between France and Spain.

Demand along the corridor is impacted by a couple of issues:

- **Population** growth rates in the area of the corridor show a homogeneous trend in Spain, France and Italy with an average growth of around 2 - 2.5% between 2008 and 2012. The two major population centres are located in Spain (Madrid and Barcelona regions with 6.4 and 5.3 million inhabitants respectively). However, looking longer term into the future, growth rates in all Member States along the Mediterranean as well as along the Atlantic branch corridor are expected to decline after peaking in 2015.
- **Economy**: the central part of the CNC-MED corridor, namely Southern France and Northern Italy, dominate the corridors' gross domestic product (GDP). Before the world economic crises all countries along the corridor showed strong growth rates above the EU average. France and Spain are considered having growth rates between 0.8% (Spain) and 0.5% (France) for 2015-2018.
- **Tourism** is a particularly important variable in this corridor, but between 2010 and 2011 as a consequence of the economic downturn, overnight stays declined. For the future we can see two conflicting trends: growing incomes in northern Europe facilitating tourism, versus the consequences of climate change with hotter and dryer summers (Eurocontrol, 2009) generating the risk that leisure trips may swap from the Mediterranean area to northern European destinations.

Most dominant bottlenecks to the completion of Priority Project 3 are not the border crossing sections themselves, but the access links on the French and Spanish side. Barriers to delays are geological and network conditions (Marseilles – Perpignan), planning issues (Node of Bergara), and resistance of incumbent rail operators towards the implementation of ERTMS. Conflicting national and European objectives, economic problems and the hesitant use of modern financing instruments also contribute. The most prominent barrier, however, seems to be national protectionism and complex funding rules.

4.4.2. Impact assessment and funding

Albalate and Bel (2015) are harshly critical of many high speed projects in Europe and worldwide. The authors suggest that only two lines, Paris – Lyon and the Japan east coast line, generate profits while all other high speed lines and networks worldwide are dependent on public subsidies. This is particularly the case for the Spanish network consisting of 2515 km in operation plus 1200 km under construction. After China (11,067 km in operation) Spain operates the second largest high speed network worldwide, followed by France (2036 km in operation). Expressed in line length per square kilometre Spain operates by far the most dense network.

Spanish track access charges are comparably low with respective impacts on the business case of high speed rail links. Access charges per train kilometre are equivalent to the rather low level of Germany. However, Germany operates mixed traffic and thus yields earnings from several services. Considerable subsidies into the network of around four billion euros annually are however required for proper maintenance and renewal of the German rail network. In contrast: French access charges are considerably higher than the Spanish charges, bringing SNCF and RFF closer to a viable business case.

Due to the project's long construction history, complete records of project sums and funding sources are difficult to retrieve. The share of funding sources of the South-East Europe high speed axes is broadly as follows (Albalate and Bel, 2015):

- EUR 1.0 billion from the rail network operators;
- EUR 3.0 billion from national, local and European subsidies;
- EUR 3.8 billion loans and guarantees, of which :
    - EUR 0.77 billion from shareholders;
    - EUR 1.67 billion from private banks, of which EUR 1.06 billion with state guarantee;
    - EUR 0.76 billion from a savings fund of RFF;
    - EUR 0.60 billion from EIB.

The two French sections from Tours to Bordeaux (Atlantic branch) and from Montpellier to Perpignan (Mediterranean branch) are rather successful in terms of financing and implementation. The Atlantic section is run by Europe's largest railway PPP with construction times and costs coming in below the initial estimates. The Mediterranean section was built under a private concession. In contrast, the Spanish sections, receiving higher EC funding (14% for works) than France (11%) are progressing slower. The Portuguese sections even receive 36% TEN-T funding (see

Table 10).

Table 10: Construction costs and TEN-T funding of actual PP3 projects

Country / activity	Total activity costs (€ million)	EU contribution (€ million)	EU funding share
FR	**1 391.30**	**229.04**	**16%**
Mixed	951.43	152.05	16%
Studies	77.02	36.76	48%
Works	362.85	40.22	11%
ES	**1 652.70**	**287.22**	**17%**
Mixed	339.18	66.53	20%
Studies	96.10	46.90	49%
Works	1 217.42	173.79	14%
PT	**1 230.79**	**170.16**	**14%**
Mixed	1 146.50	136.11	12%
Studies	26.39	13.19	50%
Works	57.90	20.85	36%
Sum total	**4 274.80**	**686.41**	**16%**

Source: Fraunhofer ISI with INEA data

Along the Atlantic stretch on the French side between Tours and Bordeaux the largest PPP scheme ever applied in the European railway network is currently on-going. This is a long-term concession with traffic risk, supported by a blend of grant, EIB loan and guarantees. Commercial operations are due to start in 2017. Although the project has faced difficult geological conditions and numerous tunnel constructions, the resulting average construction costs of EUR eight billion for the 300 km stretch (EUR 27 million per km) are comparably low. The risk transfer mechanisms developed in the project and the relatively short construction time (Secchi 2013) also need to be mentioned.

4.4.3. Regional and cross-border impacts

Literature overviews and regional model applications TRT (2006) and Kiel et al. (2014) characterise regional impacts from transport investments at best being weak. Enhancing cohesion, i.e. the diminishing of local disparities in terms of accessibility to economic centres, GDP growth and employment, is a continuous process where in the short term central European regions profit more than peripheral ones. Transport investment cannot be considered the major economic leverage to regional competitiveness in the generally comparably well-off European regions.

With reference to the Spanish HSR network, Chena and de Abreu e Silva (2014) find that literature suggests that regional stimulation by transport infrastructures is driven by influencing the location decision of firms, increasing efficiency through lower travel times and by fostering the accessibility to resources, goods and markets. Although the magnitude and significance of the economic effects continue to be inconclusive and controversial, model applications for Spain show positive impacts of HSR investments together with higher education levels - on GDP, employment and accessibility at the provincial level. While concluding that there are no regional effects visible along the early French and German HSR lines, Urena at al. (2010) find that a considerable increase of long distance commute and discontinuous metropolitan processes emerged in Spain.

Despite supporting these findings, Monzon et al. (2013), Ortega et al. (2014) and TRT (2006) warn that HSR extensions may contribute to an increase in spatial imbalance and lead to more polarised patterns of spatial development. HSR networks create islands of good accessibility, depending on the quality of transport to and from the stations, but will at the same time create shadow areas outside the accessibility range of the station.

An ex-post evaluation of the Mediterranean high speed line by SNCF (2007) stipulates that, given positive impacts on the regions served by it five years after its commissioning, the TGV MED does not wish to alter existing structures. Its effects on the economy and development are not spectacular. While recognising the threat of increasing local disparities, the study acknowledges that behavioural and cultural changes towards regional development take much more time to unfold than transport demand.

4.4.4. Conclusions

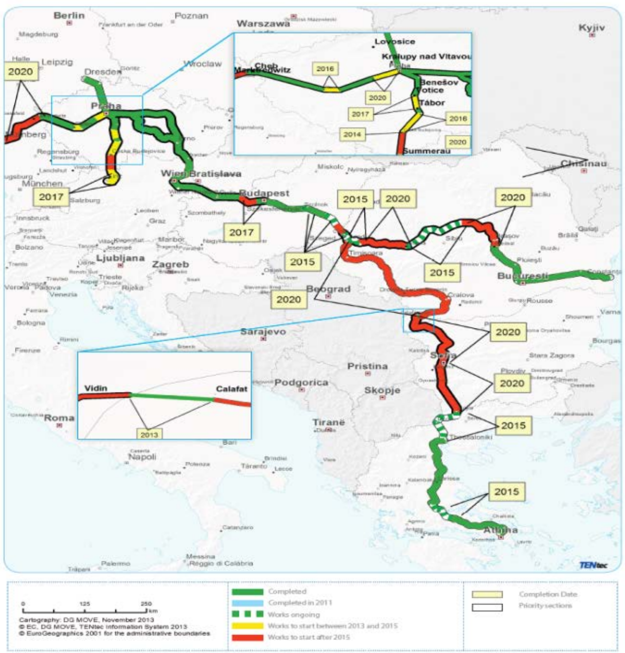
PP3 builds on a long tradition of high speed investments in the two oldest HSR networks on the continent, and is therefore well advanced in many areas. However, new links connecting the two networks and extending them to Portugal are on a slow track. Now, with declining population growth rates along the corridor and the still visible consequences of the world economic crisis in the region, business cases get more difficult.

4.5. PP22: Railway axis Athens-Budapest-Dresden

The PP22 corridor project is part of the TEN-T corridor concept which was presented in 2004 and published in the TEN-T brochure of the EU Commission (2005). This corridor of 3575 km length connects the South Eastern Member States Greece, Bulgaria and Romania with the central European countries Hungary, Czech Republic, Slovakia, Austria and South-East Germany through a major railway axis. The rail network along this axis should achieve European railway standards. The sections of the PP22 corridor are shown on Map 5, which also states whether they are completed, under construction or to be started after 2015.

According to ETISplus statistics the modal shares in passenger transport are 83% for road, 13% for rail and 4% for air. Almost 30% of the international rail passenger flows relate to Austria from and to its neighbour countries Czech and Slovak Republic, Hungary and Germany. International rail flows relating to Greece,

Map 5: Ongoing and planned work for upgrading the PP22 rail corridor



Source: Savery (2013)

Romania and Bulgaria are comparatively low, e.g. Romania contributes about 1% of international rail passenger flows of the corridor. For the freight transport volumes in 2010, 58% are reported for road, 28% for rail and 14% for inland waterways.

The forecasts of transport development are highly dependent on the underlying scenarios for infrastructure improvement and political interventions in the transport markets. The growth of passenger transport by rail is forecast as nearly stagnating with very modes growth rates between 0.04% and 0.07% p.a. because population is expected to decrease, particularly in Hungary and the Czech Republic. The freight transport forecasts show much higher growth rates in the markets and the benefit to the rail sector will be more than proportional if the planned investments on the supply side are realised and the political climate is positive as expected in the White Paper of the European Commission (2011). While the highest growth rates are forecasted for the south-eastern part of the corridor the transport volumes there are very low and even in optimistic scenarios like the EURO-3 scenario of Panteia et al. (2012) they are far below the volumes in the north-western part of the corridor.

4.5.1. Transport impacts and bottlenecks

The northern branch of the corridor between Dresden, Budapest, Bucharest and Constanta shows a good utilisation of the rail infrastructure capacity, some critical spots around Bratislava, Budapest and potential future capacity restrictions in the Romanian part. The southern part between Arad, Sofia and Athens, on the other hand, is heavily underutilised. Although 52% of the track length is single track there is no capacity problem, not even in the case of an optimistic transport development scenario. Selected major bottlenecks identified by Panteia et al. (2012) and Savary (2013) are:

- Germany: Nuremberg-CZ border;
- Czech Republic: Brno-Breclav, Prague node/bypass;
- Austria/Czech/Slovak Republic: Prague-Linz, Vienna-Bratislava;
- Hungary: Border crossing with Romania at Curtici, Budapest Danube bridge;
- Romania: Access rail links to Danube bridge Vidin-Calafat at border with Bulgaria;
- Bulgaria: many sections with poor quality between Arad and Greek border;
- Greece: Thessalonica-Bulgarian border, Athens-Thiba, Athens-Patras.

Major delays occur at border crossings as exhibited in Table 11. In other reports even higher delay times are indicated, for instance, up to 12 hrs at Curtici (Panteia et al., 2012).

4.5.2. Impact assessment and funding

Panteia et al. (2012) have analysed five scenarios of which the most interesting results are summarised below. "Do Minimum" means that all ongoing works should be completed (mainly the yellow sections in Map 5) but no further investment is undertaken. "Euro 1" adds the upgrade of the Nuremberg-Czech border and the proposed improvements on the branch Prague-Bucharest-Costanta, while the branch between Arad and Athens corresponds to the "Do Minimum" case. "Euro 3" includes the most ambitious upgrades which, after completion, will fully meet the European standards. The results are:

- Do Minimum: total investment EUR 4.7 billion, benefit/cost ratio 1.84;
- Euro 1: total investment EUR 14.3 billion, benefit/cost ratio 1.12;
- Euro 3: total investment EUR 23.2 billion, benefit/cost ratio 0.89.

Table 11: Rail freight transport waiting times at border crossings along PP22

Country	Station*	Reality		Forecast 2021
		Waiting time at the borders	Average waiting time	Average waiting time
Czech Republic	Břeclav (CZ/AT)	3-60min	30min	5min
Hungary	Rajka (SK/HU)	n/a	n/a	n/a
	Komáron (SK/HU)		25min	5min
	Lökösháza (HU/RO)	30min	30min	5min
Austria	0min (handover of trains is realized on the network of Czech Republic and Hungary)			
Romania	Curtici (HU/RO)	100-240min	140min	30min
	Calafat (RO/BG)	100-240min	140min	20min
Slovakia	Kúty (CZ/SK)		120min	20min
	Štúrovo (SK/HU)		140min	20min
* the waiting times at stations situated on the main lines are used for the purposes of calculation				

Source: Table 60: Implementation plan rail freight corridor 7 (Nov. 2013)
Source: Rhine-Danube Core Network Corridor Study (RD, 2014)

This indicates that the expected benefits don't justify bringing the whole corridor to the desired European rail standards. These standards (see section 3.3) are in some ways very ambitious and could be relaxed for section with low traffic as for instance expected in Bulgaria and northern Greece.

For the 2007-13 period INEA reports the co-finance of 9 studies on sections of PP22 with a financial volume of EUR 41.7 million and a co-finance of EUR 20.8 million. The programming period 2014-20 includes a number of works on railway sections which have been proposed for co-finance. All EU supported PP22 infrastructure improvements are located in former accession countries and co-funded according to the CF funding regulations (up to 85% co-finance). The eligible costs total EUR 2.22 billion and the EU co-finance through CEF totals EUR 1.733 billion, which equates to an average co-funding rate of 78%. The co-funding through ERDF is estimated to be between EUR 1.2 and 1.5 billion such that the total co-finance is at least EUR 3.5 billion for this programming period.

4.5.3. Regional and cross-border impacts

Panteia et al. (2012) have analysed wider economic, as well as regional and social impacts using a computable general equilibrium (CGE) model. Considering the limitations of the study the results confirm the outcome of aggregate economic assessment which showed that ambitious and expensive investments are hard to justify economically in the south-east branch of the corridor. Expensive investments for HSR (e.g.: Dresden-Prague) also have to be questioned.

Looking at the country impacts there is a clear tendency that countries with a higher unemployment rate benefit more from one unit of investment than countries enjoying a better employment situation. This is partly due to the multiplier effect of investment expenditures and partly to the induced economic activities if the transport infrastructure is presenting a bottleneck to regional development.

Apart from ambitious projects like HSR or the rail access links to the Danube bridge (RO/BG) at Vidin/Calafat the removal of cross-border bottlenecks is possible at modest investment costs. A major issue is the change of organisation for checking the border crossing trains and changing of locomotives/personnel.

4.5.4. Conclusions

The main conclusions are:

- The minimum solution of accomplishing the works started is the baseline of recommendations.
- The foreseen additional investments in the northern branch (Dresden-Costanta) have a positive economic return and can be considered for implementation. In this context an upgrade to the electrification of the Nuremberg-Marktredwitz-Cheb link is economically justified. The justification for such an upgrade for the HSR link between Dresden and Prague, promoted by CZ and the German state of Saxony, is doubtful.
- In the southern branch (Arad-Athens) the link between Athens and Thessaloniki should be accomplished as planned. For the link between Arad and Thessaloniki the expensive upgrades to the EU standard have to be questioned.
- The design of the southern branch is closely dependent on the development of a West-East link from Sofia to Burgos at the Black Sea and a connection to the Turkish border, as it is foreseen in the OEM corridor.
- The problems with the second Danube crossing at Vidin/Calafat, e.g. its over-dimensioning for road transport and the missing upgrades of access links for rail, indicate that it is not enough to finance an essential facility rather than to focus on an integrated network concept and implementation, including access links.
- The southern branch is furthermore dependent on the development of a parallel axis through FYRO Macedonia and Serbia which is 330 km shorter and is in such condition that less investment would be necessary to bring the alternative axis to EU standard. A change of the core network alignment through Bulgaria could be considered.

5. EUROPEAN ADDED VALUE OF CROSS-BORDER INVESTMENTS

The European Added Value (EAV) of transport investments consists of all kinds of social and economic benefits which are added, using an integrated European design of a network configuration, to the national isolated bottom-up design (see EU Commission, 2011). It can be generated by

- cross-border links,
- multi-modal connecting points,
- fully connected networks,

which in the case of railways presupposes an interoperable use of the network infrastructure. The economic part of the EAV can be measured by applying integrated transport and economic assessment models. Transport modelling can reveal the additional trips and trip lengths travelled following an investment in these areas ("induced traffic of the first order"). This part of additional benefit can be evaluated by means of consumers' and producers' surpluses, i.e. using usual benefit-cost approaches. Furthermore the improved network configuration generates wider economic impacts which arise through a spatial and sectoral diffusion of dynamic feedback effects which can be measured through the change of regional production potentials. These impacts lead to further transport activity, i.e. the induced traffic of the second order. Such a measurement approach has been applied for instance by IWW et al. (2001; 2009) for the PP17 corridor Bratislava-Paris and for the Stuttgart-Ulm HSR including the Stuttgart 21 regional rail network and station improvements. For the PP17 corridor the study produces an estimated induced traffic of the first and the second order of 30% for rail. The Stuttgart project, which is one of the biggest transport projects in the EU with an investment volume of about EUR 10 billion, is estimated to increase the gross value added of the state of Baden-Württemberg by EUR 440 million or 0.15% per year.

Schade et al. (2015) have found, through a literature review on European added value, that papers discussing and analysing EAV find they occur particularly on cross-border projects. Positive spillovers of projects in border regions often also occur from the project side of the border to the border region on the other side, though this also depends on additional regional factors (Exel et al. 2002, Gutiérrez et al. 2011, Condeço-Melhorado et al. 2013, Salas-Olmedo/Gutierrez 2014).

The study of Schade et al. (2015) continued with an assessment of the wider economic impacts of the cost of non-completion of the TEN-T. By using the work plans of the nine core network corridors (CNC) to feed an integrated transport-economic assessment model (ASTRA model) they defined a scenario in which the core TEN-T implementation ceased in 2015. For such a scenario they found wider economic costs of about EUR 3.000 billion of accumulated GDP which would not be generated if the investment of EUR 623 billion into the core TEN-T was not made. The economic multiplier of the TEN-T would thus be about 5 i.e. per one Euro invested, 5 Euros of additional GDP would be created over 15 years. They also applied a sensitivity scenario in which, in particular, the major cross-border projects were not implemented, while the other elements of the core TEN-T network were implemented. It turned out that the wider economic benefits of the cross-border projects give rise to a much higher economic multiplier. This shows the significant European added value of the cross-border projects.

It is common for such EAV evaluation approaches to be applied on a corridor or network scale. Therefore it is difficult, but essential, to separate out the contribution of improving single border crossings. It is evident that the share of EAV for a border crossing project is higher than for a project located in the central part of a country. Therefore, taking the above example of PP17 and the Stuttgart project, it would create a high EAV to improve the PP17 rail link between Munich and Austrian border, in particular the section Mühldorf-Freilassing (one track, not electrified) which has been neglected for a long time in German planning because of its low priority for the Deutsche Bahn AG. The costs are estimated to be about EUR 1 billion which is 10% of the Stuttgart project which receives co-funding from the federal government, the state, the airport, the regions and the EU.

The above case studies on PPs 2 and 3 clearly indicate that border crossing sections and their access links are commonly of lowest priority for national transport investors and governments. This is driven by the nature of these projects, which generate parts of benefits and user surplus outside the national influence sphere, while costs have to be fully absorbed by domestic funds. European funds as well as a European strategy for a suitable design of a transport sector generating EAV thus have to be pushed forward by trans-national institutions.

EAV does not come automatically by just providing infrastructures. Well located and conceived stations, accessibility and service concepts are all important for generating time savings for large parts of the population, for driving economic interaction across borders, for easing local disparities and therefore for increasing cohesion. These issues need to be addressed by local planning authorities in co-operation with European institutions. They also need to be consistent on both sides of the border. To a large extent the role of the European Commission is thus to coordinate European with national interests. The concept of priority project coordinators, particularly responsible for handling and solving cross-border issues, developed by the EC appears to be a good step in this direction.

6. CONCLUSIONS

KEY FINDINGS

- European railway policy has not yet achieved the desired change of trends on the passenger and freight transport markets although big efforts have been invested in the past 25 years to change the organisation, foster interoperability of the fragmented systems and to improve transport quality through infrastructure investments**. To achieve the ambitious goals of the White Paper of 2011 it is necessary to accelerate the actions necessary** to construct a consistent framework of railway infrastructure, rolling stock technology, control and safety systems, paired with incentive compatible market regulations and efficient organisation in the railway sector.
- **Reducing bottlenecks at border crossings is an effective instrument to generate European added value**. This is because national railway companies and their governments often fail to discover the benefit potential of infrastructure improvements at border crossings because they set priorities on the base of presently observed transport flows. From the European point of view the removal of bottlenecks at border crossing can generate wider economic impacts higher than average per unit of investment.
- **HSR should be extended only on busy corridors connecting agglomerations**. To avoid backwash effects for regions without HSR stations it is necessary to upgrade the regional rail network such that access to HSR stations is improved and inter- and intraregional interconnectivity is fostered. These should be included from the beginning in planning and financing concepts for the main cross border links.
- EU co-funding has accelerated railway projects in the industrialised part of the EU while it has enabled investments for the former accession and cohesion countries which otherwise would not have been possible. But as a matter of fact the **accession countries have laid higher priorities on road and air investments** because it was much easier to finance such projects by EIB loans and private co-funding. Therefore a change of priorities in the Member States is a precondition for accelerating rail investments.
- **Rail infrastructure funding from governments budgets is the prevailing source of funds** which hardly can be extended because of increasing budget constraints. New instruments to foster private-type funding such as LGTT or Project Bonds have not been successful for railway projects as they require sufficient cash flows stemming from the projects. Recently a better blending of instruments has been suggested by the use of concession-like funding which allows for constructing availability-based PPPs with modest revenue streams or mixed funds combining different financial sources including road user or externality charges.
- **Assessment of rail infrastructure investments removing cross border bottlenecks cannot be performed by standard benefit-cost analysis**. It is necessary to apply extended methods to identify and quantify wider economic impacts on a network and system's scale and to quantify the European added value.
- **Core network corridors and rail freight corridors have partly been defined on the base of incomplete information**. It can turn out after a more detailed analysis that a change of corridor and project design may be beneficial. This includes for instance a streamlining of HSR projects in Spain or a change of corridor alignment in the south-eastern branch of P22.

6.1. EUROPEAN RAILWAY POLICY: A LONG-RUN CHALLENGE

European railway reform started with Directive 1991/440/EG. It aimed at reorganising the European railway sector to stop the market decline of railways. Further Directives followed in the year 2001 and were accompanied by three railway packages and the proposal for a fourth package to guide the implementation of railway reform in the Member States. Railway infrastructure investment was fostered in the course of implementing Transeuropean Transport Networks since 1996. However, using the modal split development as an indicator of success the European railway policy was not very successful. The modal share of railways kept almost a constant for passenger transport and declined for freight transport in the past 25 years.

But this should not be interpreted as a policy failure rather than underlines that EU railway policy is a long-term challenge because of the fragmented railway systems, their poor conditions in many regions and the defensive position of Member States. With the current speed of implementation the targeted implementation of all railway projects of the core network corridors until 2030 is at risk. If the climate targets of the White Paper of the Commission of 2011 should be achieved then the railways will have to increase their market shares substantially in the next decades which implies that the process of revitalising the railways has to be accelerated.

With these long-term goals in mind it is rational to increase investment activities for the railway sector and use all kinds of suitable public and private financial sources to accelerate this process. But it has to be emphasised that investment and technical improvements will not be sufficient to achieve these goals. Certainly a continuation of organisational reform will be necessary to make the railway companies able to react more flexibly to the dynamically changing market needs. Furthermore, EU transport policy will have to continue with establishing fair market conditions by internalising external diseconomies.

EU transport policy with this regard is not supported in any case by the member states. For instance accession countries are focusing on a fast development of the road system while railways don't enjoy first priority (e.g. Bulgaria, with the consequence of a drastic drop of rail patronage). Industrialised countries like Germany are reducing road charges for HGV (by 15.7% between 2010 and 2015) while increasing rail track charges (by 13.1%) and energy taxation for rail, with the consequence that the positive development of rail freight service has stopped. There are also political issues which are not followed unambiguously by the EU Commission to give the right incentives to the member states. Examples are the cap values for HGV charging with respect to infrastructure and external costs and the silent promotion of mega-trucks for road freight transport.

6.2. CENTRAL ISSUE: REMOVING CROSS BORDER BOTTLENECKS

Railway freight transport in principle has competitive advantages on long distances and for high transport volumes as it is underlined in the US with a market share of 41.5% (2011). In EU28 this market share is only at 10.8% (2012). A major reason is the fragmentation of the European railway system. While a truck can go from Athens to Hamburg without delays at border crossings and without technical stops the transport by rail requires at least six changes of locomotives and drivers. The delays at borders usually take hours or even days and on the more congested parts of the network further waiting times occur if faster passenger trains overtake a freight train. Furthermore the participating rail companies have not solved the organisational problems at borders efficiently. This leads to the result that railways are not competitive on long haul corridors in particular on West-East or West-South East corridors.

The existing studies show that the waiting time for trains at borders can be drastically cut down, e.g. at Romanian and Bulgarian borders by more than two hours and at Hungarian and Czech borders by about half an hour per border crossing. This is widely possible by intelligent organisational measures. For instance technical checks could be performed at the station of final train make-up and forwarded electronically. In many cases the investment costs of such measures are modest, only if a major upgrading of the speed or capacity level is planned the border crossing sections will be costly components. This is for instance the case for the (still missing) upgraded rail access links for the Vidin/Calafat Danube bridge at the border between Bulgaria and Romania and for the Budapest Danube crossing.

As there is little interest of the national railway companies in investing in border crossings the stimulus has to come from the governments in cooperation with the EU Commission. Offering financial support is an important instrument which has to be supplemented by technical and organisational assistance. The support by CNC coordinators and by JASPERS are important contributions on this way because a main problem of removing cross border bottlenecks is to create a common understanding for the involved railway companies, national governments and EU bodies.

6.3. TO BE STREAMLINED: HSR-NETWORK AND RAIL FREIGHT CORRIDORS

European HSR plans are very ambitious. The Highspeed Europe Brochure of the Commission (2010) mentions a tripling of the HSR network length from 9,700 km 2008 to 30,750 km 2030. In particular the Spanish HSR network has followed this trend-line. 3,100 km HSR lines are already in service and more than 5,000 are planned, which makes it the second largest HSR network in the world after China and the largest in terms of HSR km/inhabitant. It is longer than the French HSR network while the passenger volume carried on the latter is more than four times as high. This indicates the problem with extending HSR networks: While the first lines attracted a high passenger volume and the financial figures were sound the following HSR investments need high public co-finance and attract less passengers per km per unit of EUR invested.

The Spanish HSR investment policy is driven by regional equity issues, i.e. providing regions – also middle-sized cities – good access to the HSR networks. This goes together with switching from the wide gauge to the EU standard gauge of rail tracks, i.e. with a basic modernisation of the network. It remains to be questioned whether HSR is really necessary to achieve these goals of good regional access and standardisation of rail technology. An alternative concept is to restrict HSR construction to a backbone network which combines the larger cities and to link the regions with their medium and smaller cities by an efficient regional public transport system to the HSR stations. This regional integration policy would also strengthen the internal cohesion in the regions and avoid backwash-effects as they can occur if less developed regions lie in between agglomerations with HSR stations.

Such a concept is also beneficial for the long-distance travellers as the number of stops for HSR can be reduced and travel time on long distances are cut short. International transport by rail would become more attractive and trips diverted from air to rail alongside busy corridors. Also the financial aspects have to be considered. HSR with speeds higher than 250 km/h is extremely expensive and it will take a long time and high passenger volumes to justify the investments from the financial and environmental point of view – in particular if one considers land-take and CO2 impacts of construction. Investing in regional rail networks complementing HSR implies much lower costs for tracks and rolling stock and would allow for higher frequencies which are beneficial for the regional population. As a conclusion a streamlining of the HSR extension plans and an upgrading of complementary regional rail networks in Europe is recommended.

Nine EU rail freight corridors (RFC) have been defined according to Rail Freight Regulation 913/2010. Alongside these major corridors for EU freight movements the cooperation between Infrastructure Managers should be strengthened, the needs of freight transport should be fairly balanced with passenger transport and intermodality promoted by providing efficient transhipment facilities. The basic requirements for the railway infrastructure alongside these corridors are set by the key performance indicators (KPI) for freight transport: electrification, speed of 100 km/h, train length of 740 m, axle load of 22.5 t. Six RFC are already in operation. For the remaining RFCs it will be more difficult to achieve the KPIs and this holds in particular for the Orient-East Med corridor which is widely identical in its south-eastern part to the PP22 corridor. As the transport volume in this section is rather low it could be considered to relax KPIs which don't represent essential bottlenecks for interoperability – e.g. the speed or the train length - to make the network upgrade financially feasible.

6.4. FINANCIAL SOURCES FOR RAILWAY INVESTMENTS

The governments' budgets of the Member States are the main sources of funding for transportation projects and contribute about one half of the investment costs on average and considerably higher for railway investments. The countries can complement this source by rail track charging, EU co-funding, concession finance or PPPs. However, in many countries rail track charges – at the current demand levels - recover not much more than the running costs of infrastructure for wear and tear only and cannot contribute to investment. Concession finance and PPPs are only possible in rare cases when the revenues from a project are sufficient to recover at least a substantial part of the investment costs.

The main sources of European co-funding are CEF and ERDF (up to 85% co-finance for countries fulfilling the conditions for receiving money from the cohesion fund). EIB and EBRD can give loans. For the structural funds a moderate increase of available budget for railway projects can be expected, though part of it is allocated under the CEF budget. Excluding the CF part of CEF budget also the remaining CEF budget is increasing in the period 2014 to 2020 compared to the previous period. Given the outcome of the first CEF call in which railway projects received more than 70% of the budget it can reasonably be expected that also under the CEF the budget for railway infrastructure is growing in this period. The design of the CEF funding objectives will lead to a substantial allocation of these funds towards cross-border projects. In summary, for the funding period 2014 to 2020 substantially higher co-funding budgets will go to the rail mode and these funds will be more concentrated on the cross-border sections than in the previous period.

Additionally several "new" financing instruments have been developed as for instance the Marguerite Fund, the loan guarantee instrument for Transeuropean Transport Network Projects (LGTT) or the Project Bond instrument which aims at attracting capital from large organisations as for instance insurance companies or retirement funds.

In general private finance of projects is based on market revenues generated by the project which serves to refinance the capital costs. As the number of transportation projects which can promise enough cash flow is small the number of PPPs has decreased after the financial crisis sharply. For railway projects and in particular for border crossing projects it is difficult to meet the requirements of private investors.

The problems with financial schemes have been analysed by the high level "Christophersen Group" (2015). The group suggests a number of unconventional instruments to overcome the difficulties with railway finance.

The establishment of ***railway investment funds*** is a general idea, which can be constructed in different ways. According to the existing Swiss funding scheme mark-ups on taxes, revenues from rail track charges and from road pricing (vignettes for passenger cars, distance dependent tolls for heavy goods vehicles) are combined, implying a massive cross finance from road to rail. In Germany a funding scheme for the finance of life cycle reinvestments for the rail infrastructure is existing. Government committees have suggested to extend this scheme also to other objects of rail finance.

The Christophersen group also suggests to use ***revenues from internalisation of externalities*** for co-financing investments of environmentally more friendly transport modes. This would be possible for instance for the environmental mark-ups on infrastructure costs which can be levied for heavy goods vehicles according to Directive 2011/76. To develop this instrument further it would be necessary to make it obligatory for the Member States and to extend the list of external costs of transport which presently only includes costs of exhaust emissions and noise.

Another idea is to construct ***PPPs based on availability***, i.e. independent of revenue streams, which would be a "concession-like" business model in the sense of the Christophersen group. In such schemes the private contractor would design, build and finance the project and make its use available for the concession period. New HSR projects in France are financed by this scheme while the state, the railway undertaking and the infrastructure manager contribute to the payment of annuities and interest for the private concessionaire. By this way it may be possible to realise railway projects earlier while avoiding problems with project revenues and general infrastructure management.

Availability-based PPPs can be interesting for border crossing rail infrastructure investments. In such cases the contracts will have to be prepared for the involved countries and the private consortia. Here the new European Investment Advisory Hub (EIAH) should be supporting together with the European Coordinators. Several aspects have to be considered:

- If the private share of finance is very low, e.g. below 30%, then the desired incentive effects are vanishing, eventually even adverse incentives like moral hazard may occur. In such cases it might be preferable to set up a project company which is financed by mixed public/EU sources and contracts out the final design and construction work to a general contractor.
- It has to be checked which type of financial sources affect the debt balance and the Stability and Growth Pact.
- It is recommendable to define the scope of the project appropriately, e.g. a bridge or a tunnel together with the related access links, to avoid isolated solutions which bring little progress in a network context.
- As the cost of capital and transactions are higher for PPPs compared with pure public finance it has to be analysed by use of Public Sector Comparison (PSC) methods which business model is to be preferred.

Following the recommendations of the Christophersen group a ***blending and pooling*** of financial instruments is necessary by combining the grants from CEF, ERDF, CF with the European Fund for Strategic Investment (EFSI). It will have to be clarified to which extent the EFSI funds can be used to support railway investments because it is doubtful whether the desired leverage effect of about 15 can be achieved within the current transport policy framework. In any case it is recommended to support the Member States by institutions like EPEC[9], EIAH or Jaspers with respect to the blending of financial instruments and PSC applications.

Border crossing ***road/rail projects*** may be co-financed partly by the revenues from road charging. The Oeresund project gives an example for successful financial pooling including the revenues from road users which can be applied for instance in the case of river crossings (Danube crossings at Vidin/Calafat, Budapest).

A problem arising with all above business models for private co-finance of railway investments is that they may increase public debt in the balance sheet. Therefore the off-balance status of each financing option has to be checked and eventually legally ensured.

6.5. IMPACTS OF EU RAILWAY FUNDING

The EU co-finance can have three effects:

- It can cause a windfall profit if the project has been decided and would be realised anyway. Examples are the Oeresund project or the Malpensa airport in Italy.
- It can accelerate the implementation of the project. Examples are the Stuttgart-Ulm HSR project or the PBKAL project.
- It can be the enabler of a project which otherwise would not be realised. Examples are many rail projects in the former accession countries which receive a co-finance of 60% and more (78% for the southern branch of PP22) or the Seine-Scheldt canal (Paris-Antwerp) which can expect 40% co-finance would not have a chance to be financed by the French government because of the difficult budget situation.

It is a matter of fact that without the financial support of the EU to build and upgrade new railway lines in Europe many projects would never have been built over the last two decades. In particular, this holds for railways in the New Member States acceding to the EU since 2004 and for cross-border projects. Building roads in the New Member States enabled faster implementation of infrastructure and was easier to attract private capital via the introduction of road charges on these roads. Concentrating railway funding on national links connecting urban hubs and making urban areas accessible for the regional population assigned the available budget to these links neglecting the European dimension of cross-border links that then could not be built or improved anymore.

In that sense European co-funding helped to keep the modal balance between road and rail to where it is today avoiding further decline of the railways and providing mobility options for non-car-owners and lower income households. The positive development of modal shares of the railways on North-South corridors like Rotterdam-Genova underlines that interoperability and fulfilling the essential logistic requirements are able to achieve measurable shifts to rail freight transport. A further

[9] EPEC : European PPP Expertise Centre. An Initiative of EIB, European Commission, Member States and Candidate States.

improvement by finalising the Alpine tunnels and the German access links to the Gotthard tunnel in the south and the Betuwe line in the north will exploit the full potential of the rail mode.

6.6. ISSUES FOR ASSESSING THE EFFICIENCY OF RAILWAY INVESTMENTS

Border crossing railway projects are usually evaluated by the governments concerned and by their rail infrastructure managers. As today traffic in the border areas is low (probably because of the poor border crossing conditions) there is little commercial and governments' interest to invest. Often the governments prepare the list of candidate projects on the base of pre-evaluations of the rail companies such that there is neither sufficient commercial nor public promotion for border crossing projects. Both parties neglect that border crossing project can generate substantial second order effects which in the long run lead to higher traffic volumes, operational revenues and social benefits. These effects can generate a higher benefit per EUR invested than investments in the central parts of countries. Therefore it is a prime issue for European railway policy to close this gap and foster cross-border investments to create the full corridor and network connectivity and to generate the long-term "European value".

This implies first to consider the regional impacts explicitly in assessment studies. With this respect the case studies bring the following insight:

- Regional impacts are rather hard to measure and to forecast in the small. While indicators like accessibility changes can be measured without major problems their impact in terms of GDP or employment cannot be predicted with accuracy.
- Regional impacts take time to unfold. Location patterns of companies may change the structural setting for regions in the long run. This provides difficulties for before and after studies and ex post evaluations.
- Regions profiting most from new transport infrastructures are those with a poor or outdated endowment. But while the relative (percentage) changes are high the absolute changes may be low such that traditional CBA will come out with a low result.
- Positive developments for agglomerations can be accompanied by backwash effects in regions lagging behind economically. Such effects should be avoided by integrating transport investments into regional development programmes.

While it is difficult to measure wider economic impact for a single border crossing on the micro scale it is possible to derive conclusions from statistical analysis and network-wide investigations. Such methods should be applied to the bottlenecks identified alongside of the core network corridors although their results are characterised by higher uncertainty.

6.7. FLEXIBLE PLANNING OF CORE NETWORK CORRIDORS

The corridor concept for the TEN-T has proven a powerful instrument to motivate national infrastructure planning to take trans-national impacts into account. The TEN-T 2004 concept was developed on the base of large projects ("Essen projects" from TEN-T 1996) and further projects of European importance taken from national investment plans, which then were combined to form the 30 corridors. The TEN –T 2013 concept of nine core network corridors is based on geographical indicators and has updated and changed the 2004 corridors. The recent analysis of the 2011 core network corridors has revealed some corridor parts which could be re-considered. For instance it can be doubted that the railway lines between Bulgaria and Greece should be upgraded to a high European standard. For international rail transport, in particular for freight, an alternative route from Budapest through Serbia and FYRO Macedonia appears superior as it is 330 km shorter and in a better condition compared with the planned CNC route. This could be further explored in the context of negotiations for access of these countries to the EU and the EU connections to Turkey.

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ANNEXES: CORRIDOR CASE STUDIES

1. ANNEX PP11: ORESUND FIXED LINK

KEY FINDINGS

- **Investment cost:** EUR_{2007}[10] 3.1 billion, first estimate in 1987 EUR_{2007} 1.7 billion, cost estimate for approval: EUR_{2007} 2.23 billion, cost overrun after estimate for approval: 39%.
- **Implementation period:** 112 months of planning, 81 months of construction. Construction finished 6 months ahead of plans.
- **Funding structure:** private loans of the Øresundsbron Konsortiet guaranteed by the States of Denmark and Sweden. EUR 127 million of TEN-T funds.
- **Major cross-border project(s):** combined rail-road infrastructure consisting of tunnel, artificial island and bridge with feeding links. Length 16 km plus landside connections.
- The project **successfully stimulated the regional economies** in Copenhagen and the Skane region.

1.1. DESCRIPTION OF THE PROJECT

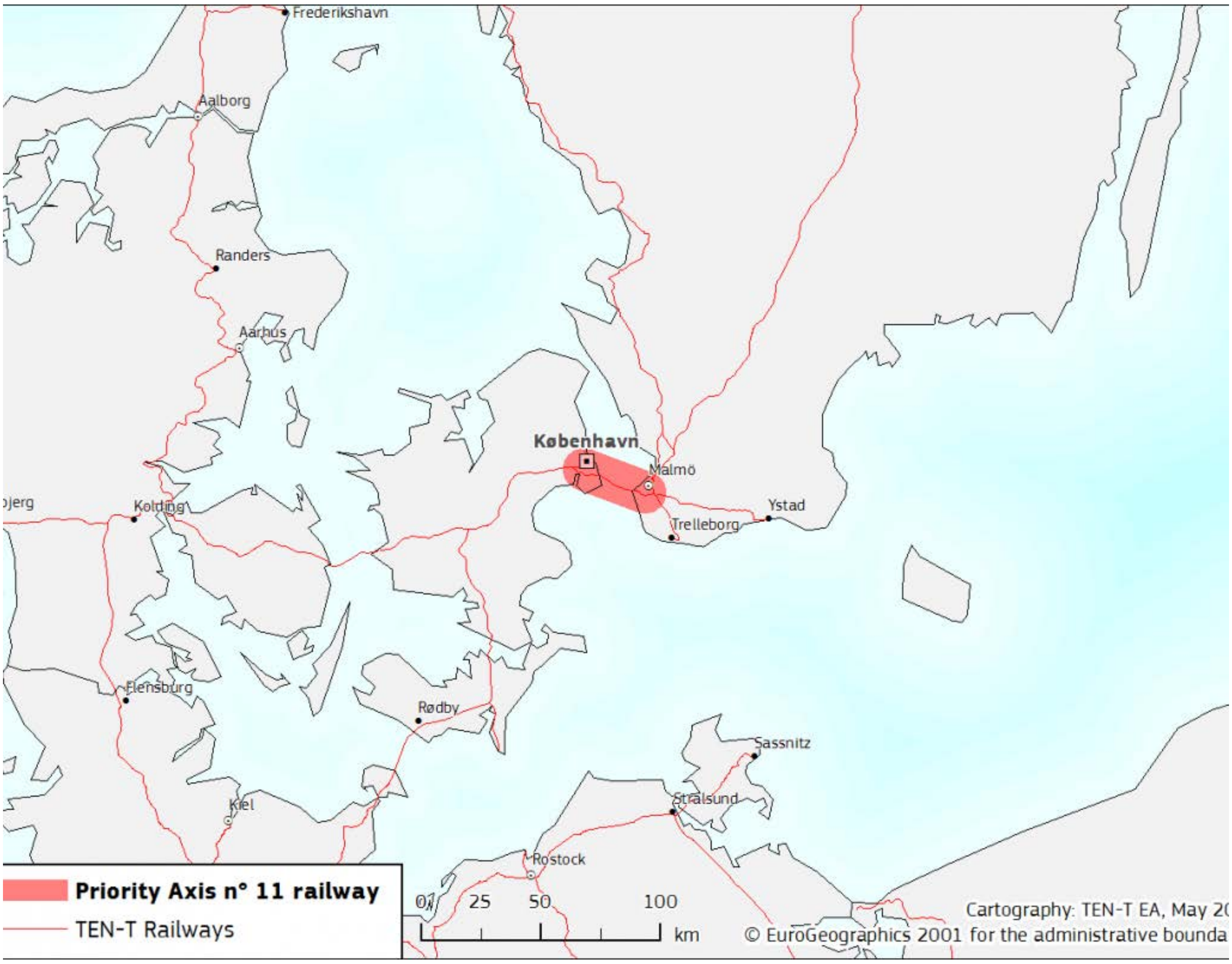
The Øresund Fixed Link connects Denmark and Sweden via the Øresund through a combination of a tunnel, an artificial island and a bridge. Basically it constitutes a cross-border project. Metropolitan areas are located at both ends of the fixed link: in Denmark the capital city of Copenhagen and in Sweden the city of Malmö, adjacent to which is the city of Lund (see Map 6). The Øresund Fixed Link was constructed between 1995 and 1999 and opened in 2000. After 15 years in operation the three cities of Copenhagen, Malmö and Lund have grown so close together that some commentators refer to the Øresund City as one integrated metropolitan area (Matthiessen 2010). This area serves a population of 2.6 million inhabitants while the Øresund Region formed by the Danish Region of Zealand, Copenhagen and the Swedish County of Skane is populated by 3.8 million inhabitants.

The Øresund Fixed Link has been part of the TEN-T network from the beginning of the definition of a concrete TEN-T infrastructure. This infrastructure commenced with the work of a high-level expert group in 1994 led by Henning Christophersen, the former Vice-President of the European Commission. The "Christophersen Group" proposed 14 projects which were adopted by the Council summit in Essen in 1994 and formed the backbone of the first TEN-T guidelines published in 1996 ("Essen Projects"). The Øresund Fixed Link was number 11 out of these initial 14 TEN-T projects. A rough estimate of the budget needed for implementation of the 14 Essen projects amounted to about EUR 96 billion and EU co-financing of up to 10% was decided upon, with a budget limit of EUR 1.42 billion.

The Øresund Fixed Link was actually one of the first completed TEN-T projects when it opened in the year 2000. This was because the governments of Denmark and Sweden had already signed an agreement to build a fixed link in 1973 and had been developing implementation plans since the mid 1980s. At that time both countries were economically weaker than other European countries and the objective of both governments was to form a large centre of economic growth by connecting Copenhagen and Malmö with a fixed link.

[10] At 2007 price levels.

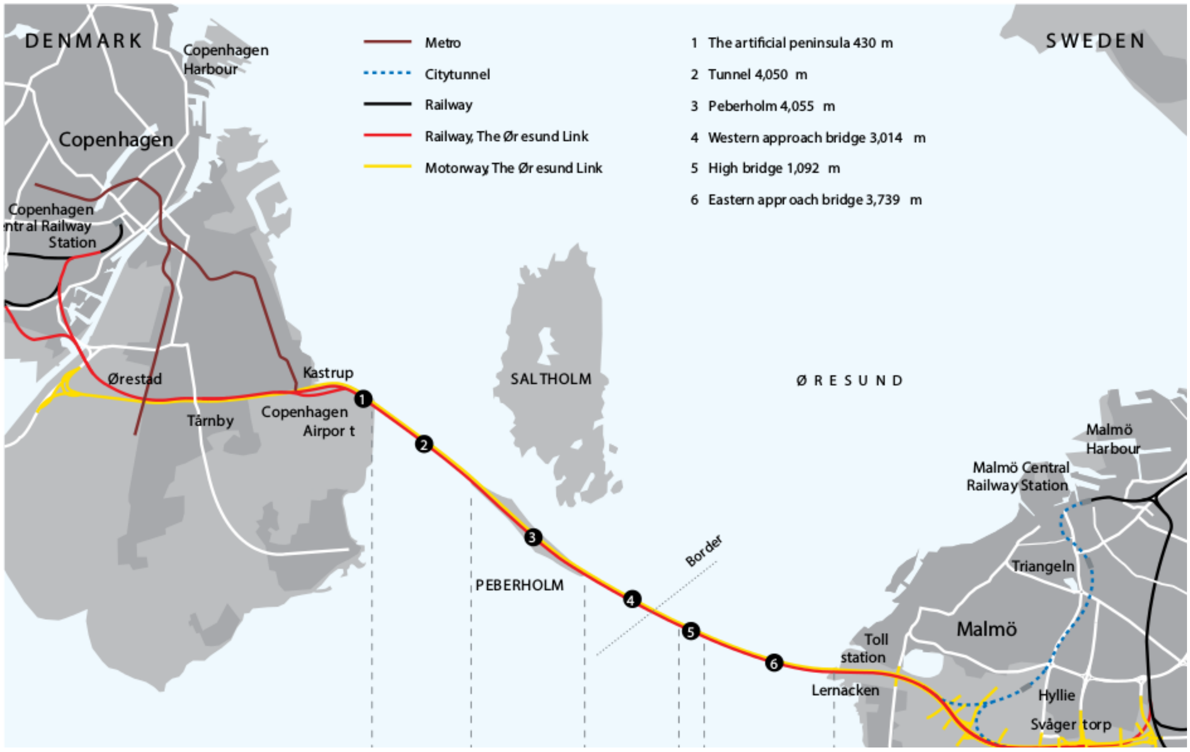
Map 6: Location of the Øresund Fixed Link



Source: INEA website on priority projects (http://ec.europa.eu/inea/en/ten-t/ten-t-projects/projects-by-priority-project/priority-project-11)

Map 7 indicates the location of Copenhagen and Malmö as well as the different elements of the Øresund Fixed Link. Starting from Copenhagen the new link establishes a fast connection to Copenhagen Airport (Kastrup) providing rail and road access to air transport for Danish and Swedish inhabitants of the region as well as to travellers entering both Denmark and Sweden. The two-lane motorway and the double track railway then passes into a 4 km long tunnel exiting on the artificial island of Peberholm for the next 4 km long section. This part is connected with the 8 km long bridge across the Øresund consisting of a 3 km long Western approach part, a 1.1 km long high bridge (maximum height 203 m, navigable clearance of 57 m) and the 3.8 km long Eastern approach part from which the rail track and the motorway connect to the urban networks of Malmö and the long distance networks of Southwest Sweden. The various elements of the Øresund Fixed Link were commissioned for construction from different consortia. The bridge was commissioned from Skanska, as a design and build contract, and was completed 6 months ahead of schedule at a cost of US$ 1.3 billion (Skanska 2009). Hertogh et al. (2008) report that the contract, when signed in 1995, was worth EUR 0.85 billion.

Map 7: Elements of the Øresund Fixed Link



Source: Project fiche (2014, http://beyondplanb.eu/project_oresund_bridge.html)

Though the Øresund Fixed Link has a length of only 16 km, new rail infrastructure of 42 km and new road infrastructure of 32 km was required to include the landside connections (Pedro/Mikic 2015).

1.2. TRANSPORT DEMAND

Transport demand cannot easily be compared with a situation without the fixed link as prior to its construction only ferry services were available. While the new rail connection offers a travel time from city centre to city centre of 35 minutes, the ferries took longer and did not connect to the centres. In 2009 about 17,000 people commuted over the Øresund Fixed Link each work day, demonstrating the attractiveness of the connection and the convenience of life styles living in one city whilst working in the other across the bridge. In 2007 about 47,000 passenger trains and 8,850 freight trains used the rail link via the Øresund. On average this means 140 trains per day crossed the Øresund Fixed Link.

Pedro/Mikic (2015) list 11 transport demand forecasts from the 1990s and into the 21st century. Most, but not all, of them overestimated the future transport demand. The outcome of the forecast strongly depended on the assumed road user charge of the bridge in comparison to the existing ferries. When charges were assumed to be the same as the ferry cost, demand was underestimated, whereas lower charges led to overestimates. Forecasts at the opening of the Øresund Fixed Link in 2000 were appropriate, expecting a road demand of 15,732 vehicles per day (VPD) for 2007 when the actual traffic was 18,432 VPD. It should be noted that the traffic in the initial year was 9,204 VPD demonstrating that over seven years road traffic roughly doubled. This shows that such large scale infrastructures cause long-term structural changes and it can reasonably be assumed that these are still ongoing after 7 years. Two decades seem a more appropriate time scale over which to assess such spatial and structural (economic) developments. For rail passenger transport the forecast was slightly above the actual traffic in 2007 with 28,000 passenger per day (PPD) forecasted and 26,600 PPD actually travelling.

Since 2007, road transport has slightly increased and it peaked in 2009 which was the year of the financial and economic crisis. After that it has remained stable with an increase in 2014 and an expected further increase when the Fehmarn-Belt Fixed Link opens. A growing proportion of road users also take the bridge for leisure purposes. Rail passenger transport was less affected by the crisis and reached its highest level so far in 2013, with close to 12 million trips per year. Freight transport also grew continuously until 2010. Since then it has remained stable at about 6 million tons per year carried by about 8,000 freight trains. The freight market is continuously shifting from the Helsingborg ferry to the Øresund bridge which took more than 50% of the demand in 2014 (Oresundsbron 2015).

It should be noted that transport demand on the Øresund Fixed Link seems rather sensitive to the economic situation as it fosters life styles of a high-performing economy, in which competition between attractive job options, business locations and leisure attractions encourage the search for new opportunities and drive structural changes that do not see distances as an obstacle.

1.3. BOTTLENECKS AND BARRIERS TO IMPLEMENTATION

Many of the bottlenecks and barriers observed in other large projects have been mitigated by the set-up of the ownership and management structure of the Øresund Fixed Link. The independent project sponsor and promoter Øresundsbron Konsortiet (OBK) (until 1999 Øresunds Konsortiet) was backed by guarantees from the States to obtain loans with comparatively low interest rates. The link is generating a continuous flow of revenues from the road users which also cross-funds the rail infrastructure. OBK professionally managed the project building using separate contracts with specialists for the individual elements of the link, taking adequate provisions for risk management and proactively communicating with the stakeholders in the early stages.

The most significant barrier was the different legal cultures in the countries at each end of the link. This had already been considered in the Treaty between Denmark and Sweden that provided the basis for the infrastructure development and the inauguration of the Øresunds Konsortiet company in 1991. In particular, the Swedish environmental protection laws related to the use and management of water, required that the Water Court approved the construction of the link. This meant that through the construction spillage must not increase by more than 5% and that water flow to the Baltic Sea should not be disturbed (Hertogh et al. 2008).

1.4. ASSESSMENT OF THE PROJECT

We could not identify an *ex-ante* Cost-Benefit-Assessment (CBA) for the Øresund Fixed Link. Leleur et al. (2000) point out that the decision on the implementation of the fixed link (see The Government Proposition 1990/1991) was taken largely on the base of qualitative evaluation of different criteria. They propose that further quantification using tools developed in various EU projects (e.g. TEN-ASSESS) could have improved the decision base.

However, since the link has been in operation for 15 years, the scientific literature provides for *ex-post* socio economic assessments. Knudsen/Rich (2013) have estimated the Benefit-Cost-Ratio (BCR) of the Øresund Fixed Link at 2.2 applying the transport demand and cost values from the year 2010 and taking into account a time horizon of 50 years. In the first ten years after opening of the link the consumer benefits accounted for EUR 2 billion, which makes-up more than 50% of the investment cost. The internal rate of return was calculated at 9.9%. Even scenarios with stagnation of demand generated a BCR greater than 1. They conclude that the investment into the Øresund Fixed Link was beneficial from the socio-economic point of view.

1.5. FUNDING OF THE PROJECT

The Øresund Fixed Link was almost completely privately funded, apart from EUR 127 million of support provided by TEN-T funds. Øresundsbron Konsortiet (OBK) an autonomous identity that managed the construction as well as the operation is backed by the States of Denmark and Sweden. As such it was in a position to obtain loans at comparatively low interest rates, equivalent to that of the States i.e. the loans obtained an AAA rating from Standard & Poors. Since there is a continuous revenue flow from the road users, as well as modest revenue from the railways, the link is paying its way through usage; the loans are expected to be paid back after a little more than 30 years. From 2017 onwards OBK estimates that it will be feasible to pay dividends to the owner companies.

Some authors consider that the key for the success of the Øresund Fixed Link is that the Øresundsbron Konsortiet (OBK) has sole authority to set the tariffs for the crossing, and is politically independent (Hertogh et al. 2008).

1.6. REGIONAL IMPACTS OF THE PROJECT

Most of the articles and papers about the Øresund Fixed Link emphasise the positive regional economic impact of the infrastructure (Matthiessen 2010, Knudsen/Rich 2013, Hertogh et al. 2008). Three particular impacts are discussed: (1) agglomeration effects through the enlargement of local markets to increase their potential market size e.g. from the Copenhagen area to the Copenhagen-Malmö-Lund area, thus creating new business networks and opportunities, (2) connection and enlargement of the labour markets and (3) expansion of the housing markets. The second effect was particularly beneficial for the young unemployed Swedes who have been able find jobs in Copenhagen since the opening of the link. The third effect was beneficial for Danish families who were more easily able to afford a house in Malmö where house prices were lower.

However, both effects caused imbalances for the tax systems as employees paid their taxes in their country of work (in this case Denmark) but need infrastructure such as kindergartens and schools in their country of residence (in this case Sweden). Despite this imbalance, the region of Skane has been the best performing in Sweden since the opening of the link and it can reasonably be argued that the infrastructure is part of the success story of the area.

Andresen Analyse (2013) shows that employment growth in the Øresund region affected by building the fixed link was significantly stronger than the national averages. In Sweden the average annual growth since 2000 was 0,8%, while in Skane it was 1,1% and in the city of Malmö even 2,5%, which was one of the highest rates across all Nordic cities. For Denmark and the city of Copenhagen the rates were 0,1% for the average growth and 0,5% for the growth of employment in the city. They conclude that the Øresund Fixed Link brought this dynamism to the region.

1.7. CONCLUSIONS

The Øresund Fixed Link can be seen as a success story of a large European cross-border infrastructure project and it was constructed without delays. Cost-overruns occurred but could largely be attributed to additional requirements of stakeholders (e.g. environmental mitigation) and the project management was sufficiently flexible to adjust to such requirements. The traffic forecasts are largely met such that there is optimism that the loans will be paid back after 33 years of operations. The socio-economic *ex-post* assessment estimates a BCR of 2.2 for medium growth scenarios, but also in pessimistic scenarios the BCR remains above 1.

In regional economic and macro-economic terms the project also seems to foster economic development by increasing employment and stimulating growth in the regions connected by the infrastructure.

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2. ANNEX PP2: PBKAL NORTH-WEST EUROPEAN HIGH SPEED NETWORK

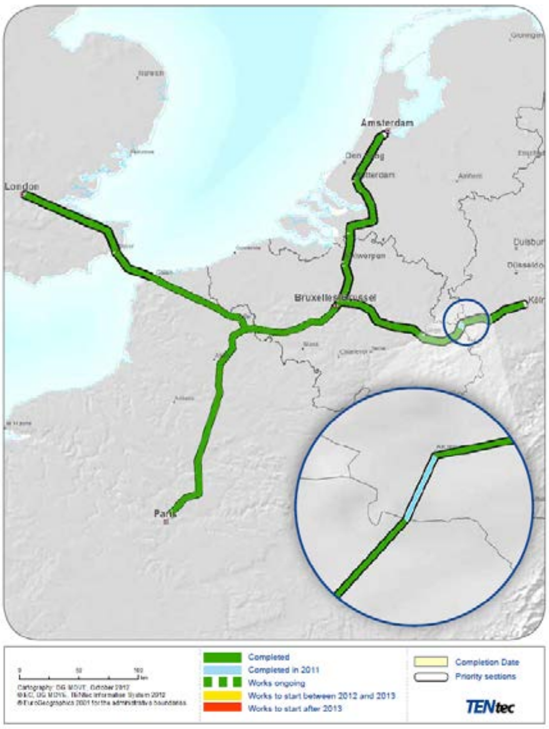
KEY FINDINGS

- **Investment costs**: Total estimated investment costs of EUR 18.8 billion receive TEN-T funding of around 5%. Cohesion and EFRE funds do not apply.
- **Implementation period**: The corridor was pioneered by the French TGV lines in the early 1980s. Including the Channel Tunnel construction and the Belgian and German investments from the 1990s, it took more than two decades for completion of the whole project. PBKAL became fully operational in 2010, and upgrades of the missing links to Aachen and Amsterdam are envisaged in the coming years.
- Planned construction periods were mostly met, but overruns of between 25% and 116% occurred. Main reasons for these were geological risks, funding issues and **changing project specifications** during the construction phase.
- **Demand analysis:** Demand of the international operators Eurostar and Thalys has increased from 12.5 million passengers in 2000 to 16 million passengers in 2010. For the important channel tunnel project, there were multiple issues causing actual demand figures to fall significantly below projections, but the trend is positive.
- **Regional cross border impacts:** Studies of regional impacts indicate agglomeration effects occur in cities with high speed rail (HSR) stations while the benefits for regions in between agglomerations not served by the link are limited, vague and may only be revealed in the long term. Improving regional networks for better access to the HSR stations and accompanying economic stimulation policies are of utmost importance for spill-over effects.
- **The role of service quality:** The service quality on the links between the large cities of Paris, Brussels, Cologne, Amsterdam and London has improved substantially, increasing demand for rail and effecting a big modal shift from air to rail. The cross border travel activities between the smaller UK and French cities at each end of the Eurotunnel, which do not have direct access to HSR stations, benefit more from higher frequency or lower cost of the cross border connections than from the HSR services themselves.

2.1. DESCRIPTION OF THE PROJECT

The high speed rail connection of Paris, Brussels, Cologne, Amsterdam and London is part of the North Sea-Mediterranean Core Network Corridor and became fully operational in 2010. Within this high speed rail network there are four cross-border links: the Channel Tunnel, and the connections between Paris-Brussels, Brussels-Amsterdam and Brussels-Cologne. In addition, it enables improved connections between some of Europe's key airports - Brussels, Frankfurt, Cologne/Bonn, Paris Charles de Gaulle and Amsterdam Schiphol. the core network is depicted in Map 8.

Map 8: PBKAL line network and construction progress



Source: European Commission (2012)

The overall length of this project is 932km. The major part was completed before 2010, leaving only a small share of the cross-border section between Belgium and Germany (Liège and Aachen) for completion in 2011. The important high speed link from Frankfurt to Cologne was completed by 2002 using national funds alone. Due to the importance of the link for the PP2 and due to the prominence of the Frankfurt – Cologne high speed project, this section is included in the subsequent corridor analyses.

Two links are still due to be finalised according to the priority project coordination report (EC 2012):

- HSR access link to the Zavemten airport (EUR 15 million TEN-T funding);
- Achen – Cologne (EUR 14.8 million TEN-T funding of EUR 950 million).

2.2. TRANSPORT DEMAND

The Priority Project 2 can be claimed as a success story, since three international operators (Thalys, Eurostar and ICE trains) share the connections. Eurostar is the dominant operator on links using the Channel Tunnel while a large segment of Thalys' total passenger volumes stems from the connection between Paris and Brussels. On both connections the travel times using HSR are lower than that of air travel.

- Between 1995 and 2014 Eurostar passengers more than doubled (Table 12). After stagnation during the world economic crises, passenger numbers rose again with the recovery of the UK economy. Accordingly, profit rates increased by 2% p.a. and the company decided to expand capacity by 7 additional train sets[11] in 2014.
- Thalys passengers have risen by more than 300% (Table 12). This is largely due to the constant increase of connections to and from Brussels. In the first half of 2014 traffic rose by 3.4% despite a slight decline on the main route Paris – Brussels due to new services to Amsterdam, Lille and the German Ruhr area[12].

For comparison: The ICE international by Deutsche Bahn AG carried 2.2 million passengers on the Amsterdam-Frankfurt line and 0.8 million passengers on the Brussels to Amsterdam route. On the latter route, 0.38 million were international passengers with a growth of 3% over 2013.[13] Passenger figures on the TGV Nord are not available, but according to press information, the number of passenger kilometres for all TGV services peaked around 2012 (Cour des comptes, 2014).

Table 12: Eurostar and Thalys yearly passengers (figures in millions)

Operator	1995	2000	2005	2007	2009	2011	2013	∆95-13
Eurostar	4.9	7.1	7.45	8.26	9.2	9.7	10.1	+106%
Thalys	1.54	5.5	6.19	6.2	6.08	6.65	6.69	+334%
ICE Int.*							3.0	n.a.

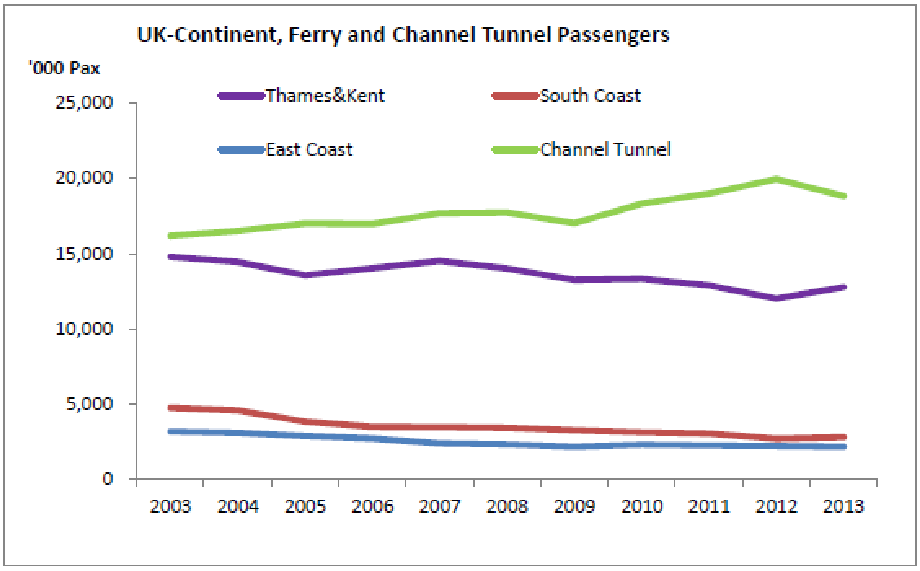
* Frankfurt–Amsterdam and Frankfurt–Brussels. national and international passengers

Source: European Commission (2012) and press releases by Thalys and Eurostar

The Channel Tunnel has the highest attractiveness for passengers crossing borders from the UK to France. Several years of stagnation followed its opening in 1993. Then passenger numbers immediately increased by 20% after the opening of the High Speed 1 line (Channel Tunnel Rail Link) from the Tunnel to London in 2009. The demand volumes presented in Figure 4 also depict the impact of the World Economic Crises as passengers shifted back to the cheaper ferry services in 2012.

11 Source: http://www.eurostar.com/uk-en/about-eurostar/press-office/press-releases/2015/eurostar-reports-continuing-growth-in-2014
12 Source: https://www.thalys.com/de/de/einfuhrung/presse/pressemitteilungen
13 Source: https://de.wikipedia.org/wiki/ICE_International

Figure 4: Cross-Channel Sea and Channel Tunnel Passengers



Source: NSMED (2014)

2.3. BOTTLENECKS AND BARRIERS TO IMPLEMENTATION

The different country policies of rail funding represented high barriers to the implementation of the Channel Tunnel project and its access links to Paris, Brussels and London. The UK government followed the philosophy of full cost coverage of infrastructure investments by fares and access charges and refused to provide any subsidy for the tunnel. For the access link from Folkestone to London several attempts were made to finance this link by private investors. This caused such major delays that the important access link to London was only realised about 13 years after the opening of the tunnel with a small subsidy from the UK government.[14] France, however, was willing to grant subsidies for the tunnel and its access links from the beginning. Accordingly, access charges cover 90% of the infrastructure of the Eurotunnel compared to 60% of the UK access link and only 20% in France (Vickerman, 2015).

Naturally, cross-border sections are the most difficult network sections to implement and are usually the last item on the priority list of rail infrastructure companies. Capacity bottlenecks may occur as new infrastructure generates demand. Furthermore, level-of-service bottlenecks lower the attractiveness of the railway system as they prevent the operators using the infrastructure efficiently for border-crossing rail transport. Identification and removal of cross-border bottlenecks is crucial in order to drive the highest EU added value investment (Steer Davies Gleave, 2011).

In PBKAL most of the cross-border obstacles have been basically overcome, besides some signalling problems between Belgium and the Netherlands which remain due to different ERTMS (European Railway Traffic Management System) equipment (EC, 2012). The Dutch government has decided to implement the ERTMS in stages and as a result has delayed it becoming fully operational by several years. The capacity increases for the cross-border sections between Belgium and the Netherlands are planned from 2014 to 2025 and are estimated at EUR 288.9 million (NSMED, 2014).

[14] Meanwhile the UK government has sold its shares of the EUROSTAR rail operating company to a consortium led by a Canadian pension fund demonstrating that the state is trying to minimise its involvement in transport businesses.

A fully interoperable high speed network on the Brussels – Cologne branch is dependant on the completion of the section between Düren and Langewehe on the German side. This 58 km stretch is to be upgraded from 160 km/h to 250 km/h and completion is planned for 2019.

Since the connections improved by PBKAL enjoy great acceptance, there are now some bottlenecks between France and Belgium and the north-south junction in Brussels, which are mainly due to high congestion in peak times (NSMED, 2014). Although these congestion issues constitute a bigger problem for freight than for passenger transport, they are projected as being the main passenger issue to be resolved in the future.

2.4. ASSESSMENT OF THE PROJECT

Out of six large investment projects analysed by the EVA-TREN (2008) project (see also Chevrolet et al., 2011) only two projects (Malpensa 2000 airport and the Oresund fixed link) deliver real ex-post assessments. Further assessments are available for TGV Nord (RFF 2005). As the priority project is rather large and its construction stretched over two decades we break down its assessment to the single links between the main capitals Paris, Brussels, Cologne (and further down to Frankfurt), Amsterdam and London in Table 13.

Table 13: Project implementation key performance indicators for PP2

Link /	Length	Opening	Construction time (years)		Costs (M€)		Demand (mill. pass.)	
project	(km)	(year)	Planned	Actual	Planned	Actual	Planned	Actual
Paris - London								
London–Channel. (CTRL/HS1) [3]	180	2007		11	5700	9087		
Channel Tunnel [1]	50	1994	6	7	2702	4568	35.8 [4]	16.2 [5]
Paris – Lille (TGV Nord) [1]	333	1993	4	4	2666	3334	7.2 [2]	5.5 [2]
Brussels – Cologne – Frankfurt								
Liège – Aachen	56	2007	4	8		830		
Aachen – Cologne [1]	58	2019			950	open		
Cologne - Frankfurt [1]	180	2002		7	2784	6015		

CTRL = Channel Tunnel Rail Link; HS1 = High Speed Line 1 (UK); HSL =

[1] Chevrolet et al. (2011); [2] RFF (2005) for base year 1985 and target year 2002; [3] 1997 GBP; exchange rate to € = 1,37, Sources: Butcher (2011), Railway Technology: http://www.railway-technology.com/projects/highspeedone/; [4] Anguera (2005): estimate 1987 for 2003; [5] DfT (2013) figure for 2003; actual demand 2013 at 18.8 million passengers.

Source: Compilation by Fraunhofer ISI using above sources

Chevrolet et al. (2011) conclude that three projects along the extended PP2 face cost overruns from 25% (Paris – Lille), 69% (Eurotunnel) to 116% (Frankfurt – Cologne). Significant changes in specification and design during the projects' life time, particularly in the case of the extensive Frankfurt – Cologne construction problems, together with a poor project and demand assessment, are deemed responsible for the more than doubling of implementation costs. In contrast, Paris – Lille showed very little change to the project design and few construction problems. Given that the

Channel Tunnel Rail Link (CTRL) connecting London to the Eurotunnel has undergone two restructurings due to funding reasons, a cost overrun of only 40% appears moderate.

Channel Tunnel

Thomas and O'Donoghue (2013) analyse that traffic counts on the UK side failed due to high access charges for the use of the Eurotunnel after refusal of subsidies by the Thatcher government and the late completion and electrification of the UK access link. Moreover, the continuing tax-free sales on cross Channel ferries and flights, and the rise of low cost airlines, have also hampered business opportunities of the Eurotunnel rail link.

A rather devastating assessment is presented by the UK Strategic Rail Authority (Anguera 2005): "The cost benefit appraisal of the Channel Tunnel reveals that the British economy would have been better off overall had the Tunnel never been constructed, as the total resource cost outweighs the benefits generated". It is argued that users of the tunnel profit at the expense of the tunnel and ferry operators. However, this statement was made before the access link from Folkestone to London was completed. After the channel tunnel rail link (CTRL or High Speed 1) became fully operational in 2007 profitability of the project increased substantially.

Liège – Aachen

On the Belgian side, High Speed Line 3 connects Liège to the German Border. Original completion date of the Brussels – Aachen link, according to the PBKAL-Consultations in 1989, was 1998. However, due to delays in agreement on track alignments, construction works only started in 2001, with completion expected in 2005. The actual completion date was 2007, but opening for traffic was further delayed until June 2009: Total costs for the Belgian part was EUR 830 million (Wikipedia 2015a). On the German side the line goes on to Aachen on upgraded high speed lines.

Paris – Brussels

An *ex-post* evaluation of the French Northern high speed line (TGV Nord) by RFF (2005) finds that the socio-economic rate of return of the line is around 5% with a 20 year discount period, which is below the 8% threshold set out by the General Planning Commission for Public Investments based on 40 year discount periods. Besides the accounting period, the report highlights that these results ignore time savings of foreigners using the line, i.e. the European added value. Planning, regional development and tourism effects are also ignored in the assessment.

Apart from connections between the major European metropolitan areas there are growing concerns of the profitability of the large high speed network. The French Cours des Comptes (2014) blame the automatic option for high speed in France being responsible for the unsustainable financial development of the system (see also Vickerman 2015 on the UK high speed plans or Albalate and Bel (2015) for Spain). Besides Paris – Lyon, the ex ante assessment of all later high speed lines lead to a socio-economic internal rate of return below the 8% desired by the French planning manual (Table 14). The relevance of the 8% margin may be questioned, however, given that public interest rates are close to zero and will most likely remain at this level for a long period of time.[15]

[15] The new French evalution scheme for public projects recommends a risk free discount of 2.5% plus a risk margin of up to 2% for benefit-cost streams up to 2070. The new German evaluation scheme for transportation projects applies a discount rate of 1.7%.

Table 14: Internal rates of return, demand evolution and cost overruns for seleted French high speed lines

Indicator		LN1 Sud-Est	LN2 Atlantique	LN3 Nord-Eur.	Inter-connex	LN4 Rhóne-Alp.	LN6 Med.
Economic IRR	*Ex-ante*	16.5%	12.0%	13.0%	10.8%	10.4%	8.0%
	Ex-post	15.2%	7.0%	3.0%	6.9%	6.1%	4.1%
Socio-Econ. IRR	*Ex-ante*	28.0%	23.6%	20.3%	18.5%	15.4%	12.2%
	Ex-post	n.a.	12.0%	5.0%	15.0%	10.6%	8.1%
Costs against	Declaration	n.a.	24.0%	25.0%	16.0%	21.0%	9.0%
	Approval	1.0%	22.0%	6.0%	-7.0%	-1.0%	4.0%
Demand against	Declaration	n.a.	-22.0%	-69.0%	-41.0%	-16.0%	-10.0%
	Approval	3.0%	-11.0%	-50.0%	-33.0%	-3.0%	-8.0%

Source: Values from Crozet (2013)

2.5. FUNDING OF THE PROJECT

Total investment costs for the period from 2007 to 2013 in this corridor are estimated at EUR 1.86 billion against EUR 16.95 billion before 2007 (European Commission, 2008). As the development and construction time of PPKAL spans over more than two decades there is no comprehensive source on the total share of TENT-T-funding for PP2. For on-going works, project fiches by INEA on feeder lines into the main PP2 corridor report a TEN-T-funding share of around 5-6% as shown in Table 15. An exception is Cologne-Aachen with a TEN-T-share of 25%. The work in those areas is typically in regions which are not eligible for the Structural Fund as PP2 stretches over countries exceeding 90% of the average EU GDP per capita (European Commission 2012, Steer Davies Gleave, 2011).

Table 15: Overview of accessible projects following the completion of the PBKAL

Name	National Budget (EUR)	EU Contribution (EUR)
Modification of Rotterdam Central Station in connection with PBKAL project Amsterdam-Dutch/Belgian border	68.3m	4m
Diabolo: Rail link of the Zaventem airport to the Thalys high speed network	223.1m	13.2m
PBKAL: Belgian part of the northern European high speed network	126.9m	5.8m
Aachen-Köln	17.4m	4.4m

Source: Own compilation according to TEN-T EA (2015)

2.6. REGIONAL IMPACTS OF THE PROJECT

The development of the North-west Europe HSR has been largely driven by the objective of joining the major metropolitan areas. Besides positive impacts on these metropolitan areas, both levels of service and potential economic impacts have been much less pronounced in intermediate areas between major hubs. (Vickerman, 2015). There is a warning that, besides commuting and leisure patterns which have expanded across local borders, the creation of the high-speed rail TEN-T has not met the primary objectives of reducing regional disparities in accessibility on regional integration. It has not led to the reduction in inequalities in accessibility and any associated economic consequences claimed by EU policies and has not been able to change the separating function of borders. But the study also points on the potential of extended service quality from the UK intermediate stops, namely Ashford and Ebbsfleet, to France.

The positive message is that long-term impacts on regional development can be achieved by accompanying high speed investment projects with regional stimulation policies and by a good integration of the high speed infrastructures into local transport networks. In order to achieve a fair balance between local and national / European interests however, the economic impacts in regions between HSR stations will have to be considered and regional policy actions taken into account to improve the competitiveness of intermediate areas and avoid regional backwash effects.

Paris – Lille

An overview of large projects by the EVA-TREN (2007) project and Cascetta et al. (2010) concluded that for Paris-Lille TGV one third of all commuting and business were affected by the introduction of the high speed rail and 6000 fixed jobs were created. This, however, is difficult to verify and allocate to the investment. Although local actors incur positive economic effects, e.g. through the location of international companies in Nord Pas de Calais, 90% of enterprises identified no impact on their overall activity (Vickerman, 2006). Other regional impacts of the new HSR rail lines include, for example, a cost increase for housing located close to the rail track leading to the Channel Tunnel (Cascetta et al., 2010). Even where cross-border integration objectives are seen as a priority by the regions themselves, problems of jurisdictional segregation, competence and competition prevent the creation of new services which could transform regional performance.

The reasons for this failure are listed as follows by Vickerman (2015):

- Choice of location of intermediate stops: for technical, cost and timetabling reasons these are often far from nearby cities providing only poor access for these regions to the HSR services.
- Little integration with local transport, failing to compensate the poor geographical accessibility of remote regional HSR stations with good access services.
- Poor service levels at intermediate stations as additional stops increase headline times and thus reduce the overall travel time between the metropolitan areas.

Channel Tunnel

The English Channel is a unique case for regional integration due to the physical barrier of the Channel, the differences in currency and language, the non-compliance of the UK with the Schengen agreement and the British Euro-scepticism (Thomas and O'Donoghue, 2013). The regions on both sides of the English Channel, Nord Pas de Calais and Kent, are both peripheral in their countries, face declining industries due to closure of coal mines in 1989 / 1990 and therefore have a negative external image. High hopes to overcome these were put into the single European market. What was achieved through a partnering of the two regions and the opening of the Channel Tunnel was a rise in leisure and shopping trips (including access to EuroDisney in Paris), but not an establishment of a common labour market. Poor time-tables and high fares through the Eurotunnel prevent a lively commuter market.

Accordingly, no measurable regional effect on per capita GDP in Nord Pas de Calais as well as in Kent can be determined from the statistics. Even worse: the figures have declined since the opening of the tunnel, with the exception of Lille. The capital of Nord Pas de Calais is within one hour of Paris and serves as a French HSR node. One third of all commuting and business were affected by the introduction of the high speed rail and the city thus attracts a lot of service business from Paris. There is however neither a spill-over effect to the surrounding region, nor a counterpart in Kent. The most positive development in Kent is that of Ashford, which however suffers from competition with Ebbsfleet (Thomas and O'Donoghue, 2013).

2.7. CONCLUSIONS

The PBKAL (Priority Project 2) is Europe's first cross-border high speed passenger rail project and became fully operational in 2010. This project includes major cross-border initiatives such as the Channel Tunnel, fostered major changes in the traffic flows between economic centres, and is the top success story for the North Sea-Mediterranean Core Network Corridor.

Transport demand: An important growth in traffic occurred in parallel with a strong modal shift from air and road transport to rail, due to important gains in time and frequency. The Eurostar attracts more than 60% of the traffic between London and Paris and airline operations have been suspended between Paris and Brussels. However, in the French network actual demand numbers fall well below initial projections due to various reasons.

Bottlenecks to implementation are different technical and operational standards across border links, in particular in terms of implementing ETCS between Belgium and France. For the Channel Tunnel the different funding philosophies in France and the UK provided major problems to implementation and operation of the Channel Tunnel. The operational side is hampered by the success of the project creating congestion at major sections around Brussels.

Project assessment: The efficiency of project implementation, expressed in cost overruns, ranges from 25% for Paris–Lille to 116% for Cologne–Frankfurt. Major inefficiencies stem from design changes during the construction phase and from unforeseen geological risks. Assessments of the French network reveal a saturated situation where most lines, and particularly new projects, are far from economically viable. The concept of serving each medium-sized city with high speed services must thus be questioned.

Funding is restricted to TEN-T and national sources due to the high income status of the area covered by the PBKAL corridor. The TEN-T proportion for this project range between 5% and 25% (Cologne-Aachen).

Regional impacts are difficult to quantify and sometimes appear to be negative based on local statistics. In particular for the Channel Tunnel, language differences, currencies, high usage costs of the Eurotunnel, poor schedules and the British Euro scepticism hamper Kent and Nord pas de Calais from profiting from the infrastructure.

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3. ANNEX PP3: THE SOUTH-WEST EUROPEAN HIGH SPEED NETWORK

KEY FINDINGS

- **Investment cost**: costs of works and studies along PP 3 supported by TEN-T and reported by the INEA database for the period 2007 - 2013 were EUR 4.3 billion, of which EUR 686 million (16%) were contributed by TEN-T. This includes large parts of the Spanish high speed network, which are not necessarily of major European added value and / or relevant for cross border traffic.
- **Implementation period / Maturity**: Major parts of the corridor have been implemented since the 1980s (France) and the 1990s (Spain). Finalisation is foreseen for 2017 (Mediterranean branch), 2022 (Atlantic branch) and beyond 2020 for the Portuguese network.
- **Funding structure**: TEN-T 12%, other national and EU subsidies 26%, loans, guarantees and commercial pre-financing 49%, of which 8% are from the EIB. Europe's largest PPP in the rail sector was successfully installed on the Atlantic cross-border link from Bordeaux to San Sebastian. Funding is completely unclear for the Portuguese branch.
- **Major cross-border project(s):** PP3 consists of two cross-border links from France to Spain: Perpignan-Figueras (operational in 2017) and Bordeaux-San Sebastian (around 2022), and the two links from Spain to Portugal: Badajoz-Evora and Salamanca-Cordoba.
- **Funding** largely relies on subsidies and loans from national and European sources. Only 15% of total costs are contributed by the Spanish network operator RFF.
- **Regional impacts** are vague at best and cannot be shown for the Spanish network outside the regions directly served by high speed trains. However, the density of lines and stations may prevent negative side effects. This is, however, at the expense of extremely high investment and maintenance costs.

3.1. DESCRIPTION OF THE PROJECT

Priority project 3 (PP3) aims to merge the two largest European high-speed networks in order to bring Lisbon, Porto, Madrid, Barcelona, Valencia, Paris, Lyon and Bordeaux closer to each other and to central Europe (European Commission 2005). The corridor connects the Iberian Peninsula with central Europe and the high-speed network of 3656 km length (Secchi, 2013) will become part of the rail networks of Portugal, Spain and France. The network comprises three branches:

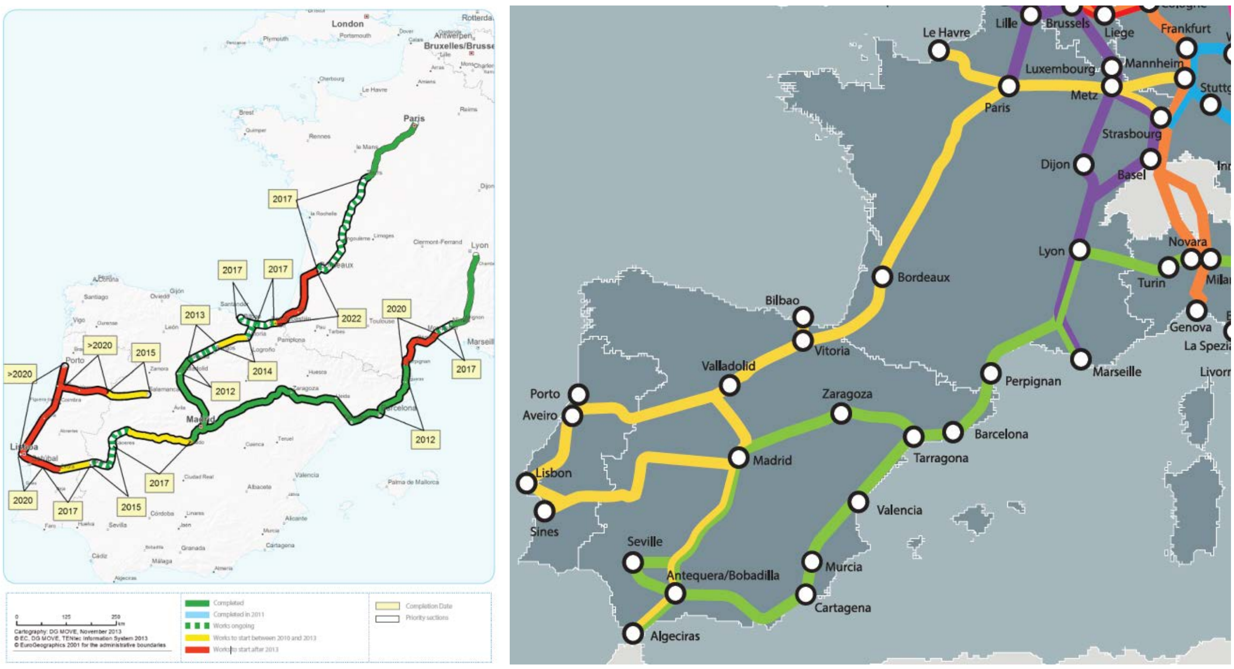
- The Mediterranean branch, connecting Madrid with Paris via Barcelona;
- The Atlantic branch, connecting Madrid with Paris via Bilbao/Bordeaux;
- The Iberian branch, linking Madrid, Lisbon and Porto.

PP3 partly overlaps with two of the newly defined TEN-T Core Network Corridors (CNCs): the Atlantic and the Mediterranean corridor. The priority project and the respective snapshot of the CNCs are depicted in Map 9. Moreover, the project overlaps significantly with PP19: High speed rail interoperability in the Iberian Peninsula. Consequently, both PPs have been promoted by the same coordinator (Carlo Secchi), who since 2014 has taken over the coordination of the Atlantic CNC, only.

While the Spanish high speed network, being the second largest in the world after China, is close to completion, the border crossing links between the three countries and / or their access routes are still awaiting finalisation. The status of construction works is as follows (Compare Map 9, left side):

- Mediterranean branch. The border crossing link from Perpignan to Figueras has been in operation since December 2013, providing direct TGV high speed services (6:28 h) from Paris to Barcelona. However, at the French access route, from Montpellier to Perpignan, construction works are envisaged to start in 2015/2016 with the line opening envisaged for 2020. The final missing link between Montpellier and Nimes (40 km) should open for traffic in 2017 (Secchi, 2013).
- Atlantic branch. The more direct connection from Paris to Madrid would run via Bordeaux and Bilbao in the North of Spain. The main cross border link between Bordeaux and San Sebastián is still pending and opening is not expected before 2022. Only the access links on both sides, from Tours to Bordeaux in France and the Basque-Y connecting Bilbao to the Spanish high speed network, are in progress and are expected to open for traffic in 2017.
- The Portuguese branch linking Madrid and Salamanca to Lisbon and Porto is at an explorative stage. The entire Portuguese high speed network is not expected to be completed before 2020.

Map 9: PP3 with construction progress (left) and CNC network (right)



Source: Secchi, 2014(left) and EC, 2015 (right)

Key Performance Indicators (KPIs): The Atlantic and the Mediterranean corridors should achieve the following standards:

- 100% electrification;
- Standard track UIC track gauge (1435mm);
- 100% ERTMS implementation.

Apart from these specifications, the CNC definitions require a standard minimum freight train length of 740 m and a permissible axle load of 22.5 t. These, however, are only relevant for freight trains and are thus disregarded concerning the analysis of the South-West Europe high speed axis.

3.1.1. The Mediterranean Branch

The cross border link from France to Spain on the Mediterranean branch is part of the LGV (high speed line) Perpignan – Barcelona. This was constructed between 2004 and 2010 for approx. EUR 1.1 billion with public subsidies of EUR 540 million (Wikipedia 2015a). After opening of the Perthus-Tunnel on the 44 km section from Perpignan (FR) to Figueras (ES) regular TGV services (Paris - Figueras–Vilafant) and freight traffic started on December 2010.

Figure 5: Key Performance Indicators for CNC-MED, rail network

Mode	Key Performance Indicator (KPI)	Type	Current	Objective	
				2030	2050
Rail	Electrification	Passenger/freight	90%	100%	
	Track gauge 1435mm	Passenger/freight	70%	100%	
	ERTMS implementation	Passenger/freight	13%	100%	
	Line speed>100 km/h	Freight	93%	100%	
	Axle load	Freight	84%	100%	
	Train length	Freight	24%	100%	

Source: PWC 2014

Current train speeds on the rail network of the Mediterranean corridor are largely above 100 km/h (compare Figure 5). While the Spanish part of the network is upgraded accordingly, the border crossing section between Montpellier and Perpignan is still under construction. According to the report of the Priority Project coordinator (Secchi 2013) finalisation is planned for 2017.

3.1.2. The Atlantic Branch

The Atlantic side of PP3 is lagging behind in the process compared to the Mediterranean branch. However, as CNC Atlantic (ATL) is entirely situated in western Countries with well established rail networks, line speed appears more advanced compared to the Mediterranean (MED) corridor. The KPIs compare as follows (Figure 5 and Figure 6):

- Electrification: 87% in ATL vs. 90% along the MED corridor ;
- UIC track gauge: 58% along ATL vs. 70% on the MED corridor;
- Line speed >100 kmh: 96% ATL vs. 93% MED (for freight trains);
- ERTMS implementation: 7% ATL vs. 13% MED.

The back log of ERTMS application represents a particular problem for interoperability and thus for the full usage of the corridors' potentials. However, France has decided to implement ERTMS as the primary safety system on their network. This could give the system, which is successfully implemented in many countries outside the EU, a final boost.

Figure 6: Key Performance Indicators for CNC-ATL, rail network

Corridor Infrastructure Performance

Mode	KPI (TEN-T requirements)	2014	2030	2050
Rail	Electrification Requirement	87%	100%	
	UIC Track gauge	58%	100%	
	line speed > 100 km/h (core freight lines)	96%	100%	
	Axle Load 22,5 t (core freight lines)	100%	100%	
	Train length > 740 m (core freight lines)	57%	100%	
	ERTMS/signalling system	7%	100%	

Source: Adapted from TIS et al., 2014

The key performance indicators of the new corridor-based TEN-T concept of the European Commission are not fully compatible with the Priority Project definition. In the new definition of Core Network Corridors (CNC) as of 2013 the components of Priority Project 3 can partly be found in the Mediterranean Corridor, which links Portugal and Spain with the Hungarian-Ukrainian border through France, Italy, Slovenia and Croatia (green lines in Map 9, right side), and the Atlantic Corridor linking the Iberian Peninsula with Northern France and South-Western Germany (yellow lines in Map 9, right side).

3.2. TRANSPORT DEMAND

The demand analysis hereinafter follows the logic of the two corridors contained in Priority Project 3: the Atlantic Corridor from Bordeaux via San Sebastián and the Mediterranean Corridor from Montpellier via Perpignan. We further refer to the demand analyses by border crossings from France to Spain and further from Spain to Portugal.

3.2.1. France – Spain via the Mediterranean corridor

Current passenger demand on the line Perpignan – Figueras between France and Spain is around 2 million passengers per year or 6700 passengers per day. Of this, one third is multi-national traffic coming from or going to third countries. The strong growth rate on the link of 2.8% between 2005 and 2010 drops to 1.9% after 2010. Applying this growth rate to the decades to come, suggests that 3.6 million passengers in 2025 and 5.7 million passengers in 2050 can be expected. (see Table 16).

Table 16: Passenger observations and forecasts on the Perpignan – Figureras line (passengers per year)

Year	Traffic between Spain and France	Long distance through traffic	Total traffic	Average annual growth rate
2005	1 629 778	744 286	2 374 064	-
2010	1 900 712	818 475	2 719 187	2.8%
2015	2 099 474	891 346	2 991 093	1.9%
2025	2 577 876	1 037 658	3 615 534	1.9%
2050	4 247 606	1 531 370	5 778 976	1.9%

Source: PWC (2014), citing SENER, 2013

Setec and Stratec 2012 (cited in RFF, 2012) for the French rail network operator RFF estimated annual growth rates of passenger traffic for 2020 and 2034 of between 1.5% and 2.5%. Further information on passenger counts was retrieved by consulting internet sources. A summary is given in Table 17. According to these figures, the Paris – Barcelona line served by TGV train sets since December 2013 already takes more than 10% of the international traffic between France and Spain (200 thousand passengers). However, when compared to the Barcelona – Madrid line (annual average 2008 – 2014: 6.5 million passengers) these figures appear moderate.

Table 17: Summary of internet statements on passenger figures on cross border rail passenger traffic between France and Spain

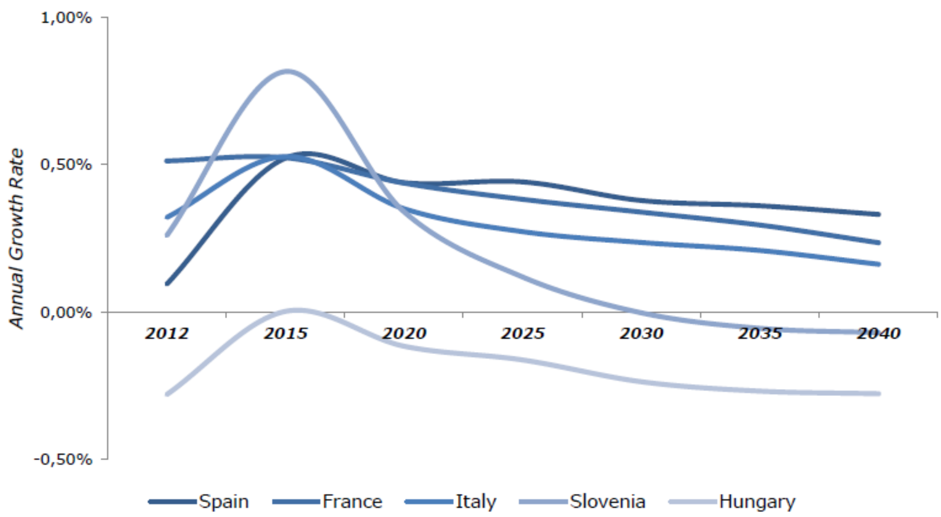
Time period	section/branch	reference	measured value
Year 2014	Spain-France	Accumulated number of passengers	1.85 million passengers on high speed connections between Spain and France in 2014, in which 800,000 were contributed from international traffic
Year 2014	Paris-Barcelona	Accumulated number of passengers	200,000 passengers on the Paris-Barcelona connection in 2014, in which 60% were international traffic and 40% national passengers within France or Spain
Year 2014	Paris-Barcelona	Passengers compared by nationalities	37% of the passengers came from France, 28% from Spain, 35% from all over the world
Feb 2008 – Feb 2014	Madrid-Barcelona	Accumulated number of passengers	33.355 million passengers were transported since the opening of the section in February 2008
Feb 2009	Madrid-Barcelona	share of transport market	one year after opening, the high speed Madrid-Barcelona railway section reached a market share of 40%
Feb 2013 – Feb 2014	Madrid-Barcelona	Accumulated number of passengers	3,184 million passengers

Source: Various internet sources access during July 2015

For railway investments future demand prospects are as much of interest as current levels. Impact factors on demand:

1. **Population**: Population growth rates in the area of the corridor show a homogeneous population growth in Spain, France and Italy with an average growth of around 2 - 2.5% between 2008 and 2012). The two major population centres are located in Spain (Madrid and Barcelona regions with 6.4 and 5.3 million inhabitants respectively). The Milan region follows with 3.2 million inhabitants. However, looking further into the future, growth rates in all Member States along the MED corridor are on the decline after peaking in 2015 (compare Figure 7).

Figure 7: Population projections along the CNC-MED corridor



Source: PWC et al., (2014)

2. **Economy**: The central part of the CNC-MED corridor, namely Southern France and Northern Italy, dominate the corridors' gross domestic product (GDP). Before the world economic crises all countries along the corridor showed strong growth rates above the EU average. For 2015-2018 France and Spain are expected to have growth rates between 0.8% (Spain) and 0.5% (France). Italian growth rates are even lower. Longer term outlooks are not presented by PWC et al. (2014) as the uncertainties involved are too high.

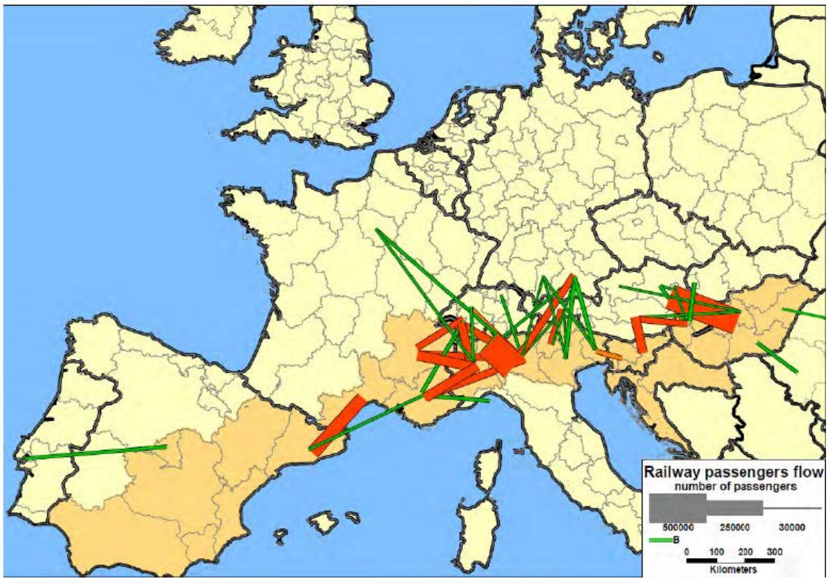
3. **Employment: Unemployment rates in the corridor countries have almost doubled** between 2008 and 2012. The rates are well above the average EU rate and – as for the economic outlook – medium- to long term projections are hardly possible.

4. **Tourism** is a particularly important variable in this corridor, since it traditionally creates a great demand for travel in the Mediterranean region, imposing implications on transport at all levels. Between 2010 and 2011 as a consequence of the economic downturn, overnight stays declined. Projections for future years are not provided by the report, but we can see two conflicting trends: growing incomes in northern Europe facilitating tourism versus the consequences of climate change with hotter and dryer summers. The latter is discussed by Eurocontrol's Challenges of Growth (Eurocontrol, 2009) arguing that leisure trips may swap from the Mediterranean area to northern European destinations.

According to the economic strength and population distribution along the Mediterranean branch, strongest passenger flows are between France and Spain. Overall mode shares for the international traffic between the corridor countries are 64% for road, 33% for air and only 3% for rail transport. Spain – France and Italy – France relations are characterised by strong road traffic, consisting mainly of short-distance trips around the border points of Irun and Le Perthus (ES-FR).

Map 10 shows current rail traffic flows along the CNC-MED. The busiest area is Northern Italy, while the French – Spanish border link is used for shorter distance trips only. Although railway and road traffic values are very different, the areas with most important traffic are more or less the same for both modes of transport. In fact five of the main origin-destination pairs are common. Map 10 is structured as follows: green represents flows between 30,000 and 70,000 passengers a year, orange represents flows between 70,000 and 100,000 passengers a year, while red represents flows over 100,000 passengers a year.

Map 10: Modelled rail traffic flows along the CNC-MED corridor



Source: PWC et al. (2014)

Stable demand conditions exist on the Spanish-French branch of PP3. These are unlikely to develop very dynamically in the coming decades. The 1.9% annual growth of passengers as indicated by Table 16 thus has to be generated from intermodal competition with road and air flows, which is in line with EC policy objectives. As road travel, however, also is dominated by short border crossing trips, and a fair share of air travel on the route goes further to remote holiday destinations, real potentials rather depend on the emergence of structural change in and between the regions now better connected.

3.2.2. France – Spain via the Atlantic corridor

Passenger traffic between France and Spain, at the crossing between Bordeaux and San Sebastian / Bilbao at the Atlantic coast, is reported to be 35 million passengers per year, of which around 27 million (77%) are done by car and only one million (3%) are done by rail (TIS et al., 2014). The low rail share is remarkable as the route is already now served by TGV from Bordeaux-St-Jean via Dax and Irun 3:17 h against 2:30 h by car (without congestion). Current daily volumes by rail amount to around 3300 passengers per day, which is around half the demand estimated for the country crossing along the Mediterranean corridor. However, the high dominance of car traffic indicates a high potential for fast rail traffic.

These figures are taken from the ETIS PLUS database and thus report only estimated flows between NUTS-2 regions along the corridor. Trips from other countries to Spain and Portugal via the corridor are not considered. Given the geographical dimension of the two countries at the Atlantic coast, road and rail connections from third countries to the Iberian Peninsula are likely to be limited.

3.2.3. Spain - Portugal

TIS et al. (2014) report 15 million cross border trips within the Iberian Peninsula per year. As between France and Spain, car share is around 80% and rail share is around 6%. Total rail market can thus be estimated as being 300 daily passengers between Spain and Portugal on the Atlantic corridor (see comments on the ETIS PLUS database above).

3.3. BOTTLENECKS AND BARRIERS TO IMPLEMENTATION

3.3.1. Barriers to railway operations

Secchi (2013) considers PP3 a success story in terms of project implementation. The Spanish high speed network is largely complete or in progress, and the French access links are also developing. For example, in order to accelerate works on the Montpellier – Nimes section the TEN-T funding had to be substantially increased to EUR 105 million in the 2012 work programme. However, some points of criticism are as follows:

- Slow progress of completing some international connections. On the French-Spanish border this concerns the French Section between Montpellier and Perpignan. This is subject to several level crossings, mixed traffic, changing electrification standards and low speeds, and works for upgrading this to high speed standards have not yet started. On the Spanish side of the Atlantic branch this concerns the node of Bergara within the otherwise well progressing "Basque –Y" (Bilbao – Vitoria – Irun/San Sebastián). Failing to find a design solution for this central node might undermine the timely implementation of the whole high-speed network in the region.
- There are more concerns for the Portuguese branch between Porto and Lisbon and their connections to Spain. The other two connections, Bordeaux – San Sebastián and Lisbon – Évora – Badajoz, as well as the entire core high speed network in Portugal, have not even started. For these, the timetable and technicalities are still largely uncertain.
- The European Rail Traffic Management System ERTMS; the Mediterranean Corridor belongs to the ERTMS Corridor D. As demonstrated by many applications – even more prominently outside Europe - ERTMS can substantially enhance rail capacity and reliability. However, due to political and psychological reasons, the incumbent companies show considerable resistance against interoperability along the corridors.

Besides these issues, the most obvious technical barriers on the corridor are related to the infrastructure systems in France and the Iberian Peninsula.

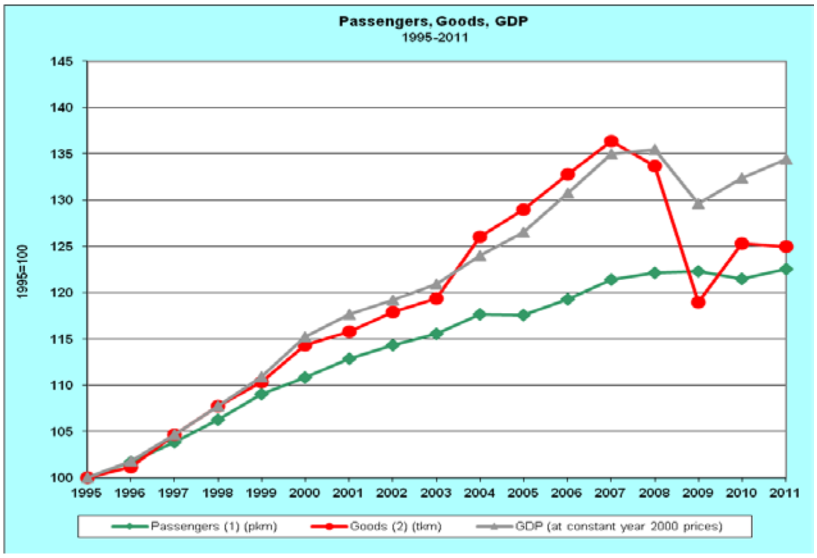
- The coexistence of two gauges. The UIC [16] standard gauge is used in most of Europe but the wide gauge used in Spain and Portugal. This can be dealt with by (i) passengers changing trains or goods being transhipped at border stations and terminals, (ii) the exchange of axle sets, (iii) dual gauge tracks as installed in parts of the Mediterranean branch of PP3, (iv) the use of variable gauge rolling stock, or (v) developing the high-speed network for the long distance connection in UIC gauge as required by the TEN-T legislation on the CNC.. The latter technique is common within the Spanish network, between Spain and France, Sweden and Finland, and between Poland and Lithuania and the Ukraine.
- Different electrifications (25kV AC in high-speed networks, 3kV DC on conventional lines in Spain and Italy, 1.5 kV DC in Southern France – conventional lines), and different standards with regards to train length and axle loads.
- Coordination of agencies in cross border links. There has been a longer period of suspended works along the PP3 Portuguese-Spanish link between Evora and Badajoz on the Madrid – Lisbon line. Only a strong coordination between national and Commission bodies enabled the implementation of a phased approach for re-launching the planning and investment process.
- Conflicting objectives and definitions. The EC is promoting three different corridor concepts: the Priority Projects that have been replaced by the Core Network Corridors (CNCs), the Rail Freight Corridors (RFCs) and the ERTMS corridors. All of these concepts are similar but not fully overlapping nor consistent with each other. A more transparent strategy and vision into EC investment programmes targets would give regions and planners a better basis for designing long-run projects.
- Coordination of financing instruments. EC provisions demand that projects cannot be funded simultaneously by TEN-T, EFRE or Cohesion Funds. Projects with mixed traffic operations or access links to high speed lines however, follow multiple policy priorities (powerful core networks, regional access, freight) and thus cannot easily be allocated to a particular funding programme following a single objective.

3.3.2. Barriers to project implementation

Economic situation: High speed rail construction is expensive, and thus gets more difficult as public budgets get constrained. The impact of an economic down-turn on passenger numbers and goods consignments is even more difficult. Figure 8 shows the effect of the world economic crisis of 2008 on passenger numbers and goods volumes carried by the European railways. Although the impact on freight volumes is extreme, and out of proportion to the fall in GDP, passenger numbers are also affected. Given that fixed costs constitute around 80% - 90% of total costs in providing railway services, such uncertainties represent a considerable barrier to viable business models of rail services in the future. Accordingly, private investors may be more reluctant to contribute to the funding of new projects.

16 UIC = International Union of Railways, Paris.

Figure 8: Rail passengers, freight volumes and GDP in the EU



Source: European Commission (2014)

National market protection: As mentioned above, institutional and psychological reasons apparently constitute the main barrier to the implementation of common European train control and safety technologies (ERTMS) for full interoperability. Although positive European examples with international competition on high speed networks (Brussels – Cologne) and with ERTMS (Lötschberg axis through Switzerland) are prominent, national protectionism remains high. Secchi (2013) accordingly criticises the European railway market as the most fragmented in the world. This is particularly the case for the Mediterranean core network corridor (CNC-MED).

Hesitant use of modern procurement instruments: Public private partnerships (PPPs) are widely used in the road sector, and the largest PPP scheme in the European rail sector is preparing to open for traffic on the French Atlantic branch between Tours and Bordeaux in 2017. The only operational section on the Mediterranean border section between France and Spain from Nimes to Montpellier was also built under a private concession. However, despite these good examples, other sections of PP3 which are lagging far behind are reluctant to apply private capital.

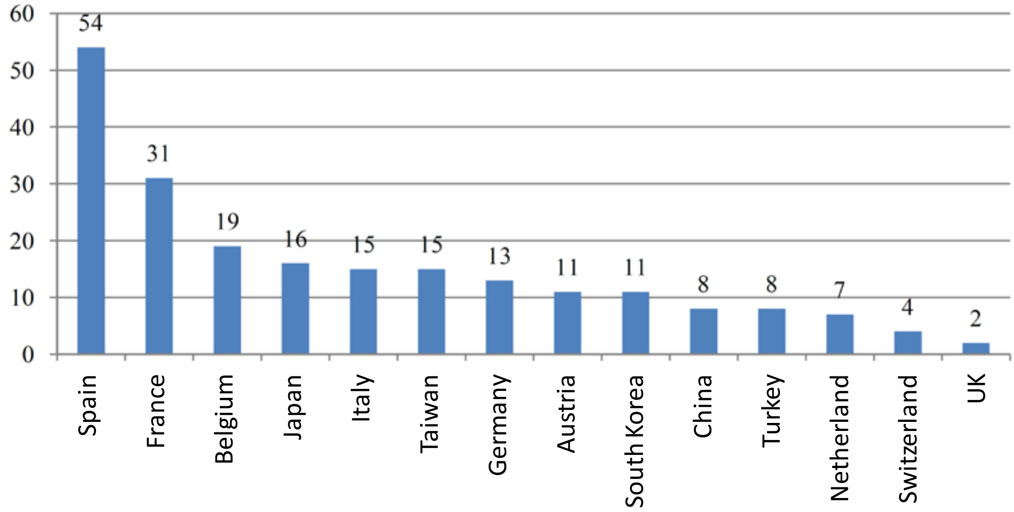
3.4. ASSESSMENT OF THE PROJECT

3.4.1. The Spanish high speed network

A joint study of the French National Railway Company (SNCF) and the railway equipment manufacturer Alstom on the profitability of high speed services (civity, 2013) report that in the long run such investments are often superior to simple medium speed upgrades as they offer more capacity reserves and shorter train circulation times in the network. However, as industry interests may have driven these results, some caution on their general validity is recommended.

A recent study by the Feder Foundation (Albalate and Bel, 2015) is critical of many high speed projects in Europe and worldwide. The authors consider that only two lines, i.e. Paris – Lyon and the Japan east coast line, generate profits while all other high speed lines and networks worldwide are dependent on public subsidies. This is particularly the case for the Spanish network of which 2515 km are in operation while 1200 km are under construction. After China (11,067 km in operation) Spain operates the second largest high speed network worldwide, followed by France (2036 km in operation). Expressed in line length per inhabitant Spain operates by far the densest network (see Figure 9).

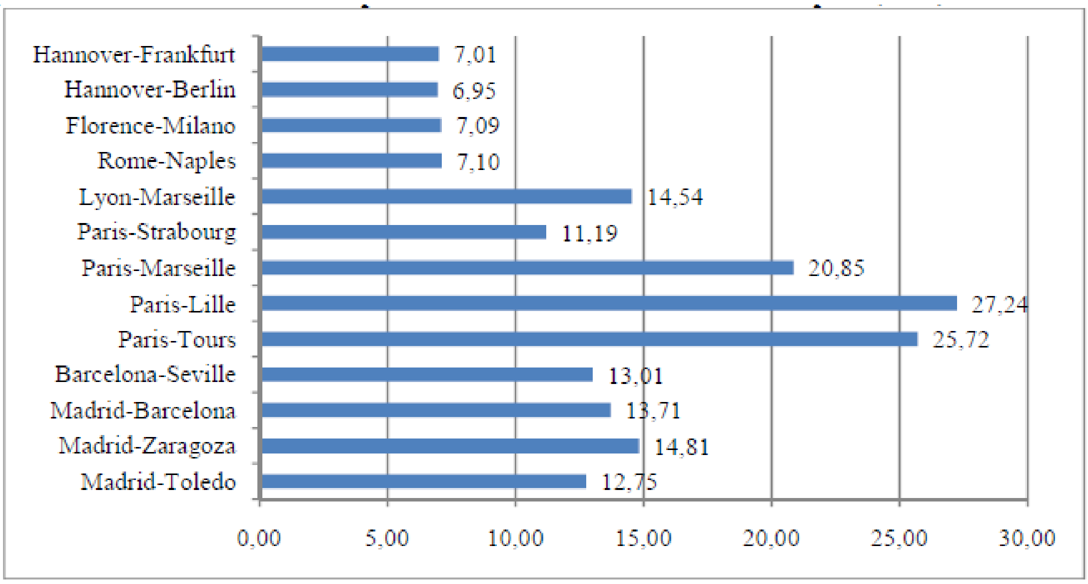
Figure 9: High speed network length per 1 million inhabitants in selected countries



Source: Albalate and Bel (2015)

Access charges per train kilometre in the Spanish high speed network are about twice the ones of Germany, while the annual revenues per kilometre from high speed traffic are just about equal. However, Germany operates mixed traffic and thus yields earnings from several services. In contrast: French access charges are substantially above those of Spain, bringing SNCF and RFF closer to a viable business case (Figure 10).

Figure 10: Track access charges in the European high speed networks 2009



Values in euro per train kilometre (2009)

Source: Albalate and Bel (2015)

3.4.2. Delays and cost overruns

Actual construction times on the Spanish-French connection as available appear to remain under a maximum duration of six years. The Portuguese branch of the corridor appears most uncertain as the Portuguese government has frozen construction works as a consequence of the country's economic down turn. To date it is still unclear when construction works will restart. Only the Spanish access link to Badajoz is completed and opened for traffic in 2015, reducing travel times from Madrid by 50 minutes.

3.5. FUNDING OF THE PROJECT

3.5.1. Funding sources

Due to the project's long construction history, complete records of project sums and funding sources are difficult to retrieve. The public database of the Innovation and Networks Executive Agency (INEA) of the European Commission provides cost and funding data for selected sections of the Priority Projects. For PP 3 data, 38 single measures are available. These consist of track works, preparatory studies and mixed activities. The results of the database are summarised in Table 18 for the period 2007 to 2013. Data for studies and construction works outside this period are not contained in the INEA database.

Table 18: Construction costs and TEN-T funding of actual PP3 projects

Country / activity	Total activity costs (M €)	EU contribution (M €)	EU funding share
France	**1,391.30**	**229.04**	**16%**
Mixed	951.43	152.05	16%
Studies	77.02	36.76	48%
Works	362.85	40.22	11%
Spain	**1,652.70**	**287.22**	**17%**
Mixed	339.18	66.53	20%
Studies	96.10	46.90	49%
Works	1,217.42	173.79	14%
Portugal	**1,230.79**	**170.16**	**14%**
Mixed	1,146.50	136.11	12%
Studies	26.39	13.19	50%
Works	57.90	20.85	36%
Sum total	**4,274.80**	**686.41**	**16%**

Source: Fraunhofer ISI with INEA data

While TEN-T funding shares for preparatory and exploration studies are constantly around 50% of costs, the TEN-T contribution for works varies widely between 11% (Spain) and 36% (Portugal).

Detailed cost data is available in Albalate and Bel (2015) for the French section of PP3 and other newly constructed links (see Table 19). Respective corridor related data on the Spanish or Portuguese side have not been identified.

Table 19: Construction costs and funding of actual French high speed line projects

Indicator	EST-2	BPL	CNM	SEA	Total
Total costs (M €)	2,000	3,300	1,800	7,800	14,900
Line length (km)	106	182	80	303	671
Costs per km (M €)	18.9	18.1	22.5	25.7	22.2
- Paid by SNCF (M €)	520	1400	0	1000	2920
- Paid by central government (M €)	680	950	1200	1500	4330
- Paid by local governments (M €)	640	950	600	1500	3690
- Paid by EU and EIB (M €)	160	0	0	0	160
EU and EIB funding share	8%	0%	0%	0%	1%

EST-2: 2nd phase of Paris – Strasbourg Baudrecout - Vendenheim; SEA = Sud Europe Atlantique (Paris – Bordeaux); BPL = Bretagne Pays de Loir; CNM = Nîmes-Montpellier bypass.

Source: Albalate & Bel (2015) and Crozet (2014) with reference to RFF

3.5.2. Innovative funding mechanisms

Along the Atlantic stretch on the French side between Tours and Bordeaux (300 km) the largest PPP scheme ever applied in the European railway network is currently ongoing. The investment project with a volume of EUR 7.8 billion is a long-term concession with traffic risk, supported by a blend of grant, EIB loan and guarantees. The selection process of the concessionaire has taken place between 2009 and 2011 and commercial operations are due to start in 2017. Broadly, the share of funding sources for the 300 km track is as follows (Albalate and Bel, 2015):

- EUR 1.0 billion (13%) from the French rail network operator RFF;
- EUR 3.0 billion(38%) from national, local and European subsidies;
- EUR 3.8 billion (49%) loans and guarantees to the concessionaire LISA, of which:
  - EUR 770 million from shareholders;
  - EUR 1.67 billion from private banks, of which EUR 1.06 billion are with state guarantee;
    EUR 760 million from a savings fund of RFF;
    EUR 600 million from EIB.

Although the project has faced difficult geological conditions and numerous tunnel constructions, the resulting average construction costs of EUR 30 million per km are comparably low. Also of note are the risk transfer mechanisms developed in the project and the relatively short construction time (Secchi 2013).

3.6. REGIONAL IMPACTS OF THE PROJECT

3.6.1. General regional accessibility, economics and employment

European literature overviews and regional model applications TRT (2006) and Kiel et al. (2014) characterise regional impacts from transport investments as being weak at best. Major improvements of higher speeds and better services are more likely to arise in eastern European regions rather than in the western part of the Union (Roteli et al., 2014). However, translating better accessibility into enhanced cohesion, i.e. the reduction of local disparities in terms of GDP growth and employment, is a continuous process where in the short run central European regions profit more than peripheral ones. Direct regional impacts during the operation phase of TEN infrastructures are low at a maximum of 3% of GDP per capita in a few particularly positive cases (TRT, 2006). Experiences from Japan further suggest that demand patterns are far from being fixed over time and can easily be altered by the existence of HSR services (Han et al., 2010).

A literature overview by Chena and de Abreu e Silva (2014) with reference to the Spanish HSR network suggests that regional stimulation of transport infrastructures is driven by influencing the location decision of firms, increasing efficiency through lower travel times and by fostering the accessibility to resources, goods and markets. However, the magnitude and significance of the economic effects are continuously inconclusive and controversial. Model applications for Spain show positive impacts of HSR investments – together with higher education levels - on GDP, employment and accessibility on the provincial level. However, sample size and the fit of the model make the results more suggestive than conclusive.

While concluding that there are no regional effects visible along the early French and German HSR lines, Urena at al. (2010) find that a considerable increase of long distance commute and discontinuous metropolitan processes emerged in Spain (see also Shen et al. (2014) for Madrid Atocha station). However, the regional impacts of peripheral HSR stations vastly depend on line configurations: dead end stations are less likely to profit from HSR services than stations along busy lines with good connections to multiple destinations.

Monzon et al. (2013), Ortega et al. (2014) and TRT (2006) warn that HSR extensions may contribute to an increase in spatial imbalance and lead to more polarised patterns of spatial development. HSR networks create islands of good accessibility as described above, depending on the quality of transport to and from the stations, but will at the same time create shadow areas outside the accessibility range of the station. For the Spanish HSR network it is observed that the highest percentage of accessibility improvements is in cities with a poorer initial situation (e.g. Valencia, Malaga, etc.). Cities with good railway connections to start with, and which are near large population centres, gain limited benefits. It can be concluded that the spatial homogeneity of the Spanish HSR network leads to overall positive effects on regional accessibility. Model applications with the Galician HSR corridor by Ortega et al. (2014) however suggest that the magnitude of the effect measured, strongly varies with the chosen geographical zoning system.

Schade et al. (2015) have found, through a literature review on European added value (EAV), that positive spillovers of projects in border regions often also occur from the project side of the border to the border region on the other side, though this also depends on additional regional factors as mentioned above (Exel et al. 2002, Gutiérrez et al. 2011, Condeço-Melhorado et al. 2013, Salas-Olmedo/Gutierrez 2014).

An ex-post evaluation of the LGV MED (Mediterranean high speed line Valence – Avignon - Marseille) by SNCF (2007) suggests that existing regional structures are not changed five years after its commissioning of the TGV MED. Its effects on the economy and development are not spectacular. While recognising the threat of increasing local disparities, the study acknowledges that behavioural and cultural changes towards regional development take a lot more time to unfold than transport demand projections suggest. Regarding this statement in a more positive light we can constitute that cross border infrastructures in the medium to long term contribute to the cohesion of European regions.

For PP3 no explicit source on cross-border impacts was found in recent literature either for the Mediterranean, or for the Atlantic branch. When looking at the rather cautious statements for the Spanish network and when further considering the natural barrier of the Pyrenees between France and Spain, high expectations in stimulating economic effects have to be considered with more caution.

3.6.2. Direct impacts of construction works

Section Nimes – Montpellier: According to RFF the project will generate around 6,000 direct jobs during the five-year construction period, of which 7% will be reserved to provide an entry to professional careers for 'people with difficulties'.
(http://www.railwaygazette.com/news/infrastructure/single-view/view/nimes-montpellier-contract-signed.html

3.7. CONCLUSIONS

Priority project 3 links the two largest high speed networks in Europe. Given the long history of establishing the national networks and the large investment sums spent by France and Spain since the late 1970s, the additional investments to close the two major links between these two networks on the Mediterranean and the Atlantic side appear acceptable. The prolongation of the corridor to Portugal on the other hand appears more difficult as here a completely new high speed network needs to be erected.

Demand and project assessment: There is throughput on the Mediterranean link between France and Spain of around 6,700 passengers per day and this is expected to double by 2050. Projections of population and economic development along the corridor however, do not support these optimistic figures. Similar concerns hold true for the Atlantic branch from Bordeaux to Bilbao / San Sebastian and even more so for the link between Madrid and Lisbon. On the other hand 80% of these markets are served by car. Fast and frequent high speed services could open up this market and shift substantial modal-shares from road to rail, although there is no guarantee of success. As the networks of Spain and France are close to completion, the remaining investments for their connection appear moderate.

Bottlenecks and barriers: Most dominant bottlenecks to the completion of Priority Project 3 are not the border crossing sections themselves, but the access link on the French and Spanish side. Delays arise due to geological and network conditions (Marseilles – Perpignan), planning issues (Node of Bergara), and resistance of incumbents towards the implementation of ERTMS. Conflicting national and European objectives, economic problems and the hesitant use of modern financing instruments also contribute to delays. The most prominent barriers, however, seem to be national protectionism and complex funding rules.

Regional impacts: For PP3 the rather cautious statements for the economic viability of the Spanish network and the natural barrier of the Pyrenees between France and Spain, high expectations in stimulating economic effects need to be considered with care as they depend on a variety of factors. This is particularly true as economic growth rates in both countries have slowed down after the world economic crises.

Regional analyses indicate that there is a risk of worsening regional disparities by promoting local centres served by high speed trains at the expense of more remote "shadow areas". While these effects have been identified for parts of the French and UK high speed networks, for Spain it is considered that the density of network helps counteract the negative side-effects of new high speed rail infrastructures. Authoritative data on regional impacts however, are not available as effects may take long time to unfold and are overlaid by external trends, including global and national economy, demographics, climate or market structures.

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4. ANNEX PP22: RAILWAY AXIS ATHENS-BUDAPEST-DRESDEN

KEY FINDINGS

- **Investment cost:** According to the CBA of 2012: EUR 4.7 (Do Minimum Scenario) - EUR 23.2 billion (full EU standard scenario). Early estimate of the Commission of 2005: EUR 11.125 billion.
- **Implementation period / Maturity:** Coordinator's report provides completion dates up until 2020. As work for major sections will start after 2015 completion dates after 2025 are more realistic. Progress is well advanced for the northern branch, but less so for the southern branch in Bulgaria and northern Greece.
- **Funding structure**: More than 50% of financial sources for railway projects stem from national budgets. The aggregate EU co-finance is about 12%. About 30% of funding sources is unknown to analysts. For PP22 the co-finance for the period 2007-13 was completely utilised for studies and amounted to EUR 20.8M out of EUR 41.7M total costs. INEA lists the Connecting Europe Facility (CEF) co-funding for the period 2014-20 as reaching EUR 1733M for PP22 projects. The CEF finance stems from the Cohesion Fund (CF) part only and is allocated to former accession countries of south-east Europe. The European Regional Development Fund (ERDF) gives total figures for countries and programmes from which the co-finance of PP22 can be estimated as EUR 1200-1600 million. From these figures a sum total of about EUR 3 billion can be derived, which is allocated to PP22 projects in 2014-20.
- **Major cross-border project(s)**: Nuremberg-Marktredwitz (DE/CZ), Border crossing Bredav (AT/CZ), Border crossing Curtici (HU/RO), Danube Bridge Vidin/Calafat (RO/BG), Border crossing section Kulata-Promachonas (BG/GR)
- **State of completion**: The West-East connections of Nuremberg-Prague-Bratislava-Budapest-Bucharest-Costanta (north branch of PP22) are widely complete and the missing links are under construction or are soon to be started. The southern branch from Curtici-Calafat-Sofia-Kulata-Thessaloniki-Athens shows heterogeneous conditions. The Thessaloniki-Athens section is on the way to completion while the Bulgarian parts are lagging behind and planning is not mature. Expected transport volumes are low enough for EU standards to be relaxed.
- **Alternative route**: The parallel sub-corridor Budapest-Belgrade-Skopje-Thessaloniki should not be overlooked because it is 330 km shorter and in a much better condition than the Bulgarian part of PP22.

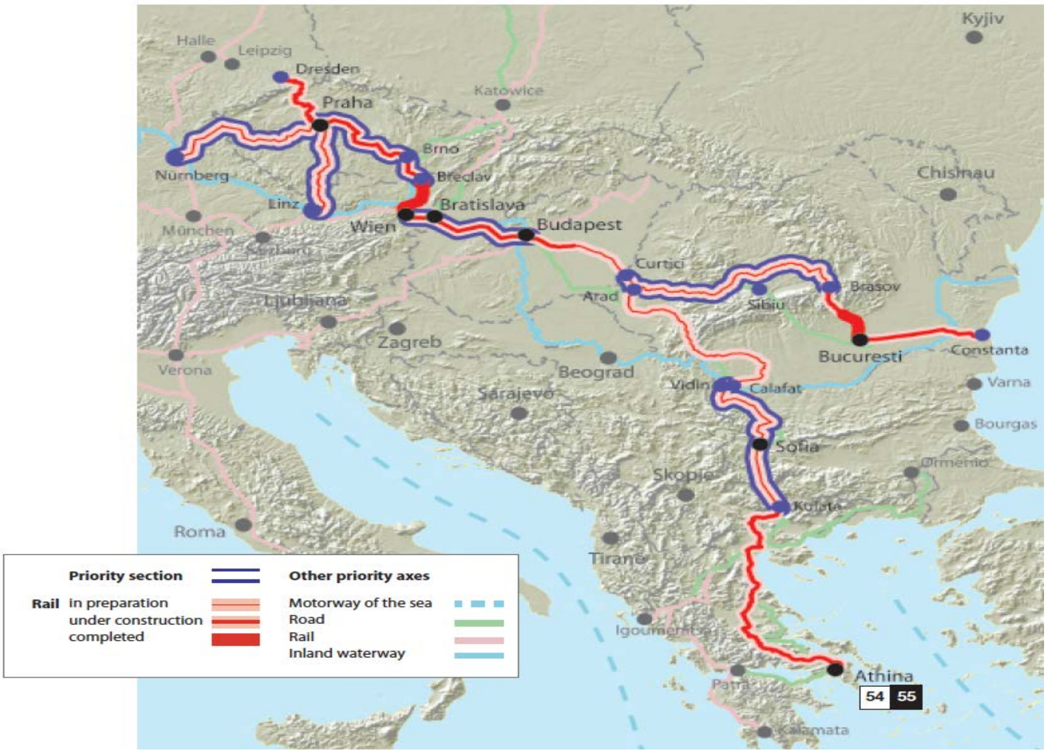
4.1. DESCRIPTION OF THE PROJECT

The corridor project P22 is part of the TEN-T corridor concept which was presented in 2004 and published in the TEN-T brochure of the EU Commission (2005). The corridor of 3575 km length connects the South Eastern Member States of Greece, Bulgaria and Romania with of the central European countries Hungary, Czech Republic, Slovakia, Austria and South-East Germany through a major railway axis (Map 11). The rail network alongside this axis should achieve the following standards:

- European standard gauge (1435 mm);
- electrified;

- double track;
- ERTMS train control;
- max. speed between 160 and 200 km/h (100 km/h for freight trains);
- max. axle load: 22.5 tons;
- max. train length: 740m.

Map 11: P22 Priority Axes



Source: EU Commission, 2005

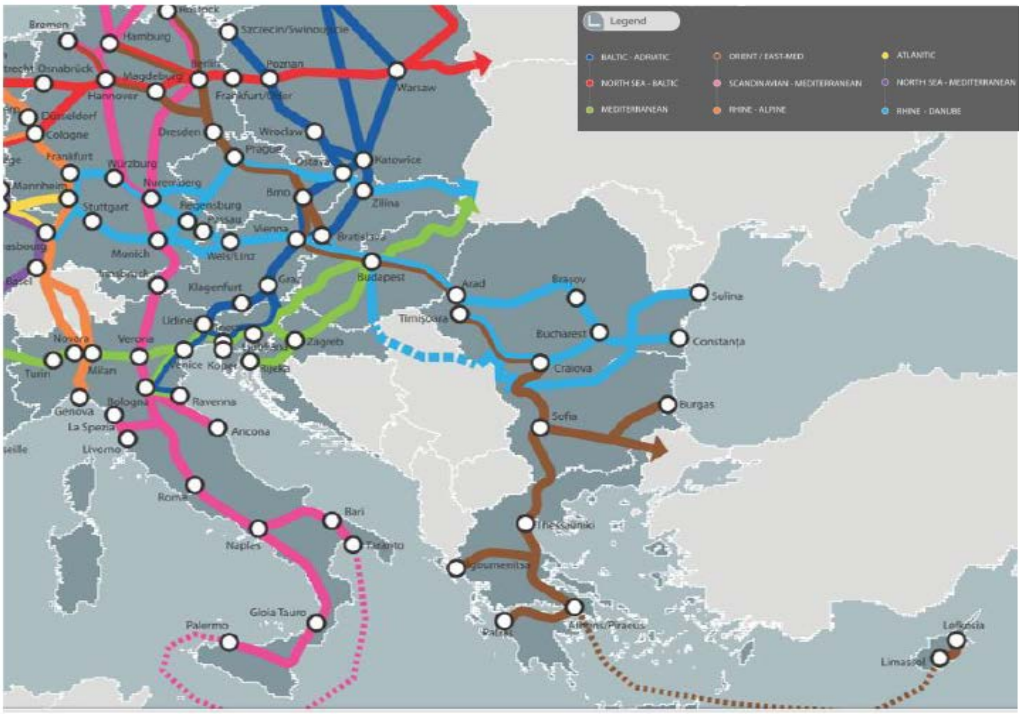
The priority measures for upgrading major sections of the corridor are marked in the figure. They comprise 2,100 km of rail tracks which should be upgraded by 2017 at a total cost of EUR 11.125 billion, as estimated in 2005.

Priority Project 22 partly overlaps with corridor P17 (Strasbourg-Karlsruhe-München-Wien-Bratislava). A further overlap is observed with the rail freight corridors RFC 7 (AT, CZ, SK, HU, RO, BG, GR) and RFC 9 (CZ, SK) in the sense that many but not all sections are identical. Several changes have been integrated since 2005, for instance an additional southern branch of the corridor in Romania from Arad through Timisoara and Craiova to Bucharest (see RD, 2014). Furthermore, an alternative route from Thessaloniki to Budapest through FYRO-Macedonia and Serbia is under discussion which would reduce the length of the southern P22 part from 1362 to 1032 km.

The complexity of the project definition and sorting of data sources has increased through the new TEN-T guidelines presented by the EU Commission in 2011 which are based on the dual concept of a Core and a Comprehensive Network. With the new definition of Core Network Corridors (CNC), as of

2013 the components of P22 can be partly found in the Rhine-Danube (RD: blue lines) and Orient-East Med (OEM: brown lines in Map 12) CNCs which show a wide overlap between Vienna and Craiova.

Map 12: Core network corridors



Source: European Commission; TENtec Public maps

Source: EU Commission, 2013

In 2014 the EU Commission launched studies for all nine CNCs. These included a detailed description of the socioeconomic database and infrastructure equipment in the regions of the catchment areas, an analysis and forecast of the traffic development and a description of the projects planned and started. The particular situation and the planned developments for the border crossing rail links for South-East Europe can be found in the ACROSSEE (2014) study.

The split of the P22 corridor into northern and southern branches, the parallel and partly redundant activities for the Rail Freight Corridor (RFC) 7 and 9 and their working groups, the changed definition of corridors after 2013 including several splits into branches in Czech/ Slovak Republics and Romania, as well as the overlapping sections for the relevant CNCs and parallel activities for the RFC, provide some difficulties for the analysis of PP22 and the ongoing progress. In this study we will follow the corridor and project definitions presented in the Activity Report of the PP22-coordinator G. Savary (2013). Data on transport market developments in the catchment areas are taken from the P22 study of Panteia et al. (2012), and the relevant parts of the CNC (Rhine-Danube (RD, 2014) and Orient-Eastern-Mediterranean (OEM, 2014)) studies while specific rail information is taken from the RFC 7, 9 reports.

4.2. TRANSPORT DEMAND

According to ETISplus statistics (2012) the modal shares in passenger transport are 83% for road, 13% for rail and 4% for air (RD, in volumes of the year 2010). Almost 30% of the international rail passenger flows relate to Austria from and to its neighbouring countries: the Czech and Slovak Republics, Hungary and Germany. International rail flows related to Greece, Romania and Bulgaria are comparatively low, e.g. Romania contributes about 1% of international rail passenger flows of the corridor.

For the freight transport volumes 2010, 58% are on the road, 28% on rail and 14% on inland waterways. The Czech Republic provides the highest contributions to the PP22 corridor transport, covering about 40% of all flows. Hungary holds 34% while Germany's contribution to the corridor transport is 9%. Austria contributes 7%, while Greece occupies only about 1% of the corridor rail freight transport. Greece shows a high share of international rail transport but the volumes are very low (0.5 M tons export, 1.4 M tons import). Transported goods are in the first instance bulk commodities (petrol, minerals, building materials and ores). Bulgaria and Romania contribute high shares (26%) but rail freight transport predominantly serves domestic demand.

The forecasts for transport development are highly dependent on the underlying scenarios for infrastructure improvement and political intervention in the transport markets. The growth of passenger transport by rail is forecast as nearly stagnating with very modes growth rates between 0.04% and 0.07% p.a. because population is expected to decrease, particularly in Hungary and the Czech Republic. The freight transport markets show much higher forecast growth rates and the benefit to the rail sector will be more than proportional if the planned investments on the supply side are realised and the political climate is positive, as expected in the White Paper of the Commission (2011). The PP22 study of Panteia et al. (2012) shows very optimistic growth rates of 3.7-5.3% p.a. which would result in a total growth of rail freight volumes of 100-180% compared with 2010. While the highest growth rates are forecasted for the south-eastern part of the corridor, the transport volumes are very low and even in optimistic scenarios, like the EURO-3 scenario of Panteia et al. (2012), they are far below the volumes in the north-western part of the corridor.

4.3. BOTTLENECKS AND BARRIERS TO IMPLEMENTATION

4.3.1. Rail infrastructure

Capacity Bottlenecks

Capacity bottlenecks stem from an over-utilisation of rail link capacities. The northern branch of the corridor between Dresden, Budapest, Bucharest and Constanta shows a good utilisation of the rail infrastructure capacities with some critical spots around Bratislava and Budapest, and capacity restrictions in the Romanian part. The southern part between Arad, Sofia and Athens, on the other hand, is heavily under-utilised. Although 52% of the track lengths are single tracks there is no capacity problem, not even in the case of an optimistic transport development scenario. Table 20 summarises the critical sections in the networks of the corridor countries.

Table 20: Major Problems for the P22 Corridor

Country	Link/Section	Problem	Remark
Germany	Nürnberg-Marktredwitz-border CZ	15 km of electrification missing 1 track	Considered in German Master Plan
Germany	Dresden-CZ border ->Prague*	Low standard for pass. transport; considered for HSR by CZ and State of Saxony	Not an element of German Master Plan and TEN-T
Czech R.	Nodes Prague, Brno, bypass Prague, Prague-Pilzen, Brno-Breclav*	Low standard	Measures underway
Austria	Prague-Linz Vienna-Bratislava	Mostly 1 track, moderate speed Central Station Vienna under construction; Vienna-Bratislava planned but not started before 2015	Linz: Only regional importance; measures underway but below KPIs; V.-Bratisl. to be opened by 2030
Hungary	Border crossing with Romania	1 track, moderate speed	Until now no bottleneck
Hungary	Budapest Danube bridge	Bottleneck, used by all type of trains (suburban, long-distance pass. and freight)	Either extension of bridge capacity or bypass needed; no detailed plan
Romania	Danube crossing Vidin-Calafat to Bulgaria*	Bottleneck for rail, access routes with very low quality	Bridge open for road transport; access rail links in poor condition; missing bridge man-agement for rail
Bulgaria	Many sections	Poor quality; no improvement of P22 links; rapid decline of rail transport (-38% for pass., -43% for freight since 2000)	No clear road map for P22 development; West-East corridor to Black Sea preferred
Greece	Thessaloniki-BG border*	Poor quality; 1 track; not electrified; intercity pass. transport stopped	Low transport volumes; link Athens-Thess. in good condition
Greece	Athens-Thiba Athens-Patras*	Shortcut planned; cut of travel times 20 min.	Pass. transport in Athens region in good condition; rail links to seaports underdeveloped

* Mentioned as corridor priorities in the presentation of the OEM coordinator (Grosch, 2015)

Source: Panteia et al, 2012, Savary, 2013, RD, 2014, OEM, 2014

Comparing the present equipment of the corridor with the KPIs listed in section 1 the corridor is substantially lagging behind (e.g.: achievement of train length KPI: 58%, axle load KPI: 56%, ERTMS KPI: 20%). In particular, the south-eastern section of P22 is a long way from meeting the desired performance, for example 52% of the tracks are single and the target speed for freight trains of 100 km/h is an illusion in Bulgaria where speeds of just 30 to 60 km/h are reached on the track between Craiova and Arad. It is important that such weaknesses do not cause physical capacity bottlenecks, leading to a poor level of service and market decline for rail freight services. It would result in a high under-utilisation of the link capacities in the south-eastern branch, for example 20% at rail border crossing Bulgaria/Greece at Kulata or an average daily traffic of 0.4 trains at the Promachonas border crossing.

4.3.2. Delays at border sections

The delays at border sections exhibited in Table 21 are caused by technical and organisational processes (except for the Schengen border between Hungary and Romania at Curtici).

Most stops at the border are caused by change of locomotives and drivers because the electrical power supply, signalling and safety systems and regulations/language for the drivers are different. The right column of Table 21 indicates the significant potential for reducing these delays. Savings of 2-4 hours can be achieved which indicates that substantial time savings are available with better organisation and coordination. Expensive investments are not required.

Table 21: Current and forecast waiting times at border crossings for P22

Country	Station *	Current situation		Forecast 2021
		Waiting time at the border	Average waiting time	Average waiting time
Czech Republic	Bředav (CZ/AT)	3-60 min	30	5
Hungary	Rajka (SK/HU)	n/a	n/a	n/a
	Komárom (SK/HU)		25	5
	Lőkősháza (HU/RO)	30 min	30	5
Austria	0 min (the trains are handed over on the Czech Republic and Hungary network)			
Romania	Curtici (HU/RO)	100 - 240 min	140	30
	Calafat (RO/BG)	100 - 240 min	140	20
Slovakia	Kúty (CZ/SK)		120	20
	Stúrovo (SK/HU)		140	20

* The **waiting** times at stations situted on the main lines are used for the purpose of calculation

Source: RD (2014)

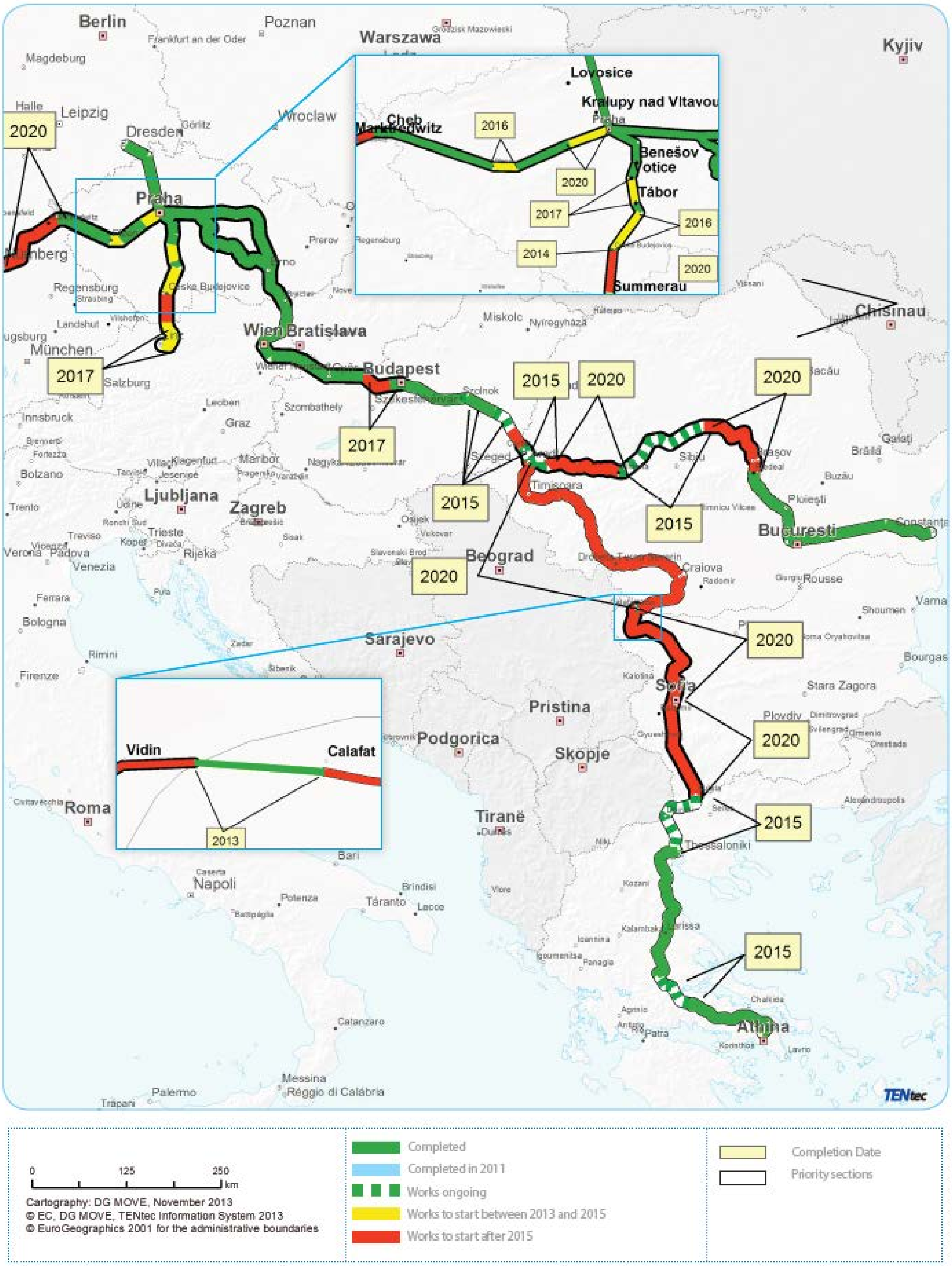
Improvement Work

"Unsurprisingly, the most significant progress has been made where national and European objectives converge. This is the case, for example, for the Decin-Prague-Breclav, Breclav-Vienna-Hegyershalom-Györ-Budapest-Gyoma, Athens-Thessaloniki and Predeal-Bucharest-Constanta sections." (Savary, 2013).

Map 13 illustrates the planned upgrading measures alongside the P22 corridor and the expected dates of finalisation. The northern branch is a good way to being completed within the next 10 years. The southern branch between Arad and the Bulgarian/Greek border at Kulata is planned to be finalised by the year 2020 but this is questionable given the slow progress of improvement work in Bulgaria. However the goal to create an integrated rail corridor between then North, the Baltic Sea and the Black Sea will probably become reality in the foreseeable future.

The southern branch between Arad and Kulata will remain problematic. The Bulgarian government is favouring a West-East branch from Craiova to Burgas at the Black Sea (which has been included in the OEM corridor), with an alternative route between Thessaloniki and Budapest through Skopje and Belgrade for the international transport becoming increasingly likely.

Map 13: Ongoing and planned work for upgrading the P22 rail corridor



Source: Savary, 2013

4.3.3. Rail intermodality and level of service

The Orient-East Med CNC Study (OEM 2014, p.39; taken up by Grosch, 2015) describes the example of rail transport from Athens to Hamburg which faces the following problems:

- a locomotive would need to be equipped with 7 different signalling systems; alternatively it would have to be changed 6 times;
- even if the locomotive was equipped with the 3 different electrification systems needed, it would have to be replaced by diesel locomotives 4 times;
- maximum length of a train is 600 m except for Bulgarian sections where the maximum train length is 445 m;
- maximum axle load is 200 kN;
- it would run at 80 km/h or lower on approximately 510 km.

This example points to two major problems with the south-eastern branch of the corridor: Firstly the unsatisfactory standard of the infrastructure between Vidin and Thessaloniki, and secondly the interoperability issues which remain even after a major upgrade of the infrastructure in line with EU standards. The three different electrification systems would remain such that locomotives would need expensive hybrid technologies. Even in the case of full ERTMS equipment for the corridor, the organisation regulations and languages are different and require a change of personnel at several borders. It will be hard to compete with road transport which can pass borders with the same technology and personnel without major delays.

4.4. ECONOMIC ASSESSMENT OF THE PROJECT

Panteia et al. (2012) have evaluated 6 scenarios:

- a "Do-Nothing" scenario leaving the situation as it stands at the end of 2011;
- a "Do-Minimum" scenario, which assumes that all ongoing works are completed but no further investment is undertaken;
- a "Euro 1" scenario adding the upgrade of Nuremberg-CZ border and all foreseen interventions on the northern branch Prague-Costanta while the "Do-Minimum" scenario is applied to the southern Arad-Athens branch;
- three further "Euro" scenarios 2, 3, 3* with combinations of further investments in addition to the "Do-Minimum" scenario. Euro 3 includes a full upgrade to EU standards for all sections.

Table 22: Results of a CBA for corridor P22

Scenario	Total investments (million EUR)	Net present value at 5.5% (million EUR)	Internal rate of return	Benefits over costs
Do Minimum	4,474	3,784	8.90	1.84
Euro 1	14,315	1,250	6.09	1.12
Euro 3	23,245	-1,929	4.82	0.89

Source: Panteia et al. (2012)

It can be concluded from the results in Table 22 that the best economic alternative is to complete ongoing works but stop further extensions. It would be still economically viable to electrify the Nuremberg - CZ border link and realise all foreseen interventions for the northern branch of the Prague-Costanta corridor. Upgrades beyond the ongoing works would not be economically beneficial for the southern Prague-Athens section going through Bulgaria. The prospects for transport development will be very modest even under optimistic scenario assumptions.

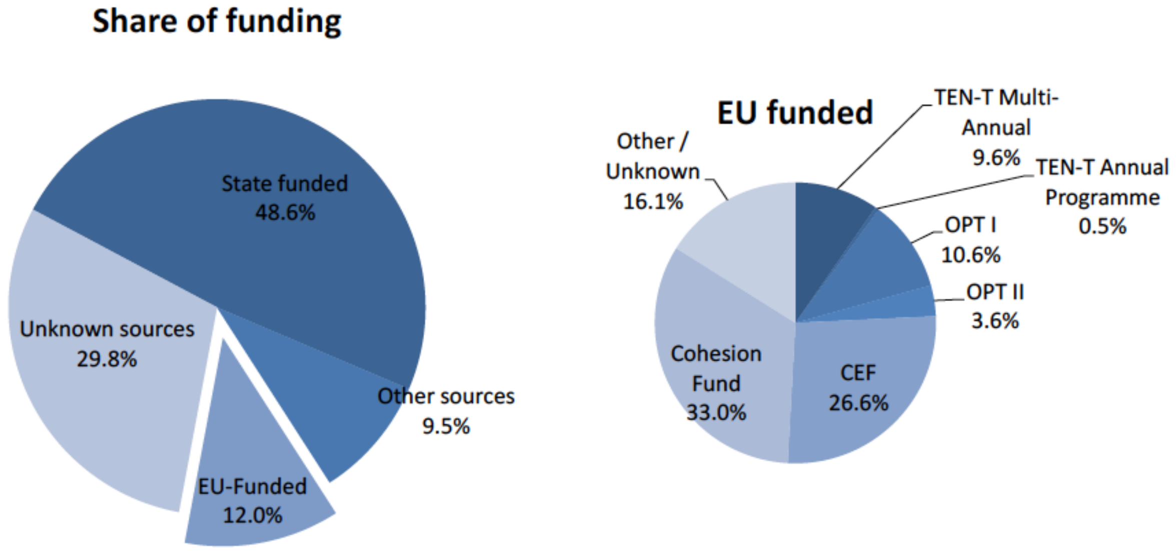
These results give rise to tactical and strategic considerations for the southern branch of PP22. On the tactical side one should check whether the design standards can be reduced in areas with low transport volume. A single track, with speeds of 80 km/h and axle loads of 20 t might be sufficient for the next 20 years. On the strategic side two changes could be considered. Firstly, the Bulgarian government is favouring a link between Sofia and the Black Sea at Burgas. This could connect to a link to the Turkish border and Istanbul. These links are included in the OEM corridor. Secondly an alternative axis could be developed between Thessaloniki to Belgrade and Budapest crossing FYRO Macedonia and Serbia. This route would be 330 km shorter compared with the Southern branch of P22.

4.5. FUNDING OF THE PROJECT

4.5.1. Aggregate funding of railway projects

The RD Report of Panteia et al. (2014, p. 223) includes an overview on the funding of railway projects. For 79 out of 111 projects the financing of costs is completely known and secured. However, Figure 11 summarises the unsatisfactory result that altogether almost 30% of sources are unknown. State funding counts for about one half and EU-funding for 12% of the known funding sources. The right part of Figure 11shows the allocation of EU funding to the different funding programmes. Cohesion and CEF funding contribute almost 60%, followed by the Operational Programmes for Transport with almost 15%. A share of about 16% has not been allocated to a dedicated programme.

Figure 11: Main Sources of Funding of Rail projects (all rail projects, all Member States)



Source: Panteia et al. (2014)

4.5.2. Funding of PP22

A complete overview on updated cost estimates and the funding sources for PP22 projects cannot be given because the Commission expressed the opinion in a communication to the study team that this might include confidential data from member states such that a consultation of all involved member states would be necessary. Therefore we focus in this study on EU funding through the main CEF and ERDF sources. While the CEF data are very detailed and relate to the single projects for the programming periods 2007-13 and 2014-20 (first call)[17] the ERDF data relate to countries and programmes such that the allocation to PP22 can only be roughly estimated.

For the period 2007-13 INEA reports the co-finance of 9 studies on sections of PP22 with a financial volume of EUR 41.7 million and a co-finance of EUR 20.8 million. The 2014-20 programming period includes a number of works on railway sections which have been proposed for co-finance. All EU supported PP22 infrastructure improvements are located in former accession countries and co-funded according to the CF funding regulations (up to 85% co-finance). Table 23 gives an overview on the PP22 sections.

[17] The 2014-20 data are extracted from a list which is composed according to different criteria (objectives, priorities, new CNC classification). The first call includes more than 50% of the sum total of the CEF-budget. From this it follows that the volumes of the next yearly calls will be substantially lower.

Table 23: CEF co-funding for PP22 projects 2014-20 (kEUR, first call)

Core Network Corridor	Country Project	Recomm. Eligible Costs	CEF-Co-funding	Percent of Eligible Cost	Remark
OEM	CZ Prague-Hostivar	134,295	110,310	82.14	Cohesion Call
OEM	BG Sofia-Voluyak	104,571	76,337	73.00	„
OEM	BG Sofia-Elin Pelin	67,985	57,787	85.00	„
OEM	RO Craiova-Caransebes	9,921	8,432	85.00	
OEM	RO Craiova Calafat	1,737	1,476	85.00	„
OEM	HUBekesaba-Lokoshaza	4,440	3,774	85.00	„
OEM	HU Budapest Arad-Airport	17,460	14,841	85.00	
OEM	GR Rododafni Psathopirgos	297,169	212,090	71.30	„
OEM	GR Tithorea-Domokos	444,288	299,805	67.48	„
OEM	GR Thessaloniki -Promachona	1,000	0,500	50.00	
RD	CZ Pilzen Junction	49,925	35,761	71.63	„
RD	CZ Pilzen Bridges	41,855	29,981	71.53	„
RD	CZ Beroun-Kaluv	72,726	54,952	75.56	„
RD	RO Brasov-Simeria	972,243	826,406	85.00	„
Sum total		2219,615	1732,592	78.06	

Source: INEA, 2015

The co-finance stemming from ERDF is aggregated by countries, taking programmes with a CNC/rail specification. It cannot be decomposed by project. One can assume that the volumes exhibited for Greece and Bulgaria in Table 24 relate to PP22; this is the case for the majority of ERDF funding exhibited for the Czech Republic and Hungary. Therefore the PP22 co-finance by ERDF may be estimated to be between EUR 1.2 and EUR 1.5 billion. This would result in an estimated EU co-funding in an order of magnitude of EUR 3 billion for the programming period 2014-20. As the maximal co-funding rates are very high (75-85%) one can estimate the total eligible cost as being in an order of magnitude of EUR 3.5 to EUR 4 billion.

Table 24: ERDF co-funding related to PP22, 2014-20, Core Network Corridors, Rail

Country	Programme	ERDF-Funding, kEUR
BG	Opt. Progr. „Transport and Transport Infrastructure"	572,344
CZ	Transport	221,744
GR	Transport, Infrastructure Central Macedonia, Thessaloniki, Western Greece	344,088
HU	Integrated Transport	480,000
Sum total		1,618,176

Source: EU Commission, 2015

4.6. REGIONAL IMPACTS OF THE PROJECT

4.6.1. Wider economic impacts

The assessment study of Panteia et al. (2012) on PP22 includes an analysis of regional social and economic effect of the different scenarios. For this purpose the EDIP model ("European Model for the assessment of Distribution and Inequality effect of Economic Policy"), a computable general equilibrium model, was applied for a time frame of 2004-2050. The wider impacts are measured by GDP changes (producer benefits through time and operational improvements) and welfare changes (consumer surpluses). As neither measures can be quantified completely by the authors and they are not cumulative, it is hard to interpret the results.

The consumer surplus measures a part of the CBA benefit criteria (time and operation cost savings enjoyed by consumers). The GDP impacts measure incorporates the CBA benefits for producers and the secondary impacts (second round effects) on the economy. Looking at the results there seems to be little doubt that the "Do Minimum" scenario is a sound strategy. The Euro-1 scenario comes out as the second-best solution, but a final judgement is not possible because of the incomplete quantification of indicators. The more ambitious scenarios Euro-1 and Euro-2 are not supported by the model results (Table 25).

Table 25: Corridor impacts on GDP and Welfare (EUR million)

Scenario	GDP (EUR mill.)	Welfare (EUR mill.)	Investment (EUR mill.)	GDP/ Investment	Welfare/ Investment
Do minimum	2,549.3	5,805.5	4,443.6	0.57	1.30
Euro-1	3,663.6	9,422.7	11,620.3	0.32	0.81
Euro-2	3,705.4	9,814.3	14,031.3	0.26	0.69
Euro-3	4,806.8	13,681.4	18,099.0	0.27	0.76

Source: Panteia et al. (2012)

4.6.2. Regional impacts

The regional distribution of welfare benefits is strongly dependent on the unemployment rate because countries with a low unemployment rate will achieve only low employment effects through transport investments. Accordingly, the conversion ratios (welfare induced by one unit of investment) are low in Germany and Austria and high in Romania and Greece. Bulgaria's conversion rate is relatively low because of the small economic changes induced on the southern branch of the P22 corridor to Greece.

Table 26: Ratios of welfare over investment by country

Country	Scen	Welfare (EUR mill.)	Investment (EUR mill.)	Conversion ratio
AT	Euro-1	60.84	426.91	0.14
BG	Euro-1	29.49	154.35	0.19
CZ	Euro-1	630.67	2,754.56	0.23
DE	Euro-1	21.85	278.01	0.08
HU	Euro-1	236.37	1,056.42	0.22
RO	Euro-1	1,902.90	6,372.16	0.30
SK	Euro-1	0.00		
GR	Euro-1	314.27	1,118.60	0.28

Source: Panteia et al. (2012)

These results underline the findings of regional economics that transport investments can contribute to economic growth and competitiveness of less developed regions if transport quality represents a serious bottleneck for economic activities. If there are no transport related bottlenecks then the economic impacts reduce to multiplier effects in regions with higher unemployment rates but will hardly induce a long-term growth effect. If transport investments are intended to work as a leverage for growth then they should be planned as components of a regional development strategy including a host of policy measures to attract private capital.

4.7. CONCLUSIONS

Priority project 22 is still in a rather early planning stage with some key elements still to be designed and agreed between the EC and the member states. In its current state the following conclusions can be drawn:

- The "Do Minimum" scenario of accomplishing the works started is the baseline of recommendations for rail infrastructure investments of PP22.
- The additional investments foreseen in the northern branch (Dresden-Costanta) have a positive economic return and can be considered for implementation. In this context an upgrade to electrification of the link Nuremberg-Marktredwitz-Cheb section is economically justified. The latter is less viable for the HSR link between Dresden and Prague which is promoted by CZ and the German state of Saxony but not included in the German master plan and the TEN-T CNC.
- In the southern branch (Arad-Athens) the link between Athens and Thessaloniki should be completed as planned. For the link between Arad and Thessaloniki the expensive upgrades to the EU standard have to be questioned.
- The design of the southern branch is closely dependent on the development of a West-East link from Sofia to Burgas at the Black Sea and a connection to the Turkish border, as it is foreseen in the OEM corridor.
- The southern branch is furthermore dependent on the development of a parallel axis through FYRO Macedonia and Serbia. This is 330 km shorter and in a better condition than the proposed route, requiring less investment to bring it to EU standard.

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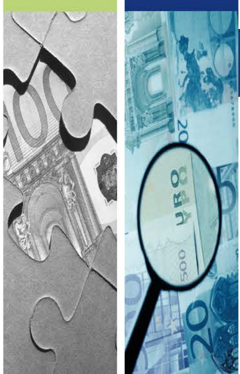

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