Traffic and Market Research Update for European Freight Corridor No 4

Synthesis Report
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ATLANTIC CORRIDOR

04/03/2015

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Overview

The Atlantic Corridor, previously named the European Rail Freight Corridor No. 4 (RFC4), extends across three countries. From Lisbon, and the major ports of the Portuguese west coast, it continues throughout the western and central regions of Spain, including Madrid, heads north and crosses the Pyrenees going up the Atlantic coast to Paris where it separates into two branches, one heads westwards along the Seine down to the English Channel, and the other heads east joining the European Rail Freight Corridor No 2 (Lyon-Antwerpen) in Metz.

From Metz, the Corridor will soon be extended to Germany by one or two branches, connecting to Mannheim and/or the French-German border of Strasbourg. These extensions, which should be fully operational by November 2016, raise the need for a market study update for the Corridor.

The present Traffic and Market Research Update for the Atlantic Corridor builds upon the first market study carried out in 2012. It shares with it all the information related to the base year of forecasts (2010), namely in terms of freight flows OD matrices, and the determinants (attributes and factors) influencing the choice of transport mode (price, time, reliability ...), based on an extensive set of stated preference surveys conducted with the actors of freight transport (shippers or freight forwarders).

First, an update on the Economic and Territorial frameworks was developed. Thus, countries and regions along the corridor have been the subject of an analysis on economic variables and their overall situation regarding freight transport. A particular attention has now been given to Germany, due to its imminent inclusion in the Corridor.

On the basis of these analyses and taking into account the latest long-term projections for trade partners' GDPs, available from internationally recognized sources, all econometric models were updated to deliver an updated foresight on global freight travel demand in the short, medium and long-term (respectively 2020, 2030 and 2050).

From the supply side, the transport infrastructure projects provided for different horizons were reviewed and analyzed to take into account their impact on traffic projections. Particular attention is now given to the German rail freight infrastructure in what concerns capacity, transhipment facilities, tracks (loading profiles, axle loads, train lengths and weights, etc), and infrastructure development plans. This exercise is topped with an overview of the most important terminals along the corridor connections between Saarbrücken-Mannheim and Strasbourg-Kehl.

Germany's inclusion in the corridor imposed a revision of the zoning system and of the catchment areas definition (in what concerns the nature of traffic flows in the corridor - Internal, Exchange, or Transit).

This update deals with new extensions to terminals and seaports (La Rochelle, Nantes/St Nazaire, Valongo), as well as with new connections to corridors 6 and 9, in Zaragoza and Manheim/Strasbourg, which are subject to particular in-depth analyses in the study documentation, showing the benefits that can be expected from further extensions of the Corridor No. 4 eastwards.

A new set of comprehensive discussions was undertaken with a large variety of stakeholders in the four countries covered by the RFC4, i.e. port operators, railway operators, terminal operators, shipping companies, corridor managers, infrastructure managers and logistic operators. The interviews aimed at analysing the Corridor's strengths, opportunities, weaknesses, and threats, as well as the need for improvements along the corridor. As in the previous market study, we were again surprised by the stakeholder's consensus about the issues to be addressed for a successful implementation of rail services competitive with road transport.

Finally, revised demand forecasts on freight flows on the Corridor are provided - taking into account all the elements mentioned above (economic forecasts, context, demand, supply and determinants of modal choice). Based on these results, it was possible to produce a first estimate of the capacity allocation (pre-arranged train paths) that it would be necessary to put in place to ensure rail meets the expected demand. Traffic projections for rail highways, whose evolution responds to different dynamics from those considered in other segments of rail transport, have also been reviewed and updated, bringing forward an extended set of possible direct connections.

Diagnosis

Socio-economic Developments

All socioeconomic analyses and freight transport statistics delivered in the first study were now updated, highlighting whenever relevant the major differences between current datasets (2014) and those considered in 2011. The sources for the most recent figures are mainly Eurostat or the National Statistics Offices of the Corridor countries. These analyses include all countries now formally connected by the corridor - Portugal, Spain, France and Germany.

Table 1 – Socioeconomic and transport indicators (2013)

	France	Germany	Portugal	Spain
Population [10^6 hab]	65.6	82.0	10.5	46.7
GDP [10^6 €]	2114	2809	171	1049
GDP per capita [€/hab]	32236	34248	16220	22449
Rail transport [10^9 t.km]	32.0	117.4	2.1	9.6
Rail modal share	15.2%	23.1%	6.1%	4.8%

The following two graphs depict rail transport development in recent years, in terms of freight flows, in millions of tonnes.Km traveled and rail modal share (%).

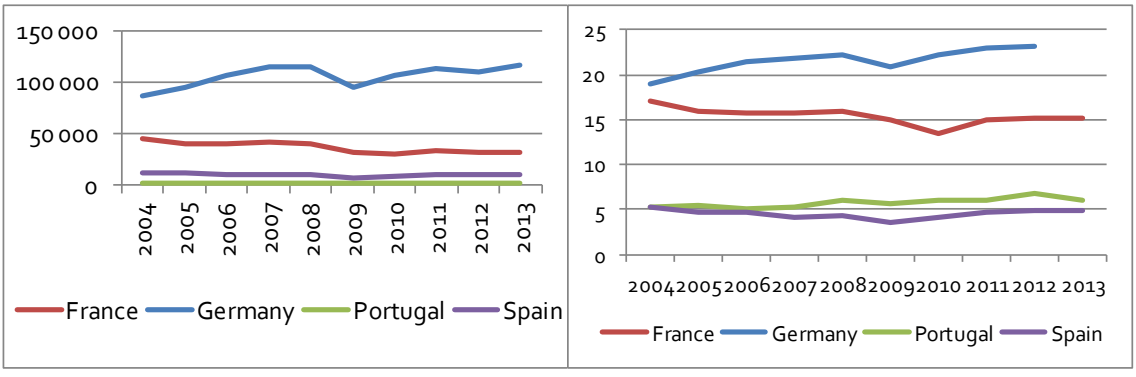

Figure 1 - Rail freight volumes [10^6 ton.km] and modal share [%]

The above elements are Eurostat data. A real gap exists in terms of the rail mode share on each side of the Pyrenees, with the Iberian rail showing a considerable lower market share than that of their European counterparts. Geography and technological issues certainly explain these discrepancies, as GDP differences alone cannot explain it. For instance, for each Euro of GDP throughput Germany achieves 42 t.km, against France's 15 t.km, while Portugal gets 12 t.km and Spain only 9 t.km.

The evolution of rail share in total inland modes is also particular for each country. Portugal and Spain had both a 5.3% market share in 2004, which climbed 15% in the Portuguese case, to 6.1%, while Spain's figures declined 9% to 4.8%, in 2013. Germany and France also show contrasting trends. Starting from a similar point in 2004, Germany witnessed a 20% increase in its rail modal share to 23%, in 2012, while France's rail share declined more than 10% to just over 15%. Due to reasons related to data harvesting from railway operators, these figures may overestimate the decline observed over the 2008-2010 period.

Global Potential Transport Demand

The origin-destination matrices of freight flows (at NUTS3 level for the countries directly concerned) for the base year (2010) were retrieved from the first market study. These are disaggregated by nature of cargo (13 categories considered) and mode of transport. The particular situation of cargos travelling by train down to the Pyrenees to be then loaded onto lorries to complete their routes at the Iberian Peninsula (and vice versa) - explained by the interoperability issues between France's and Spanish rail infrastructure - are specifically taken into account under the denomination "Rail-Road" flows. Finally, three different types of flows are distinguished by its trade partners, corresponding to the three distinct sources of information available for 2010:

- Portugal-Europe: these are all the flows between Portugal and its European partners (Spain included). These flows were established on the basis of the OTEP survey, a cross-border freight assessment conducted between Portugal and Spain, and on information provided by rail operators;
- Spain-Europe: these correspond to all the flows between Spain and its European partners, with the exception of Portugal. These flows were established on the basis of the CAFT Transit survey;
- All other corridor flows: those between origin-destination pairs that use at least part of the corridor (above the Pyrenees). These flows were calculated using information from the cargo database Etis+, by the European Commission

Figure 2 - Flow segmentation by trade partners

The selection of relevant origin-destination pairs (and thus the overall zoning system) for the corridor was performed on the basis of a "select link" analysis of European traffic flows as described by Etis+ data. By modelling the path of goods flows, it was possible to isolate the flows performing part of their journey on the corridor.

The maps below represent some of the "select link" analyzes conducted as part of the detection of relevant origin-destination pairs. The red sections set the location where the flow information is gathered. Thus any flow of goods between an origin and a destination through these links has been added to the list of origin-destination pairs.

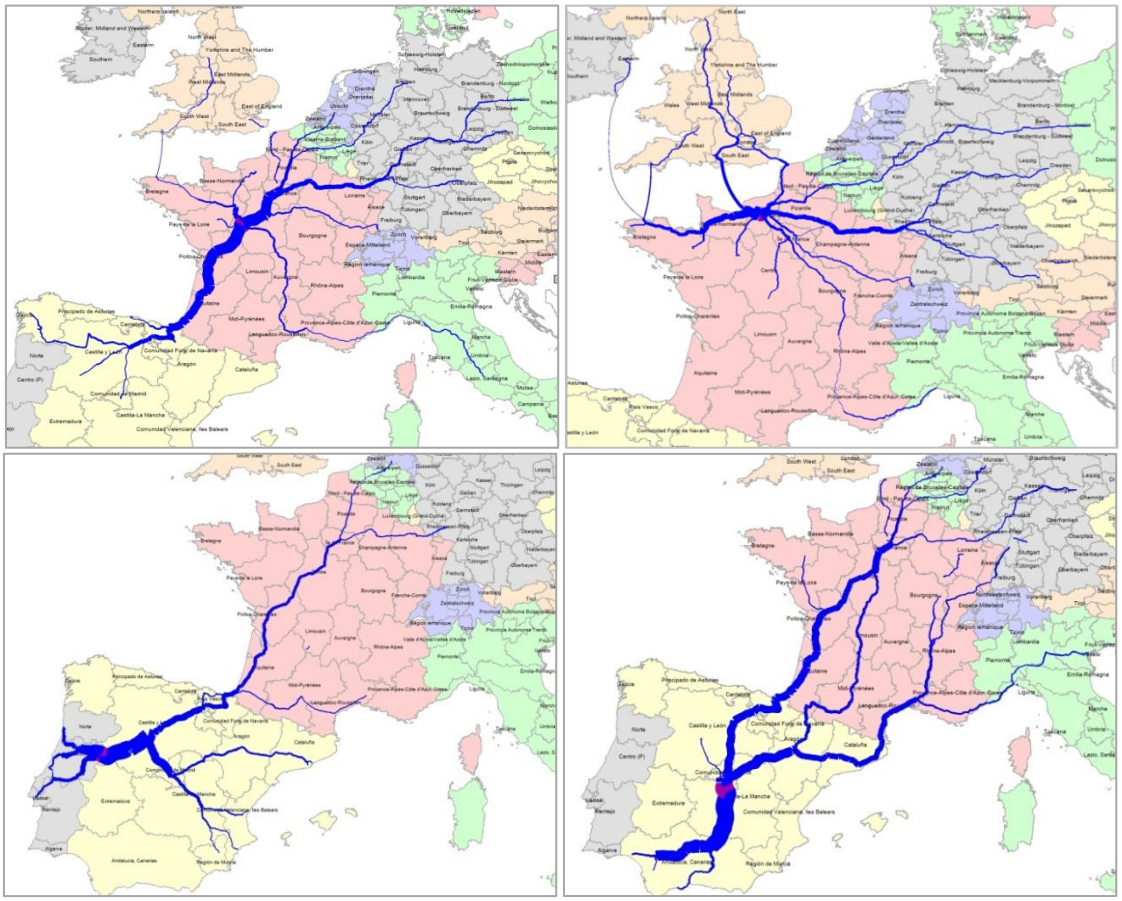

Figure 3 - "Select link" analyses of Corridor's freight flows

Below is a summary of all flows considered for the established of 2010 demand matrices.

Table 2 – 2010 relevant freight flows, by mode and trade partners [Kt]

Mode		Portugal-Europe (inc. Es)	*Just Portugal-Spain*	Spain - Europe (exc. Pt)	Other Corridor flows	Total
Road		39 758	*30 162*	78 254	44 918	**162 931**
Rail	Rail-Rail	793	*793*	1 570	6 762	**10 692**
	Combined	-	-	1 567		
	Rail-Road	29	-	1 899	-	**1 928**
Fluvial		-	-	-	2 307	**2 307**
Marit.		20 002	4 717	71 034	29 833	**120 869**
Total		**60 582**	***35 673***	**154 323**	**83 821**	**298 726**

Portugal is accountable for a fifth of the flows considered in the matrices, while Spain answers for almost two thirds. Nearly 30% of all flows on the corridor axis run in its northern part, never crossing the Pyrenees. One should note this table encompasses all freight flows going through the Pyrenees, including those shared with the Mediterranean corridor.

When possible, due to data availability, rail flows were distinguished between conventional flows (or Rail-Rail) and combined transport streams. This last one, based on the use of standard containers that can be easily transferred between modes, has been experiencing a continuous and solid growth that is expected to continue over the next decades.

Flows between Countries

The next table provides an OD matrix of all 2010 European freight flows relevant to the corridor, by country of origin and destination.

Table 3 – OD matrix of 2010 relevant freight flows, by country [Kt]

	Belgium	Switzerland	Germany	Spain	France	Ireland	Italy	Luxemb.	Netherlands	Portugal	UK
Belgium	-	316	804	4 578	7 045	-	271	-	-	1 035	145
Switzerland	40	-	-	245	1 166	-	-	-	-	48	-
Germany	886	-	-	8 021	11 806	-	-	-	-	1 267	679
Spain	3 567	488	8 370	-	23 188	474	11 669	59	4 978	20 513	6 135
France	3 973	4 453	9 227	26 347	-	292	5 549	3 848	2 289	3 475	2 769
Ireland	-	-	-	407	170	-	333	-	-	309	-
Italy	171	-	-	11 078	5 853	271	-	-	-	1 033	820
Luxemb.	-	-	-	144	1 917	-	-	-	-	12	-
Netherland	-	-	-	5 682	3 490	-	-	-	-	2 127	-
Portugal	808	152	1 449	15 159	2 129	355	935	33	1 867	-	1 301
UK	205	-	899	6 194	2 855	-	550	-	-	2 129	-

One must bear in mind when reading this table that, apart from Iberian flows, only flows with at least a part of their journey on the corridor were considered. Thus, it is natural that those

countries involved in the corridor show the highest tonnage flows, followed by those countries nearer to corridor countries, particularly Italy and the Benelux countries. The selection of the potential ODs using the corridor was carried out at this stage of the study, on such a broad basis in order to keep all relevant traffics in our exercise. When the analyses pinpointed an OD flow not relevant for the corridor, it would cease to be taken into account.

Scenarios and Projections

Global Demand Projections

To project future traffic on the corridor, two different methods are used:

- For flows relating to Spain and Portugal, a series of econometric models were developed based on trade evolution over the last decades, for each country pair and each kind of cargo (13 categories considered). These models were based on the evolution of the GDP of Spain and Portugal, as well as those of their trading partners.
- For other origin-destination pairs, anticipated changes in flows are computed on the basis of the GDP share of each country, and on the elasticities of import and exports volumes to its GDP. These elasticities were calculated in the Transport World Report 2012/2013 of ProgTrans.

As has been said, regardless of the method used, the GDP growth projections are at the core of these exercises. The econometric models developed for the first market study considered the European Commission's 2012 Ageing Report's "Potential" scenario series for GDP projections.

For this update, the following assumptions on GDP growth for all countries considered are given by:

- The actual GDP evolutions between 2010 and 2013;
- The latest European Commission Economic short term forecasts – "Spring 2014", for 2014 and 2015;
- From 2016 up to 2030, update the previously used forecast (Ageing Report 2012) with the differences arising between Prognos' projections for GDP (WR2014 and WTR2011), and
- From then on, use the average between the previous growth figures (Ageing Report 2012) and Prognos' latest projections for GDP (WR 2014).

The following table sums up the variations of GDP forecasts between the original study and this update. As it can been noticed, the new forecasts are higher for Germany, Spain (except for 2020) and Portugal. On the other hand, the forecasts are significantly lower for France and for a few other EU countries (United Kingdom, Poland and Netherlands).

Table 4 – Variations of GDP forecasts for both studies

Country	2020	2030	2050
Germany	**3,2%**	**7,2%**	**9,9%**
Belgium	-3,5%	0,7%	2,7%
Spain	**-0,9%**	**2,4%**	**3,7%**
France	**-4,7%**	**-3,8%**	**-2,2%**
United Kingdom	-2,8%	-6,2%	-6,4%
Italy	3,5%	6,3%	4,3%
Luxembourg	-2,1%	-2,1%	-2,1%
Netherlands	-3,5%	-0,5%	-1,2%
Poland	-8,3%	-3,0%	2,7%
Portugal	**2,0%**	**5,8%**	**6,0%**

The following table illustrates the results of directly applying, up to 2030, the assumptions on GDP growth presented above to base year freight flows, given in Below is a summary of all flows considered for the established of 2010 demand matrices.

Table 2 (e.g., without taking into account future modal competitiveness evolution and its impact on modal choice, or any other issue).

Table 5 – 2030 "Business as Usual" freight flows, by mode and trade partners [Kt]

Mode		Portugal-Europe (inc. Es)	*Just Portugal-Spain*	Spain - Europe (exc. Pt)	Other Corridor flows	Total
Road		61 772	*48 701*	128 130	80 284	**270 186**
Rail	Rail-Rail	1 267	*1 267*	2 970	13 871	**20 756**
	Combined	-	-	2 649		
	Rail-Road	35	-	2 933	-	**2 969**
Fluvial		-	-	-	4 230	**4 230**
Marit.		27 656	*8 115*	115 810	48 227	**191 693**
Total		**90 730**	***58 082***	**252 492**	**146 612**	**489 833**

In this scenario, the relations amongst different market segments are kept pretty much unchanged from 2010 figures, whether it be the weight of different modes in total traffic, the structure of different types of flow or even the cargo categories, not shown here.

Future Transport Infrastructure Supply

Two major subjects regarding future infrastructure supply are thoroughly addressed in this study: interoperability, particularly the gauge difference between (standard) European and Iberian rail networks, but also power supply and signaling/communication issues, and the future potential of rail motorway services in the corridor.

Indeed, the current situation imposes lengthy and costly transhipments on the French-Spanish border. The total migration from Iberian to standard UIC gauge is a complex issue, involving heavy investments and therefore requiring a long time if ever, to be fully implemented. However, the planned interventions regarding UIC gauge penetration on Iberian rail freight network will undoubtedly push a qualitative leap in terms of cross-border rail traffic in the Corridor.

These infrastructure projects shall be accomplished over the coming decades. For what concerns the Atlantic Corridor, the line from the French border down to Valladolid (covering about 70% of the total distance up to the Spanish-Portuguese border) should be UIC Gauge compatible by 2020 (down to Cartagena at the Mediterranean corridor).

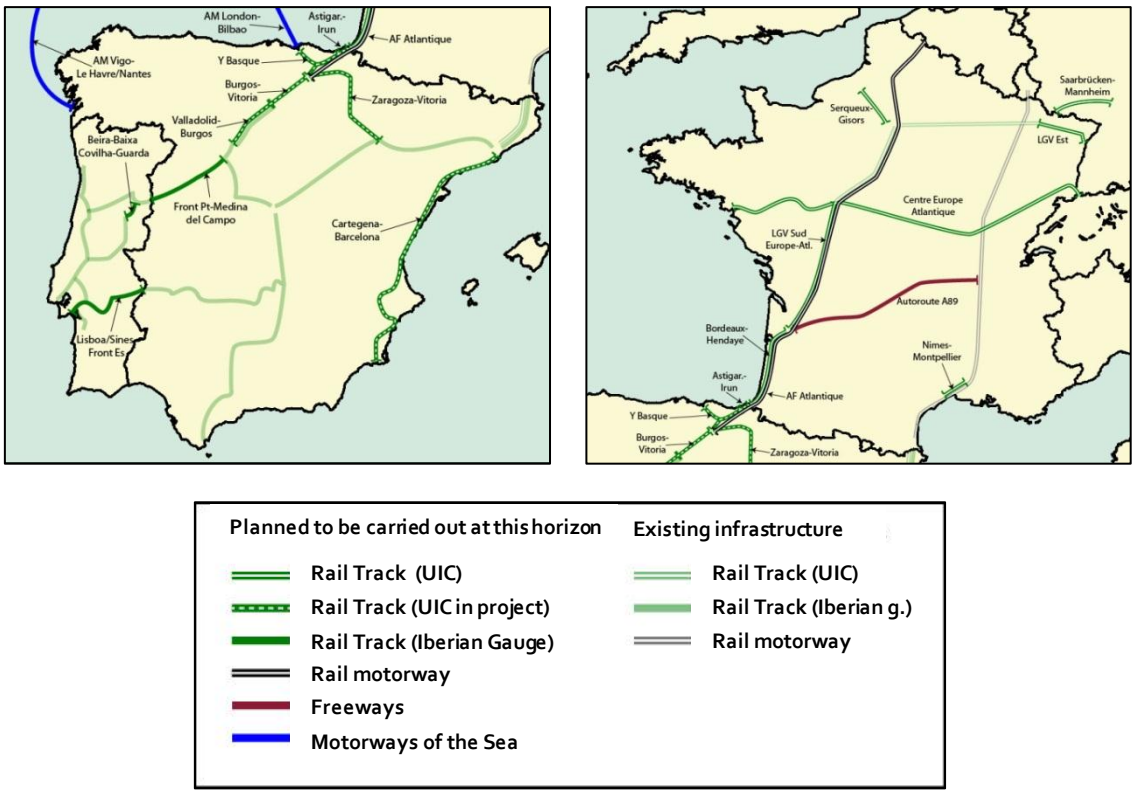

Figure 4 - Rail infrastructure developments due by 2020

By 2030, a relevant part of the Spanish and Portuguese rail networks should have been put to work in UIC gauge (see maps below), namely the connections to all *CEF's*[1] Core seaports in the Corridor.

[1] *CEF – Connecting Europe Facility*

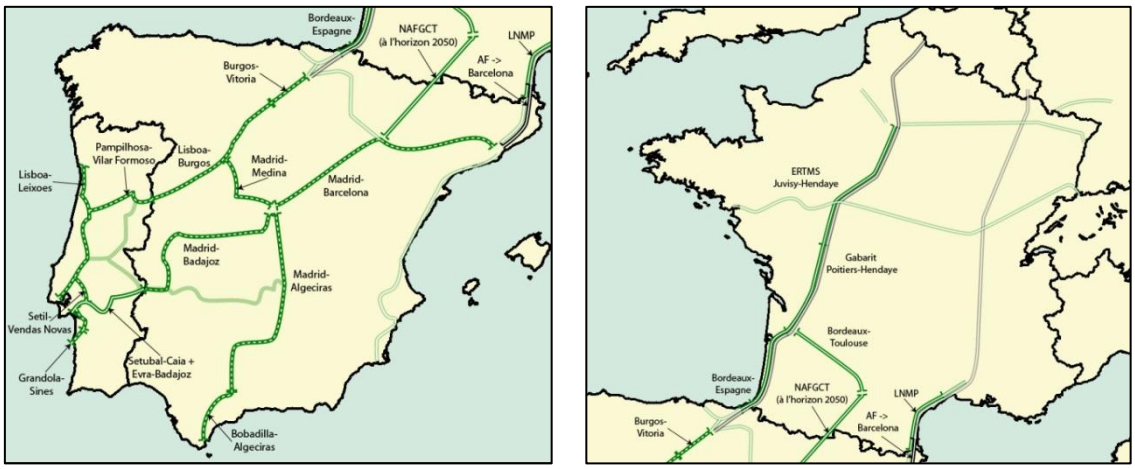

Figure 5 - Rail infrastructure developments due by 2030/2050

Rail motorways consist of a transport system in which heavy goods vehicles (HGV) are loaded (unaccompanied) onto suitable trains. Each train can move up to forty HGV over long distances, avoiding the multiple negative externalities inherent in road transport.

One of these rail motorways runs between Bettembourg (Luxembourg) and Perpignan, near the French-Spanish border, since 2007. Its extension to Barcelona is expected to be achieved by 2020. By that time, a similar service (Ecofret) will expectedly be running along the Atlantic corridor, offering a direct connection between Lille (Dourges), Bayonne (Tarnos) and Vitoria.

By 2030, these two lines may well offer several additional direct connections. This study adds a couple of new services to the set of potential direct connections established within the framework of the first study. So, in addition to Madrid-Lille, Vitoria-Paris, Madrid-Paris or Lisbon – Lille services, demand projections are now also provided to services linking Bettembourg, Mannheim or Oporto. These new services end up sharing the same market with the initially foreseen connections. Regarding the Mediterranean corridor, new rail motorway services are expected to connect Barcelona-Lyon, Valencia-Bettembourg, and Valencia-Lyon.

Analysis of the Determinants of Mode Choice

The determinants of modal choice were calculated during the first study from an econometric analysis based on stated preference surveys. These surveys were designed to provide a qualitative and quantitative analysis of the key factors driving the choice between different freight transport modes, providing a better understanding of predictable market reaction to supply changes.

A preliminary analysis of the key factors for mode / service choice has identified six attributes: time travel (door to door), total cost, reliability, safety, frequency, and number of transshipments.

In total, 74 companies were interviewed in the course of these investigations. This allowed us to analyze 90 typical international trips and perform 810 stated preference exercises.

This analysis has identified the utility functions that characterize the willingness to pay and trade-offs between all different attributes considered. The model results, presented below, contain only statistically significant segmentations that gave a better fit to the model.

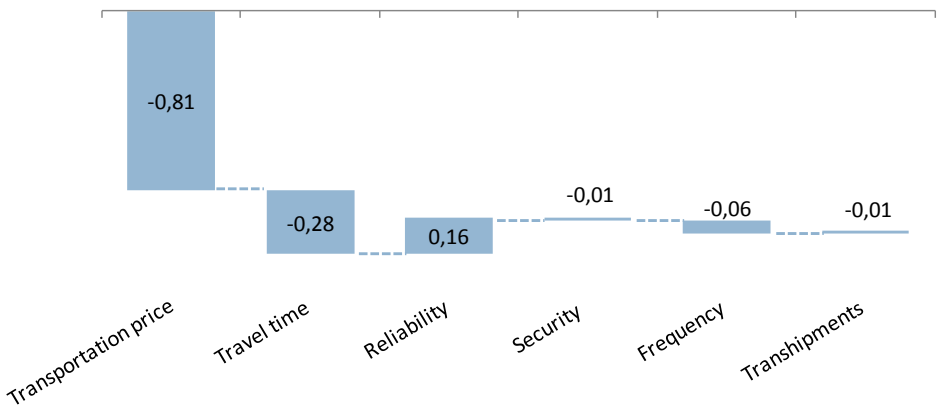

Figure 6 - Components of the estimated utility function

The results confirm that the total price of the trip corresponds to a significant proportion of the value of an alternative. However, in a competitive market environment, travel time and reliability can have a significant impact on the determination of market share.

These analyzes allowed us to distinguish different values of time for commodity groups NST1 (food) and NST6 (building materials) with a higher commercial value to € 3000 / tonne. These commodity groups have a significantly higher value of time (willingness to pay to reduce time travel) than the average freight transport market.

The following table summarizes the results of the estimation of this variable on different segments of goods. In averages terms, market participants are willing to pay 0.33 euros per tonne for each hour of travel time saved.

Table 6 – Value of travel time savings for relevant NST groups

NST1	NST6 (>3000 €/ton)	Other NST	Total
0,63 € /h.ton	0,58 € /h.ton	0,29 € /h.ton	0,33 € /h.ton

The utility functions were later adjusted with the inclusion of modal constants and scale factors to calibrate the existing market shares properly, thus determining the modal choice model to use.

Interviews wrap-up

Several in-depth discussions took place with a large variety of stakeholders, i.e. port operators, railway operators, terminal operators, shipping companies, corridor managers, infrastructure managers and logistics operators in the four countries covered by the RFC4. Although every stakeholder naturally presented his particular point of view, one can summarise that superposing all issues discussed gives a very clear picture of the strengths/opportunities, but also the observed weaknesses/threats of the RFC4 at the current state.

One can clearly cluster two segments of leverages: firstly operational measures (short- or mid-term considerations) and – secondly – more long term infrastructural measures. Stakeholders unanimously mentioned problems related to the different track gauges on the Iberian Peninsula. This leads to sometimes severe problems at the French – Spanish borders, which was often cited as one of the main reasons for the low market share of rail freight on the corridor.

The following chapters highlight the main topics addressed.

Information

The utmost priority for improving the competitiveness of international rail freight is to provide a reliable information platform on actual conditions in which it takes place. Lacking a integrated information platform that enables sharing information on the follow-up of each consignment, to provide real-time information to customers, the frequent replacement of time paths (in the Portuguese case the operator can swap a path without a utilization rate penalty within 7 days) and of the train number, the allocation in each country of different train numbers to the same international freight service, are some examples of the difficulties in obtaining reliable information on international rail services.

These difficulties may be overcome with the development of corridor's integrated management tools. The Performance Monitoring Reports will include, among others, the following KPIs: achieved punctuality in previously selected points along the chain, average waiting time in passing areas, or deviations between the actual and the scheduled time in corresponding paths.

The need to coordinate multiple activities which involve several different entities in four national rail spaces, such as the path allocation, traffic management, operations at terminals, rail and road transport make the integration of all these interventions particularly difficult to manage, requiring an effective coordination of efforts between the entities that manage the infrastructure, the terminals and rail operations.

Value Chain Management

Rail-based integrated supply chains have to be competitive in the face of the highest standards of service established by road haulage solutions, both in terms of price and of level of service offered, measured in terms of reliability, availability, flexibility, customer information (tracking & tracing), quality and safety/security.

In the current framing, it is essential to provide proper support for infrastructure accession by large integrators, by providing the essential conditions of safety, traceability and management of the point-to-point physical processes. They can bring their logistics expertise and the capability to identify the requirements of different markets, the capacity to promote the consolidation of cargos in strategic nodal points in the network, and ensure the necessary occupation rates and balancing of loads.

In order to increase the uptake of rail traffic flows it is important to engage core clients, with volume regularity (that support the launching of services with attractive frequency levels), and merge them with groupage cargo customers (with lower levels of cargo flows). Ultimately, this market may be enticed with the introduction of Rail Motorways, running trucks on top of railcars.

Integration of the last mile into the PAP's

Terminal and port operators miss the integration of the last mile into the PAP's. They argument that a non-coordination of Corridor slots and terminal slots leads to time losses on the last mile. According to these operators it can't be made understandable to the final customer, that competitive corridor transport times are wasted between the corridor and the terminals.

On the other hand it was also clarified that priority on scarce terminal slots allocation is given to the big clients of the terminals, bound with long term contracts. This will challenge the train path planning to fit the PAP's with available terminal slots. But, anyhow, this was seen as a step by step task for improving the whole corridor efficiency.

Corridor Extensions

Connection to Corridor 6 at Saragossa

The Mediterranean Rail Freight Corridor runs from Algeciras in the South of Spain to the Hungary-Ukraine border and beyond, holding a common section with the Atlantic Rail Freight Corridor in the Algeciras – Madrid rail link. The new Atlantic Corridor extension to Zaragoza, creating a new connection between both corridors, adds the Autonomous Communities of Aragón and Navarra to the corridor's catchment area.

Figure 7 - Mediterranean and Atlantic Corridors contact points

The strategic sectors of the Aragonese economy are the automotive industry, logistics and transport. Aragón holds a relevant geostrategic position between the highly populated economic centres of Madrid, Barcelona, and the Basque Region. Some 50% of the Spanish automobile production is distributed through Aragón.

Aragón is one of the top 3 automotive clusters in Spain, being home to the GM Figueruelas site - General Motors most productive assembly plant in Europe - and over 300 tier 1, 2, 3 and 4 automotive suppliers, including Brembo, Mann+Hummel, Valeo, Arcelor Mittal or Fujikura. Other large plants in the region include factories for train engines (CAF - Construcciones y Auxiliar de Ferrocarriles S.A.), household appliances (Balay), or stationary products (SAICA and Torraspapel). Agriculture production, traditionally a relevant economic sector of Aragón, thrive on a well-developed irrigation system around the Ebro River.

The economic structure of Navarra differs from the Spanish average for the importance of the industrial sector, highly technological and showing strong export capacity. The following sectors stand out: Automotive, machinery and electrical equipment, food Industry (there are several Registered Designation of Origin in Navarra, particularly in cheese, wine, and peppers), and renewable energy.

Volkswagen Navarra SA is home to Spanish production and export champion VW Polo, the only 'made in Spain' car among the twenty best selling models worldwide. BSH Home Appliances España SA is another example of a leading company in the region.

These industries comprise several significant international rail freight shippers. We could name, for instance, GM's and VW's automotive flows to/from the assembly plants located in these Communities and elsewhere in Europe (using the Atlantic or Mediterranean corridors alike, in the case of GM), or the stationary related flows to/from Portugal.

There are also other international services that run through this extension (Zaragoza – Vitoria/Miranda del Ebro railway line), such as Portugal – Catalonia flows which use it to avoid going through Madrid's *Cercanias* congested rail network, as does Transfesa's twice-weekly IBEREXPRESS service.

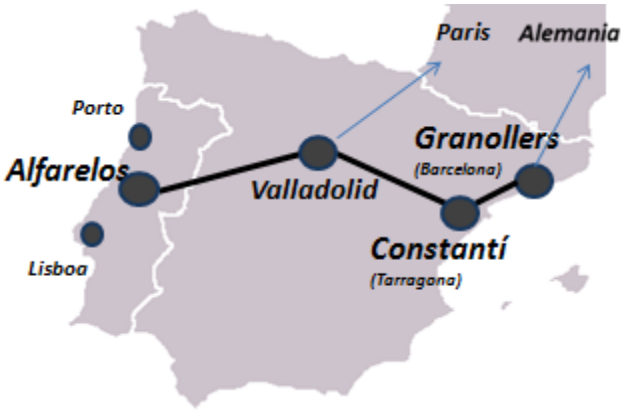

Figure 8 - Transfesa's IBEREXPRESS uses the Corridor Extension to Zaragoza

Several relevant logistics platforms are also located in this region, such as Zaragoza Plaza or Mercazaragoza, which is the base for a Port of Barcelona's inland terminal (TMZ), fostering maritime business in Zaragoza and the Ebro Valle, since 2012. Zaragoza Plaza is, on its own, the largest logistics premises on the European continent. Its intermodal service capacity (railways, roads, and air routes) have made PLAZA the site chosen by such as INDITEX, Imaginarium, Memory Set, Porcelanosa, TDN, DHL Express, Barclays Bank, MANN+HUMMEL IBÉRICA, S.A.U., etc. Several weekly rail services are offered on its premises, as illustrated below.

The new intermodal terminal at Noáin, near to Pamplona, supports the increased use of railways by local Industries from Navarra, which heavily rely on road transport. Located on existing Adif's premises, close to Pamplona Airport and the "Ciudad del Transporte de Pamplona", it has 15,000 square meters of warehouses and seventeen tracks, nine of them for loading and unloading, and eight for reception.

The terminal is currently operated by Tercat - Barcelona's BEST (Barcelona Europe South Terminal) terminal operator, materializing Adif's new strategy for the increased involvement

of supply chain agents in terminal management and operations, such as the handling of intermodal units and provision of ancillary services (other recent examples include Huelva, Villafria de Burgos or Tarragona terminals). Noáin Terminal rail services to BEST terminal, performed by 70 TEU trains, started on a weekly frequency, and a second or a third frequency are expected shortly.

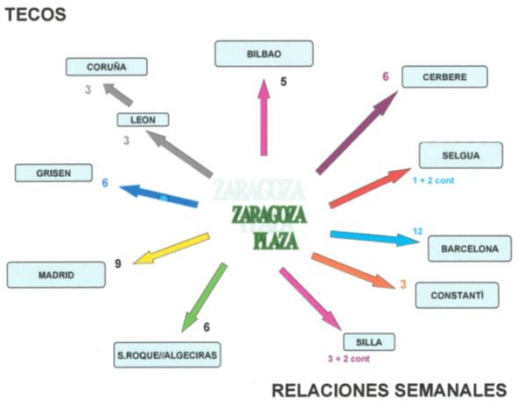

Figure 9 - Weekly services from/to services from Zaragoza Plaza per direction

The following tables provide the total forecasted tonnes for these region's international freight flows, along with the rail freight catchment potential for this new connection, which also includes the flows between Portugal and Catalonia.

Table 7 – Projections of freight flows to/from Portugal on the new extension to Zaragoza

ES-PT [kt]		To/from Aragón/Catalonia	To/from Navarra	Total
All Modes	2010	940	76	1 015
	2020	1 123	91	1 214
	2030	1 570	120	1 690
	2050	2 454	195	2 649
Rail flows	2010	260	-	260
	2020	401	14	416
	2030	810	60	870
	2050	1 388	117	1 506

There were over one million tons traded between Portugal and these Spanish Autonomous Communities in 2010, with rail seizing almost 28% modal share. These freight flows are estimated to growth over 2.5 times up to 2050, while rail flows will expectedly multiply by 6 its current figures, doubling today's figures to reach a modal share of almost 60%, in 2050. Depending on future network congestion and/or border cross, a significant part of these may be expected to use this connection (as opposed to going through Madrid).

Table 8 – Projections of freight flows through the Pyrenees and the new extension to Zaragoza

thrg.Pyrenees [kt]		To/from Aragón	To/from Navarra	Total
All Modes	2010	8 284	4 066	12 350
	2020	9 896	4 885	14 781
	2030	13 189	6 610	19 799
	2050	19 454	9 786	29 240
Rail flows	2010	485	180	665
	2020	724	260	984
	2030	829	354	1 183
	2050	1 480	525	2 005

Regarding trans-Pyrenean trade flows, 2010's tonnes figures are estimated to multiply by 2.3 by 2050, while rail flows triples, increasing its market share from 5.2% to 6.5%. It is worth mentioning here that the implementation plans established in the framework of this study consider the new high-capacity rail axis across the Pyrenees (Central Crossing) only in 2050.

Connection to Corridor 9

With the extension of corridor4 to Germany, there will be the opportunity to connect the Atlantic Corridor directly with the Rhine-Danube corridor (corridor 9). The later runs from Mannheim and Strasbourg via Munich, Vienna, Bratislava and Budapest to Constanta in Romania on the Black Sea. This provides additional opportunities to manage future rail flows between Portugal, Spain, France and the East-/South-East European countries.

There are two possibilities connecting corridor4 to Germany and further to the East:

- via Stiring-Wendel/Saarbrücken and;
- via Strasbourg/Kehl/Offenburg.

The following figure shows that the main additional potential road transport flows between Germany and France were using the links via Metz-Saarbrücken in the North and Mulhouse in the South.

Figure 10 - Road transport flows Metz/Saarbrücken and Mulhouse

The link Metz – Saarbrücken is of highly relevance for Atlantic corridor. In contrast, the potential for a modal shift from road to rail on the Mulhouse link is mainly relevant for the Mediterranean corridor. As the above figure illustrates, this link is of less relevance for RFC4.

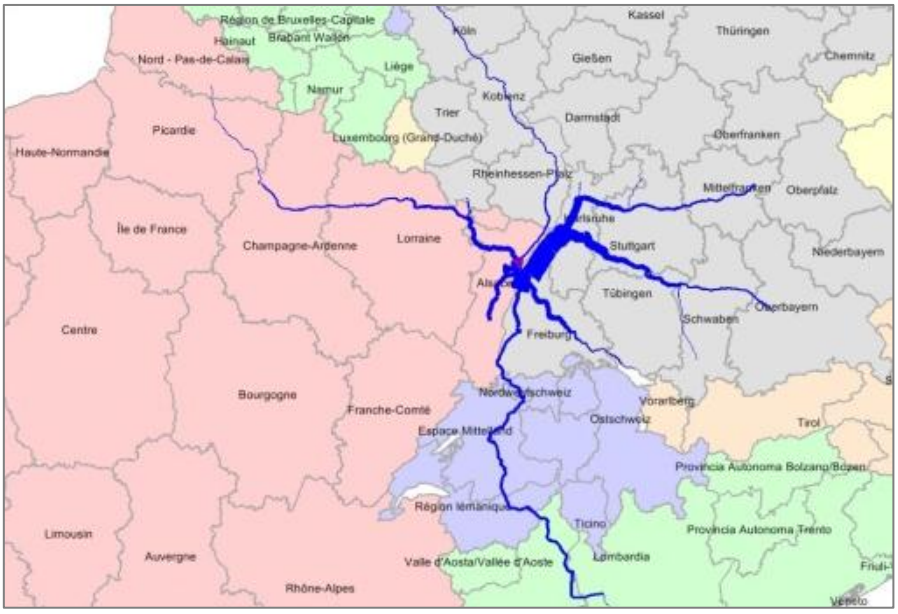

Figure 11 - Road transport flows using border crossing station Kehl/Offenburg

The alternative route via Strasbourg – Kehl – Offenburg is mainly relevant for regional transport flows (figure 11). Only a few transport flows refer to long distance transport. In 2013, about 1'200 cross-border freight trains used the connection via Kehl/Strasbourg. Compared to the connection via Stiring-Wendel/Saarbrücken, Kehl/Strasbourg carries about 10% of the observed cross-border rail freight traffic between France and Germany. As conclusion, the connection via Strasbourg – Kehl – Offenburg is of limited interest for RFC4, although it can serve as a backup route to Stiring- Wendel/Saarbrücken.

The following figures show the expected progress of road transport volume of Portugal, Spain and France from/to the East-/South-East European countries. This data is relevant to help establish the modal shift potential of future road flows between these countries.

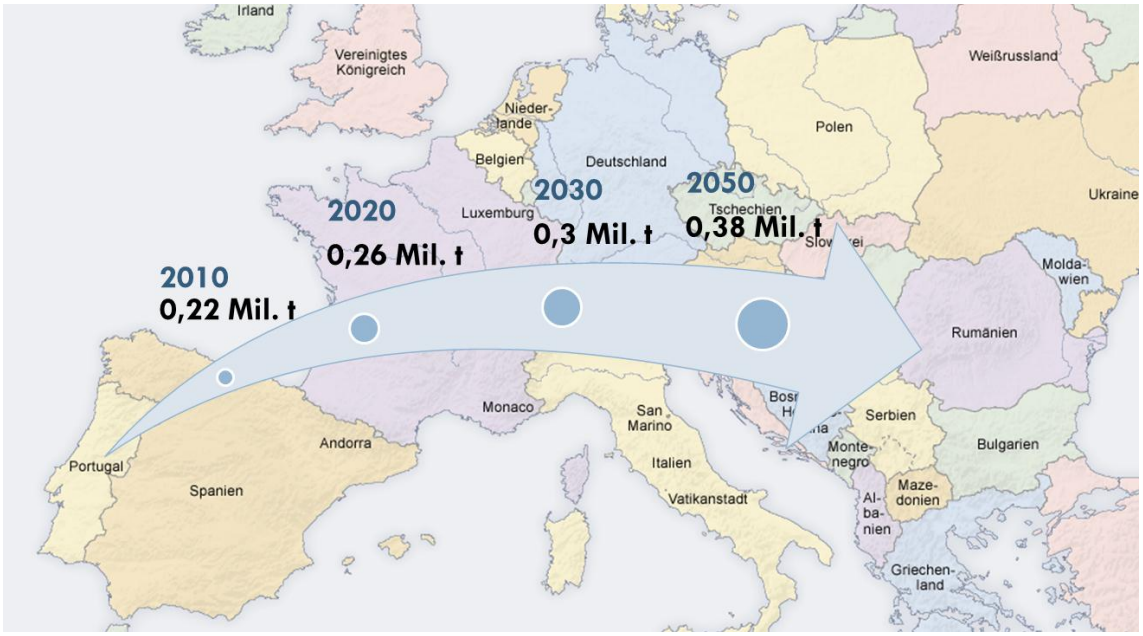

Figure 12 - Road freight volumes between Portugal and East-/South-East Europe (both directions)[Mt]

Figure 13 - Road freight volumes between Spain's Corridor area and East-/South-East Europe (both directions)[Mt]

Figure 14 - Road freight volumes between France's Corridor area and East-/South-East Europe (both directions)[Mt]

Road transport volumes between Portugal and the East-/South-East European countries are very low, resulting in just 0.38 million tonnes in 2050, which mainly run from Portugal to East-/South-East Europe and precisely Poland. The main commodities transported are machinery, transport equipment, manufactured articles and miscellaneous articles (NSTR9).

In contrast, the road transport volumes between Spain and the East-/South-East Europe will almost double between 2010 and 2050, resulting in 4.8 million tons. The most relevant transport volumes in East-/South-East Europe are oriented to Poland and the Czech Republic, and only limited volumes are going to other East-/South-East European countries. In addition the transport flows are quite unbalanced: About 60% of the transport volume originates in Spain and goes to the Eastern-/South-Eastern European countries. Main transport goods are NSTR9 (Machinery, transport equipment, manufactured articles and miscellaneous articles), foodstuffs, metal and agriculture products as well as chemicals.

Since these flows are handled mainly in combined transport terminals, and not transported directly from their origin to their destination, the opportunities for handling goods in German terminals were analysed, based on a DB Netz database. Several terminals in Germany currently run direct international services to East-/South-East European cities, such as those located in Mannheim or Kehl (corridor 9 connections to the Atlantic Corridor), but also those terminals located in Cologne or Duisburg. The example of Duisburg connections is given in figure13.

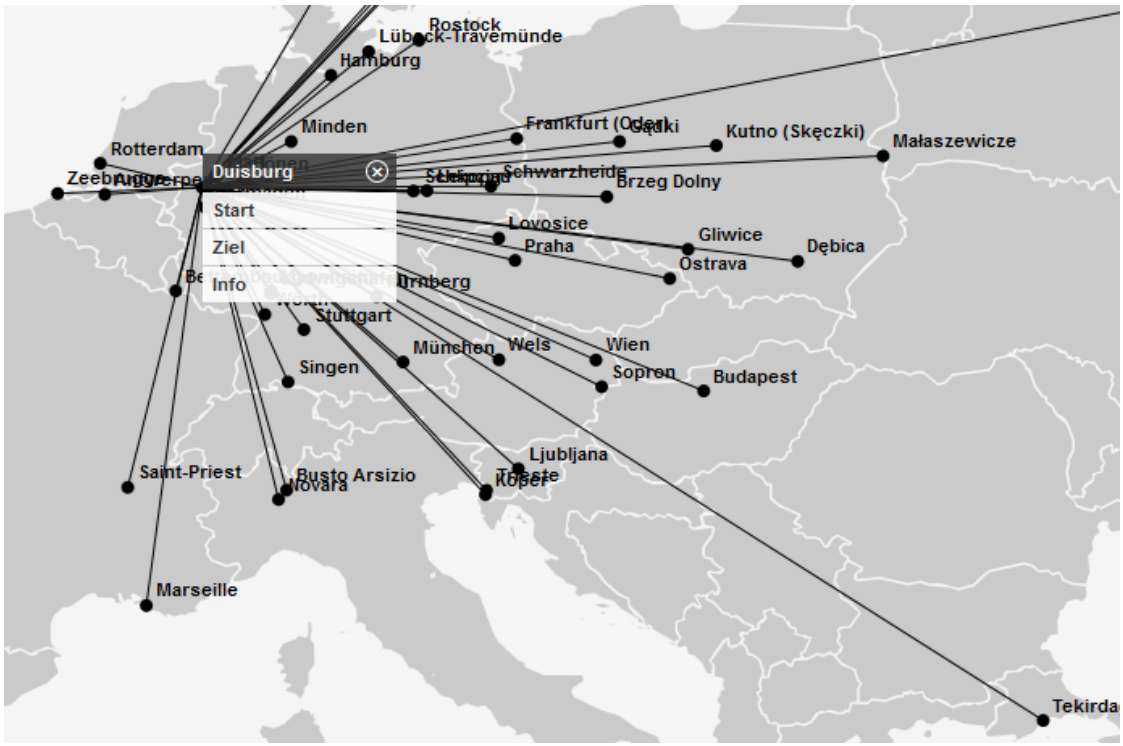

Figure 15 - Connections of Terminal Duisburg to the East

As a result of this analysis, it can be stated that there are some important eastward connections subsequent to Corridor4, via the Rhine-Alpine and Rhine-Danube Corridors. The central Gateway terminal in this context is Duisburg, providing up to 20 regular connections to East and South-East European countries. In addition, up to 4 connections are available from/to the terminals in Mannheim and Ludwigshafen.

New Connections to Terminals and seaports

Nantes/St. Nazaire and La Rochelle Seaports

In addition to the new Atlantic Corridor's connections to corridor 6, at Saragossa, and to corridor 9, in Germany, the rail links connecting the French seaports of Nantes/St. Nazaire and La Rochelle were also included into the corridor. Since both ports are major seaports in France, its inclusion in RFC4 may lead to additional international rail transport volumes along the corridor.

Therefore, the potential road transport volumes from/to Germany, Portugal and the corridor area in Spain which might be shifted to rail were analysed, and summarized in Table 9, for the NUTS3 regions Nantes/St. Nazaire and La Rochelle. One should take note that this table does not distinguishing between loco and port traffic.

Table 9 – International road freight flows to French seaports (@NUTS3) [kt]

O/D (both ways)		2010	2020	2030	2050
Nantes/St. Nazaire	Germany	680	860	1130	1560
	Spain	680	820	1100	1800
	Portugal	90	110	120	200
La Rochelle	Germany	190	230	290	400
	Spain	160	200	290	460
	Portugal	19	21	27	43

As it can be seen in table 8, the transport flows are on a relatively low level and, in the particular case of Portugal, totally negligible. When analysing the transport flows in detail, only few O/Ds between regions will have sufficiently high volumes suitable for rail transports. But this is only the case under the condition that these flows are sufficiently locally massified on a few shippers to be of interest for rail transport:

From/to La Rochelle

- Südbayern: 126'000 (2010) – 300'000 tons per year (2050)
- Niedersachsen: 70'000 (2010) – 150'000 tons per year (2050)

From/to Nantes/St. Naziare

- Südbayern: 37'000 (2010) – 87'000 tons per year (2050)
- Niedersachsen: 41'000 (2010) – 94'000 tons per year (2050)
- Stuttgart: 29'000 (2010) – 70'000 tons per year (2050)

The main commodities transported are Machinery, transport equipment, manufactured articles and miscellaneous articles (NSTR9) whereas the other commodities are distributed to all the other commodity groups.

As conclusion, with the exception of some potential between Spain and Nantes/St. Nazaire, the potential for rail connections of the Iberian Peninsula with Nantes/St. Nazaire and La Rochelle is of minor interest. The transport volumes between Germany and Nantes/St. Nazaire or La Rochelle are relatively low and distributed to disperse O/D pairs and commodities. Those conditions are more or less inappropriate for rail transport.

Valongo terminal (SPC Multiusos)

The Valongo Terminal, recently integrated in the Atlantic Rail Freight Corridor, lies in a 16 ha site in the Industrial Area of Campo (Valongo), situated at about 29 km from the Port of Leixões and at about 20 km from Francisco Sá Carneiro Airport. With 8.000 Sqm of warehousing area (including a customs bonded area) and a storage capacity of 2.300 TEUS, it can operate 500 m long electric trains 24 hours/day, holding a theoretical capacity for 8 block trains a day.

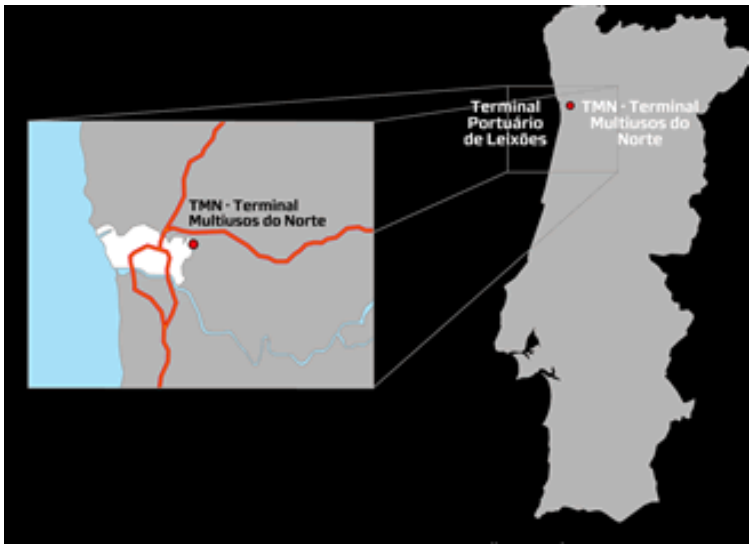

Figure 16 - TMN Valongo's location near Oporto

This strategic location allows it to serve the northern part of Portugal, and perform as a backup site to the Port of Leixões future Logistics Platform. This is quite relevant as, increasingly, feeder movements between Portuguese seaports are being captured by rail, and particularly those with a leg in Sines seaport, such as MSC operations to the Port of Setúbal (a operation performed at SPC's terminal at the Sapec Bay Industrial Area).

SPC main vocation is terminal operations management, and it operates several rail and Logistics terminals close to the main Portuguese Atlantic freight hubs, such as Valongo (Oporto), Setúbal (TMS), but also Bobadela (Lisbon – just by CP Carga's Terminal) and a

couple of other sites. It enjoys privileged partnerships with terminal players located in strategic locations in Spain (Irun, Tarragona and Sagunto).

SPC is one of CP Carga largest international transport customers, e.g. in the Iberian Link Service (an intermodal CPCarga / Renfe partnership connecting the Portuguese Atlantic rail hubs - Bobadela and Leixões - to Madrid and Catalunya). Its core customers lie in the chemical industry, to whom it provides added values services, such as container tanks heating, and its biggest commitment goes toward capturing market share in specific freight categories that involve larger scale operations, such as chemicals, industrial raw and intermediate materials, steel, wood, and shipping containers.

Chemicals represent around 50% of Portuguese rail freight imports, mainly in 30 foot intermodal containers that usually return emptily to their origin. 90% of chemicals' import flows are destined to the Northern part of Portugal (from Santo Tirso down to S. João da Madeira), while export flows originates mainly from the southern part of the country (Repsol).These flows are most relevant between Bobadela and Valongo, in Portugal, and Tarragona in Spain, Europe's second most important - and Iberian first - chemistry hub.

SPC also has some experience in managing rail services. Just recently, SPC set up an international rail freight operation in a joint operation with Geodis, connecting its main terminals to Catalunya. This operation lasted for several months and summed over 100 trains during its lifetime up to its end, in March 2014, when Geodis lost its main customer (IKEA) to Transfesa/Klog and dropped the train.

Traffic Projections

General Tonnage Projections

Total international freight flows in the corridor axis summed up 196 Mt in 2010 of which 113 Mt correspond to land traffics. These figures relate to the Atlantic Corridor only (especially, trans-Pyrenean flows by the Mediterranean corridor are not included in this analysis), and can be split into three distinct markets:

- The "South" flows, between Spain and Portugal (35 Mt including 30 Mt on land modes)
- The trans-Pyrenean flows, established between the countries of the Iberian Peninsula and their partners (107 Mt of which almost 53 Mt relate to land modes), and
- The "North" flows that use the corridor links north of the Pyrenees (establishing trade routes between France, Germany and its partners, excluding Portugal and Spain (55 Mt including 29 Mt on land)

These traffics can additionally be characterized by three different types of relationships:

- Internal traffic (12% of rail flows in 2010), when both origin and destination of flows are located inside the corridor´s influence area. By definition, all these flows materialize trade relations between Germany, France, Portugal and Spain,
- The exchange traffic (59% of flows) which include either the origin or destination inside the corridor influence area, and
- The transit traffic (29% of flows) that gathers all flows likely to go through any corridor link but neither the origin or destination are located inside the corridor (eg a route Brussels-Paris-Metz-Basel)

The following contingency table displays the interrelations between the above dimensions in 2010 and relevant projection horizons, skimming the rail flows by its different services. It illustrates the strong growth of rail traffic between 2010 and 2020, particularly for cross-border flows, due to the combined impact of extending the UIC gauge from the French border down to Valladolid, and the establishment of the first Ecofret rail motorway service to Vitoria. Rail modal share in 2020 (including rail motorway flows) jumps to 10.6% (against 5.9% in 2010).

Table 10 – International Transport flows in the Atlantic Corridor [kt]

		Internal				Exchange				Transit				Total			
		Rail			Land modes	Rail			Land modes	Rail			Land modes	Rail			Land modes
		Conventional + Combined	Rail Motorway	%Rail		Conventional + Combined	Rail Motorway	%Rail		Conventional + Combined	Rail Motorway	%Rail		Conventional + Combined	Rail Motorway	%Rail	
North of the Pyrenees	2010	149	-	12.2%	1 219	2 003	-	11.1%	17 975	1 772	-	15.7%	11 297	3 924	-	12.9%	30 490
	2020	275	-	17.0%	1 611	3 390	-	14.9%	22 794	2 919	-	21.6%	13 521	6 583	-	17.4%	37 926
	2030	408	-	18.9%	2 157	5 139	-	16.3%	31 598	4 645	-	24.3%	19 149	10 192	-	19.3%	52 904
	2050	607	-	20.1%	3 021	8 238	-	17.5%	47 190	7 688	-	25.8%	29 742	16 533	-	20.7%	79 954
Across the Pyrenees	2010	394	-	2.9%	13 459	1 409	-	4.3%	32 694	160	-	2.5%	6 448	1 963	-	3.7%	52 601
	2020	753	193	5.9%	15 929	3 184	1 795	12.9%	38 476	393	33	5.4%	7 837	4 330	2 021	10.2%	62 242
	2030	1 254	1 435	12.2%	22 043	5 339	4 166	18.7%	50 774	594	277	8.7%	10 048	7 187	5 877	15.8%	82 865
	2050	2 520	2 432	14.5%	34 164	8 967	7 044	21.7%	73 767	1 059	470	10.6%	14 353	12 546	9 945	18.4%	122 285
South of the Pyrenees	2010	367	-	3.2%	11 515	426	-	2.4%	18 092	-	-	0.0%	186	793	-	2.7%	29 792
	2020	544	-	4.3%	12 666	645	-	3.2%	20 069	1	-	0.6%	206	1 190	-	3.6%	32 941
	2030	1 380	-	7.5%	18 527	1 151	-	3.9%	29 222	4	-	1.5%	299	2 535	-	5.3%	48 048
	2050	2 280	-	8.0%	28 492	2 042	-	4.6%	44 484	6	-	1.4%	455	4 328	-	5.9%	73 431
Total	2010	764	-	2.9%	26 192	3 984	-	5.8%	68 761	1 932	-	10.8%	17 931	6 680	-	5.9%	112 884
	2020	1 314	193	5.0%	30 206	7 476	1 795	11.4%	81 340	3 313	33	15.5%	21 563	12 103	2 021	10.6%	133 109
	2030	2 666	1 435	9.6%	42 727	12 005	4 166	14.5%	111 594	5 243	277	18.7%	29 496	19 915	5 877	14.0%	183 816
	2050	4 843	2 432	11.1%	65 678	19 810	7 044	16.2%	165 441	8 753	470	20.7%	44 550	33 406	9 945	15.7%	275 669

The increased penetration of UIC gauge all the way through the Iberian Peninsula and the establishment of additional Ecofret services, by 2030, causes yet again a significant increase (14.0%) of rail modal share in 2030. Subsequently, rail ever-increasing modal share continues but much more moderately, reaching 15.7% in 2050.

As we can see, trans-Pyrenean rail share in 2010 is very low (close to 4% of total land flows), and clearly part of the explanation for this fact is the existing interoperability issues between rail infrastructures on both sides of the mountain range. The estimated boost in the tonnage between 2010 and 2030, multiplying by 3.7 present rail flows (excluding rail motorway services), is directly linked to the increased adoption of the UIC standard on Iberian rail infrastructure.

Rail flows "South" of the Pyrenees also experience several interoperability and infrastructural (and "cultural") issues that hinder its efficiency and competitiveness, such as the diverse (or inexistent) power supply, communication and signalling systems between the Spanish and Portuguese infrastructures, or the limitations on maximum train lengths and weights, due to a few localized steep gradients or the lack of suitable and plentiful 750m length crossing stations. All these have contributed to the "all-road" market currently observed (less than 3% modal share for rail). The expected improvements in the Iberian rail infrastructure up to 2030 will also tackle these issues, supporting the expansion of Iberian rail flows, with international tons figures expectedly multiplying by 3 current flows, while doubling today's market share.

"North" rail flows, on the other hand, are characterized by a modal share quite closer to the European Union average (17% in 2010). The expected increases in tonnage and rail modal share are accordingly more moderate here than on the former cases.

Train Paths Demand Projections

By 2020

The following table gives a summary on the train paths allocation scenario established in this study. This scenario is based on traffic projections by origin-destination pairs for 2020, looking to keep only a limited number of services. It was assumed that Irun / Hendaye will retain much of its current weight as a point of articulation between the Iberian Peninsula and the northern rail networks by 2020. This explains the large number of services that have one end in Irun / Hendaye. The flows are given aggregating the two directions of traffic. These services are either direct services or services with only one intermediate stop when indicated.

Table 11 – Total flows and number of trains per section in 2020

Origin	Destination	Intermediary stop	Rail flows modelled for 2020 (in tons)	Number of trains per year for 2020
Irun/Hend	Metz		277 689	427
Metz	Irun/Hend		313 415	482
Irun/Hend	Mannheim		1 042 163	1 603
Mannheim	Irun/Hend		974 699	1 500
Irun/Hend	Paris		560 456	862
Paris	Irun/Hend		772 579	1 189
Irun/Hend	Le Havre		202 264	311
Le Havre	Irun/Hend		133 926	206
Irun/Hend	Vitoria		608 851	1 290
Vitoria	Irun/Hend		458 113	971
Irun/Hend	Porto		86 502	183
Porto	Irun/Hend		137 290	291
Irun/Hend	Madrid	Vitoria	1 647 287	3 490
Madrid	Irun/Hend	Vitoria	1 228 507	2 603
Irun/Hend	Algeciras		175 327	371
Algeciras	Irun/Hend		124 820	264
Irun/Hend	Lisboa		134 463	285
Lisboa	Irun/Hend		198 751	421
Lisboa	Madrid		225 895	479
Madrid	Lisboa		446 417	946
Mannheim	Paris	Metz	1 605 809	2 470
Paris	Mannheim	Metz	1 219 740	1 877
Metz	Le Havre	Paris	1 269 790	1 954
Le Havre	Metz	Paris	1 375 801	2 117
Madrid	Porto		56 427	120
Porto	Madrid		97 408	206

Figure 17 - 2020 trains by link

By 2030

For 2030, the choice of services was made taking into account, on the one hand, the matrix O/D flows and, on the other hand, flows between main production and consumption centres, again trying to keep a limited number of services.

In the following table, services are either direct services or services with an intermediate stop when specified.

Table 12 – Total flows and number of trains per section in 2030

Origin	Destination	Intermediary stop	Rail flows modelled for 2030 (in tons)	Number of trains per year for 2030
Irun/Hend	Metz		364 811	561
Metz	Irun/Hend		132 886	204
Irun/Hend	Mannheim		250 911	386
Mannheim	Irun/Hend		165 429	255
Lisboa	Paris		241 125	438
Paris	Lisboa		186 306	339
Vitoria	Paris		524 160	953
Paris	Vitoria		700 268	1 273
Vitoria	Metz		133 799	243
Metz	Vitoria		372 903	678
Lisboa	Mannheim		215 137	391
Mannheim	Lisboa		172 505	314
Algeciras	Paris		122 880	223
Paris	Algeciras		220 346	401
Lisboa	Madrid		574 464	1 044
Madrid	Lisboa		1 008 949	1 834
Le Havre	Mannheim	Paris	1 092 997	1 682
Mannheim	Le Havre	Paris	1 085 845	1 671
Mannheim	Madrid		463 169	842
Madrid	Mannheim		243 789	443
Mannheim	Paris	Metz	4 072 775	6 266
Paris	Mannheim	Metz	3 607 828	5 551
Mannheim	Vitoria	Metz	619 087	1 126
Vitoria	Mannheim	Metz	692 421	1 259
Porto	Vitoria		256 802	467
Vitoria	Porto		363 444	661
Irun/Hend	Madrid	Vitoria	940 511	1 710
Madrid	Irun/Hend	Vitoria	542 539	986
Algeciras	Irun/Hend	Vitoria	288 094	524
Irun/Hend	Algeciras	Vitoria	350 834	638
Porto	Mannheim		142 064	258
Mannheim	Porto		63 028	115
Porto	Paris		179 530	326
Paris	Porto		118 735	216
Paris	Madrid		582 522	1 059
Madrid	Paris		262 548	477
Porto	Madrid		247 691	450
Madrid	Porto		139 960	254

Figure 18 - 2030 trains by link

The above figures are net of rail motorway flows, which are dealt separately in the next section.

Demand Projections for Rail Motorways

By 2020, the Ecofret connection between Vitoria-Lille will be the first rail motorway service running on the Atlantic Corridor. The traffic on this route is estimated at 2Kt (equivalent to 4,034 trains) per year. The demand projections for 2030 are summarized in the following elements.

Table 13 – 2030 Rail Motorways estimates for the Atlantic Corridor

2030		In Kt	In number of trains
Vitoria	Paris	589	1 176
Vitoria	Lille	871	1 738
Madrid	Lille	1 019	2 033
Madrid	Paris	516	1 030
Lisboa	Paris	221	441
Lisboa	Lille	508	1 013
Porto	Paris	295	589
Porto	Lille	262	522
Vitoria	Bettembourg	266	532
Madrid	Bettembourg	171	342
Vitoria	Mannheim	713	1 424
Madrid	Mannheim	446	890
		5 877	**11 731**

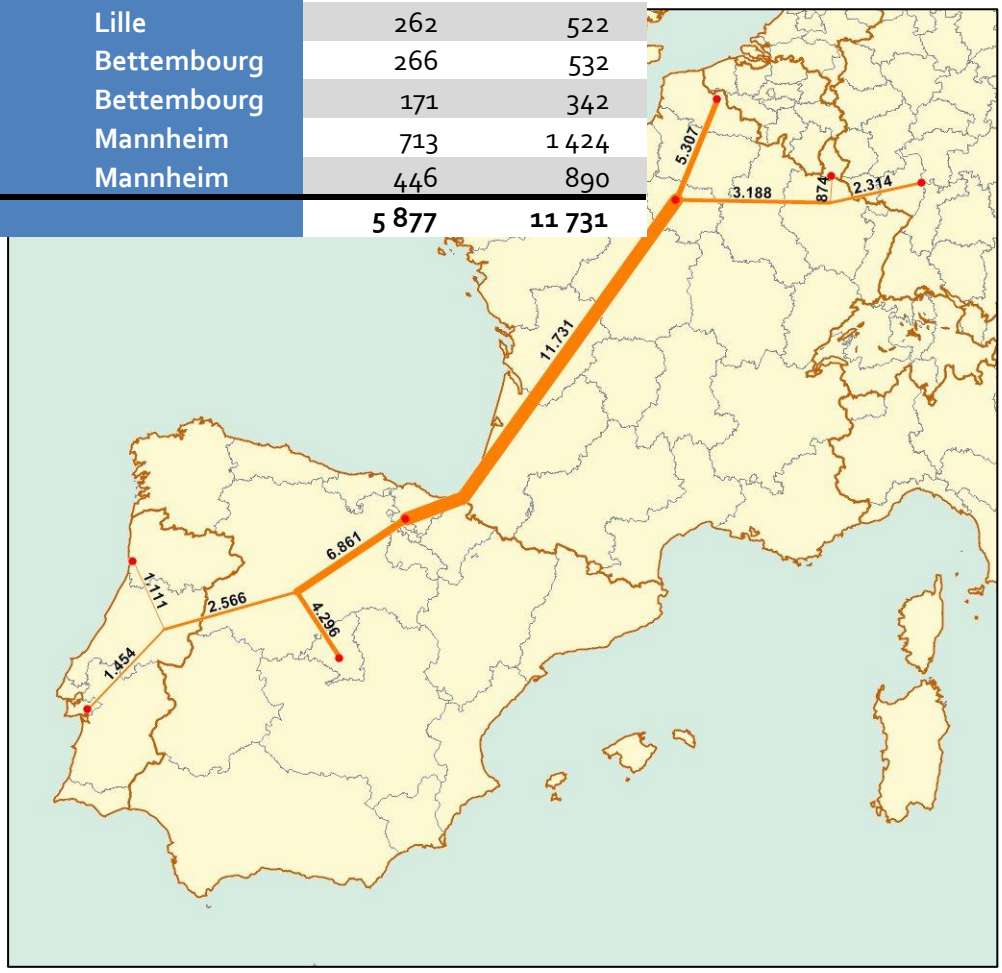

Figure 19 - 2030 rail motorway trains by link

The following provides the same information for the 2050 rail motorway projections.

Table 14 – 2050 Rail Motorways estimates for the Atlantic Corridor

2050		In Kt	In number of trains
Vitoria	Paris	980	1 956
Vitoria	Lille	1 457	2 909
Madrid	Lille	1 746	3 485
Madrid	Paris	895	1 787
Lisboa	Paris	372	742
Lisboa	Lille	876	1 748
Porto	Paris	477	952
Porto	Lille	426	851
Vitoria	Bettembourg	443	885
Madrid	Bettembourg	298	594
Vitoria	Mannheim	1 200	2 394
Madrid	Mannheim	776	1 549
		9 945	**19 851**

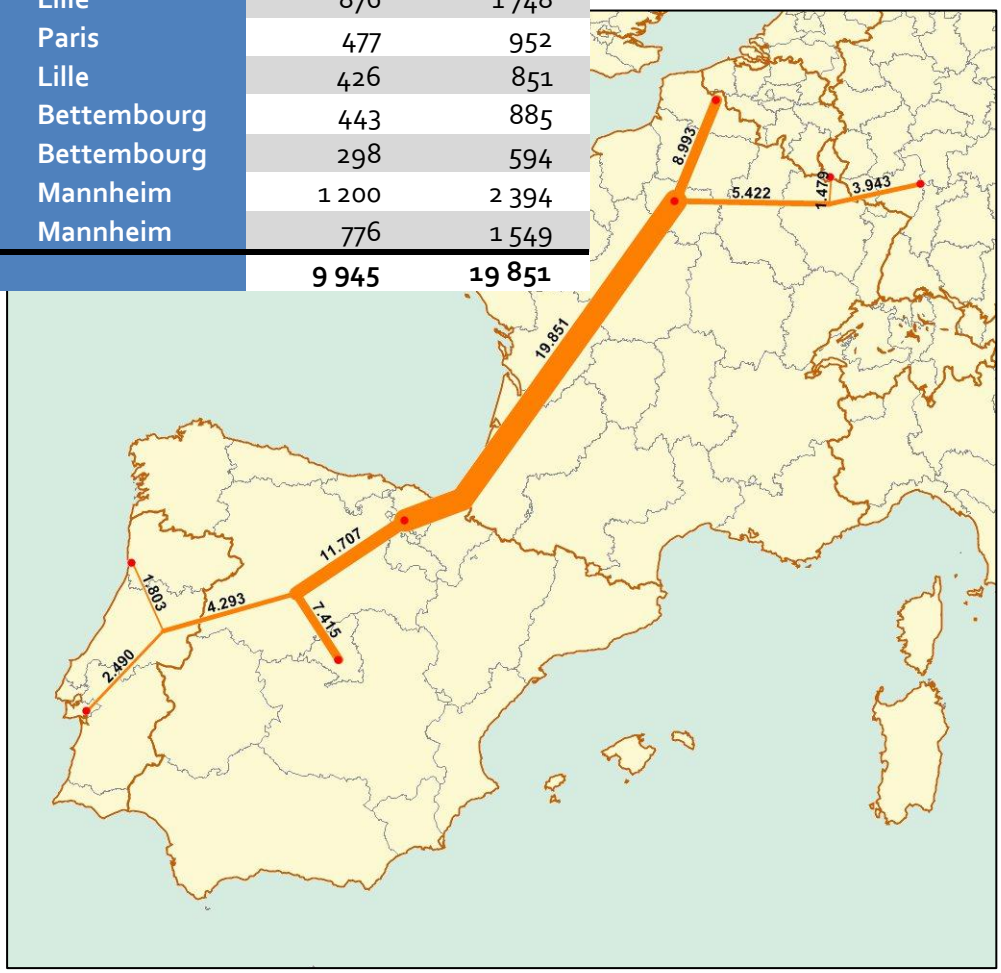

Figure 20 - 2050 rail motorway trains by link