Ports and their connections within the TEN-T

Vigie Fiche 394-1, B1
TREN/R1/350-2008 Lot 2

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Final Report

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Contents

1 Background

1.1 Introduction

For many years, the European Commission's Directorate General for Mobility and Transport (DG-MOVE) has recognised the importance of the maritime sector within the development of the trans-European transport network (TEN-T), as a contributor to economic growth, trade development, EU economic cohesion and to the alleviation of inland congestion. With these objectives in mind, a considerable body of work has been created to support policy analysis. It has become increasingly evident that as the maritime sector grows, there is an ongoing need to divert greater attention towards the integration of the maritime network and the supporting inland networks.

While the study focuses upon the TEN-T network, and therefore upon the EU member states, the trade networks that constitute the basis for the port services market and many of the important decision making organisations are global. Many other strategic factors affecting ports such as the demand and supply of energy, the performance of the global economy, the shifts of production towards low cost centres, environmental and security issues are similarly global in scope. Policies directed towards the development of the maritime sector therefore need to be based upon scenarios in which these global drivers are considered.

1.2 Main study objectives

This study specifically addresses the issue of how port related traffic interacts within the TEN-T, and how this is likely to evolve over time. Its database and results will be used within forthcoming traffic forecasting work related to TEN-T.

Three essential steps were implemented:

- The development of a central economic and policy **scenario for 2030** based in the ITREN-2030 study.
- The **modelling** of sensitivity analyses around this scenario, using TRANSTOOLS V2.0 methodologies.
- The **assessment** of policy options with regard to TEN-T objectives, setting out proposals for the implementation of the most beneficial scenario.

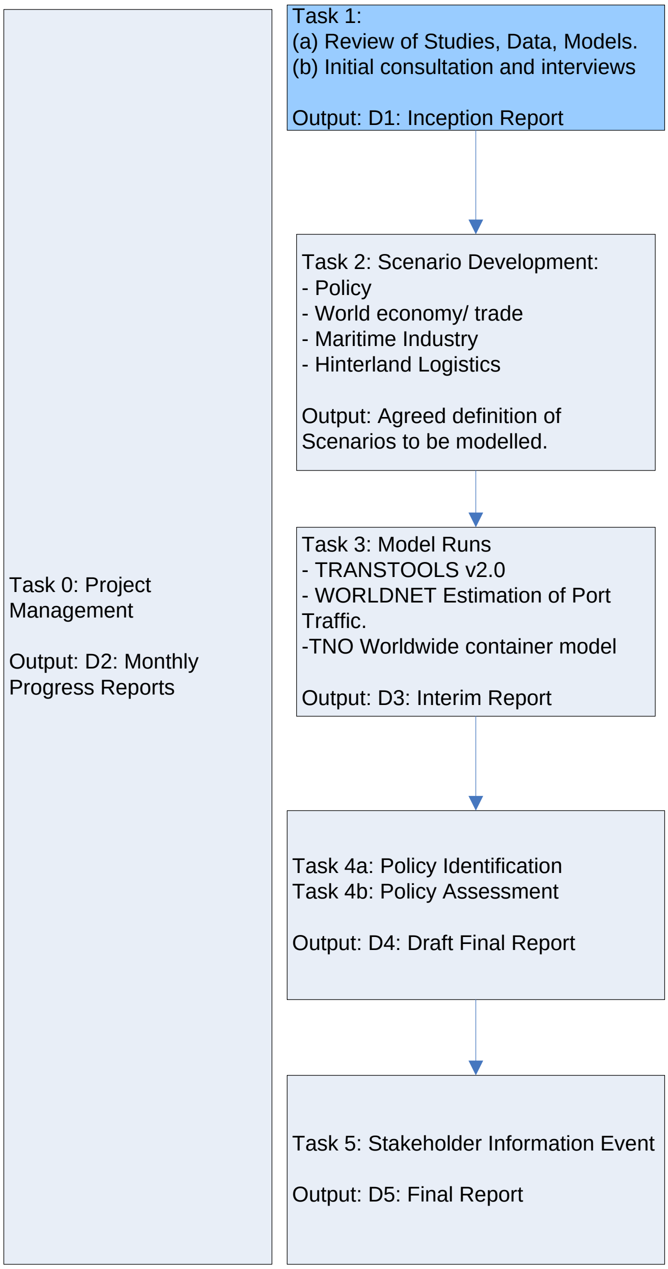
Following these analyses, a recommendation has been made by the consortium regarding the selection of ports for a future European core network. This is a conclusion of the study and does not imply a commitment. Subsequent analyses related to other transport categories (inland freight and passengers) will be carried out, which potentially can affect the completion of the network.

1.3 Content of Final Report

This report presents the final results collected within Project Tasks 1 to 5 (see below) bringing together existing material, including new quantitative results compiled from recent FP6 and FP7 research. In the context of this study, these are new results providing a picture of how the European port sector and their hinterland networks might evolve.

Thus the initial emphasis has been upon understanding and achieving a synthesis of existing material, including, crucially, the TEN-CONNECT study and the associated TRANSTOOLS V2.0 transport model, which were conceived as all-purpose EU transport planning studies, but which have now been applied for the subset of maritime transport flows. The main focus has been towards freight flows, although it is recognised that passenger flows do play a role in the maritime networks influencing the distribution of ferry services, and a large role in the competition for inland capacity where passenger and freight vehicles interact.

Figure 1-1 Overview of Project Structure



1.4 Scope of the Study

The geographical scope is based upon a core European region, including the EU27, Norway, Switzerland, and Accession countries including Turkey and Croatia. Impact assessment has been carried out for these core countries.

For the scenario building, it was also necessary to consider the influence of external changes in neighbouring countries, so following WORLDNET, a wider area has been considered, including Russia, Ukraine, Georgia, and North Africa. Trade analysis has covered all flows between the core region and all other countries, so the effects of intercontinental economic integration has been taken into consideration.

1.5 Overview Methodology

Detailed knowledge of spatial distribution patterns within port hinterlands is not recorded at a European level, and even individual port operators may only have a partial or picture of the onward distribution of their own traffics. A modelled approach, based on pre-existing databases and modelling tools has therefore been undertaken, with TRANS-TOOLS V2.0 to be used as the main tool for traffic impact analysis.

It has therefore been necessary to adapt the existing tools and databases, many of which have been designed originally for inland transport modelling, so that they can be applied to the specific issues raised within this study. TRANS-TOOLS V2.0 has been developed for the TEN-CONNECT study. It has been updated to 2005, and provides a fairly conventional four-step transport modelling package, including in particular:

- A base year freight flow MATRIX, in which maritime traffics can be identified.
- A TRADE model, providing the means to forecast goods traffic growth according to different economic growth assumptions.
- A MODE SPLIT model, in which the shares of inland modes react to changes in transport costs.
- An ASSIGNMENT model, allowing freight flows (e.g. hinterland traffic) to be traced throughout the road, rail and waterway networks, to set the basis for impact and bottleneck analysis.

WORLDNET (FP7), running in parallel with the construction of TRANS-TOOLS V2 has developed data, and techniques that allow maritime flows to be extracted from the general set of traffic flows, made compatible with TRANS-TOOLS and assigned within TRANS-TOOLS. Furthermore the project has introduced a geo-referenced network of ports, collected port traffic data, and developed techniques for building TRANS-TOOLS compatible mode chains, calibrated to the port data. This has been the basis for a flow database containing hinterland traffic.

Sensitivity analyses have been developed around a central forecast, using the trade model to estimate commodity flows. However, additional input has been used from the literature review, taking into account more targeted market research in each of the main cargo sectors:

- Dry bulk, including solid fuel, ores, construction materials, grain etc.
- Liquid bulk, including petroleum products.
- Other conventional cargo, e.g. steel, paper and forest products.
- Containerised cargo, and
- Roll-on roll off, including HGVs, passenger cars and trade cars.

Thus, the existing freight flow matrices have been refined for the sectors most relevant for the study, bearing in mind the *specialisation* that exists within the ports industry.

One key aspect to this has been to integrate assumptions of energy demand from relevant studies e.g. iTREN into the trade flow forecasts. WORLDNET showed, for example that some two thirds of EU27 maritime imports are bulk commodities, of which a high proportion are energy products. Therefore the expectations of this sector in terms of energy demand, the types of fuel to be used and the overseas sources have particular relevance.

The approach has therefore been primarily top-down with trade flows being modelled at a region to region level and assigned via seaports to produce estimated transport chains, relating port volumes to estimated hinterlands. Forecasts of the trade flows are combined with supply side assumptions to produce five sensitivity analyses:

- High Growth
- Low Growth
- Higher concentration at biggest ports
- Higher concentration at Southern ports
- Higher inland costs.

2 Literature Review

2.1 Overview

Full reporting of the structured literature survey has been presented in the Interim Report, so this section contains only a summary of the sources considered.

To date, a large volume of research has been undertaken in the maritime domain, and a number of policy oriented decision support tools are already available, both within the Commission and outside. The commercial sector and its industry associations, for example provides regular market research in all areas of the ports and shipping sector.

The scope for the literature review (aside from EC policy documents) is listed.

Table 2.1 Overview of literature review

Subject	*Study*	*Relevance*
TEN-T	TEN-CONNECT (2008) DG-MOVE	Development of scenarios and modelling tools for the TEN-T, taking into account the external dimension. Outputs include: TRANSTOOLS v2.0 Model, bottleneck analysis (including maritime bottlenecks), analysis of competing trade routes, and development of cost benefit methodology.
MACRO	ITREN 2030 (2009) DG-MOVE	Integrated transport , environment and energy scenario development until 2030, including post-credit crisis economic analysis. Energy demand scenarios and accepted settings for relevant policy levers have been used to inform demand analysis.
FREIGHT FLOW	WORLDNET (2009) DG-MOVE	Development of a freight flow database, a port demand and supply database, and a methodology for analysing flows within TRANSTOOLS v2.0.
COMMERCIAL	COMMERCIAL PUBLICATIONS AND TRADE PRESS	Latest commercial market research designed for shipping industry, including market analysis post credit-crisis.
SHIPPING	OPTIMAR (2009)	Study relating to strategic developments in the shipping industry until 2018, with scenario development, and policy recommendations. Provides a recent synthesis of trends in the shipping industry. Includes database of port traffic.
EU PORTS	ESPO (2009)	Study by ITMMA (Antwerp University), looking into European port systems and underlying logistical processes and market dynamics. Emphasis is upon the role that ports play within interconnected supply chains.

UK PORTS	Container Transhipment Study and UK Port Demand Forecasts (2006)	Studies on behalf of the UK Department for Transport by MDS Transmodal, in which a modelling and assessment methodology has been developed for planning port development.
NL PORTS	Port Demand Forecasts published by NL Ministry of Transport (2008)	Recent policy documents relating to the development of the port sector, and the implications for sustainable transport policy. "Zeehavens als Draaischijven naar Duurzaamheid", Ministerie van Verkeer en Waterstraat, 2008.
DE PORTS	Masterplan Güterverkehr und Logistik (2008)	German National port strategy
DE PORTS	Seeverkehrsprog-nose 2025 (2007)	Forecasts of maritime flows Germany 2025
HR PORTS	Croatian Master Plan for the development of a core transport network,	The future Trans-European Transport Network (TEN-T) in the Republic of Croatia and priority projects of European interest in the framework of this TEN-T network, Government of the Republic of Croatia, 2008
TR PORTS	TURKLIM forecasts of port traffic growth in Turkey, 2008	Turkish Port Sector Report 'Vision 2023' (2008), by TURKLIM, the Turkish Port Operators' Association.
EU Neighbour-hood	TRACECA Maritime Links (2008)	Analysis of Black Sea ports in TRACECA countries, including scenario development and traffic forecasts.
	MEDA Motorways of the Sea	Detailed supply and demand data covering Mediterranean area, including non-EU countries.
	TRACECA MoS (2009)	Identification of short and medium term pilot projects and feasibility studies to promote efficient intermodal freight transport connecting the Black and Caspian Seas' and neighbouring countries with the enlarged EU
East Med region	East Med MoS	http://www.eastmed-mos.eu/
West Med region	West Med MoS	Objective: development of a master plan for the definition and implementation of the Motorways of the Sea in the western Mediterranean region. Involved MS: Italy, Spain, France, Malta
Baltic Sea Region (BSR	Baltic Maritime Outlook (2006)	Good flows and maritime infrastructure in the Baltic sea region
Northern Dimension	The Northern Transport Axis (2007)	

2.2 Summary of Literature Review

Important Conclusions from the Literature Review

- Many studies, including TEN-CONNECT argue that the main bottlenecks exist in the hinterlands rather than the ports themselves, once existing port expansion plans are taken into consideration.
- The need is recognised for an understanding of the relationship between ports and supporting logistics networks as a contributory factor in the choice of port – the European Distribution Effect (EDC) effect (ITMMA), i.e. that the point of final consumption has to be considered together with the point of intermediate storage.
- There is an emerging consensus that port-hinterland planning should address port clusters/ multi-port gateway regions rather than individual commercial entities.
- Future perspectives need to focus upon unitised cargo as the fastest growing sector, especially containers.
- Rates of containerisation are increasing, so there is still large potential for container traffic growth even if economic growth is moderate. In South East Europe containerisation rates are currently lower than the European average, so a higher potential for increasing containerisation exists in this region.
- In the short run, the credit crisis has reversed three years of trade growth, but multi-sectoral forecasting studies such as ITREN-2030 foresee a return to growth. Recent data show volumes returning to pre-crisis levels e.g. in Europe/Far East, but there are still significant risk factors.
- Port planning methodologies used in existing studies tend to opt for a top down methodology, based on economic projections. They address the question of how much capacity will be needed, but not specifically the impact this will have on supporting networks.
- There is typically a national or regional scope within such port planning studies, rather than a European scope.
- In terms of traffic projections the range of uncertainty is high; even for studies carried out before credit crisis.
- Optimar and Traceca studies as well as national Croatian and Turkish studies indicate capacity shortages in ports, mainly in container sector.
- German study identifies new potential towards the East, for ports in Adriatic and Baltic.
- Mediterranean ports' advantage is proximity to Suez, with highest growth forecast for Europe-Far East connections. Disadvantage is hinterland connectivity.
- IUAV (Venice) study identifies potential for decarbonisation by greater use of Southern ports, for Far Eastern cargo.
- Trade and traffic data indicates the most striking imbalance in European port shares is between Eastern and Western countries. Around 80% of all EU27 port traffic is still handled in just nine EU15 member states.

Possible Gaps in Existing Literature

- Studies tend to focus on shipping and port markets, and not hinterland implications.
- Complex aspects such as container transhipment (ship to ship) and the role of maritime hubs may be overlooked.
- Plans are rarely on European or wider scale.
- Role recommended for policy maker may vary amongst:
  - Intra European Economic Cohesion – short sea shipping.
  - Provision of International Gateways – trade development.
  - Modal shift/co-modality.
  - Alleviation of congestion near ports.
  - Decarbonisation.

3 Sectoral Analysis

3.1 Overview

Port related traffic, as a part of the overall European traffic mix constitutes a significant volume. WORLDNET estimated that some 603bn inland tonne kilometres are generated annually within the EU territory from seaborne freight, about a quarter of total freight. For certain mode sectors e.g. waterway, the share is higher, given that many ports have direct access to freight services using non-road modes.

Table 3.1 Hinterland Traffic Volumes, EU27, 2007, Billion tonne-kms

	Total	*Port Related*	*Share*
Road	1,927	406	21%
Rail	452	118	26%
Waterway	141	78	55%
Total	2,520	603	24%

Source: EU Statistical Pocketbook, 2009; WORLDNET estimates.

Over 80% of port volumes are handled within nine EU countries. As an oil producing country, and an island, the UK is the most maritime dependent EU country, relying on maritime traffic for virtually all of its intra EU trade, and all of its extra EU trade. The Eurostat figures also indicate a concentration of traffic in the Northern and Western countries, with the main port cargo volumes along the English Channel and North Sea, as well as the Western Mediterranean. The heaviest cargo concentrations per port are in the Netherlands, Belgium, Germany and France, with Rotterdam occupying the top position in the European port ranking by a large margin.

Table 3.2 Gross weight of seaborne goods handled by country, 2005, 2008

	Total Tonnage 2008	*Total Tonnage 2005*
By Port Country		
United Kingdom	562.2	585.7
Netherlands	530.4	460.9
Italy	526.2	508.9
Spain	416.2	400.0
France	352.0	341.5
Germany	320.6	284.9
Belgium	243.8	206.5
Sweden	187.8	178.1
Greece	152.5	151.3
Other EU 27	627.4	600.0
Total	3,918.6	3,717.8

Between 2005 and 2008 only small changes in the market structure of the European maritime trade had taken place, placing the Netherlands on the second place after UK as the largest EU maritime country instead of Italy who occupied this position for the previous 10 years. The North Range ports remain the largest in the European maritime trade.

Table 3.3 Gross weight of seaborne goods handled by port, 2005, 2008

	Total Tonnage 2008	*Total Tonnage 2005*
By Port		
Rotterdam (NL)	384.2	345.8
Antwerp (BE)	171.2	145.8
Hamburg (DE)	118.9	108.3
Marseille (FR)	92.5	93.3
Total (Top 4)	766.80	693.2

Source: Eurostat

However, this static analysis potentially obscures the actual and potential growth within the Baltic countries, and the increasing trade development around the Black Sea and Eastern Mediterranean seas. Accession countries such as Turkey and Croatia are relevant in this respect. With improved inland infrastructure, fewer non-EU border crossings, as well as relatively high economic growth, it is likely that a greater North-South balance will be restored.

3.2 Historical development

As the following data shows, the EU's maritime traffic is large in overall volume and, until the recent economic crises it was experiencing a steady growth. The first impacts of the crisis on the maritime sector were seen in the second half of 2008 with some decrease in EU port activity (0.5% decrease in handling of goods on an annual basis).

Table 3.4 Growth in EU Port Traffic , 1997-2008

Year	*EU15*	*EU27*
1997	2,887.2	
1998	2,951.8	
1999	2,930.5	
2000	2,974.0	
2001	3,037.6	
2002	3,091.0	
2003	3,188.8	3,450.5
2004	3,304.6	3,568.4
2005	3,434.5	3,717.8
2006	3,545.9	3,835.9
2007	3,647.3	3,937.5
2008	3,628.8	3,841.6

Source: Eurostat

On the individual country level the growth rate in 2008 varied considerably by country. Some countries registered quite an important increase (for example 24,4% growth in Lithuania, 6.7% in Bulgaria and 6.2% in Cyprus)[1], while others had decreased (Estonia, - 19.5%, Greece – 7.2%, Poland -6.9%). As Eurostat data shows further, in 2008 63% of EU 27 maritime transport concerned extra-EU trade flows.

In 2008 liquid bulk goods accounted for 40% of the total maritime cargo handled in EU 27 ports, followed by dry bulk goods (25%) and containers (18%). During the last 10 years the overall maritime container traffic almost doubled in Europe (EU 27). Because of the crisis in 2008 the growth rate of the container traffic had fallen, but there was still a net increase of 0.1% in comparison with 2007, achieving 64,531 thousand TEU. In 2008 the top three European container ports (Rotterdam, Hamburg and Antwerp) together handled more than 33% of the containerised volumes in Europe. Both Rotterdam and Hamburg recorded a fall of 1% in 2008 compared to 2007.

Below, the port traffics recorded for EU27 countries, Norway and Croatia are shown, split by European port range and traffic type for the periods 2000, 2003, 2005, and 2008. Estimates have been added to fill gaps by interpolation.

[1] Amerini G. Eurostat Statistics in Focus 11/2010

Table 3.5 Port Ranges

Label	*Port Range*	*Countries*
HLH+	Hamburg Le Havre Plus	NL, BE, DE, Northern FR
BSEM	Black sea and East Mediterranean	BG, CY, GR, HR, RO, SI, TR, AL, ME
WMED	West Mediterranean	ES, Southern FR, IT, MT, PT
SBALT	Southern Baltic States	EE, LT, LV, PL
UK/IRE	UK and Ireland	UK, IE
SCAN	Scandinavia and Nordic Region	DK, FI, IS, NO, SE

Table 3.6 European Port Traffic, 2000, Millions of Tonnes

2000	*Dry*	*Liquid*	*Containers*	*Other* Non bulk	*TOTAL*	*Share*
HLH+	310	411	170	171	1,062	31%
BSEM	72	68	39	63	226	7%
WMED	223	408	125	122	875	26%
SBALT	56	85	4	46	184	5%
UK/IRE	114	301	57	119	590	17%
SCAN	106	227	24	118	470	14%
EC/HR/NO	881	1,500	419	639	3,407	100%
EU27	812	1,308	389	566	3,062	90%
South Share	34%	32%	39%	29%	32%	

Source: Eurostat, and consultants' estimates

Table 3.7 European Port Traffic, 2003, Millions of Tonnes

2003	*Dry*	*Liquid*	*Containers*	*Other* Non bulk	*TOTAL*	*Share*
HLH+	301	408	212	159	1,080	31%
BSEM	78	75	25	54	232	7%
WMED	224	434	158	129	946	27%
SBALT	55	82	6	37	180	5%
UK/IRE	128	273	58	122	580	17%
SCAN	123	218	26	122	489	14%
EC/HR/NO	909	1,490	484	623	3,507	100%
EU27	860	1,378	480	603	3,322	95%
South Share	33%	34%	38%	29%	34%	

Source: Eurostat, and consultants' estimates

Table 3.8 European Port Traffic, 2005, Millions of Tonnes

2005	*Dry*	*Liquid*	*Containers*	*Other* Non bulk	*TOTAL*	*Share*
HLH+	304	453	260	175	1,193	31%
BSEM	84	82	30	43	240	6%
WMED	252	466	188	139	1,045	27%
SBALT	69	77	10	29	184	5%
UK/IRE	140	277	62	137	616	16%
SCAN	128	224	29	143	524	14%
EC/HR/NO	978	1,579	580	666	3,803	100%
EU27	919	1,465	575	640	3,599	95%
South Share	34%	35%	38%	27%	34%	

Source: Eurostat, and consultants' estimates

Table 3.9 European Port Traffic, 2008, Millions of Tonnes

2008	*Dry*	*Liquid*	*Containers*	*Other* Non bulk	*TOTAL*	*Share*
HLH+	336	495	328	187	1,346	34%
BSEM	89	91	26	41	248	6%
WMED	240	463	222	160	1,084	27%
SBALT	61	79	12	27	178	4%
UK/IRE	139	252	68	135	595	15%
SCAN	150	217	34	148	549	14%
EC/HR/NO	1,015	1,597	688	699	3,999	100%
EU27	946	1,503	682	672	3,804	95%
South Share	32%	35%	36%	29%	33%	

Source: Eurostat, and consultants' estimates

A direct comparison between the years 2000 and 2008 is shown below. Here, the average annual growth rates are computed between 2000 and 2008 to show the relative growth of the various geographical and commodity sectors.

Table 3.10 Average Annual Growth Rates in Port Traffic, 2000 to 2008

2000-2008 Growth	*Dry*	*Liquid*	*Containers*	*Other* Non bulk	*TOTAL*
HLH+	1.0%	2.4%	8.5%	1.1%	3.0%
BSEM	2.6%	3.6%	-4.8%	-5.1%	1.1%
WMED	0.9%	1.6%	7.4%	3.4%	2.7%
SBALT	1.1%	-1.0%	14.2%	-6.6%	-0.4%
UK/IRE	2.6%	-2.2%	2.2%	1.7%	0.1%
SCAN	4.4%	-0.6%	4.4%	2.9%	2.0%
EC/HR/NO	1.8%	0.8%	6.4%	1.1%	2.0%
EU27	1.9%	1.8%	7.3%	2.2%	2.7%

Overall the market is growing by 2% per annum, but the container sector was growing at 6.4% per annum over the same period. Dry bulks are growing in line with the market, and liquids are more static.

Perhaps surprisingly, the two main Western blocs, namely Hamburg Le Havre and the West Mediterranean have been outperforming the market as a whole (gaining share) with the Eastern continental blocs (BSEM-Black Sea and East Med and SBALT- South Baltic) growing more slowly or experiencing some negative developments.

3.3 Trade Growth

An analysis of recent trends in European trade based on Eurostat trade data is shown below. Forecasts derived from the ITREN-2030 project are attached.

Trade volumes (tonnages) have been analysed for a core region consisting of European countries, up to but not including the Russian Federation.

Table 3.11 shows all trade by all modes arising from the core region, amounting to 6,604 million tonnes in 2005 for example, which is mainly intra-EU traffic.

Growth rates are shown in the right hand columns, expressed as compound annual growth rates (CAGR).

Table 3.11 Pan European trade in million tonnes

	1995	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
EU 27	2,519	3,723	5,537	6,183	4.0%	2.0%
Other Europe	350	572	907	1,246	5.0%	3.2%
North Africa	192	255	342	531	2.9%	3.0%
Other Africa	140	196	309	374	3.4%	2.6%
Middle East	193	203	298	366	0.5%	2.4%
Central Asia	73	141	204	228	6.8%	1.9%
Other Asia	127	237	648	1,136	6.4%	6.5%
Russian Fed.	404	632	901	1,005	4.6%	1.9%
North America	260	329	402	353	2.4%	0.3%
Latin America	178	258	301	366	3.8%	1.4%
Oceania	57	58	41	35	0.2%	-2.0%
TOTAL	4,493	6,604	9,892	11,822	3.9%	2.4%
NON EU	1,974	2,881	4,355	5,640	3.9%	2.7%

Source: ITREN-2030

In, the flows between core countries with land borders have been removed in order to identify the trade flows which are most likely to use the sea mode. Thus flows within the core area and towards the Russian Federation are removed.

Table 3.12 Europe Total Maritime Trade million tonnes

	1995	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
EU 27	541	693	956	960	2.5%	1.3%
Other Europe	131	169	171	182	2.6%	0.3%
North Africa	191	253	340	528	2.9%	3.0%
Other Africa	139	195	308	370	3.4%	2.6%
Middle East	191	201	295	361	0.5%	2.4%
Central Asia	59	98	134	152	5.2%	1.8%
Other Asia	127	235	644	1,127	6.3%	6.5%
Russian Fed.	234	410	521	507	5.8%	0.9%
North America	259	327	398	350	2.4%	0.3%
Latin America	176	255	296	359	3.8%	1.4%
Oceania	56	56	38	30	0.0%	-2.5%
TOTAL	2,105	2,893	4,100	4,925	3.2%	2.2%
NON EU	1,564	2,199	3,144	3,966	3.5%	2.4%

Source: ITREN-2030

European maritime trade amounted to 2,893 million tonnes in 2005. Of this intra EU short sea shipping was 693 million tonnes. Intra EU traffic generates two port handling requirements per shipment, so the implied volume of port traffic in the EU is around 3.5 billion tonnes. Within this figure, trade with Asian markets is the fastest growing, and also expected to generate most growth in future at around 6.5% per annum.

Growth overall is expected to continue at around 2.2% per annum up to 2030.

As regards the Russian Federation, historically large quantities of maritime goods transported to the EU (mainly raw materials as crude oil and coal) were transited through Baltic States and its main ports in Latvia, Lithuania and Estonia. After the accession of these countries to NATO and EU in 2004, Russia started a policy to completely re-route these flows and via Russia's own northern outlets in the Baltic Sea. Since then, large investments were made to extend the capacity of existing ports and build up new ones.

The Transport Strategy of Russian Federation till 2030 and special Sea Transport sub-program, elaborated within it, continues this strategy and preview new important investment into Russia's Baltic Sea ports in order to extend their capacities. This means that part of the flows (Russian flows which transit Baltic countries and than go further to Europe) which is currently considered within Pan European intra-sea flows will be redistributed to Russian Federation and therefore, the total volume of Pan-Europe – Russia maritime flow – is increasing.

As oil and petroleum products are one of the main items of EU – Russia trade, the redistribution of some flows into the pipelines which are currently under construction can also affect the current forecast.

Table 3.13 Pan European TOTAL trade per commodity

NST1	*1995*	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
Agricultural Produce	313	445	628	747	3.6%	2.1%
Food	352	499	731	887	3.6%	2.3%
Solid Fuel	238	383	581	696	4.9%	2.4%
Oil and Petroleum	1,563	2,324	3,228	3,654	4.0%	1.8%
Ores Scrap	362	434	629	785	1.8%	2.4%
Metals	266	413	748	911	4.5%	3.2%
Crude Minerals	471	629	1,010	1,265	2.9%	2.8%
Fertilisers	105	116	172	231	1.0%	2.8%
Chemicals	332	542	861	1,036	5.0%	2.6%
Misc Manufactures	491	820	1,303	1,609	5.3%	2.7%
TOTAL	4,493	6,604	9,892	11,822	3.9%	2.4%
Non-Fuel	2,692	3,898	6,082	7,471	3.8%	2.6%
Non-Bulk	1,441	2,274	3,643	4,443	4.7%	2.7%

Table 3.14 Pan European Maritime trade per commodity

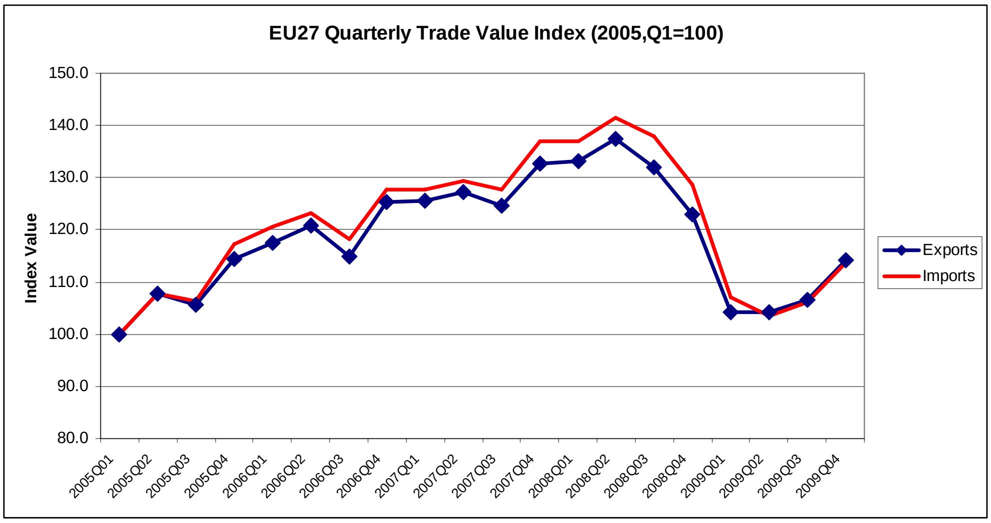
NST1	*1995*	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
Agricultural Produce	91	127	197	244	3.4%	2.6%
Food	147	182	260	306	2.2%	2.1%
Solid Fuel	138	239	332	378	5.6%	1.9%
Oil and Petroleum	1,018	1,354	1,643	1,765	2.9%	1.1%
Ores Scrap	188	217	297	387	1.4%	2.3%
Metals	88	126	230	297	3.7%	3.5%
Crude Minerals	107	156	273	379	3.8%	3.6%
Fertilisers	45	54	95	136	1.8%	3.8%
Chemicals	104	165	306	405	4.7%	3.7%
Misc Manufactures	178	273	468	628	4.4%	3.4%
TOTAL	2,105	2,893	4,100	4,925	3.2%	2.2%
Non-Fuel	948	1300	2126	2782	3.2%	3.1%
Non-Bulk	517	746	1264	1636	3.7%	3.2%

Analysis by cargo group shows that oil and petroleum products remain the largest import/export categories in pure tonnage throughout the time series. Even though their growth rates are reducing, this cargo group will still represent 35% of EU import (tonnes) and almost 26% of EU export (tonnes) in 2030 from which 53% and 73% respectively will be provided by maritime transport.

Different peak oil production scenarios exist. For example the International Energy Agency (IEA) assumes an average decline rate of 4.1% per year of the conventional oil production from 2008 to 2030. IEA forecast a reduction in the oil demand from EU 27 as from 2015. In its Reference oil scenario they state that in 2030 primary oil demand will constitute 11.3 million barrels per day which is 0.4% less than in 2015.

Europe’s international trade is currently experiencing the impact of a severe international recession. Trade flow data reveals that the economy peaked in the second quarter of 2008 and rapidly fell so that one year later, trading volumes were around 30% lower. Three years’ growth was turned around in three quarters. Since then, growth has returned but volumes at the end of 2009 were still below those of 2006.

Figure 3-1 EU27 Trade up to Q4 2009



Source: EUROSTAT, Consultants' estimates

These patterns have been reflected in port statistics worldwide, particularly in the container sector which accounts for a disproportionate share of world trade by value.

Data published by *Containerisation International* (March 2010) shows that volumes for the main North European ports fell by 15.1% between 2008 and 2009, and Southern European ports by 14.3%. Within this overall pattern, some ports such as Zeebrugge and Marseilles recorded gains, whereas others such as Hamburg and Barcelona recorded declines approaching 30% year on year.

Outside Europe, the big five container ports, Singapore, Shanghai, Hong Kong, Shenzen and Busan, recorded a collective decline of 12.9% year on year (Source: Containerisation International).

In 2010, early indications are that the recovery in trade growth is strengthening. Figures published by the European Liner Affairs Association (ELAA) show that European container traffic in January 2010 was growing.

Table 3.16 European Container Traffic January 2010

	Export		*Import*	
Europe-Overseas	January 2009	January 2010	January 2009	January 2010
Europe-Far East	310,437	418,800	1,018,749	1,126,400
Transatlantic	198,871	207,800	194,254	207,700
Middle East/India	151,327	182,400	116,222	131,300
Latin America	59,937	78,100	98,032	114,100
Oceania	28,258	31,700	14,889	11,700
Sub Sahara Africa	72,703	83,500	44,780	50,600
Total	821,533	1,002,300	1,486,926	1,641,800
Jan 2010/Jan 2009		+22%		+10%
Intra Europe	Southbound		Northbound	
Intra Europe	64,551	82,600	53,121	64,200
Jan 2010/Jan2009		+28%		+21%

Source: ELAA

These increases of 10% in the import direction and 22% in the export direction for European container trade with the rest of the world are broadly in line with the trade data.

4 Model System

4.1 Overview of approach for maritime flow estimates

This section describes the transport/traffic modelling that has been used to connect the scenario definition (Task 2) to the policy identification and assessment (Task 4) with quantified forecasts of the main transport indicators for this market segment. The main analytical tool has been the TRANS-TOOLS v2.0 model, as developed originally by the TEN-CONNECT study, together with TRANS-TOOLS extensions developed by WORLDNET.

These systems offer a broad geographical scope but they are not optimised for all maritime sectors. Certain market sectors require additional specialised analytical tools. Therefore, in addition to the modelling with TRANS-TOOLS in Task 3 the TNO Worldwide container model has been modified and run with the scenarios developed in Task 2. For impact assessment, the methodology based on the HEATCO project has been used.

The fundamental concept behind the model application has been to generate a forecast of trade growth, and to use this to estimate future port handling requirements, and the volumes of generated traffic per inland mode, with a multimodal approach.

Trade data provides the basis for estimating origin/destination flows, indicated above with the red line as a connector. Transport data and transport modelling techniques are used to convert trade flows into multi-modal transport chains, routed via seaports and connected via hinterland networks. From a system such as this it becomes possible to develop a transport forecast from an economic forecast. A trade forecast can then be used to indicate growth in sea transport, in port volumes and in hinterland (road, rail and waterway) volumes.

4.2 TRANS-TOOLS Based Modelling Approach

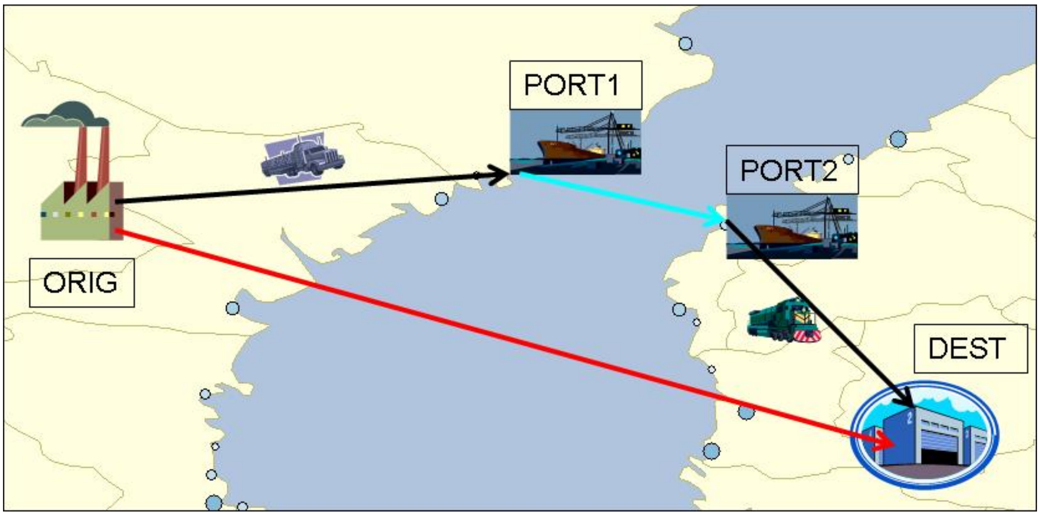
TRANS-TOOLS is the European Commission's reference transport network model. It is a comprehensive model covering passengers and freight, long and short distance trips, focusing mainly on the impacts within European networks. As such it needs adaptation in order to provide the necessary tools for analysing the development of the seaport sector.

Some simplification is required in order to limit the model to medium and long-distance freight flows i.e. those for which sea transport required or potentially competitive. In this way it is possible to extract port-related traffic from the full set of freight flows. Then, extensions need to be included so that the processes involved in freight generation can be integrated further into the modelling.

One of the key concepts in the freight model is the use of **multi-modal transport chains**. Thus trade flows are translated from a series of single-mode stages and connected at interchange points into multi-modal chains. For trades involving sea transport, these interchange points will be the seaports.

The advantage of this approach is that changes in one modal network (e.g. maritime) can influence outcomes in another (e.g. inland waterway). Division of traffic between modes is not a fixed-sum calculation, and in general, a tonne of maritime cargo will also generate inland traffic.

Figure 4-1 Overview of Modelling System

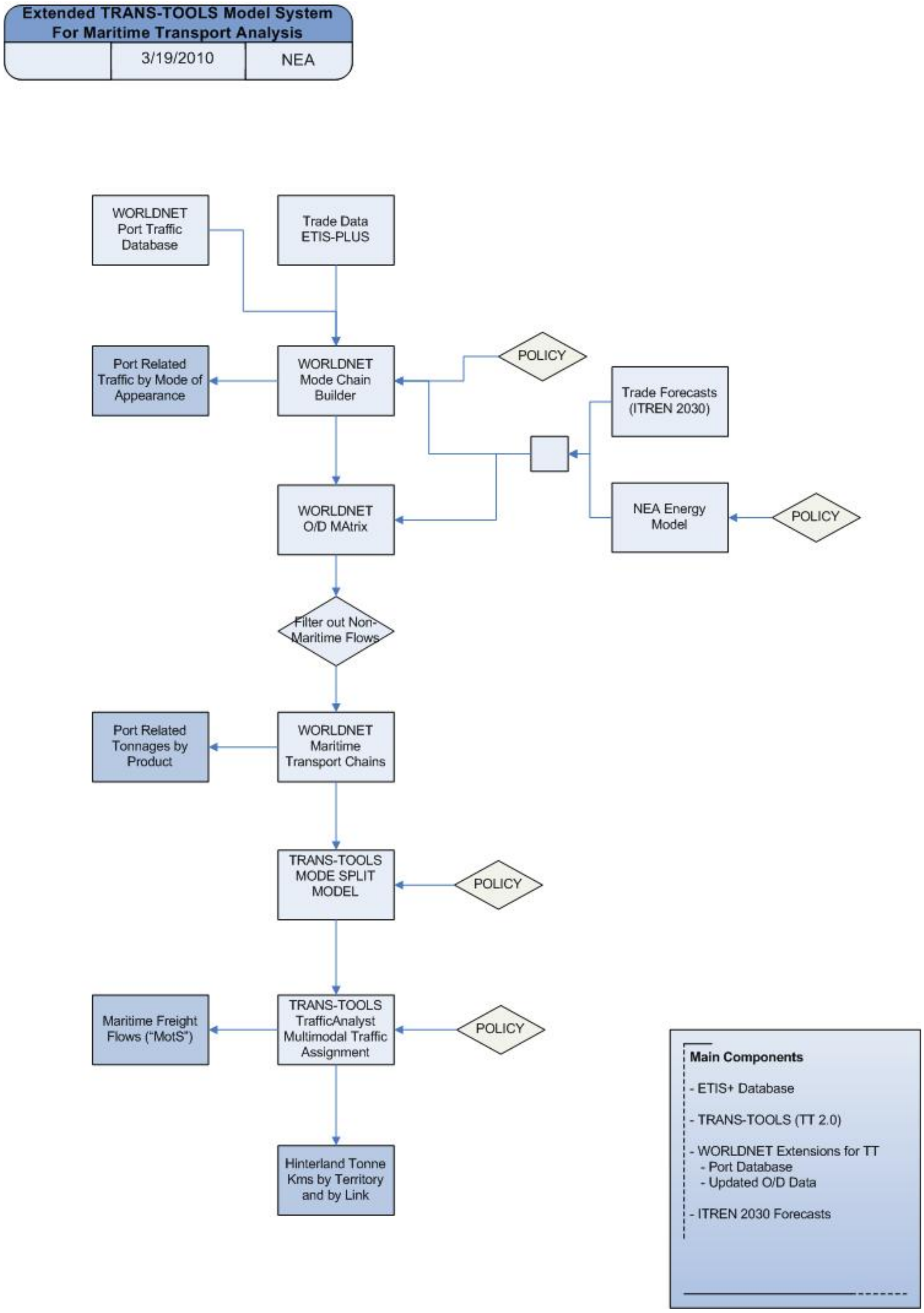


From the perspective of inland transport networks seaports are cargo generators and attractors, but using the TRANS-TOOLS transport chain principle it is possible to distinguish between points of production/consumption, where goods are manufactured or consumed and intermediate points within the transport network. The demand for port handling is derived from the underlying trade networks, and whereas trade networks may evolve slowly in response to economic development, the direction of cargo routeing may in some cases be far more flexible. Shippers have a short term option in terms of which ports and which inland modes are selected, and this is a process which may respond to transport variables, also over the short or medium term.

TRANS-TOOLS requires a database of multi-modal transport chains as an exogenous input, so the processes which lead up to their estimation also need to be made transparent within the overall model framework.

The model system is shown overleaf in Figure 4-2 .

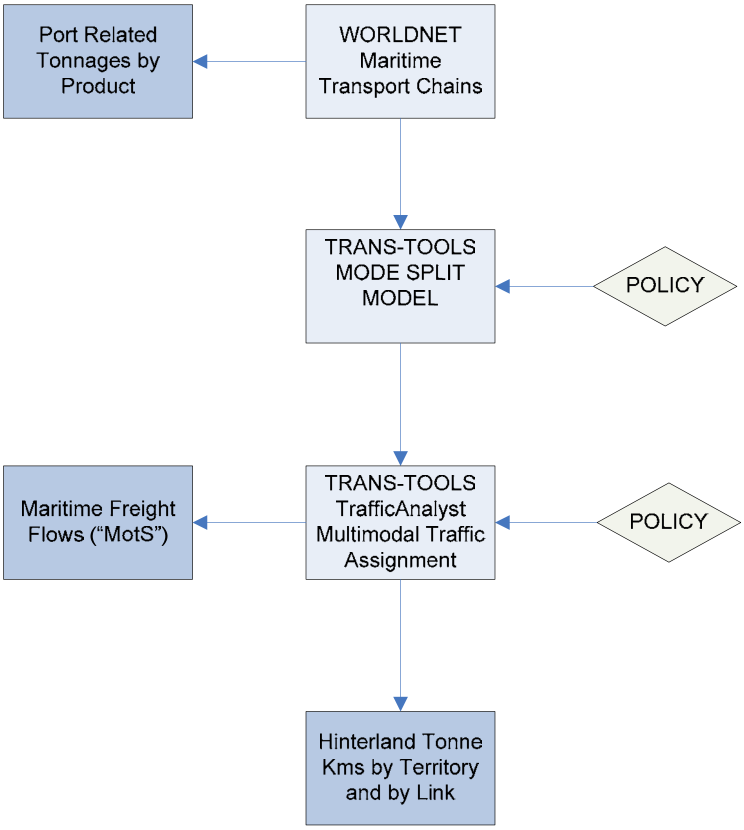
Figure 4-2 Overview of TRANS-TOOLS Based Model System



Starting with the lower part of the diagram, we show the core routines of the TRANS-TOOLS model stage by stage. Transport chains are fed in as inputs, and passed to mode split and network assignment routines. These functions react mainly to supply-side variables such as transport costs. The outcome is a set of assigned networks showing for example, estimated lorry counts per network link.

For the current undertaking, the method was to input only those chains where the sea mode is used, so that the resulting impacts clearly identify port-related effects.

Figure 4-3 Core TRANS-TOOLS Freight Model



In order to analyse the traffic flows further it is necessary to bring in an analysis of the demand, and to consider in more depth the patterns of transport chains. Forecasting is also needed. Here, the necessary extensions and inputs have come from:

- ETISplus – data collection,
- WORLDNET – estimation of transport chains, and
- ITREN 2030 – forecasts.

4.2.1 ETISplus Data Extensions

ETISplus (2009-2012, DG-MOVE, FP7) provided new data sources related to maritime transport and trade. The study has developed a database containing the main Eurostat sources, and configured them to allow greater integration with the databases of TRANS-TOOLS.

For the current study, the two key Eurostat sources are COMEXT (trade) and NEWCRONOS (maritime transport).

Maritime Trade

Trade statistics have been collected for the WORLDNET project, validated and harmonised into a single reference database. Input sources are:

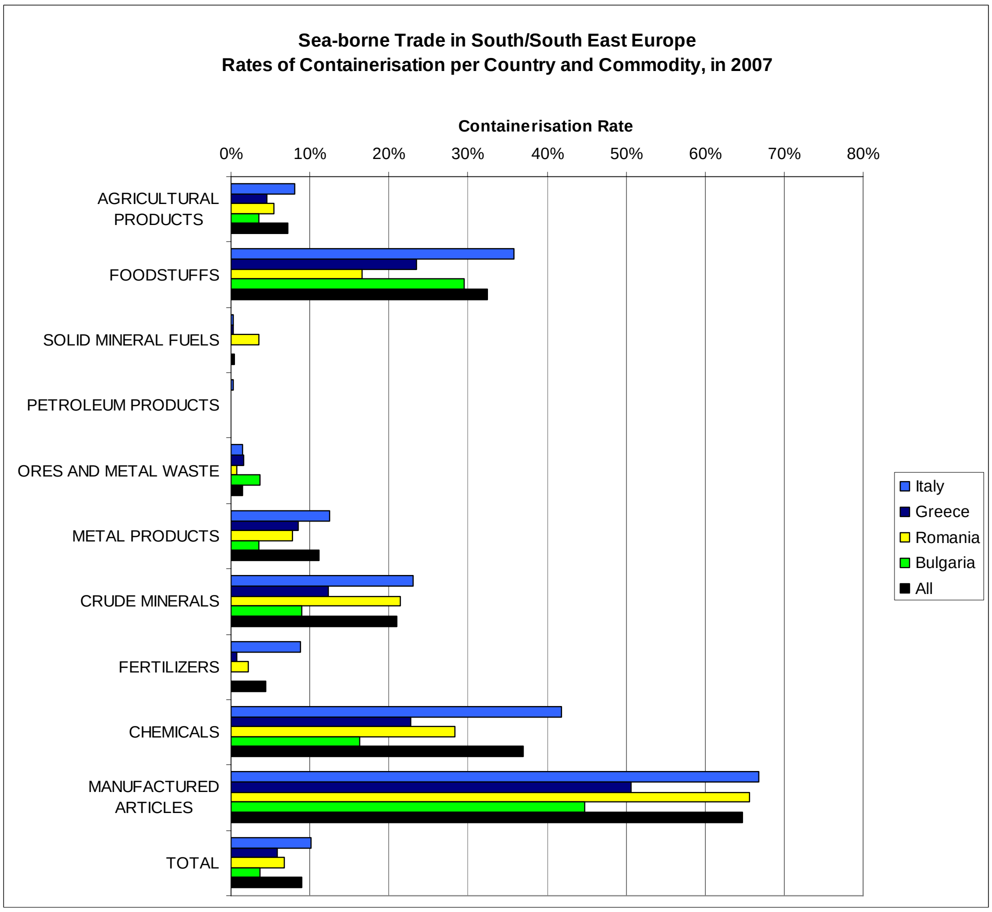
- COMEXT (Eurostat) – EU27 trade data.
- COMEXT (Eurostat) – Extra EU trade data, containing greater detail about transport modes.
- COMTRADE (UN) – trade data for non-EU countries.

Maritime traffic generated by European countries requires a combination of these sources. Intra-EU flows are detailed in terms of products and countries, but do not show transport modes. COMTRADE provides coverage of non-EU countries, but traffic flows must be converted from value measurements (dollar value) into estimated weights. The Extra-EU data can be used to provide additional information about transport modes, and levels of containerisation. An example of the containerisation factors for a group of Mediterranean countries is shown below (Figure 4-4).

Containerisation factors vary by:

- Product group,
- European market,
- Overseas market, and
- Time period.

Figure 4-4 COMEXT Data: Containerisation Factors by Product, 2007



In recent years container traffic has risen in share compared to the market in general.

Table 4.1 European Rate of Containerisation, 2000-2008

	2000	*2005*	*2008*	*Diff. 2008 vs. 2000*
Container TEU (m) (EUROSTAT)	45.000[1]	69.527	83.048	185 %
Container TEU (m) (ESPO)	51.000	73.729	90.710	178 %
Total Tonnes (m) EEA-IS+HR[2]	3,300.00[1]	3,946.60	4,141.20	125 %
Approx. Containerisation Rate[1]	14%	18%	20%	

1. Consultants estimate

2. European Economic Area minus Iceland, plus Croatia

In 2000 it is estimated that 14% of all port tonnage was containerised. By 2008 this has risen to 20%. Among the top 20 cargo ports in Europe, Eurostat measures containerisation currently at 29%, higher than the European average.

Maritime Transport

Maritime statistics are collected in three broad categories:

- Maritime freight handled by port, and type of goods.
- Maritime passengers by port
- Vessel arrivals by port

At time of writing, the figures are available up to 2008.

Table 4.2 Main Eurostat Maritime Data Sources within ETISplus

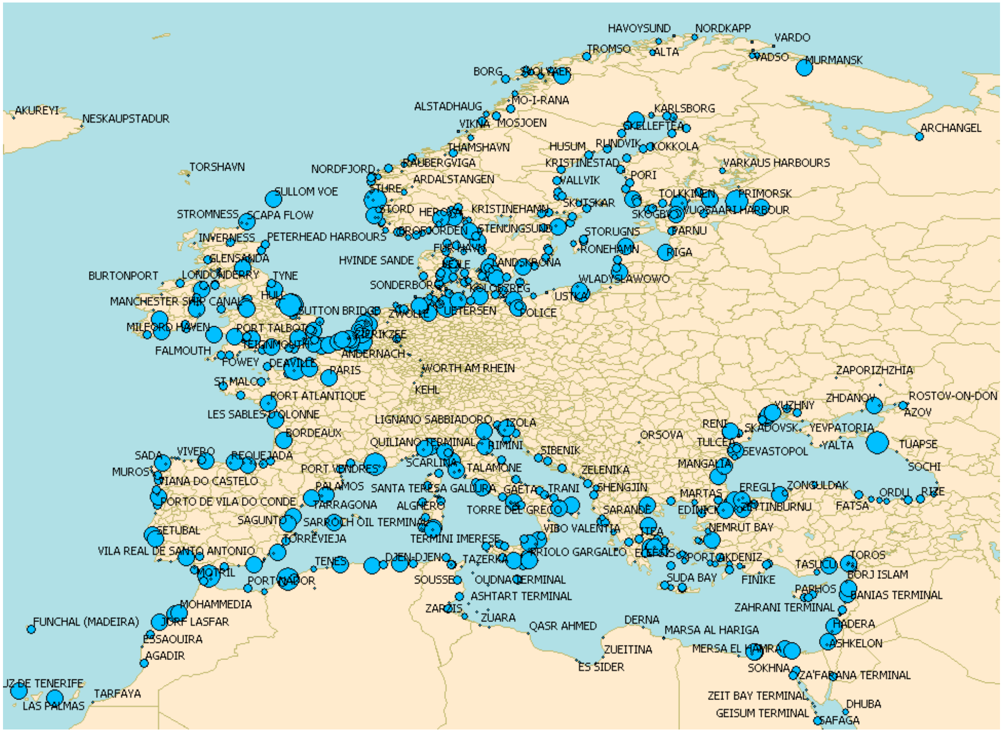
MAR_GO_AA	*Maritime transport - Goods (gross weight) - Annual data - All ports - by direction*
MAR_MG_AM_CVH	Country level - Volume (in TEU) of containers handled in main ports, by loading status
MAR_MT_AM_CSVI	Country level - Number and Gross Tonnage of vessels in the main ports (based on inwards declarations), by type of vessel
MAR_PA_AA	Maritime transport - Passengers - Annual data - All ports - by direction
MAR_SG_AM_CV	Short Sea Shipping - Country level - Volume (in TEU) of containers transported to/from main ports, by loading status
MAR_SG_AM_CWS	Short Sea Shipping - Country level - Gross weight of goods transported to/from main ports, by sea region of partner ports

The main limitation of these data sources is that they do not connect the port volumes, either by mode of transport or by region of origin/destination to the hinterland. Therefore, modelling steps are needed to provide this connection.

4.2.2 Maritime Extensions from WORLDNET

WORLDNET (2009, DG-MOVE, FP6) has been developing extensions for TRANS-TOOLS, focusing on long-distance freight and the estimation of transport chains. As the network model has developed it has become possible to attempt to generate the multi-modal transport chains using a route/mode choice assignment algorithm. WORLDNET's mode-chain builder constructs the trip sequences synthetically, and the results are calibrated according to port traffic volumes by an iterative process. The project also constructed a database of European and Worldwide seaports (see Figure 4-5).

Figure 4-5 WORLDNET database of seaports



Source: WORLDNET

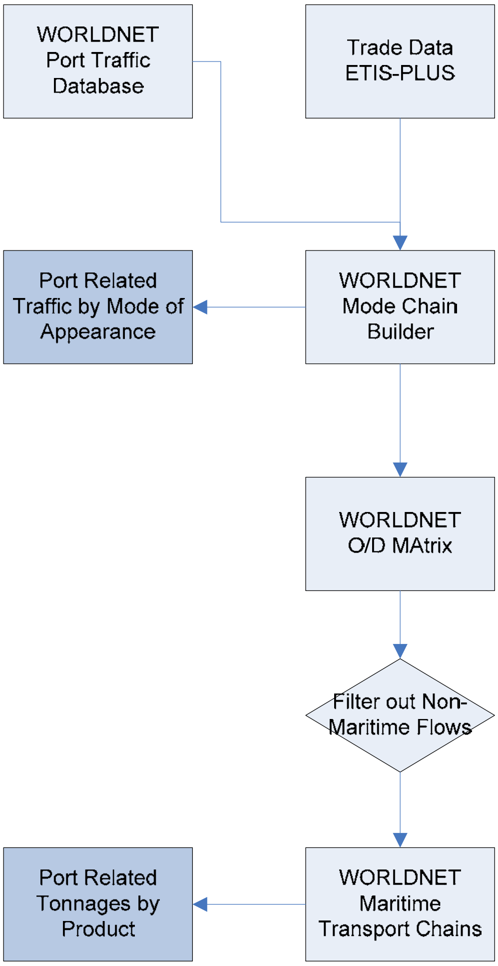
It does not contain an exhaustive list of European ports, but the objective has been to include all the ports reporting cargo statistics within Eurostat, and to add the main non-European ports which serve as gateways for European cargo.

Traffic figures are classified by:

- Dry bulk
- Liquid Bulk
- Conventional General Cargo
- Containers
- Roll-on, Roll-off

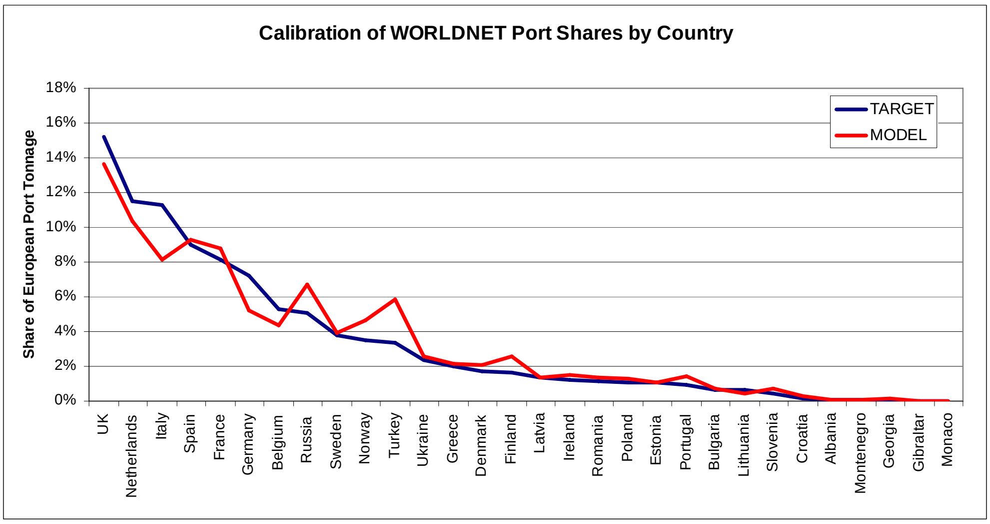
It is therefore possible to match products to ports according to the cargo flows that they are currently handling.

Figure 4-6 WORLDNET extensions for TRANS-TOOLS



A summary of the results from the mode chain builder is shown below (Figure 4-7).

Figure 4-7 Comparison between 2005 Port Data and Modelled WORLDNET data



Here, the port volumes are aggregated by nationality and ranked according to their measured volumes. By a two-way process of improving the traffic estimates and improving the model assumptions, it is possible to reduce the gap between the modelled and measured figures.

By constructing transport chains it has been possible to define *modelled* hinterlands. There is insufficient data to determine whether these are realistic, but they are sufficient to create a transparent linkage between growth of trade and growth in port traffic.

4.2.3 Estimates of Containerised Traffic

With the identification of maritime transport chains, further analysis is required to convert tonnages, by product, origin and destination into container flows which can then be linked to the worldwide container model (WCM). Container traffic is normally quantified in TEU (twenty foot equivalent units).

A conversion process has been constructed, operating upon the detailed WORLDNET sea chains. The sequence is:

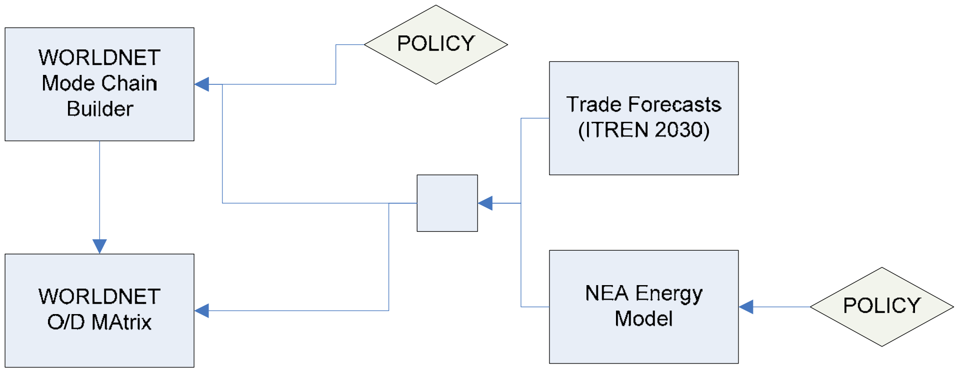
- Total tonnes are split between containerised and non-containerised, using ratios specified per commodity (NST2) and according to the combination of world region e.g. Europe-North America, or Europe-Far East.
- Containerised tonnes are then converted into cubic metres, using approximate densities, and then into loaded container TEUs.
- Empty containers are then estimated by calculating the import/export imbalances.
- A summarised country to country matrix quantified in TEUs (loaded plus empty) is produced as the output.

4.2.4 Forecasts from ITREN-2030

In the recent ITREN-2030 project (for DG-MOVE, Fraunhofer-ISI et al, 2010) methods for developing trade forecasts towards 2030 have been developed, and methodologies for combining them with TRANS-TOOLS data structures have been tried and tested.

So far they have been applied to the base year O/D matrix, but potentially they can also be applied to the inputs of the mode chain builder. A further enhancement would be to relate the trade forecasts to expectations for energy demand and supply, since a large part of total port tonnage is attributed to fossil fuels.

Figure 4-8 Forecasting Mechanism



The trade model forecasts are summarised below.

They show:

- Aggregated Trade for a core European bloc (EU27 plus European neighbours, excluding Russia)
- All products
- Only country pairs requiring maritime transport. (Most intra EU trade is therefore excluded)

Table 4.3 European Maritime Trade: Exports

	1995	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
EU27	328	417	533	536	2.4%	1.0%
Other Europe	8	14	30	35	5.4%	3.7%
North Africa	33	52	126	201	4.7%	5.5%
Other Africa	23	38	86	118	5.1%	4.6%
Middle East	37	65	150	210	5.9%	4.8%
Central Asia	4	13	27	31	11.4%	3.6%
Other Asia	64	93	295	545	3.8%	7.3%
Russian Fed.	8	16	40	47	7.0%	4.5%
North America	108	203	218	182	6.5%	-0.4%
Latin America	22	29	52	73	2.5%	3.8%
Oceania	4	5	5	6	3.1%	0.4%
Total	640	945	1,561	1,984	4.0%	3.0%
Short Sea/Med	414	549	839	982	2.9%	2.4%
Deep Sea	226	396	722	1,002	5.8%	3.8%

Table 4.4 European Maritime Trade: Imports

	1995	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
EU27	214	276	422	423	2.6%	1.7%
Other Europe	122	155	141	148	2.4%	-0.2%
North Africa	158	201	214	327	2.4%	2.0%
Other Africa	115	156	222	252	3.1%	1.9%
Middle East	154	136	145	151	-1.3%	0.4%
Central Asia	55	85	107	121	4.5%	1.4%
Other Asia	63	142	350	582	8.5%	5.8%
Russian Fed	226	394	481	460	5.7%	0.6%
North America	151	124	181	167	-2.0%	1.2%
Latin America	154	226	244	287	3.9%	1.0%
Oceania	52	51	32	25	-0.2%	-2.9%
Total	1,465	1,947	2,539	2,942	2.9%	1.7%
Short Sea/Med	874	768	922	1,049	-1.3%	1.3%
Deep Sea	591	1,180	1,617	1,893	7.2%	1.9%

Table 4.5 European Maritime Trade: Total

	1995	*2005*	*2020*	*2030*	*CAGR 95-05*	*CAGR 05-30*
EU27	541	693	956	960	2.5%	1.3%
Other Europe	131	169	171	182	2.6%	0.3%
North Africa	191	253	340	528	2.9%	3.0%
Other Africa	139	195	308	370	3.5%	2.6%
Middle East	191	201	295	361	0.5%	2.4%
Central Asia	59	98	134	152	5.1%	1.8%
Other Asia	127	235	644	1,127	6.4%	6.5%
Russian Fed.	234	410	521	507	5.8%	0.9%
North America	259	327	398	350	2.4%	0.3%
Latin America	176	255	296	359	3.7%	1.4%
Oceania	56	56	38	30	0.1%	-2.5%
Total	2,105	2,893	4,100	4,925	3.2%	2.2%
Short Sea/Med	1,288	1,317	1,761	2,030	0.2%	1.7%
Deep Sea	817	1,576	2,339	2,895	6.8%	2.5%

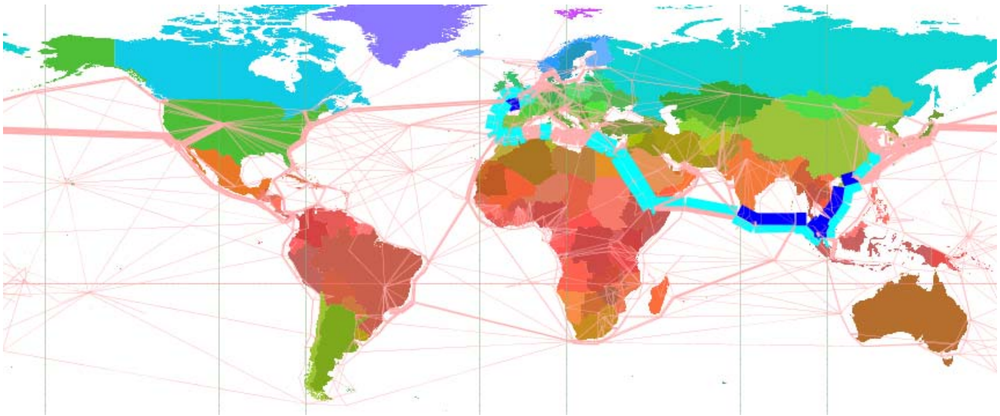
The principal conclusions of this analysis are:

- Future growth rates are likely to be lower than those experienced in the period 1995-2005.
- Total European maritime trade is expected to grow at 2.2% per annum, implying total growth of 72% over 25 years.
- The import direction will remain dominant.
- Export growth will be faster than import growth.
- Deep sea traffic i.e. ocean cargo generated to and from Europe will grow faster than short sea shipping.
- The most important trading partner region will be Other Asia (Asia excluding Middle East and Central Asia), i.e. China, Japan, Korea, ASEAN, India etc.

4.3 Worldwide Container Model (WCM) for policy scenarios

In order to be able to analyse the impacts of transport policies on container port transhipment, the study has employed the TNO worldwide container model (WCM) as add-on to TRANS-TOOLS. The WCM is a strategic, behavioural choice model that estimates routing patterns of yearly container flows between 437 ports worldwide and over 800 known liner services. The WCM is sensitive to various changes in network characteristics.

Figure 4-9 Snapshot of output of the model



The model assumes that route choices are made by profit maximizing shippers who are aware of the main routing alternatives over land and sea. Unknown and non-rational factors in these decisions are accounted for as a variation around the "rational mean" of optimal routing. The basis for the routing model is a discrete choice (logit) model, modified for use in networks, applying path enumeration to tackle network complexity. Choice probabilities depend on the route and port specific generalized costs, based on shipping time and rates. Behavioural coefficients of the model were either obtained from literature (value of time) or statistically estimated (cost sensitivity parameter, route overlap parameter and alternative specific constants) using observations from 2005 from Comtrade, Eurostat and ESPO statistics.

The model has been applied in the investigation of the effect of exogenous changes in the transport market on port turnover in Europe. As the container market is both growing and geographically shifting in terms of origins and destinations, we expect that these changes will affect the present competition balance. The main variables through which the model shows changes in port turnover are changes in origins and destinations (trade) provided by Worldnet and changes in transport times and costs both at sea and on the continent. Depending on the scenario, sensitivity tests can be run to test the volatility of flows for various factors (such as spatial concentration among ports, scale benefits or value of time), by changing the model coefficients.

5 Scenario Definition

European ports policy is broadly based, and achieving an adequate set of policies for optimising hinterland impacts goes well beyond port capacity development. Growth in European port traffic is a facet of globalisation, but many aspects of hinterland traffic management are influenced by public policy, land use planning, competition policy, infrastructure provision, transport pricing, through to the development of intelligent transport systems and the elimination of cross-border procedures.

This study has taken place during a phase of European policy review, in relation to the forthcoming Transport White Paper and the Revision of the TEN-T. The aim has to be develop forecasts compatible with the likely assumptions of the new White Paper (as signalled by the discussions surrounding the ITREN-2030 project). Furthermore, to inform policy choice a set of model variables have been used to provide a band-width for the main forecast.

5.1 Policy Context for scenario development

The analysis focuses upon one single economic and policy scenario, based on the ITREN-2030 integrated scenario (see also Section 2.5). A number of sensitivity tests have been carried out taking into account both demand and supply side market forces, as well as the development of transport policy, including energy-related and environmental policies. It therefore covers a broad spectrum. Some important aspects are set forth in brief, with emphasis upon the question of port-hinterland interaction. The main variables concern:

- Relative transport prices (e.g. maritime versus inland);
- Economic Growth, and
- Regional shifts in Europe.

5.1.1 Internalisation of external costs

One of the likely developments for the foreseeable future is the introduction of more widespread charging systems for road transport based on the marginal external cost. This has two consequences in this context. It provides the basis for assessing traffic impacts using an agreed methodology for quantifying externalities. It also suggests that future transport cost levels for inland transport will change. Already, EU transport forecasts are considering the mode split impacts of applying higher levels of distance based charges across Europe.

The Commission's strategy for the internalisation of external costs[1] goes on to suggest that revenue arising from internalisation should be invested in the transport sector. For international flows, including port related traffic, this "new" public revenue could potentially be invested in maritime networks and their hinterland infrastructure e.g. dedicated rail links, so for the study, future scenarios will need to take into account changing cost structures relatively per mode.

5.1.2 Short Sea Shipping

One of the distinctions to be made in analysing the maritime sector within the context of European transport policy is between short-sea and deep-sea services, with greater emphasis typically being directed historically towards the short sea sector, since these directly impact upon intra-EU cohesion.

Deep sea (inter-continental) freight flows are typically captive markets for the maritime sector, so apart from a marginal degree of competition with air in niche markets, the question of modal competition does not arise. The profile of deep sea traffic is rising however, mainly because of increasing volume.

In the short sea sector, sea versus land competition does occur, for example in the Black Sea, the Adriatic and across the English Channel. Several policy instruments have been set out relating to, for example, intelligent transport systems, simplified administrative procedures, transparent charging systems, and potentially even funding via the Motorways of the Sea programme. The scope for EU policy to affect maritime distribution patterns is therefore greater for the short sea sector.

Relative shifts in maritime and inland transport costs have the potential to shift traffic.

5.1.3 Hinterland Logistics

In order to achieve a realistic outlook for the development of the European ports sector, many market-related and policy-related factors for the hinterland need to be considered. EU policy addresses a number of key topics including:

- The establishment of a rail-freight oriented network, for which a first proposal for consultation has been published.[2]
- The deployment of intelligent transport systems.[3]
- An action plan for freight logistics.[4]

[1] Strategy for the internalisation of external costs, COM(2008) 435
[2] Towards a rail network giving priority to freight, COM(2007) 608
[3] Action Plan for the Deployment of Intelligent Transport Systems in Europe, COM (2008) 886
[4] Freight Transport Logistics Action Plan

Together these point towards a scenario in which some of the information-related and institutional barriers to efficient multi-modal transport might be reduced. Rail transport is the main alternative to road for hinterland traffic, and many European ports are well placed to access the rail network. However, some of this potential has been lost, often as a result of a lack of integration between national railways. Where these have been addressed e.g. along the north-south corridor connecting the Netherlands to Italy, the results have been noticeable. Although, certain traditional rail markets are static or declining, the port related ones, e.g. deep sea containers are expected to grow, in which case there is a string connection between port-hinterland dynamics and rail freight policy, a central issue for TEN-T.

5.1.4 European ports policy[1]

EU ports policy is broadly based, emphasizing the economic importance of the sector, the role that ports play in EU cohesion and the contribution they make towards sustainable transport, recognizing the active participation of commercial stakeholders, and the need to maintain a transparent and fair environment for investors.

Achieving higher levels of operation efficiency within ports is stated as a goal of EU policy, so that the ports do not themselves become bottlenecks in the transport network either in terms of cargo handling or in the administrative procedures involved.

COM(2007) 616 broadens the scope of port planning policy by introducing more strategic aspects in terms of door to door transport. Under-capacity in certain European ports provides a possible opportunity for developing direct short-sea and feeder services to alleviate inland congestion at hub ports, by directing cargo more closely to its ultimate point of consumption.

This emphasises the role that ports policy can make towards sustainable distribution, and at the same time highlights two core issues for the study:

- Operational benchmarks e.g. capacity utilisation;
- Transport costs e.g. cost and service performance differences between land and sea modes, where there is direct competition.

Estimates of operational capacity at ports are notoriously difficult to measure objectively, and transport costs are highly variable, so stakeholder involvement can contribute significantly in these areas.

An additional emerging theme, relevant for the study is the influence of competition between EU and non-EU located ports. To a certain extent this limits the level of regulation that can be applied within the EU, and may introduce perverse incentives, particularly for sectors such as container transhipment. For this reason, additional attention is necessary for non-EU neighbours, including the accession countries.

[1] Communication on a European Ports Policy, COM(2007) 616

5.1.5 TEN-T policy review[1]

TEN-T provides a more general framework for the development of the trans-European transport network, to which this study will contribute in relation to the specific issue of ports. TEN-T emphasises EU cohesion by interconnecting national transport networks, as well as sustainable development. COM (2009) 44 accentuates the green dimension of motorways of the sea and suggests the inclusion of sea connections within the green freight corridor concept. In relation to port hinterlands, the issue of cargo concentrations at hubs leading to severe pressure on supporting land infrastructure, creating a risk of additional externalities is noted.

Following the reports of the Expert Groups, the concept of defining two planning layers: a comprehensive network, and a core network has been adopted.

The new concept of a geographically defined “core network” is emerging. Since seaports are not just road-sea connectors but also important access points for rail freight and inland waterways and gateways for European traffic, they have an elevated role in this context.

5.2 Development of Scenarios and Sensitivity analyses

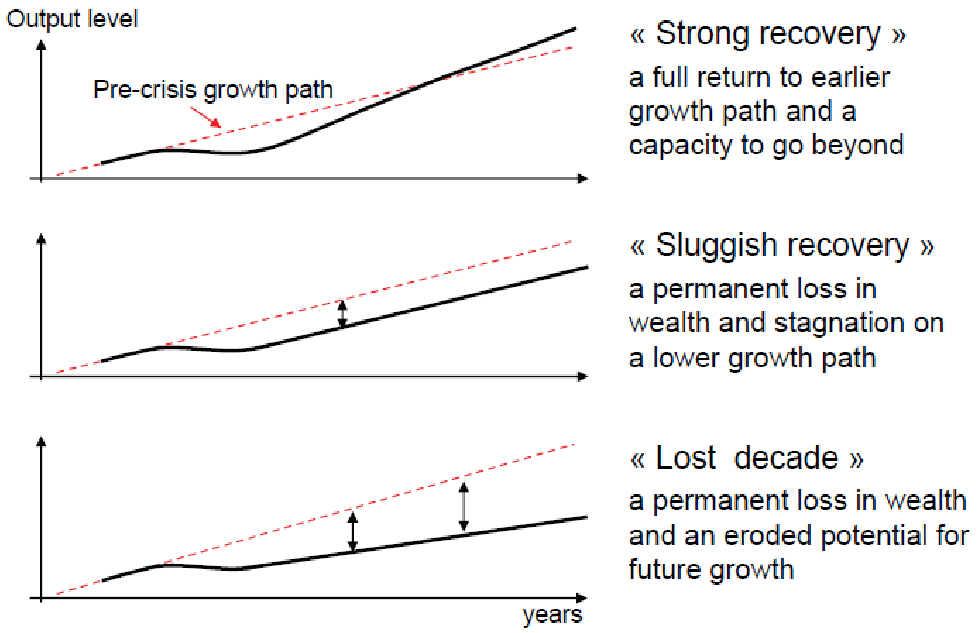
5.2.1 Overview

Three economic scenarios were devised for the study, along with ***three sensitivity analyses.*** The central economic scenario is based on the integrated 2030 scenario as defined by the ITREN-2030 project (ISI-Fraunhofer et al., 2010). This has been formulated with post economic crisis assumptions. Additionally low and high growth scenarios have been defined based on the future scenarios presented by J.M. Barroso in February 2010. ITREN-2030 did not provide upper and lower bounds.

The Barroso scenarios indicate the different ways in which Europe could respond to the recent economic crisis.

[1] Green Paper, TEN-T: A policy review, Towards a better integrated trans-European transport network at the service of the common transport policy. COM(2009) 44

Figure 5.1 **Future scenarios for Europe**



Source: Presentation of J.M. Barroso to the Informal European Council, 11 February 2010

Following these trends, this study sets out ***three economic scenarios***:

- Central Scenario (ITREN-2030, equivalent to Sluggish Recovery, in which the economic trend is parallel to the pre-crisis trend line).
- Low Economic Growth (Lost Decade, in which economic growth is diverging from the pre crisis trend).
- High Economic Growth (Strong Recovery, in which economic growth converges quickly towards and then overtakes the pre-crisis trend).

The central scenario accurately describes the unaltered model output, which is therefore used as the base scenario. The high and low economic scenarios are derived from it, and constructed in such a way that they reflect the assumptions of the strong recovery and lost decade scenarios. In practice, this means that the existing growth factors are altered either up or down to obtain the desired result.

In the current context, three additional ***sensitivity analyses*** are defined, based on the central economic scenario (sluggish recovery). They are defined as follows, and incorporate shifts in the distribution of cargo rather than the absolute volume of trade. In reality these trends also reflect and may in turn influence the underlying trade patterns, but in the analysis following, the volumes of trade, per commodity and per country do not change, only the routeing and the choice of modes.

Table 5.1 Overview of Sensitivity Analyses

Sensitivity Tests	*Definition*
Larger Ships	Shift of traffic from smaller to larger ports. Shipping and port costs reduced by 10% per port for the larger ports.
North to South Shift	Shift of Traffic from Northern to Southern ports. Shipping and port costs reduced by 10% per port for the Southern ports.
Higher Hinterland Pricing	Increase in inland transport costs. All inland costs increase by 10%.

The three sensitivity analyses are based on the central growth assumptions.

5.2.2 Larger Ships Sensitivity Analysis

In this analysis the largest European ports, which are capable of handling large ships, are assumed to become more attractive.

With relatively high growth in the deep-sea markets, shipping lines have realized savings through the deployment of larger and more modern vessels. Gradually these are replacing previous generations of vessels which are respectively cascaded onto shorter routes. In parallel, restrictions on vessel size such as the Panamax constraint for ships entering the Panama Canal are expected to be released. The WOLRDNET project showed how container vessels of 3000 TEU and greater have increased their share of the world fleet from 40% in 2000 to 60% in 2008, growing to around 80% by 2025 (Source: OSC Ltd).

As fleet composition changes, the deployment also potentially changes, partially because certain ports are limited by the depth of water, and also because the operating costs change. One possibility is that shipping lines will prefer to concentrate more of their port calls at larger facilities. This consolidation implies that more goods are landed further away from their final destinations, but this may be compensated by the wider range of hinterland destinations which can be served by frequent and economically attractive intermodal connections. Concentration of cargo flows, logistics centres and multimodal connections around main ports may therefore work together to increase the shares of the biggest ports.

In certain respects this view of the future suggests the (continued) emergence of a market driven core network for maritime related cargo, and therefore this sensitivity analysis provides insight into possible consequences of the development of a TEN-T core network of seaports.

This is implemented in the model methodology by reducing the cost on the maritime links that include the largest ports. The largest 25 ports have been identified by using a combination of throughput (tonnage), the number of ship arrivals and the number of large vessel arrivals (the number of vessels in excess of 50,000 tonnes gross tonnage).

Links connecting these ports to the rest of the world are reduced in cost by 10%, and links connecting these ports to each other are reduced by 20%.

Table 5.2 Assumptions for Large Ships Analysis

	Selection 25 ports	*Other European ports*	*Other World*
Selection 25 ports	20% decrease in cost	*No change*	10% decrease in cost
Other European ports	*No change*	*No change*	*No change*
Other World	10% decrease in cost	*No change*	*No change*

Links between the selected 25 large European ports and other European ports are assumed to be limited by vessel size, but links to the rest of the world are assumed to benefit from lower costs since the majority of deep sea services call at main hub ports with adequate terminal capacities.

It is not specified whether the cost savings arise from port operations, inland distribution or from lower costs at sea. In principle both fixed and variable elements may be reduced, so the cost reduction is applied quay to quay. Inland costs (quay to door) were not changed since this potentially disrupts the model's handling of inland transport which is assumed here to be invariant.

5.2.3 North to South Sensitivity Analysis

One of the prominent statistical features of European port volumes is the concentration of many of the largest ports along the English Channel and North Sea. Eight of the European top ten cargo ports, with combined traffic close to 1 billion tones, and a combined share close to 25% are found in this cluster.

Part of the reason for this concentration is the historical pattern of industrialisation in Europe as well as the predominance of the trans Atlantic corridors. Recently, and perhaps in future as well, industry has been developing more rapidly in Southern and Eastern regions, and the most rapid trade development has occurred in relation to Far Eastern trade lanes. Mediterranean and Central Asian trade routes currently under-perform by comparison, and may therefore become more prominent in future.

One consequence of this Southern and Eastwards shift may be accelerated growth both in terms of traffic volumes, port efficiency and supporting hinterland capacity for ports located along the South coast of Europe, so that the natural growth in trade becomes instrumental in modernizing the distribution networks.

Currently, the three largest Mediterranean container ports are Valencia, Algeciras and Gioia Tauro. Two of these are specialist transhipment (sea to sea) ports indicating that deep sea lines often prefer to serve Southern Europe via feeders rather than diverting their ships away from the main East-West sea lanes. The lack of equivalent specialist transhipment centres in Northern Europe indicates that these ports are receiving import and export traffic directly from the inter-continental vessels.

In the South East part of Europe, along the Balkan peninsula, port volumes are relatively low, compared for example with Italian and Spanish ports. Although their hinterland has been experiencing rapid growth, only Constanta in Romania has grown sufficiently to partially rebalance the volumes within the EU. With the opening up of long distance routes within the Balkans, the potential hinterland that can be addressed can increase.

Therefore this sensitivity analysis addresses the situation where a combination of trade growth, lower shipping costs owing to more direct calls and land-side efficiency gains will combine to increase the shares of South European ports relative to the North.

In the model settings, the Southern European ports are made more attractive, to simulate a traffic shift from the north to the south. It is done in the same manner as the Large Ships analysis by reducing the cost of the maritime links into the Southern ports.

5.2.4 Higher Hinterland Costs

The third category of traffic shifts considered here would be a modal shift from land modes to sea. To a large extent, maritime and land transport networks are complements (chained) but for intra-European flows there may also be substitution. In some cases e.g. Spain to Italy maritime transport competes with direct land alternatives (via France), and in others e.g. UK to Germany, hauliers can choose routes which either maximize or minimise the sea transport leg depending upon their preference for lower costs, lower journey time or better reliability.

In policy terms this could involve a combination of measures. Pricing for inland transport networks, particularly road pricing may be influential here, both in terms of the direct cost and its effect on the congestion arising from personal traffic. From the other side, this sensitivity analysis also envisages a continuation and refinement of the Motorways of the Sea policy in which multi-modal chains involving sea are promoted.

In the model runs for this analysis, the costs of hinterland traffic were increased by 10 percent across all inland modes. This applies to all inland modes (road, rail and inland waterways), so even if the cost increases are felt most directly in the road sector, it is assumed that rail prices follow, reflecting possible reductions in revenue support. The sea costs remained the same. The sensitivity analysis can be interpreted either as an increase in inland transport performance due to congestion, and/or an improvement in maritime services arising from the development of short sea shipping and motorways of the sea.

Table 5.3 Summary of Model Runs Performed

	ITREN-2030 Policy Settings	*Larger Ships*	*North to South Shift*	*Hinterland Pricing*
Low Economic Growth				
Central, ITREN-2030 Forecast				
High Economic Growth				

6 Forecasts for 2030

Within the designated methodology, the forecasts can be analysed at different levels:

- Trade: Volumes transported between countries;
- Port Countries: Volumes handled in ports, aggregated by country;
- Port Ranges: Volumes handled in ports, aggregated by coastline;
- Port Regions: Individual port (or port group) volumes;
- Inland Traffic by National Territory: inland tonne kilometres by mode aggregated by national territory;
- Link Volumes: tonnes of freight per link, for different modes.

Using the top-down TRANS-TOOLS methodology trade volumes are assigned to ports, and then via an estimation of inland modality to the hinterland networks. Main results are shown below.

6.1 Throughputs by port range and scenario

The 2030 forecasts of the port throughputs are aggregated by port cluster. They cover various countries as shown in the following table. Six port ranges have been defined allowing the data to be summarized. The first four split Continental Europe into quarters, and the last two cover the regions centred around Britain and Sweden.

France is split in two so that the Mediterranean and Channel coasts can be arranged into their natural ranges. Denmark is included in the Scandinavian region for conventional reasons, even though it would also naturally fall into the extended Hamburg to Le Havre range. Iceland is also included in the Scandinavian block, rather than the British and Irish one.

The East West split follows the line from the Polish/German border in the North to the Italian/Slovenian border in the South. Malta is in the West Mediterranean group and Cyprus is in the East. The country set includes all EU27 with coastlines, the non-EU Balkan countries, notably Croatia and Turkey, Norway and Iceland. The most important *excluded* neighbouring countries include Ukraine and the Russian Federation.

Table 6.1 Port Ranges

Label	*Port Range*	*Countries*
HLH+	Hamburg Le Havre Plus	NL, BE, DE, Northern FR
BSEM	Black sea and East Mediterranean	BG, CY, GR, HR, RO, SI, TR, AL, ME
WMED	West Mediterranean	ES, Southern FR, IT, MT, PT
SBALT	Southern Baltic States	EE, LT, LV, PL
UK/IRE	UK and Ireland	UK, IE
SCAN	Scandinavia and Nordic Region	DK, FI, IS, NO, SE

The analysis attempts to capture all cargo types, aggregated by convention into four groups for dry and liquid bulks, and with container traffic separated from other modes of appearance for non-bulk cargo.

Table 6.2 Commodity Groups

Label	*Full Name*
Dry	Dry Bulk
Liquid	Liquid Bulk
Containers	Containers
Other Non-Bulk	Other Non-Bulk Traffic including roll-on roll-off and general cargo.

The following tables compare the 2030 forecasts by port range and mode of appearance (dry bulk, liquid bulk, containers and other non-bulk) for the three scenarios and three sensitivity analyses, with the base year figures.

Table 6.3 Base Year Port Traffic Volumes

2008	Dry	Liquid	Containers	Other Non bulk	TOTAL
HLH+	336	495	328	187	1,346
BSEM	89	91	26	41	248
WMED	240	463	222	160	1,084
SBALT	61	79	12	27	178
UK/IRE	139	252	68	135	595
SCAN	150	217	34	148	549
EU27/HR/NO	1,015	1,597	688	699	3,999
Southern %	32%	35%	36%	29%	33%

Source: EUROSTAT, WORLDNET.

Table 6.4 Central ITREN-2030 Forecast, 2030, Port Traffic in Million Tonnes

ITREN reference case 2030	Dry	Liquid	Containers	Other Non bulk	TOTAL
HLH+	522	423	461	264	1,670
BSEM	258	133	179	156	726
WMED	266	358	280	191	1,096
SBALT	137	95	28	27	287
UK/IRE	235	217	125	183	760
SCAN	149	229	70	87	535
TOTAL	1,568	1,455	1,142	908	5,073
South Share	33%	34%	40%	38%	36%
EU27/HR/NO	1,466	1,379	1,015	792	4,652

Source: NEA, TNO

Compared with the base, it is important to note some differences in scope. The base year figures only include EU27, Norway and Croatia, whereas the forecasts include additional accession countries, notably Turkey. For the forecasts, an additional total is provided to permit comparability for the EU27, Norway and Croatia.

Overall, volumes are expected to increase from 3.999 billion tonnes to 4.652 billion for the comparable group of countries, with higher growth in the non-bulk sectors, moderate growth in dry bulk cargo and little or no growth in the liquid bulk sector. That result is directly linked to the ITREN-2030 results concerning energy usage.

Also, there is an expectation within the central scenario of a natural rebalancing of cargo from North to South. In the base year 33% of port traffic is in the South, whereas 36% is expected in 2030. This results depends only upon changes in trade patterns, and not on any measures to redirect cargo.

Volumes are slightly lower than those forecast for 2030 by the TEN-Connect project, with the liquid bulk sector accounting for most of the difference.

Table 6.5 LOW Growth Forecast, 2030, Port Traffic in Million Tonnes

ITREN low growth scenario	*Dry*	*Liquid*	*Containers*	*Other Non bulk*	*TOTAL*
HLH+	*449*	*408*	*416*	*246*	*1,519*
BSEM	*173*	*129*	*147*	*144*	*593*
WMED	*225*	*347*	*251*	*179*	*1,003*
SBALT	*103*	*93*	*21*	*26*	*244*
UK/IRE	*197*	*209*	*111*	*171*	*688*
SCAN	*121*	*223*	*61*	*82*	*488*
TOTAL	*1,269*	*1,409*	*1,008*	*848*	*4,534*
South Share	*31%*	*34%*	*40%*	*38%*	*35%*
EU27/HR/NO	*1,198*	*1,336*	*900*	*741*	*4,175*

Source: NEA, TNO

In the low scenario, total port volumes are some 500 million tonnes lower than the central forecast. Relatively there is greater difference in the high scenario with a total volume over 6 billion.

Table 6.6 HIGH Growth Forecast, 2030, Port Traffic in Million Tonnes

ITREN high growth scenario	Dry	Liquid	Containers	Other Non bulk	TOTAL
HLH+	692	498	531	313	2,033
BSEM	292	163	195	177	828
WMED	343	443	323	228	1,337
SBALT	163	104	30	34	331
UK/IRE	299	279	145	216	939
SCAN	189	301	83	108	682
TOTAL	1,979	1,787	1,307	1,076	6,149
South Share	32%	34%	40%	38%	35%
EU27/HR/NO	1,866	1,701	1,170	945	5,682

Source: NEA, TNO

In the sensitivity analyses, the total volumes do not change greatly relative to the Central forecast, but there are shifts between the port ranges.

Table 6.7 Large Ships Sensitivity Analysis, 2030, Port Traffic in Million Tonnes

SA01 Big Ships	Dry	Liquid	Containers	Other Non bulk	TOTAL
HLH+	535	437	468	277	1,716
BSEM	253	125	172	153	702
WMED	271	358	270	191	1,090
SBALT	137	94	27	27	285
UK/IRE	237	220	124	188	769
SCAN	145	228	69	87	528
TOTAL	1,577	1,463	1,130	922	5,092
South Share	33%	33%	39%	37%	35%
EU27/HR/NO	1,475	1,388	1,008	808	4,680

Source: NEA, TNO

In the Large Ships case, where more traffic is diverted to the largest ports, the main gains are found in the HLH+ range. The share of Southern ports falls by one percentage point.

Table 6.8 North to South Shift, 2030, Port Traffic in Million Tonnes

SA02 North South shift	*Dry*	*Liquid*	*Containers*	*Other Non bulk*	*TOTAL*
HLH+	*515*	*416*	*435*	*255*	*1,620*
BSEM	*264*	*138*	*178*	*157*	*737*
WMED	*285*	*366*	*304*	*207*	*1,162*
SBALT	*136*	*93*	*27*	*27*	*283*
UK/IRE	*235*	*217*	*125*	*183*	*760*
SCAN	*149*	*228*	*69*	*87*	*533*
TOTAL	*1,584*	*1,459*	*1,137*	*917*	*5,096*
South Share	*35%*	*35%*	*42%*	*40%*	*37%*
EU27/HR/NO	*1,486*	*1,384*	*1,014*	*803*	*4,686*

Source: NEA, TNO

In the North to South Shift, the pattern is reversed. The HLH+ range falls relative to the Central scenario with gains in the West Mediterranean, East Mediterranean and Black Sea regions. Southern ports gain 1-2% share depending upon the commodity sector. Although this is relatively small shift, it amounts to 50 million tonnes, equivalent for example to the total throughput of a major European port such as Valencia or London.

Table 6.9 Hinterland Pricing, 2030, Port Traffic in Million Tonnes

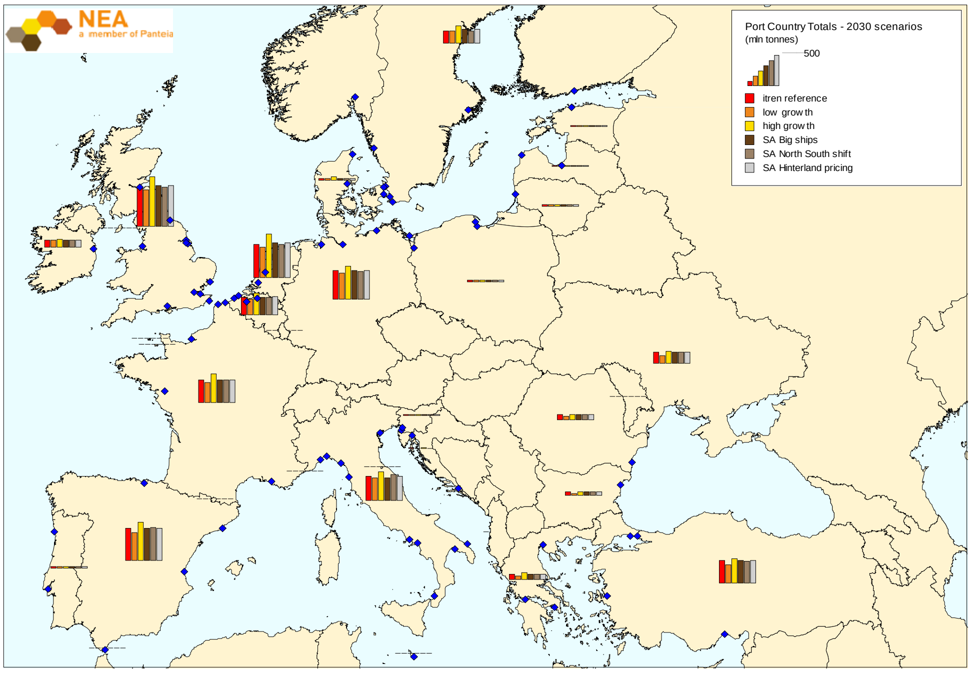
SA03 Hinterland pricing	*Dry*	*Liquid*	*Containers*	*Other Non bulk*	*TOTAL*
HLH+	*540*	*436*	*463*	*279*	*1,719*
BSEM	*269*	*134*	*178*	*162*	*744*
WMED	*284*	*364*	*278*	*201*	*1,127*
SBALT	*144*	*97*	*28*	*30*	*299*
UK/IRE	*246*	*221*	*124*	*189*	*780*
SCAN	*156*	*234*	*70*	*96*	*557*
TOTAL	*1,641*	*1,486*	*1,142*	*957*	*5,225*
South Share	*34%*	*33%*	*40%*	*38%*	*36%*
EU27/HR/NO	*1,528*	*1,407*	*1,015*	*836*	*4,787*

Source: NEA, TNO

The hinterland pricing sensitivity analysis is different to the previous two because it generates more maritime traffic. The other two mainly result in different port choices for flows already using the sea mode. Relative to the Central Scenario, these assumptions suggest that 225 million tonnes might be generated through land to sea modal shift. Growth is forecast in all port ranges and in most product sectors. Container traffic does not react significantly because it is mainly the short sea flows which are influenced by these assumptions.

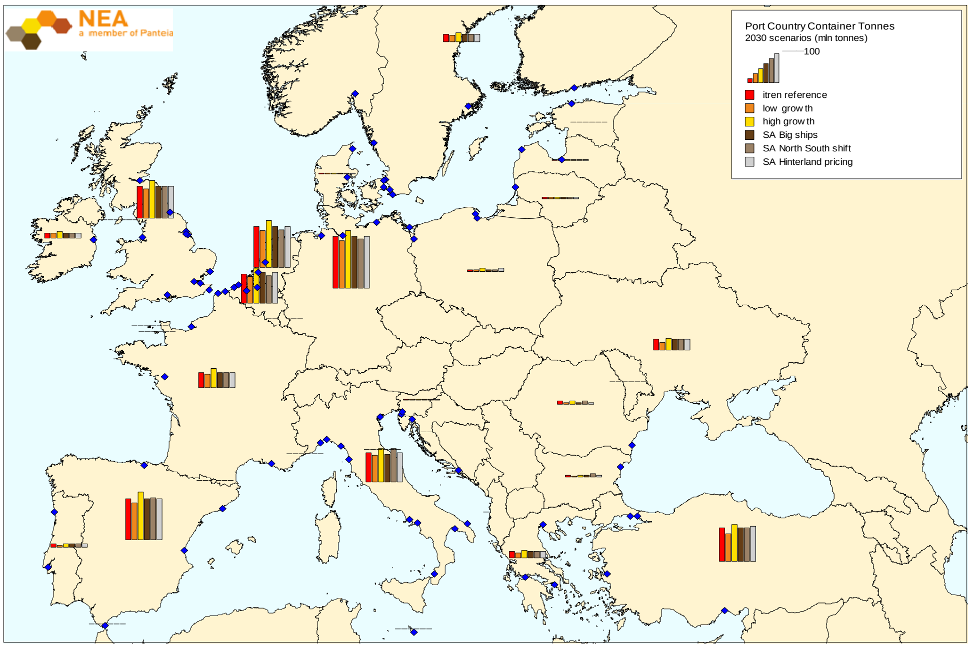
These forecasts are shown graphically per country below. The volumes are shown per port country (i.e. according to the country where the port handling takes place).

Figure 6-1 Total Traffic per Port Country per scenario, 2030



Source: NEA and TNO

Figure 6.2 Container Tonnes per Port Country, per 2030 Scenario



Source: NEA

6.1.1 Stakeholder Input Regarding Container Growth

Following the Stakeholder Conference, Brussels, July 2010, updated (post-crisis) forecasts have been provided by MDS-Transmodal (UK), based on their World Cargo Database, as published in Containerisation International, and therefore widely circulated within the container sector. Results for up to 2030 for the European Union, broken down by world trade area, are shown below. The forecasts are based on individual country - country - commodity forecasts using historic trade data held in the MDST World Cargo Database (WCD). The WCD holds trade data for the whole world since 1996 in a unified format and the forecasts are up-dated every quarter. These forecasts show average annual growth in maritime containerised trade between 2005 and 2030 of 2.3% for imports and 3.0% for exports.

Table 6.10 Forecast EU maritime containerised imports from the Rest of the World, 2005-30, Thousand maritime TEU

Origin region	*1996*	*2005*	*2020*	*2030*	*Change 2005-30*	*CAGR 2005-30*
AUSTRALASIA	434	285	281	317	11.0%	0.5%
E&S AFRICA	375	461	565	668	44.8%	1.9%
FAR EAST	3,877	9,611	14,163	17,784	85.0%	3.1%
INDIAN OCEAN	468	858	1,538	1,888	120.0%	4.0%
LATIN AMERICA	984	1,404	2,182	2,645	88.4%	3.2%
MEDITERRANEAN	746	1,308	1,921	2,374	81.5%	3.0%
NORTH AMERICA	2,304	1,924	2,249	2,654	38.0%	1.6%
NORTH EUROPE	1,536	2,198	2,973	3,609	64.2%	2.5%
WEST AFRICA	476	435	438	494	13.5%	0.6%
TOTAL	11,200	18,485	26,310	32,433	75.5%	2.3%

Source: MDS Transmodal World Cargo Database

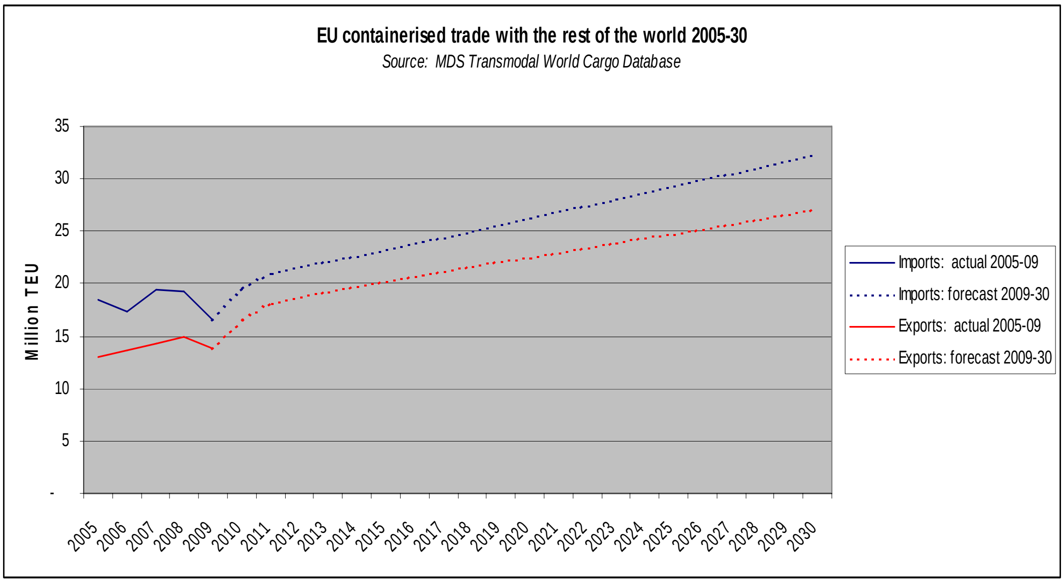
Table 6.11 Forecast EU maritime containerized exports to the Rest of the World, 2005-30, Thousand maritime TEU

Destination region	*1996*	*2005*	*2020*	*2030*	*Change 2005-30*	*CAGR 2005-30*
AUSTRALASIA	227	334	510	594	77.9%	2.9%
E&S AFRICA	349	448	914	1,062	137.2%	4.4%
FAR EAST	1,911	2,609	6,450	7,713	195.6%	5.6%
INDIAN OCEAN	794	1,431	3,125	3,602	151.7%	4.7%
LATIN AMERICA	673	761	1,444	1,647	116.4%	3.9%
MEDITERRANEAN	1,083	1,530	2,566	2,916	90.6%	3.3%
NORTH AMERICA	1,636	3,073	3,783	4,560	48.4%	2.0%
NORTH EUROPE	1,493	2,229	3,145	3,814	71.1%	2.7%
WEST AFRICA	361	599	1,058	1,203	101.0%	3.6%
TOTAL	8,527	13,013	22,997	27,110	108.3%	3.0%

Source: MDS Transmodal World Cargo Database

These tables, which include trade between EU27 and the rest of the world, therefore excluding intra EU and transhipment, appear to be broadly in line with the ITREN 2030 forecasts indicating a potential doubling of the EU market, based on trade growth.

Figure 6.3 EU Containerised Trade with Rest of the World, 2005-2030

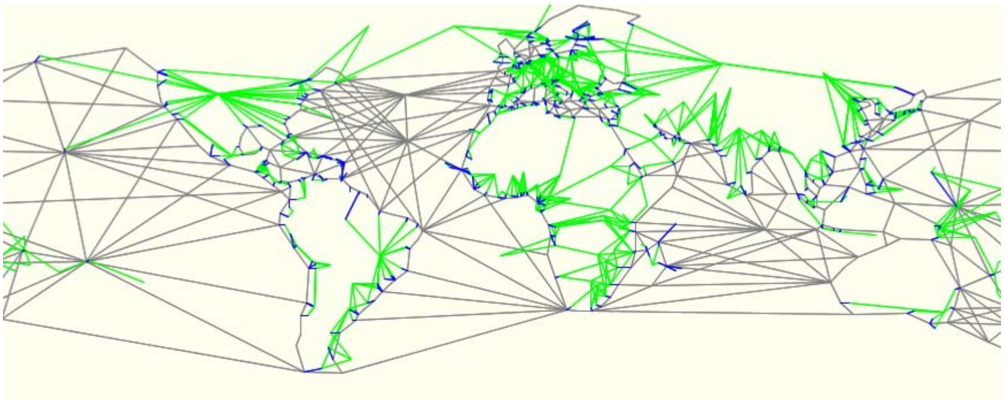


Source: MDS Transmodal World Cargo Database

6.2 Container Sector Results

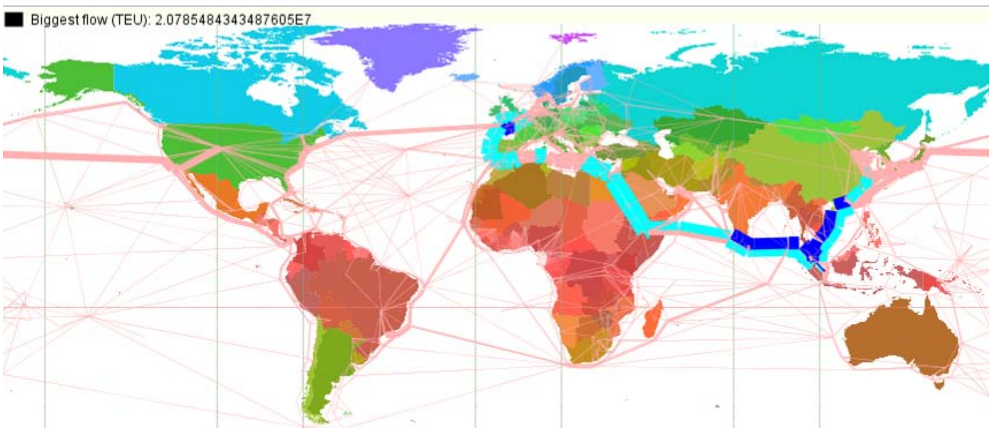
Container flows have been modelled separately by the TNO World Container Model macroscopic model. The model allocates the world wide container flows to the maritime and hinterland network (see below).

Figure 6.4 World Container Model



The port choice is modelled indirectly by picking a route from a choice set. This choice set is based on the present service patterns in the maritime world. The model has a matrix of origin – destination flows of containers between countries as input. For each of this origin – destination pair a choice set is created. When the different possible routes are created, a route choice model is applied. When the route choice is done for all the origin – destination pairs, the flow will be aggregated for each service.

Figure 6.5 Example of global container flows



The route choice model is a logit-function based on maritime transport costs, transhipments costs and hinterland transport costs. The model is calibrated against observed port throughput statistics. The output of the world container model is the transported volume for each combination of country to port, to port, to country.

The World Container Model is used to determine the port choice and thus the throughput volumes in general economic scenarios and the model is used to do sensitivity analysis in order to analyse the impact of specific developments on the port choice of container flows. In this project the model has been used to determine the throughput in the original iTREN-2030 scenario and the low and high economic growth alternatives. Besides, the World Container Model has been applied for the three sensitivity analyses hinterland pricing, shift from North to South and big ships.

Figure 6.6 shows the absolute volumes of the container throughput for each country in Europe. It includes the results of the iTREN-2030 scenario (original) and the scenario with low economic growth (low) and the scenario with high economic growth (high). Figure 6.7 shows results for the same scenarios, but it gives the relative change for the low and high alternatives compared to the iTREN-2030 scenario. This figure shows that the container throughput in the low scenario has a volume around 85 to 90% of the iTREN-2030 scenario. In the high scenario, the volumes lie around 105 to 115% of the iTREN-2030 scenario. The differences between these three scenarios are completely driven by the differences in macro-economic developments in these scenarios. In the container market no differences are assumed.

Results iTREN-2030 and low and high alternative

Figure 6.6 Absolute Container Flows Transported (TEU per annum)

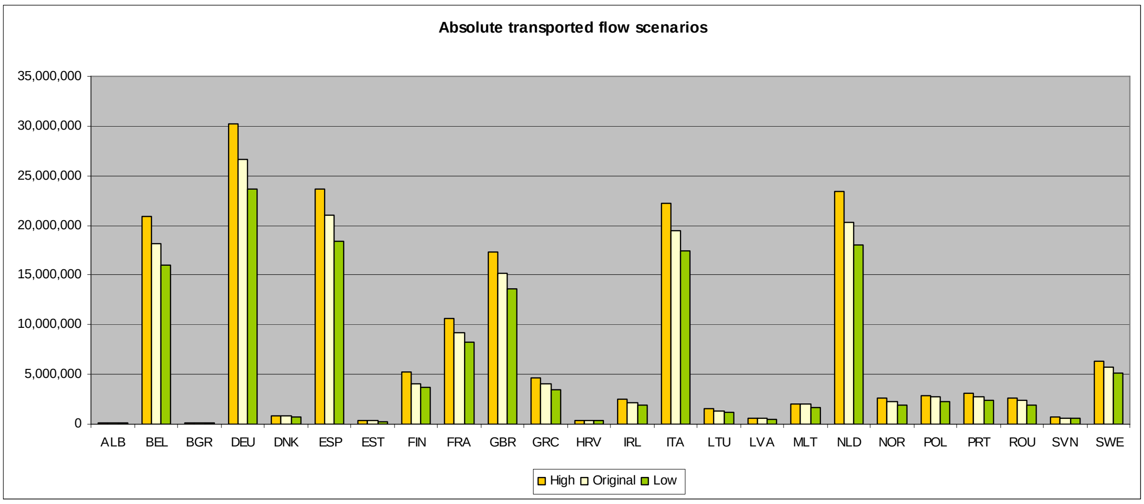
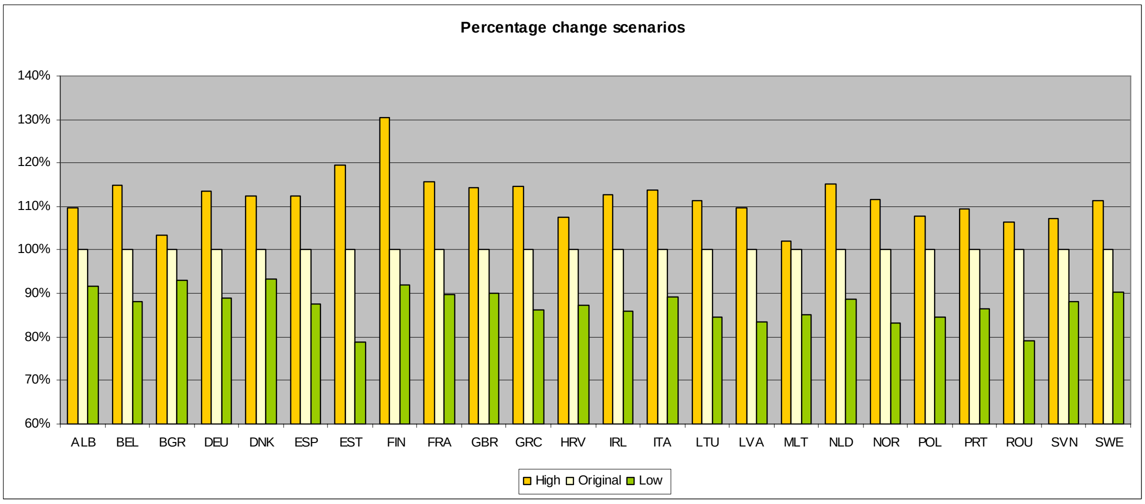


Figure 6.7 Percentage Change in Container Flows by Scenario



Results sensitivity analyses

Contrary to the low, central and high economic scenarios for the sensitivity analyses it is assumed that the macro-economic developments are the same, but several developments take place in the container market.

In the same way as before, figures 6.8 and 6.9 show the absolute volumes of the container throughput and the relative change of a sensitivity analysis compared to the iTREN-2030 scenario. Especially for the sensitivity analysis it is necessary to analyse both absolute volumes and the relative changes since it happens that high relative changes occur with very low volumes.

In the sensitivity analysis the impact of hinterland pricing is rather limited, as the main effect of this change relates to short sea traffic. For the sensitivity analyses shift North to South and Big Ships larger changes are visible since these are affect port choice. If we focus on the countries with larger volumes it becomes clear that for the sensitivity analyses North to South mainly the countries Belgium (- 5%), Germany (- 8%) and the Netherlands (- 3%) lose volume and the countries Spain (+ 7%) and Italy (+ 12%) gain volume.

In the sensitivity analysis Big Ships, especially the Netherlands gains volume (more than 15%). In other countries also changes are visible on the level of seaports. For instance in Belgium the throughput of Zeebrugge (coastal port) increases in this sensitivity analyses, but because the throughput of Antwerp (river estuary port) decreases, the overall impact for Belgium is limited. A similar development takes place in Germany where the throughput of Bremen increases, but the throughput of Hamburg decreases.

Figure 6.8 Absolute Container Volumes by Sensitivity Analysis (TEU per annum)

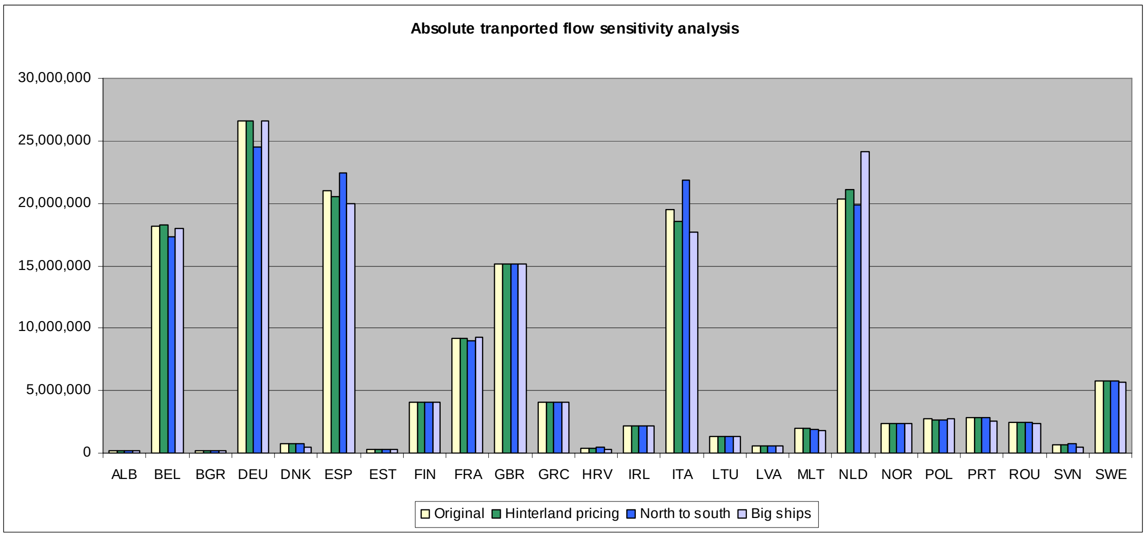
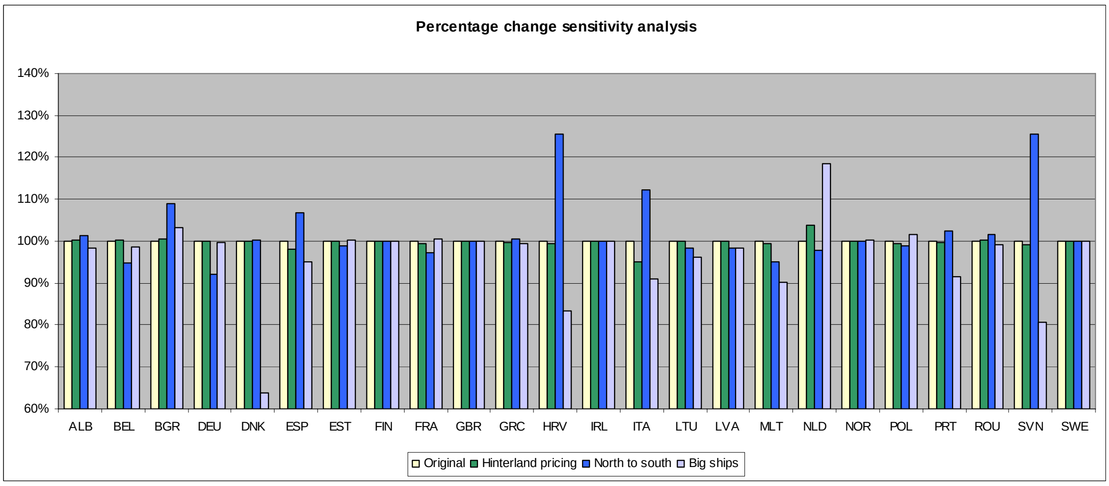


Figure 6.9 Percentage Changes in Container Volumes by Sensitivity Analysis



In 2010, greater confidence is starting to return in the container sector, with industry sources reporting healthier figures for turnover, profitability and orders for new vessels. Although much of the increase in global demand is forecast to take place outside Europe, the trade analysis indicates that although instability remains in the global economy as a major risk factor, substantial growth at European container ports is still the most probable outcome.

Trade forecasts show that containerised tonnage will increase from 642 million net tonnes (approx 80m TEU) to 1,142 million tonnes (approx 165m TEU) by 2030 in the central case. In a high scenario, these total volumes could increase a further 15%. towards 188 million TEU. In the low scenario, 146m TEU are forecast.

Sensitivity analyses suggest that the overall pattern of container handling by coastline area has a range of approximately plus or minus 10-15% for a feasible range of cost changes. In all cases the market is dominated by the same seven Western countries; Belgium, Germany, Spain, France, Britain, Italy and the Netherlands.

Thus much of the absolute growth foreseen (perhaps a further 80m TEU excluding transhipments within the next 20 years) is likely to be concentrated within the core ports belonging to those seven Western European countries.

To a large extent this continued prominence of the major ports is aided by the existing patterns of logistical activity around the major EU27 ports, the maturity of the multi-modal networks supporting them, the insurance these provide against road cost increases, and the expansion plans already agreed.

In absolute numbers the largest potential shifts could occur in the Hamburg-Le Havre range to or from the North Italian ports. A shift of 5 million TEU between Hamburg-Le Havre and Northern Italy ports is equivalent to perhaps 3 million HGV trips. Today the number of lorries crossing the Alps is around 10 million, so the consequences for inland networks are not insignificant. Shifts related to the Ligurian ports would affect the Gotthard and Simplon routes. Shifts related to the Adriatic ports would affect primarily the Brenner corridor.

6.3 Inland modes

Using the forecasts the freight flows have been assigned to the TRANSTOOLS networks in order to estimate the traffic impacts across the network and according to the inland regions.

A series of results are shown in the following pages, showing the assigned volumes per mode for the central scenario, and the changes arising for each alternative scenario and for each sensitivity analysis.

The networks used for traffic assignment in the Eastern regions, mainly Ukraine and Turkey are less dense than the average, so there is a tendency for higher impacts per link, per tonne assigned. Note also that the scales used per mode are different, with higher bands used for road.

6.3.1 Assignment Method

The inland analysis has been carried out by making an “all or nothing” assignment to the TRANS-TOOLS networks. Such assignments cannot be calibrated to or compared with actual volumes because the maritime flows under consideration only represent approximately 25% of total freight trips. The routeings are therefore based on estimates of journey distance and the time taken. Interactions with non-maritime freight flows and passenger transport are not considered, so the user optimal routeing as calculated, may differ from reality. Thus, the results should only be used to examine the broad geographical shifts taking place, and cannot be relied upon at the link level.

Within the model system, the freight flows are calibrated to base year traffics at the seaports, according to the mode of appearance, but inland modes and routeings are estimates based on the network impedances recorded in the TRANSTOOLS networks.

A more complete assignment will be carried out for the subsequent TEN-CONNECT 2 study, where all traffic flows are considered, and the possibility exists at least partially to calibrate the numbers of vehicles per link.

Figure 6.10 2030 Port Related Road Traffic, Central ITREN Scenario

Figure 6.11 2030 Port Related Inland Waterway Assignment, Central ITREN Scenario

Figure 6.12 Port Related Rail Assignment, Central ITREN Scenario

Figure 6.13 Comparison between 2030 Low Case and Central Scenario, Road Transport

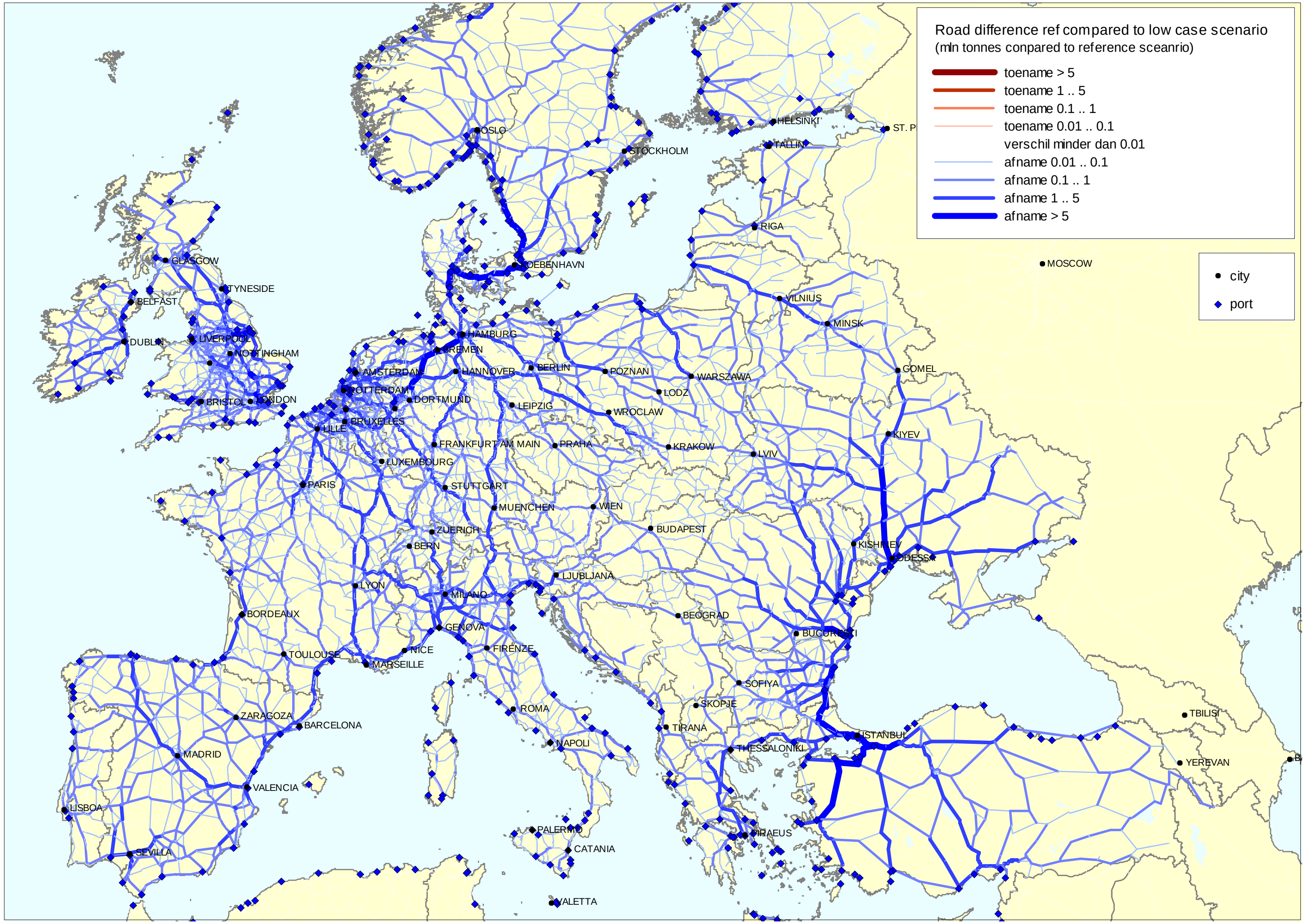


Figure 6.14 Comparison between 2030 Low Case and Central Scenario, Rail Transport

Figure 6.15 Comparison between 2030 Low Case and Central Scenario, Rail Transport

Figure 6.16 Comparison between 2030 High Case and Central Scenario, Road Transport

Figure 6.17 Comparison between 2030 High Case and Central Scenario, Rail Transport

Figure 6.18 Comparison between 2030 High Case and Central Scenario, Waterway Transport

Figure 6.19 Comparison between 2030 Large Ships Analysis and Central Scenario, Road Transport

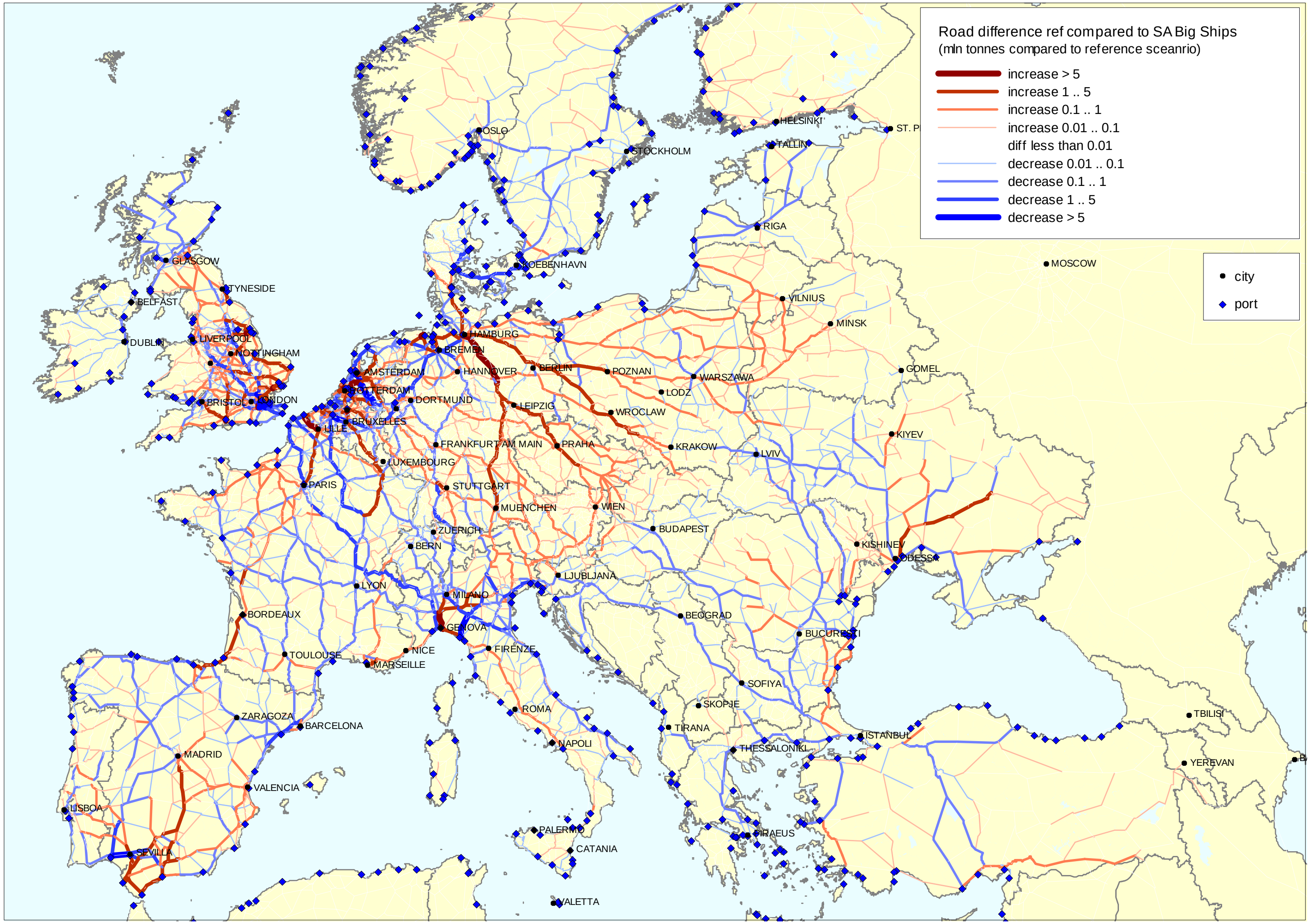


Figure 6.20 Comparison between 2030 Large Ships Sensitivity Analysis and Central Scenario, Rail Transport

Figure 6.21 Comparison between 2030 Large Ships Sensitivity Analysis and Central Scenario, Waterway Transport

Figure 6.22 Comparison between 2030 North to South Sensitivity Analysis and Central Scenario, Road Transport

Figure 6.23 Comparison between 2030 North to South Sensitivity Analysis and Central Scenario, Rail Transport

Figure 6.24 Comparison between 2030 North to South Sensitivity Analysis and Central Scenario, Waterway Transport

Figure 6.25 Comparison between 2030 Hinterland Pricing Sensitivity Analysis and Central Scenario, Road Transport

Figure 6.26 Comparison between 2030 Hinterland Pricing Sensitivity Analysis and Central Scenario, Rail Transport

Figure 6.27 Comparison between 2030 Hinterland Pricing Sensitivity Analysis and Central Scenario, Waterway Transport

7 Methodology for identifying core ports

7.1 Background

As part of the review of the TEN-T, the European Commission has been engaged with the question of how to define a planning methodology following the Commission's Green Paper "TEN-T policy review – Towards a better integrated trans-European network at the service of the common transport policy[1]". One of the new concepts, receiving strong support is the development of a Core Network. A proposal for a planning methodology has been published, following the discussions of Expert Group 1[2].

Key elements of the Expert Groups findings for the current project include:

- Multimodality - Inclusion of main gateway ports and airports;
- Continuity – the core network should "span the entire EU in a coherent way, with the individual elements linking up to form continuous axes";
- Intra EU linkages – connecting important nodes in the EU;
- Extra EU linkages – connecting the EU with markets beyond its borders.

The Core Network will be built up from main nodes, which can be expected to include the main cities. In addition, "Gateway ports or port clusters and airports as the Community's main entrance/exit points for freight and passengers shall be main nodes as well, if they are not parts of main node cities anyway."

Previously, TEN-T planning has been based on two layers, a comprehensive network, and a set of priority axes. Motorways of the Sea are one of the priority axes, but since the priority projects address specific bottlenecks rather than creating a seamless network, the role of port nodes has not been so important. Certain seaports happen to part of the priority set, but in principle the majority of ports are TEN-T nodes within the comprehensive network. Therefore the new policy direction and the Core Network focus more attention upon short-listing candidate ports as main nodes.

Methodologies for determining such a list of port nodes is not precisely specified, since it is acknowledged that a "single model, which can deliver all the inputs needed for a comprehensive assessment of Core Networks, does not exist." However, the TRANS-TOOLS system is recommended as a decision support platform owing to its "relatively detailed level of regional detail". Since TRANS-TOOLS is also the basis for the forecasting and scenario development of the current project, it is on this basis that we have built a methodology for selecting nodes.

[1] COM(2009) 44 final, 4.2.2009
[2] TEN-T Policy Review, Expert Group 1, "Methodology for TEN-T Planning", Proposal on TEN-T Network Planning, Final.

Key TRANS-TOOLS components include:

- Transport networks (road, rail and inland waterway), including WORLDNET extensions outside Europe;
- Regional zoning, including WORLDNET extensions outside Europe;
- Freight flow matrices (most recent matrices developed for TRANS-TOOLS by WORLDNET).

TRANS-TOOLS is essentially providing a traffic assignment function, routeing flows on network links to allow impacts to be analysed at a high level of detail. In this sense, the land-based networks are givens, and the variables relate to the choices made by agents. The problem of selecting main nodes is somewhat different, since the network itself becomes a variable to be optimised according the distribution (or forecast distribution) of demand. In this context we use the term “network” to imply a network superset, containing all the strategic links from all of the modal layers. Nodes such as ports are modal interchanges, so they become one of the most important foundations of this multimodal network.

The selected methodology is therefore to attempt to identify the optimal set of ‘n’ ports to maximise accessibility to the main shipping lanes. This has been approached by using the detailed TRANS-TOOLS data within a Location-Allocation-Problem algorithm.

The location-allocation algorithm is typically posed as the:

> “process of finding the best locations for one or more facilities that will service a given set of points and then assigning those points to the facilities, taking into account factors such as the number of facilities available, their cost, and the maximum impedance from a facility to a point[1]”

Within realistic problem sets, solutions cannot be found exhaustively, i.e. trying all combinations of ‘n’ ports selected from ‘p’ possibilities, because the search space rapidly becomes very large. Therefore a heuristic is used.

Here, a straightforward process is followed. The program identifies the best single location (the one that minimises access cost) to create a network with one facility. It then looks for the next location that minimises access cost in combination with the first one. Then it tries to swap the first location to optimise further. It can be demonstrated with small problem sets that the solutions found by this heuristic either match the true optimum, or achieve very similar performances.

This section sets out the results obtained in selecting a set of core ports for the TEN-T network.

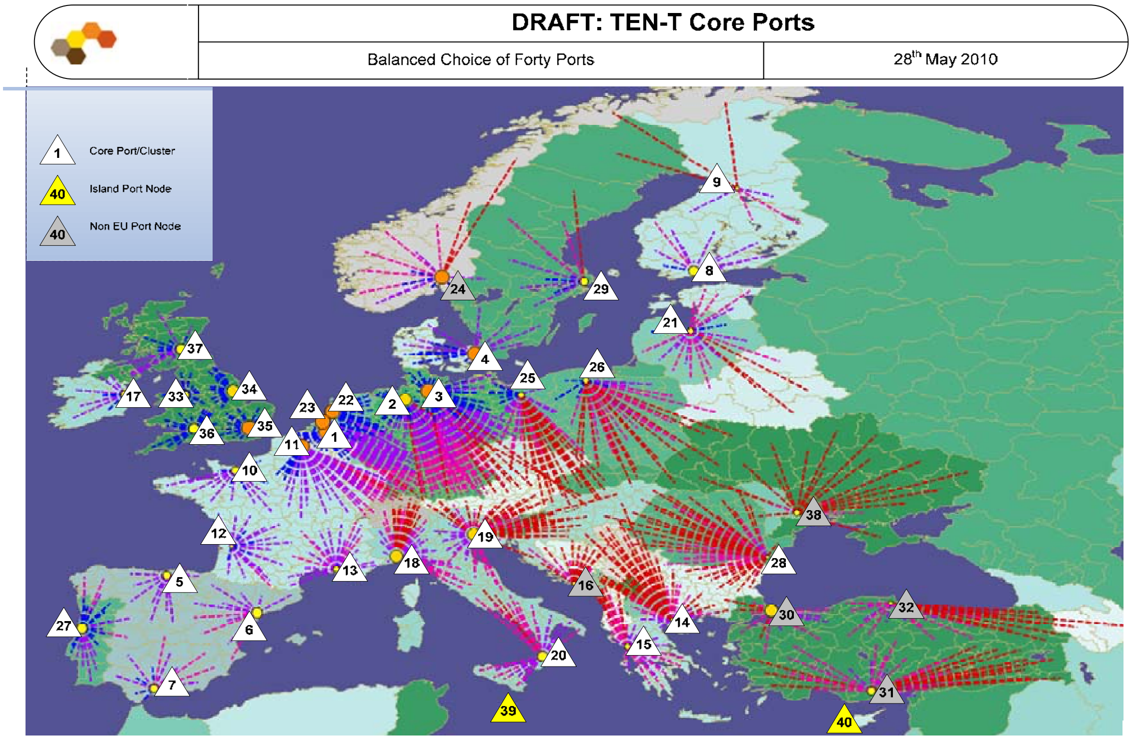
[1] Wikipedia, accredited to Wade, T. and Sommer, S. eds. A to Z GIS.

7.2 Description of Methodology

The project team has developed a methodology for selecting candidate seaports for the TEN-T core network. There have been three major steps in selecting the core ports.

(1) Interim results, including 40 core ports, have been circulated to European stakeholders for consultation (See map below). The interim selection of core ports is shown in the map below.

Figure 7.1 Interim Core Port Selection



(2) Following consultation, a larger set has been estimated.

(3) In a third step the modelled core ports have been further reduced to 57 ports or port groups.

7.3 Stakeholder Consultations

During the stakeholder conference, the provisional results have been presented and discussed. Furthermore detailed inputs have been received in writing, relating to the main project results:

- Analysis of current maritime freight flows, and their relation with hinterland networks;
- Forecast of freight flows/ impact of crisis and expected outlook;
- Analysis of demand and supply in ports;
- Methodology for selecting candidate ports for the core TEN-T network.

The views can be summarized as follows:

Analysis of current maritime freight flows, and their relation with hinterland Networks

It was suggested to provide a further distinction of the port clusters due to their heterogeneity, e.g. for the West-Med ports.

A different measurement of sea-borne traffic flows was recommended in order to appropriately evaluate bulk. Very often, bulk generates high added-value activities in seaports, it also is essential for its impact on maritime hinterland relations. The free capacity on waterways e.g. determines whether this type of flow, often in high quantities, can grow in certain seaports or not, since the capacity on road and rail networks is limited to absorb such volumes.

It was taken into account that the sea-borne traffic flows should be measured in tonnes and not by their monetary value. This is especially in favour of bulk goods.

Forecast of freight flows/ impact of crisis and expected outlook

It was mentioned that the forecasts which were based on the TRANSTOOLS model do not take into account the whole effect of the crisis. This is for example true in relation to transit traffic which in the case of hub ports has increased.

By combining demand and port capacity, the capacity shortfall in seaports is measured. Although not explicit, it seems that capacity is only measured with regard to maritime handling. It is suggested to measure the capacity of land handling and connections to hinterland networks in seaports in order to reduce the risk to maintain bottlenecks or create new ones. The entire chain must become bottleneck free to ensure seamless freight flows from and to the hinterland, underpinning the objective of a TEN-T core network.

Analysis of demand and supply in ports

It was mentioned that an additional increase of port capacity can be expected due to the development of automatic and semi automatic container terminals. Furthermore it was pointed out that port related traffic is identified with maritime related trade relations. But these are not the only trade relations that are important in generating port traffic. It was suggested that the model could be improved by taking into account of the fact that port based industries such as petrochemical clusters generate an important amount of non-maritime related traffic as well and take up an important share of land-based capacity of the infrastructure network, e.g. rail corridors.

Methodology for selecting candidate ports for the core TEN-T network

In general it was suggested to increase the number of modelling steps in case further improvements might be identified. Also, the use of monetary value to evaluate accessibility was criticised, and it was requested to use tonnages. Many felt that the technique was too theoretical and that the accessibility criteria should be combined with more clear cut measures such as volume.

It was recommended to refine the methodology by including further considerations, such as the distinction of different types of services in addition to the core ports resulting from the model. For example with respect to the occidental Mediterranean traffic there are three different types of services; dedicated services (calling Mediterranean ports and returning to Far East, loop services (calling Mediterranean ports and continuing to North Europe) and round-the-world services (calling Mediterranean ports and continuing to the Americas). So far only loop services have been considered in the methodology when defining main shipping lanes which distorts the related outcome.

The model does not take account of the difference in environmental performance of the port nodes, nor of the difference in their potential for improvement of the environmental performance; it was suggested that environmental (and climate) issues should already be taken into account in this stage.

The modelling technique does not take into account some key characteristics of the maritime infrastructure of ports, such as depth of water alongside and in approach channels.

The maritime route selected for the modelling is relevant to the existing (and highest volume) maritime trade for deep sea containers between the Far East and Europe. The modelling does not appear to take into account transatlantic (and any other) deep sea container routes. The use of the TNO Container Model at the next stage of the study may improve the analysis for the deep sea container market. Short sea ferry routes do not appear to have been considered in the analysis.

The modelling technique is quite complex, which means that it may not be particularly transparent for stakeholders.

7.4 Revised Methodology

Following consultation, the methodology for core port identification has been revised. The trade weighting method has changed from monetary trade value to tonnage, and the number of iterations run was increased from fifty to eighty.

Because the results may be unstable from iteration to iteration, all the eighty solutions were analysed to see which locations were stable and which transient.

These results have been translated into a new selection of core ports. In general, the grouping of ports has been reduced, so that the nodes are more clearly defined, and as far as possible the advice of the stakeholders has been adopted. For example, the number of port groups involving more than one country has been reduced, and the geographical range per group has also been reduced.

From this theoretical network, other criteria (apart from hinterland access) have been introduced following responses from stakeholders.

These are:

- Total traffic;
- Total traffic excluding liquid bulk;
- Total ship arrivals and
- Arrivals of the largest ship categories.

In addition:

- Island nations have been allocated one core port each in order to guarantee connection to the core network.
- As far as possible it has been attempted to balance the allocation geographically so that no coastal stretches are empty.
- Intra-EU cohesion has been taken into account by including important internal sea connections.
- As far as possible, the number and size of port groups has been minimised and groups involving ports from more than one country have been avoided.
- Each group only contains named ports.

7.5 Final Selection of Core Ports

The numbering of the core ports has no significance other than as a labelling convention. The list is ordered by country (Belgium-BE to United Kingdom-UK) and where there are groups of ports, these are ordered alphabetically.

Table 7.1 Core ports

Nr	*Name of port (group)*	*Nr*	*Name of port (group)*
1	ANTWERP	29	TRIESTE, VENEZIA
2	GHENT, OOSTENDE, ZEEBRUGGE, ZEELAND	30	BRINDISI, TARANTO
3	VARNA	31	GIOIA TAURO
4	LIMASSOL	32	NAPOLI, SALERNO
5	BREMERHAVEN	33	KLAIPEDA
6	HAMBURG	34	RIGA, VENTSPILS
7	ROSTOCK	35	MARSAXLOKK
8	COPENHAGEN/MALMO PORT, HELSINGBORG, HELSINGOR, TRELLEBORG	36	AMSTERDAM
9	AARHUS, FREDERIKSHAVN	37	ROTTERDAM
10	TALLINN	38	OSLO
11	ALGECIRAS	39	GDANSK, GDYNIA
12	BILBAO	40	SWINOUJSCIE, SZCZECIN
13	VALENCIA	41	OPORTO – LEIXOES
14	BARCELONA	42	LISBOA
15	HELSINKI	43	CONSTANTA
16	CALAIS, DUNKERQUE	44	GOTEBORG
17	LE HAVRE	45	STOCKHOLM
18	MARSEILLE	46	KOPER
19	NANTES ST NAZAIRE	47	AMBARLI

Nr	*Name of port (group)*	*Nr*	*Name of port (group)*
20	PATRAS	48	IZMIR
21	PIRAEUS	49	MERSIN
22	THESSALONIKI	50	DOVER
23	PLOCE	51	FELIXSTOWE
24	RIJEKA	52	FORTH
25	DUBLIN	53	GRIMSBY & IMMINGHAM, HULL
26	REYKJAVIK	54	LIVERPOOL
27	GENOVA, SAVONA	55	LONDON, MEDWAY, THAMESPORT
28	LA SPEZIA, LIVORNO	56	SOUTHAMPTON
		57	TEES & HARTLEPOOL

Main Exclusions based on Traffic Volumes

The largest ports excluded from the analysis are Bergen (NO), Wilhelmshaven (DE), Tarragona (ES) and Milford Haven (UK). All of these are predominantly handling liquid bulks which have limited impacts upon road, rail and waterway connections. In the trade analyses, the liquid bulk sector is not expected to grow as fast as the other sectors, so its future impact on multipurpose transport infrastructure will be less severe.

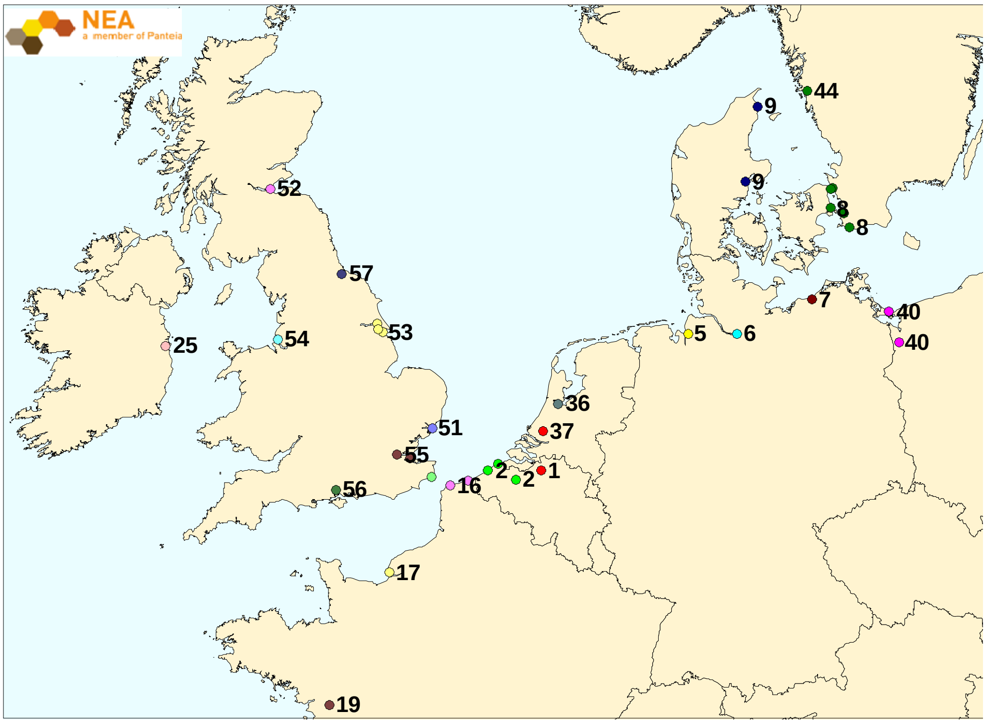
Main Exclusions based on Ship Arrivals

The busiest ports for large vessels excluded are Mariehamn(FI), Turku(FI), Valetta (MT), Harwich (UK), Wilhelmshaven (DE) and Sines (PT).

7.6 Final Results

The following figures show the location of the selected core ports. Where they are close together the labels may be obscured. Numbering refers to the list of ports and port groups in Table 7.1.

Figure 7.2 North Sea Core Ports

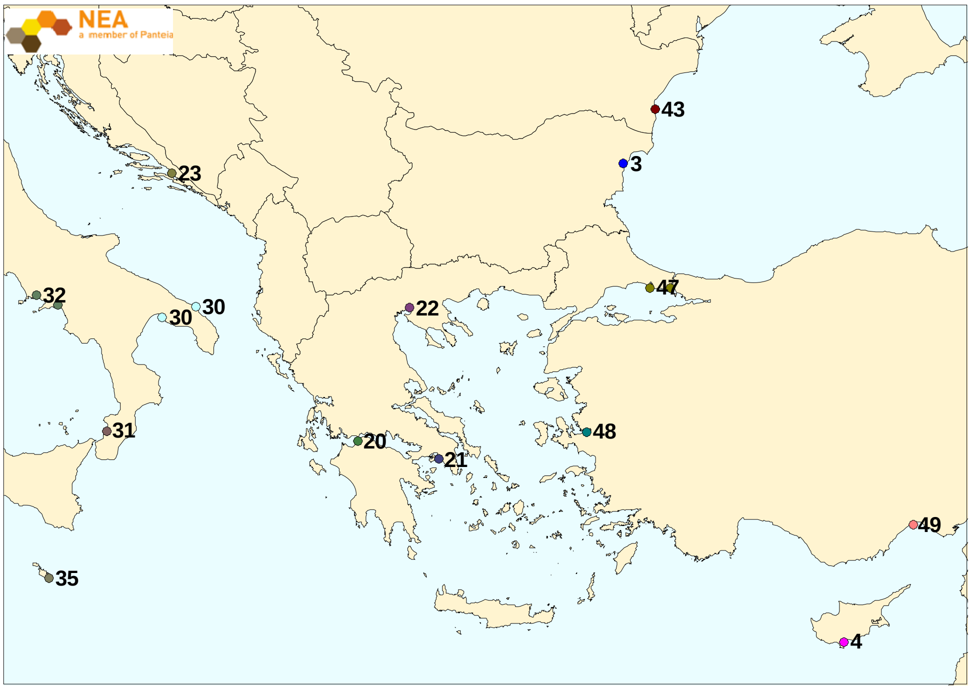


Source: NEA

Figure 7.3 Black Sea Core Ports

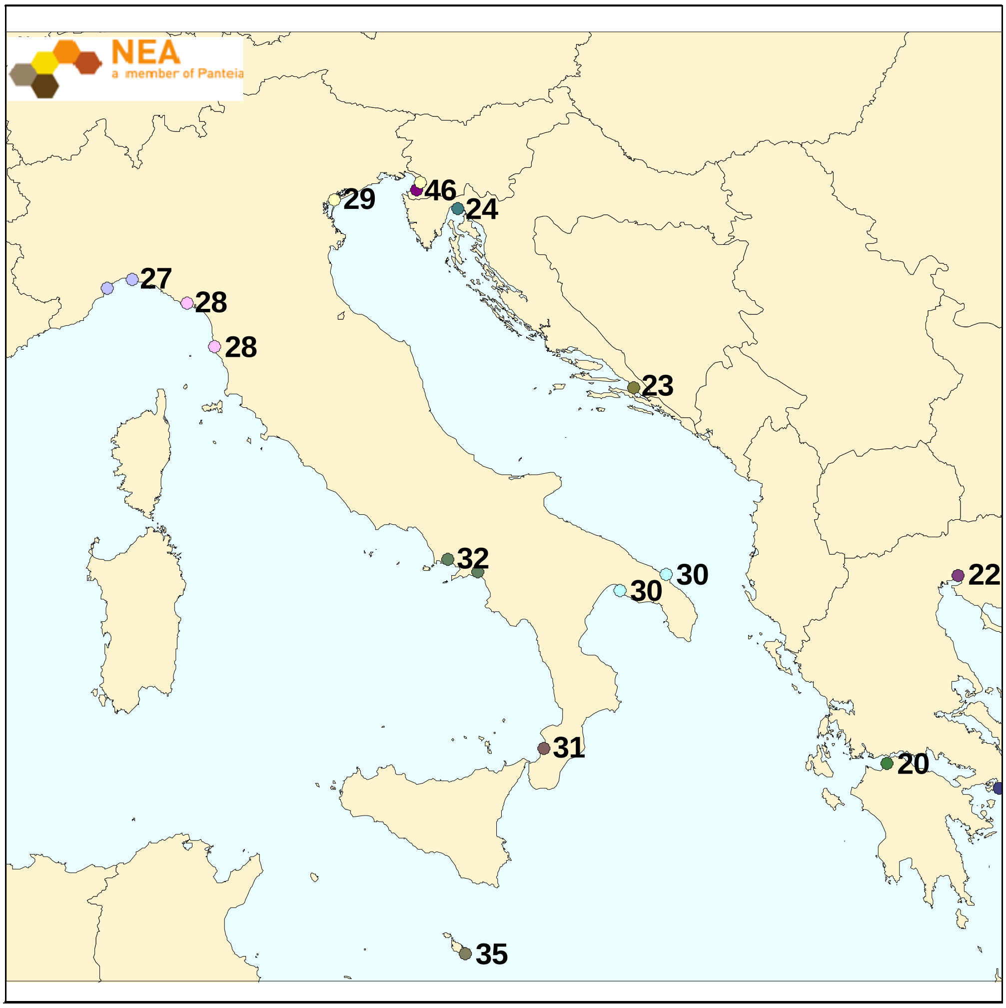
Source: NEA

Figure 7.4 East Mediterranean Core Ports



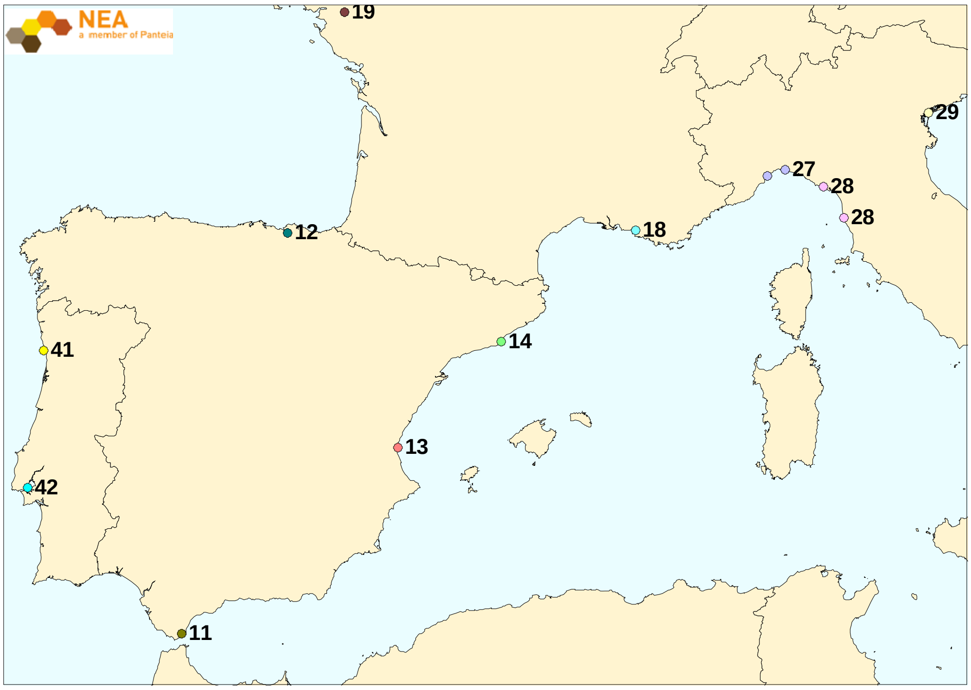
Source: NEA

Figure 7.5 Italian Core Ports



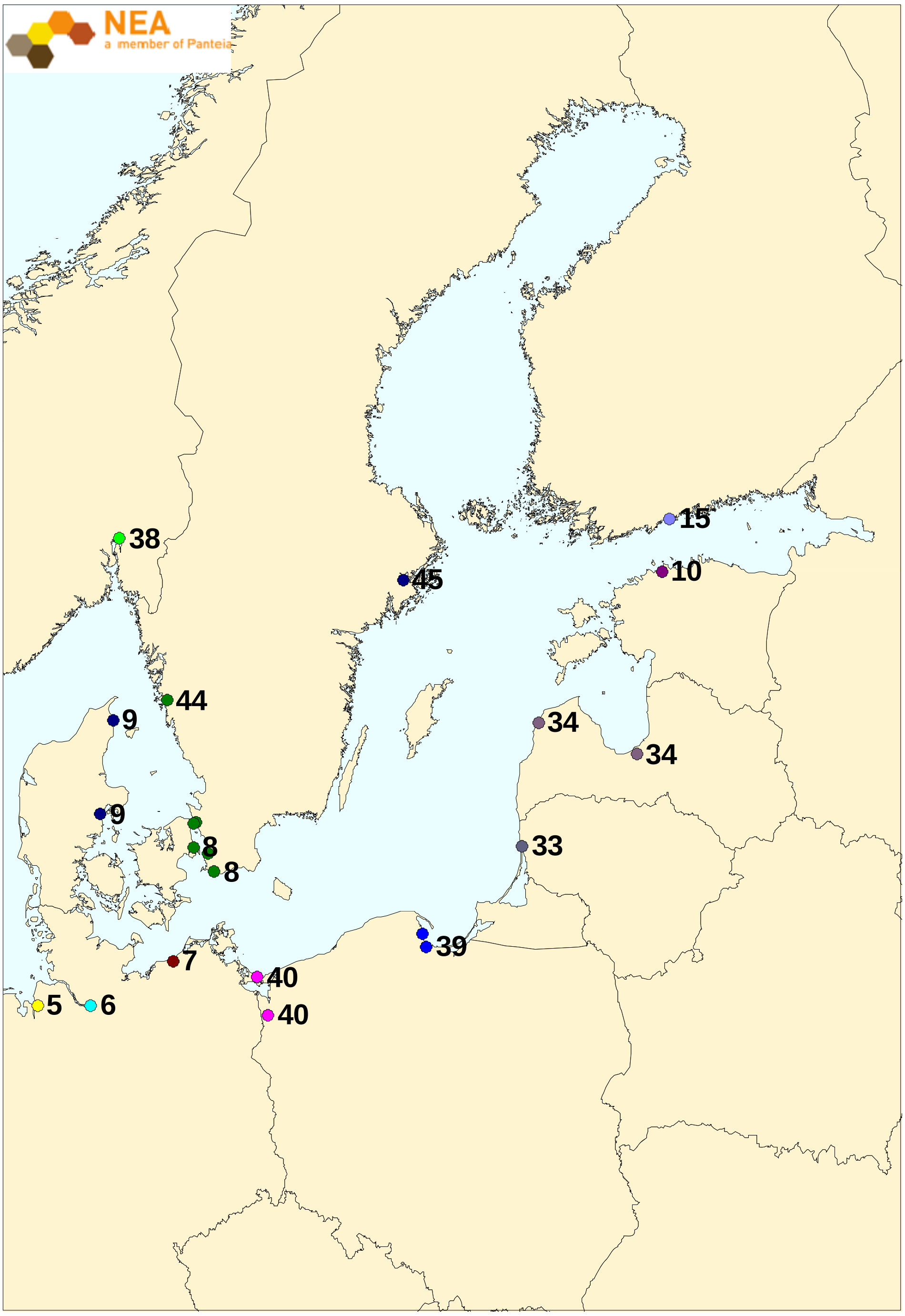
Source: NEA

Figure 7.6 West Mediterranean Core Ports



Source: NEA

Figure 7.7 Baltic and Scandinavian Core Ports



Source: NEA

The rationale for the final selection of 57 core ports is set out below. Each core port is listed, with its annual tonnage and its hinterland orientation. The latter provides the basis for establishing a connection into the European core network.

7.6.1 Antwerp

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
1	Antwerp	Belgium	171

Antwerp is the second ranked port in the EU, and the largest in Belgium, providing a gateway for all cargo types to the neighbouring regions of France, Netherlands and Germany, via road, rail and waterway networks. It is one of Europe's main continental gateways for container traffic, ranked third in Europe in this sector.

Orientation	*Inland Node*
East	Duesseldorf (DE)
South East	Aachen (DE)
South	Brussel (BE)

7.6.2 West Scheldt Group

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
2	Gent	Belgium	27
	Oostende	Belgium	8
	Zeebrugge	Belgium	35
	Zeeland Seaports	Netherlands	33
	Total		103

The West Scheldt group which includes Belgian ports Gent and Oostende as well as the Dutch Zeeland ports of Terneuzen and Vlissingen, handles a combined throughput of 103 million tonnes. Zeebrugge itself is ranked 14th in Europe as a container port with 2m TEU and is also important for RORO services e.g. to the UK.

Gent is located on the Gent-Terneuzen canal, so there is an important shared Dutch/Belgian transport link. Vlissingen, on the North bank of the Westerschelde river is marketed jointly as Zeeland Seaports with Terneuzen. A new container terminal (WCT) is being developed here, potentially adding a further 2m TEU capacity to the cluster. The main orientation is South East and South, including access towards Paris via the Seine-Scheldt TEN-T priority project 30.

Orientation	*Inland Node*
South East	Brussel (BE)
South	Lille (FR)

7.6.3 Varna

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
3	Varna	Bulgaria	11

Varna is the main port in Bulgaria handling a mix of cargo including RORO and containers. It is relatively small and it lacks deep water, but has national importance as the country's largest container terminal and can play an important role within the East-West Traceca corridor. Road and rail links run Westwards towards Sofia.

Orientation	*Inland Node*
West	Sofia (BG)

7.6.4 Limassol

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
4	Limassol	Cyprus	4

Limassol is the largest port in Cyprus and the main container terminal with around 370,000 TEU per year. It also serves as a ferry port. Its inclusion in the core network is based upon the need to connect all the island nations.

Orientation	*Inland Node*
North East	Nicosia

7.6.5 Bremen/Bremerhaven

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
5	Bremerhaven/Bremen	Germany	75*
In 2008, Bremerhaven handled 60m tonnes, and Bremen 15m tonnes.			

Bremerhaven is ranked fourteenth for cargo handling in Europe and fourth for container handling with 5.4 million TEU per annum. Cars are an important additional market segment. Road and rail connections account for the majority of inland transport, with a predominantly North South orientation towards from Bremerhaven to Bremen onwards to Hannover and Central Germany. Access inland by rail is not shared with nearby Hamburg.

Orientation	*Inland Node*
South	Hannover

7.6.6 Hamburg

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
6	Hamburg	Germany	119*
*Eurostat figure. Port authority reports 140 million tonnes in 2008.			

Hamburg is the third ranked port in Europe for total throughput, and the second ranked port for containers with 9.7 million TEU in 2008. It is an important gateway for the German rail network with around 40 million tonnes being loaded or unloaded via the rail network per annum. It provides an important access point for Eastern Germany, Poland and the land-locked countries of Central Europe.

Orientation	*Inland Node*
North	Flensburg (DE) and Kolding (DK)
South	Hannover (DE)
South East	Berlin (DE)

7.6.7 Rostock

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
7	Rostock	Germany	21*
* Port authority reports 27 million tonnes			

Rostock is the main port located on Germany's Baltic Coast, with important short sea connections via RORO services to the Nordic regions. Thus it is differentiated from the other selected German ports in terms of the type of port activity, through its hinterland connections, which are predominantly not shared with Hamburg, and through its maritime links towards the Baltic rather than the North Sea.

Orientation	*Inland Node*
South	Berlin (DE)
South/West	Magdeburg (DE)

7.6.8 Sound

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
8	Copenhagen/Malmo	Denmark/Sweden	18
	Helsingborg	Sweden	8
	Helsingor	Denmark	4
	Trelleborg	Sweden	12
	Total		42

Port group eight is focused upon the Sound. The largest member is the Copenhagen-Malmo Port (CMP), a joint Swedish-Danish venture, owned by both cities. It is located at the Southern part of the Sound (Oresund). Collectively all the major ports along the Sound account for 42 million tonnes of cargo. The East West link via Oresund Bridge forms part of the TEN-T priority project 11.

Orientation	*Inland Node*
West	Kolding (DK)
North East	Huskvarna (SE)

7.6.9 Jutland

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
9	Aarhus	Denmark	12
	Frederikshavn	Denmark	3
	Total		15

Denmark is an important maritime country with a strategic position, particularly in relation to short sea traffic and feedering between the North Sea and the Baltic. Its geography and coastline has resulted in a large number of medium sized ports, many of which play a specialist role e.g. RORO, containers or liquids.

Port group nine is a cluster based on the Jutland port of Aarhus which handles 12 million tonnes per annum and is the largest Danish container port. It includes the port of Frederikshavn, which is important for RORO services to Sweden and Norway.

Orientation	*Inland Node*
South	Hamburg (DE)
East	Copenhagen (DK)
North	Via RORO to Norway and Sweden

7.6.10 Tallinn

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
10	Tallinn	Estonia	29*
Baltic Port List 2006 reports 41 million tonnes in Tallinn.			

Tallinn is both the largest city and by some margin the largest port in Estonia. It is predominantly an export port for liquid and dry bulks, and also a ferry port to other Baltic countries, including Finland. The main inland orientation is Eastwards via road and rail towards St. Petersburg in Russia, South East towards Tartu and Moscow, and South towards Latvia. It is the northern point of the North South Rail Baltica towards Warszawa.

Orientation	*Inland Node*
East	St Petersburg (RU)
South East	Moscow (RU)
South	Riga (LV)
North	Via RORO to Helsinki (FI)

7.6.11 Algeciras

Core Port	**Name**	**Country**	**Tonnage Throughput (mill)**
11	Algeciras	Spain	62

Algeciras in Spain is ranked eighth in Europe by total volume and sixth for containers. It is predominantly a transhipment centre for deep sea containers, but also an important RORO link to North Africa. Including transhipment ports in the core network provides a link between the core ports and the ports of the comprehensive network.

Orientation	*Inland Node*
North	Sevilla (ES)
East	Malaga (ES)
South	Via RORO to Tangier (MOR)

7.6.12 Bilbao

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
12	Bilbao	Spain	37

Bilbao is the largest port on the North coast of Spain, and the nineteenth port in Europe for container traffic with 894,000 TEU per annum. The immediate hinterland is an important industrial area in its own right, and Bilbao also provides access from the North towards the centre of Spain. It is situated on the Northern/Western branch of TEN-T priority corridor 3, potentially offering better passenger and freight railway connections in future into Spain and North East towards Dax and Bordeaux.

Orientation	*Inland Node*
South East	Zaragoza (ES)
South	Madrid (ES)

7.6.13 Valencia

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
13	Valencia	Spain	59
Annuario Estadistico 2008			

Valencia is ranked twelfth in Europe for cargo handling and fifth for containers with 3.6 million TEU. It is the main port in the South East of the Iberian peninsula, and the closest port for Madrid.

Orientation	*Inland Node*
South	Murcia (ES)
West	Madrid (ES)
North West	Zaragoza (ES)

7.6.14 Barcelona

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
14	Barcelona	Spain	50
Annuario Estadistico 2008			

Barcelona is ranked nineteenth in Europe for cargo handling and ninth for containers with 2.6 million TEU. It is the main port in the North East of Spain, connected Westwards to Zaragoza and Northwards in France. Like Bilbao it is situated to benefit from TEN-T priority project 3, improving rail access towards Madrid and via Perpignan towards Lyon.

Orientation	*Inland Node*
West	Zaragoza (ES)
North	Perpignan (FR)/Toulouse (FR)

7.6.15 Helsinki

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
15	Helsinki	Finland	12

Helsinki is the main city, and apart from Kilpilhati which mainly handles liquids, the largest port in Finland, with inland links by road and rail towards Tampere, Lahti as well as Eastwards towards Russia.

Orientation	*Inland Node*
North West	Tampere (FI)
North	Lahti (FI)
North East	Vyborg/ St Petersburg (RU)

7.6.16 Nord Pas de Calais

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
16	Calais	France	19
	Dunkerque	France	50

Port group sixteen is located in the North East corner of France. Dunkerque is ranked eleventh in Europe for cargo handling, with a mix of cargo including approximately 200,000 TEUs, as well as conventional cargo. Together with Calais the cluster is the most important RORO link between the UK and France, with railway and motorway links South towards Paris and South East towards Lille and Metz.

Orientation	*Inland Node*
South	Paris (FR)
South East	Lille (FR)
North	Via RORO to Dover (UK)

7.6.17 Le Havre

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
17	Le Havre	France	76

Le Havre is the fifth largest port in Europe, and second in France after Marseille for total cargo handling. It is the leading French port for container handling with 2.5 million TEU and the tenth container port in Europe. It is primarily oriented South East along the Seine valley towards Paris, with road, rail and waterway connections available.

Orientation	*Inland Node*
South East	Paris (FR)

7.6.18 Marseille

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
18	Marseille	France	92

Marseille is the largest French port, ranked fourth in Europe for cargo handling and eighteenth for containers with 900,000 TEU per annum. It is also the main port in the region with inland connections by road, rail and via the Rhone waterway towards Lyon.

Orientation	*Inland Node*
North	Lyon (FR)

7.6.19 Nantes

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
19	Nantes St Nazaire	France	33

Nantes St Nazaire is a large port by European standards with over 30 million tonnes and the largest on the French Atlantic coast. Much of the cargo handled is bulk, but there is also container handling. La Rochelle and Bordeaux, which also provide access from the Atlantic coast to the centre West of France, handle 8 million and 7 million tonnes respectively.

Orientation	*Inland Node*
East	Tours (FR)

7.6.20 Patras

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
20	Patras	Greece	4

Patras is a relatively small port with only 4 million tonnes per annum, but this is mainly RORO cargo. The port handles around 300,000 trucks per annum and over a million passengers. Ferry connections to Italy are important with a

European context, since they also provide a direct route avoiding detours and border crossings. Patras is also an important transport node in Greece with road links Eastwards towards Korinthos and Athens, and via the Rio-Antirion bridge which connects the Peloponnese peninsula to the less accessible Western regions of the Greek mainland.

Orientation	*Inland Node*
East	Korinthos (GR)
North	Rio (GR)
North West	Via RORO to Italy

7.6.21 Piraeus

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
21	Piraeus	Greece	9*
* Eurostat figure. Port authority reported 20 million tonnes in 2007, 10m in 2008.			

Piraeus is one of the major ports for throughput and transhipment in the Eastern Mediterranean region. In 2007 the port authority reported container traffic of 1.3 million TEU which is top 20 volume, but this figure was approximately halved in 2008. Piraeus has been an important hub for domestic and international transhipment as well as inland distribution. It is the main port for the Athens region.

Orientation	*Inland Node*
West	Korinthos (GR)
North	Larissa (GR)

7.6.22 Thessaloniki

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
22	Thessaloniki	Greece (GR)	16

Thessaloniki is the main port in the North of the Aegean with 16 million tonnes of cargo throughput, and 447,000 TEU in 2007, 238,000 on 2008. It provides the main gateway for the central part of the Balkan peninsula, including Northern Greece, the Former Yugoslav Republic of Macedonia and Serbia. It is a focal point on the Priority Corridor 7 in TEN-T.

Orientation	*Inland Node*
North (E)	Sofia (BG)
North (W)	Nis (RS)
East	Kavala/Alexandroupoli (GR)
South	Larissa (GR)
South West	Ioannina (GR)

7.6.23 Ploce

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
23	Ploce	Croatia (HR))	5
Croatian statistics report 5.1 million tonnes in 2008			

Ploce is the second largest port in Croatia, but relatively small on a European scale. Its main relevance for the core network is to create an access point in the core network to the central part of the Eastern Adriatic. Ploce is oriented by road towards Sarajevo and Beograd.

Orientation	*Inland Node*
North East	Sarajevo

7.6.24 Rijeka

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
24	Rijeka	Croatia	3
Croatian statistics report 13 million tonnes in 2008.			

Rijeka is the largest port in Croatia with 13 million tonnes and 4 million passengers. It is oriented East and North East towards Zagreb and Budapest, providing the most direct maritime connection for a European region which is relatively land-locked.

Orientation	*Inland Node*
North East	Zagreb (HR)

7.6.25 Dublin

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
25	Dublin	Ireland	21

Dublin is the largest city, the main national transport hub and the largest port in the Republic of Ireland. It handles more than half of Irish port traffic, and is particularly strong in the RORO and container sectors. Dublin handled 548,000 TEU in 2009.

Orientation	*Inland Node*
North	Drogheda (IE)
West	Athlone (IE)
South West	Naas/Cork (IE)

7.6.26 Reykjavik

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
26	Reykjavik	Iceland	3

Reykjavik is the largest port in Iceland with over 3 million tonnes of cargo and approximately 300,000 container TEUs. In order to connect Iceland to the core network, a maritime node is necessary.

Orientation	*Inland Node*
National Connection	N/A

7.6.27 North West Italy

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
27	Genova	Italy	46
	Savona	Italy	16
	Total		62

Genova is ranked fifteenth in Europe for cargo handling and twelfth as a container port with 1.5 million TEU per annum, the largest in Italy after Gioia Tauro. It provides access to the North Western cities of Torino and Milano, and onwards into the continental hinterland.

Orientation	*Inland Node*
North	Milano (IT)
North East	Torino (IT)

7.6.28 West Italy

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
28	La Spezia	Italy	17
	Livorno	Italy	28
	Total		45

Group 28 consists of two large ports in the Eastern part of the Ligurian sea. Livorno handles more cargo volume, but La Spezia is the larger container port with 1.2 million TEU, putting it into sixteenth position in Europe. La Spezia is oriented towards Parma and the North whereas Livorno is oriented East towards Firenze.

Orientation	*Inland Node*
North East	Parma (IT)
East	Firenze (IT)

7.6.29 North East Italy

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
29	Trieste	IT	37
	Venezia	IT	30
	Total		67
Port authority figures show 30 million tonnes at Venezia, and 48 million at Trieste.			

Venezia and Trieste form a group located along the North coast of the Italian Adriatic. Of the two, Trieste has the higher volume, but Venezia has more container traffic with 379,000 TEU in 2008 compared to 335,000 in Trieste, with plans to expand this further. Some 30 million tonnes handled at Trieste are liquid bulks, whereas Venezia is mainly handling unitised and dry cargo. Trieste, which is located close to Koper is oriented towards the East, Venezia is oriented towards Verona and onwards into Italy as well as to the North (Brenner). Both ports link via Udine to Tarvisio.

Orientation	*Inland Node*
North	Udine (IT)
West	Padova/Verona (IT)
South West	Bologna (IT)

7.6.30 South East Italy

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
30	Brindisi	Italy	11
	Taranto	Italy	50
	Total		61

Taranto and Brindisi form a cluster in the South East of Italy linked via the Eastern coastal routes to the rest of Italy. Taranto is the largest port in Italy with 50 million tonnes including container traffic amounting to 786,000 TEU. It is ranked thirteenth for cargo handling in Europe. Brindisi is smaller, but also important for RORO services.

Orientation	*Inland Node*
North	Bari (IT)

7.6.31 Gioia Tauro

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
31	Gioia Tauro	Italy	31

Gioia Tauro is Italy's largest container port with 3.5 million TEU per annum, approximately one third of all containers handled in Italy. Like Algeciras it is a specialist transhipment port for the Mediterranean, so its main function within the TEN-T is as part of the maritime networks bringing containers to the ports of the comprehensive network rather than the Italian hinterland.

Orientation	*Inland Node*
North	Napoli (IT)

7.6.32 Campania

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
32	Napoli	Italy	19
	Salerno	Italy	9
	Total		28
Italian Sea Ports Association reports 19 million tonnes for Napoli in 2008. Port of Napoli reports 16 million.			

Napoli and Salerno form a group in Campania amounting to 28 million tonnes of cargo. Napoli handled 481,000 TEU in 2008 and Salerno 330,000 TEU. With the other selected core ports located at the Northern and Southern extremes, this cluster provides access from the central regions of Italy, including northwards to Roma.

Orientation	*Inland Node*
North	Roma (IT)

7.6.33 Klaipeda

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
33	Klaipeda	Lithuania	27

Klaipeda the main port in Lithuania with over 80% share overall. It is predominantly an export port, handling dry and liquid bulk cargoes, but container volumes have risen to 373,000 TEU in 2008. It is oriented towards the South East, via Kaunas and Vilnius towards Belarus with an important rail node at Radviliskis

Orientation	*Inland Node*
South East	Vilnius (LT)

7.6.34 Latvia

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
34	Riga	Latvia	28
	Ventspils	Latvia	27
	Total		55

Riga and Ventspils form a group with over 50 million tonnes. Both handle a high proportion of dry and liquid bulks, but Riga's container volumes have increased to 207,000 TEU in 2008. Both ports are part of an important East-West corridor stretching inland towards Moscow. Additionally, Riga is connected to the Rail

Baltica project, which is making a North South link using standard rail gauge between Tallinn and via Kaunas to Warszawa.

Orientation	*Inland Node*
East	Moscow (RU)
North	Tallinn (EE)
South	Kaunas (LT)

7.6.35 Marsaxlokk

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
35	Marsaxlokk	Malta	Underestimated in Eurostat at 0.8 m
Container handling in 2008: 2.3 million TEU			

Marsaxlokk is a large container transhipment port located in Malta. It is not listed in the Eurostat rankings, but with 2.3 million TEU per year it is approaching a top 10 position in Europe. Since the core network needs to connect all EU countries, a node is required in Malta. However, as a major transhipment hub it also feeds traffic into other TEN-T ports.

Orientation	*Inland Node*
National Connection	N/A

7.6.36 Amsterdam

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
36	Amsterdam	Netherlands	74

With 74 million tonnes of traffic, Amsterdam is the sixth largest port in Europe. In 2008 the port achieved 436,000 TEU, but this has now diminished. Apart from being an important cargo region in its own right Amsterdam is oriented Eastwards via Utrecht and Amersfoort into Western Germany.

Orientation	*Inland Node*
East	Utrecht (NL)

7.6.37 Rotterdam

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
37	Rotterdam	Netherlands	384

Rotterdam is by a large margin the biggest port in Europe, more than twice the size of the nearest competitor, and approximately five to ten times bigger than most other core ports. It is also the largest container port with over ten million TEU per annum. Its hinterland covers a large part of continental Europe, focusing upon the Rhein valley towards Switzerland and the Ruhr area of Germany. Inland transport is shared between inland waterway, road and rail.

Orientation	*Inland Node*
North East	Utrecht (NL)
East	Nijmegen (NL)
South East	Aachen (DE)
South	Antwerp (BE)

7.6.38 Oslo

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
38	Oslo	Norway	6

Oslo represents a cluster of ports along the Oslofjord. Relatively speaking the volumes are small, with Bergen being the largest Norwegian port. However, in terms of EU connectivity e.g. to Denmark, and in view of the Priority axis 12 configuration, which contains an East West connection to Stockholm and a North South connection via Goteborg, Oslo is the relevant node in the region.

Orientation	*Inland Node*
East	Stockholm (SE)
South	Goteborg (NO)
South via RORO	Frederiksvavn (DK)

7.6.39 Wisla

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
39	Gdansk	Poland	17
	Gdynia	Poland	13
	Total		30
In 2006, the Baltic Port List reports 24 million tonnes for Gdansk and 14 million for Gdynia.			

Group 39 is formed around the mouth of the Wisla river, with the neighbouring ports of Gdansk and Gdynia. Of the two, Gdansk has more traffic but Gdynia is more important for unitised cargo. Both ports are oriented North South along priority corridor 23 towards Warszawa and onwards to Central and Eastern Europe. Road and rail are the most important inland modes.

Orientation	*Inland Node*
South	Warszawa (PL)

7.6.40 Odra

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
40	Swinoujscie	Poland	9
	Szczecin	Poland	8
	Total		17

Group 40 is similar to 39, consisting of two nearby ports with similar traffic volumes. They are marketed as a single entity, Zarząd Morskich Portów Szczecin i Świnoujście S.A. Swinoujscie is important for dry bulk and RORO traffic. Szczecin also handles a large volume of dry bulk cargo, and also a small volume of containers. They are located on the mouth of the Odra river with a North South hinterland orientation towards Berlin and Prague.

Orientation	*Inland Node*
South West	Berlin (DE)
South East	Poznan (PL)
South	Prague (CZ)

7.6.41 Leixoes

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
41	Oporto-Leixoes	Portugal	15

Leixoes is the main container port in Portugal handling 400,000 TEUs per annum. Additionally, dry and liquid bulks are transported. Leixoes provides access to the Northern part of Portugal, and along the coast towards Lisbon.

Orientation	*Inland Node*
North	Viana do Castelo (PT)
South	Coimbra (PT)

7.6.42 Lisboa

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
42	Lisboa	Portugal	12

Lisbon is smaller than Leixoes, but handles a higher volume of containers. Container volume in 2008 was 556,000 TEU. Orientation is also mainly North South.

Orientation	*Inland Node*
North	Leiria (PT)
South	Faro (PT)

7.6.43 Constanta

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
43	Constanta	Romania	46

Constanta is ranked sixteenth overall in Europe, and thirteenth as a container port with 1.4 million TEU in 2008, having enjoyed rapid growth during the 2000s. Primarily it is serving the Romanian hinterland from the Black Sea coast. Road, rail and waterway via the Danube provide East –West links into Bucharest.

Orientation	*Inland Node*
West	Bucharest

7.6.44 Goteborg

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
44	Goteborg	Sweden	42

Goteborg is the largest seaport in Sweden, ranked eighteenth in Europe for cargo volume, and twentieth as a container port with 864,000 TEU in 2008. Almost half of its total volume is liquid bulk. It provides access along a North South corridor stretching from Oslo to Malmo, and along an Eastern connection via Jonkoping towards Stockholm. For rail the main Eastern connection runs North of Jonkoping towards Skovde and Hallsberg.

Orientation	*Inland Node*
North	Oslo (NO)
South	Malmo (SE)
East	Jonkoping (SE)

7.6.45 Stockholm

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
45	Stockholm	Sweden	5

Along the Eastern coast of Sweden into the Gulf of Bothnia, there are a large number of small and medium sized ports. Within this group, one of the most important clusters ranging from Gavle to Norrkoping is centred on Stockholm which is also the focal point for the inland networks. Collectively the ports in this range account for around 20 million tonnes, and Stockholm itself for 5 million, including RORO and container traffic.

Orientation	*Inland Node*
North	Gavle (SE)
North West	Vasteras (SE)
South West	Norrkoping (SE)

7.6.46 Koper

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
46	Koper	Slovenia	16

Koper is the main seaport in Slovenia handling 16 million tonnes in 2008, including container traffic and RORO. Container volumes in 2008 were 568,000 TEU. It provides direct access to the city of Ljubljana and onwards via priority route 6 towards Maribor, Vienna and Budapest.

Orientation	*Inland Node*
North East	Ljubljana (SI)

7.6.47 Turkish Straits

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
47	Ambarli/Istanbul	Turkey	27

Ambarli represents a complex of port terminals on the Western outskirts of Istanbul. With an estimated 2.3 million TEU handled per annum, it is the biggest concentration of container transport in Turkey, broadly equivalent in size to Le Havre and other top 10 EU container ports. It is located on a Northwest-Southeast axis stretching from the Bulgarian border past Istanbul and across the Turkish Straits towards Izmit and Ankara. It is also a hub location for the Black Sea.

No Turkish Black Sea port has been selected for the core network, so this is the only EU/Accession coastline for the European mainland without a single core port. Much of the port activity along the North Anatolian coastline consists of specialised facilities for port-side industry. Possible candidates could be Samsun, Trabzon, or Zonguldak/Filyos. Under the current methodology it is noted that the network would benefit from a Turkish Black Sea port and that today, Samsun appears the most likely candidate.

Orientation	*Inland Node*
North West	Edirne (TR)
East	Istanbul (TR)

7.6.48 Izmir

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
48	Izmir	Turkey	11

Izmir is the main port on Turkey's Aegean coast providing access into the Western part of Anatolia. It is also an important container port with 895,000 TEU in 2008. As one of the TCDD (national railway) ports it is rail connected towards the East and the North.

Orientation	*Inland Node*
East	Usak (TR)
South East	Aydin (TR)
North East	Manisa (TR)

7.6.49 Mersin

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
49	Mersin	Turkey	18

Mersin is the main port on Turkey's Mediterranean coastline with 18 million tonnes of cargo and an estimated 850,000 TEU of container traffic. It is the only Southern Turkish port with rail access running North towards Kayseri and then North West towards Ankara. Links to the East (towards Syria) also exist here.

Orientation	*Inland Node*
North	Kayseri (TR)
East	Adana (TR)

7.6.50 Dover

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
50	Dover	UK	24

Dover is the UK's main ferry port, and therefore the busiest RORO connection with France. In 2008 Dover handled 14 million passengers, 2.8 million cars, and 2.3 million trucks. It is oriented West and North West towards London. The Western access co-incides with the connection for the Channel Tunnel.

Orientation	*Inland Node*
West	Folkestone (UK)
North West	Canterbury (UK)

7.6.51 Felixstowe

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
51	Felixstowe	UK	25

Felixstowe is the UK's largest container port, ranked eighth in Europe with 3.1 million TEUs. Inland connections run North West towards Ipswich and then split between the North West A14 route to the Midlands and the A12 South West route towards Colchester and London.

Orientation	*Inland Node*
North West	Bury St Edmunds (UK)
South West	Colchester (UK)

7.6.52 Forth

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
52	Forth	UK	39

Forth represents a cluster of Scottish terminals along the Forth river near Edinburgh, operated by Forth Ports PLC, handling bulks (mainly liquids), containers and RORO. In 2008 Forth accounted for 275,000 TEU. It includes the terminals of Grangemouth, Leith and Rosyth, and is the largest Scottish port cluster. Orientation is North towards Perth and West towards Glasgow.

Orientation	*Inland Node*
North	Perth (UK)
West	Glasgow (UK)

7.6.53 Humber

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
53	Grimsby and Immimgham	UK	65
	Hull	UK	10

Grimsby and Immingham is the largest UK port, ranked seventh in Europe. Together with the port of Hull they form an important cluster on the Humber Estuary in North East England. Approximately half the volume is accounted for by liquid bulks, with the other half including coal, ores, general cargo, containers and RORO. Orientation is mainly West towards Scunthorpe and Goole and the A1 and M62 corridoors.

Orientation	*Inland Node*
West (N)	Goole (UK)
West (S)	Scunthorpe/Doncaster (UK)

7.6.54 Liverpool

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
54	Liverpool	UK	32

Liverpool is ranked seventh in the UK with a throughput of 32 million tonnes in 2008 and 687,000 container TEU. It is the most important multi-purpose port on the UK's West coast. Milford Haven in South Wales is bigger in gross tonnage, but this is almost entirely bulk fuels. Liverpool operates in most sectors, including RORO to Ireland. The Mersey estuary also provides access to the Manchester Ship Canal.

Orientation	*Inland Node*
East	Manchester (UK)
South East	Stoke on Trent (UK)
North East	Preston (UK)

7.6.55 Thames/Medway

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
55	London	UK	52
	Thamesport/Medway	UK	13
	Total		65

London and Medway form a cluster around the Thames estuary in the South East of England. London by itself is ranked ninth in Europe for cargo handling, and seventeenth for containers with 983,000 TEU in 2008. The Medway added a further 773,000 TEU. Further capacity for container handling is planned at the London Gateway terminal, on the North side of the Estuary. London is the focal point of the UK's road and rail networks. The main orientation is towards the Midlands, the North and the West.

Orientation	*Inland Node*
North	Luton (UK)
North West	Oxford (UK)
West	Reading (UK)

7.6.56 Southampton

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
56	Southampton	UK	41

Southampton is the UK's fourth largest port, and the second largest container port. It is the main port on the South Coast, providing direct access to the South West quarter of the UK. Southampton is ranked twentieth in Europe overall and eleventh for container traffic with 1.6 million TEU handled in 2008. Inland orientation is North East towards Basingstoke and London, North towards Newbury and Birmingham, and North West towards Salisbury and Bristol.

Orientation	*Inland Node*
North East	Basingstoke (UK)
North	Newbury (UK)
North West	Salisbury (UK)

7.6.57 Tees and Hartlepool

Core Port	*Name*	*Country*	*Tonnage Throughput (mill)*
57	Tees and Hartlepool	UK	45

Tees and Hartlepool is ranked seventeenth in Europe with 45 million tonnes in 2008. Around half of the tonnage is accounted for by bulk fuels but otherwise there is a range of cargo including 11 million tonnes of dry bulk, 155,000 container TEU. Short sea RORO services also operate from Teesport. Hinterland orientation is mainly along the A1 and A19 routes running North-South between Leeds and Newcastle and onwards to Scotland.

Orientation	*Inland Node*
North	Newcastle (UK)
South	Leeds (UK)

7.7 Developments of Network

Following this study, the TEN-CONNECT 2 study will elaborate the full core network to include inland nodes. This raises the prospect that the recommended core port list is not adopted in full or alternatively that gaps are found in the network. Although it may be possible to find optimal port locations according to a given set of criteria (e.g. accessibility), or volume thresholds, there is no absolute target for the ideal scale of the network. Shorter variants e.g. the highest twenty ports by volume allow a greater degree of prioritisation with respect to hinterland investments, longer variants such as all ports exceeding one million tonnes are more suitable for a pan-European network with good accessibility from all regions.

Stricter volume-based criteria would tend to re-emphasise the roles to be played by the ports in the most active port regions; Spain, Italy, France, UK, Belgium, Netherlands and Germany. Networks would be highly clustered in the North Sea, West Mediterranean and Ligurian Sea. Under the proposed approach, twenty eight countries would have at least one core port and nearly all of the coastlines are represented.

The resulting network does however contain some possible gaps. It has already been mentioned that there is no candidate on the Black Sea coast of Turkey. Today, volumes of hinterland traffic from the Black Sea ports are relatively small by Turkish standards. Potential locations cannot easily be grouped due to the distance between them, and the lack of shared hinterland networks. In future, it is possible that the port of Samsun, also named within the Turkish transport master-plan as a growth centre would be added.

So far, island nations such as Malta, Cyprus, Ireland, UK and Iceland are all included with at least one core port since all of their intra and extra European trade must be carried by sea. However, island regions of mainland countries e.g. Greece or the UK are not included because the network is primarily aimed at fostering cross-border communication.

Although the network extends from the EU27 to Norway, Iceland and accession countries, not all neighbouring countries are included. If the Russian Federation, Georgia and Ukraine were included it is likely that St Petersburg, Novorossiysk, Odessa, Illyichevsk, Poti and Batumi would be considered for inclusion. Albania is also excluded.

Including Oslo as the only Norwegian port is a minimal selection, catering mainly for intra-European links towards Denmark. A large potential gap therefore exists along the Western coastline of Norway. Bergen would be the main candidate here, with over sixty million tonnes, albeit mainly in the bulk sectors.

Further gaps exist in the far North. No ports have been selected between Stockholm and Helsinki, so the coastline for the Sea of Bothnia does not have a candidate. There are many ports in this region, and although it is not a densely populated area, collectively they handle significant volumes of cargo.

In the United Kingdom, although eight core ports are identified, there are gaps in Wales, South West England and Northern Ireland. Potential candidates might include Holyhead which is one of main RORO ports on the Irish Sea, Milford Haven with 34 million tonnes (albeit mainly bulks), Bristol with 12 million tonnes and good inland communications and Belfast which is the main port for Northern Ireland. In the Republic of Ireland, only Dublin is selected. Other smaller candidates might include Cork in the South and Limerick in the West.

In the South West, France, Spain and Portugal all have core ports on each coastline. However, possible gaps exist in the South West of France near Bordeaux and Bayonne, and in the North West of Spain, where perhaps Gijon, La Coruna or Vigo might be considered.

Italy, like the UK has a high concentration of core ports, but gaps exist along the central stretches of the peninsula, and amongst the islands e.g. Calgiari in Sardinia.

8 Impact Assessment

8.1 Overview

Reliable and justifiable impact assessment of policy options needs to be based on theoretically well-founded methodologies, consistently applied. The terms of reference for this study require the use of the TRANS-TOOLS v2.0 model. From this model emanate traffic flow predictions that form an appropriate initial basis for the estimation of the impacts of alternative policy options.

Specifically, for each scenario, data is available detailing the estimated tonne-kilometre traffic flows (measured in million tonne-kilometres) for each of the 43 states examined in this study split across the four modes, Inland Waterways, Rail, Road and Sea. In addition, there is some aggregate data in relation to maritime flows and aggregations in relation to flows in the EU15, EU12 and EU27.

8.2 Growth Related Inland Traffic Impacts

A summary of inland volumes is presented below. The geographical regions indicate the incidence of hinterland impacts, and not where the port handling takes place. More detailed tabular results are included in the appendix. The impacts can also be seen in the Chapter 6 maps.

Table 8.1: Country Groups for Inland Traffic Analysis

Group	*National Territories*
Alpine	Austria, Liechtenstein, Switzerland
Benelux	Belgium, Luxembourg, Netherlands
Balkans	Bulgaria, Cyprus, Greece, Croatia, Romania, Slovenia, Turkey, Bosnia, Albania, Serbia, Montenegro, FYROM.
Central	Czech Republic, Germany, Hungary, Slovakia
Nordic	Denmark, Finland, Norway, Sweden
Baltic	Estonia, Lithuania, Latvia, Poland
Iberia	Andorra, Portugal, Spain
France	France
UK/Ireland	Ireland, UK
Italy/Malta	Italy, Malta
Neighbouring	Belarus, Ukraine, Moldova

Table 8.2: Base Year (2005) Hinterland Traffic by European Region (mill Tkm)

	IWW	RAIL	ROAD	SEA	Inland TOTAL	Region Share
Alpine	394	3,229	8,220		11,843	2%
Benelux	23,102	5,085	35,514		63,701	10%
Balkans	2,380	6,080	57,005		65,465	10%
Central	24,107	27,902	74,019		126,028	20%
Nordic	0	20,970	35,766		56,736	9%
Baltic	2,188	5,486	14,874		22,548	4%
Iberia	0	1,136	45,288		46,424	7%
France	18,026	13,099	63,984		95,109	15%
UK/Ireland	97	5,815	52,138		58,050	9%
Italy/Malta	0	6,144	50,514		56,658	9%
Neighbouring	26	9,140	24,970		34,136	5%
Sea Transport				15,540,918		
TOTAL Europe	70,320	104,086	462,292		636,698	100%
Mode Share	11%	16%	73%		100%	

These estimates show the predominance of road as the inland mode and also the incidence of a disproportional impact in the Central (Germany, Slovakia, Czech, Hungary and French regions.

The volume of sea traffic cannot be associated with specific national territories, so it is only shown as a total. The figure includes all Europe-related sea flows, including both deep sea and short sea traffics.

Table 8.3: ITREN Scenario (2030) Hinterland Traffic by European Region (mill Tkm)

	IWW	*RAIL*	*ROAD*	*SEA*	*Inland TOTAL*	*Region Share*
Alpine	865	5,164	15,209		21,238	2% =
Benelux	40,040	8,936	60,684		109,660	9% -
Balkans	4,544	15,773	159,271		179,588	15% +
Central	38,896	53,777	153,611		246,284	20% =
Nordic	0	49,928	70,247		120,175	10% +
Baltic	1,777	24,375	33,440		59,592	5% +
Iberia	0	1,608	79,610		81,218	7% =
France	27,415	19,794	94,149		141,358	11% -
UK/Ireland	98	7,451	91,544		99,092	8% -
Italy/Malta	0	9,448	77,011		86,459	7% -
Neighbouring	36	25,842	65,365		91,242	7% +
Sea Transport				25,747,094		
TOTAL Europe	113,671	222,095	900,141		1,235,907	100%
Mode Share	9% -	18% +	73% =		100%	

By 2030 total inland impacts have increased in line with port traffic growth, with volumes growing in all regions and modes. The direction of these relative shifts compared to the base year is shown as a suffix to the mode and region share figures. However there has been a relative shift in shares from regions such as France, Spain and Britain to the Balkan (including Turkey) and Baltic (including Poland) regions. Since these are regions where road and rail dominate, there has been a relative shift away from waterways.

8.3 Policy Related Impacts

The three sensitivity analyses:

- BIG SHIPS,
- NORTH-SOUTH, and
- HINTERLAND PRICING

are now compared against the central 2030 forecast (ITREN). Changes in absolute volumes are therefore very small but there are important regional and modal shifts. The direction of these shifts is shown as a suffix to the mode and region volumes and corresponding share figures. For example waterway traffic has a share of 10% in the BIG SHIPS scenario, and the "+" indicates that this is an increase compared to the ITREN scenario. A "-" indicates a decrease. The "=" next to the figure that shows a 2% share of inland traffic in the Alpine countries, indicates that there is no significant change in share. The "=" next to the inland total shows that there is no significant change in volume.

Table 8.4: BIG SHIPS Scenario (2030) Hinterland Traffic by European Region (mill Tkm)

	IWW	***RAIL***	***ROAD***	***SEA***	***Inland TOTAL***	***Region Share***
Alpine	1,018	5,157	15,029		21,203 =	2% =
Benelux	42,592	9,559	61,039		113,189 +	9% +
Balkans	3,672	14,382	157,911		175,965 -	14% -
Central	42,847	55,315	158,508		256,670 +	20% +
Nordic	0	54,479	68,852		123,331 +	10% +
Baltic	1,807	26,311	35,098		63,216 +	5% +
Iberia	0	1,945	80,563		82,508 +	7% +
France	28,071	20,759	92,721		141,551 +	11% -
UK/Ireland	90	7,909	91,838		99,838 +	8% -
Italy/Malta	0	9,488	76,520		86,009 -	7% -
Neighbouring	36	25,170	65,139		90,345 -	7% -
Sea Transport				25,799,176		
TOTAL Europe	120,133+	230,474+	903,218+		1,253,824 +	
Mode Share	10% +	18% +	72% -			

In the BIG SHIPS scenario, inland traffic levels increase for all three modes, but with a modal shift from road to the other modes. Higher volumes are found mainly in Northern and Central Europe. Italy and the Balkans experience lower volumes relative to the ITREN scenario.

Table 8.5: NORTH-SOUTH Scenario (2030) Hinterland Traffic by European Region (mill Tkm)

	IWW	***RAIL***	***ROAD***	***SEA***	***Inland TOTAL***	***Region Share***
Alpine	890	5,135	15,377		21,402 +	2% =
Benelux	39,202	8,370	57,518		105,091 -	8% -
Balkans	5,058	14,301	163,672		183,030 +	15% +
Central	38,146	50,220	147,016		235,383 -	19% -
Nordic	0	49,577	69,410		118,988 -	9% -
Baltic	1,771	23,311	32,826		57,908 -	5% -
Iberia	0	1,548	80,982		82,530+	7% +
France	25,805	17,847	94,673		138,325-	11% -
UK/Ireland	98	7,466	91,634		99,197=	8% -
Italy/Malta	0	10,258	82,905		93,163+	7% +
Neighbouring	35	26,952	68,908		95,895+	8% +
Sea Transport				25,725,149		
TOTAL Europe	111,005-	214,985-	904,921+		1,230,911 -	
Mode Share	9% -	17% -	74% +		100%	

In the NORTH-SOUTH scenario, inland volumes fall overall, but there is a shift away from rail and waterway towards road. Road gains share and volume. Rail and waterway lose share and volume. Main increases in traffic volumes can be found in Italy, Iberia and the Balkans.

Table 8.6: HINTERLAND PRICING Scenario (2030) Hinterland Traffic by European Region (mill Tkm)

	IWW	*RAIL*	*ROAD*	*SEA*	*Inland TOTAL*	*Region Share*
Alpine	904	5,150	15,050		21,104=	2% =
Benelux	42,205	9,111	60,650		111,965+	9% +
Balkans	5,019	13,000	159,278		177,297-	14% -
Central	42,241	53,645	153,587		249,473+	20% +
Nordic	0	48,537	70,715		119,252-	10% -
Baltic	1,877	23,070	35,990		60,937+	5% +
Iberia	0	1,752	79,003		80,755-	7% =
France	29,525	19,316	92,495		141,336=	11% =
UK/Ireland	119	8,119	91,319		99,557+	8% =
Italy/Malta	0	9,535	77,595		87,130+	7% +
Neighbouring	41	24,010	67,969		92,019+	7% +
Sea Transport				26,050,761		
TOTAL Europe	121,931+	215,244-	903,651=		1,240,826+	100%
Mode Share	10% +	17% -	73% =		100%	

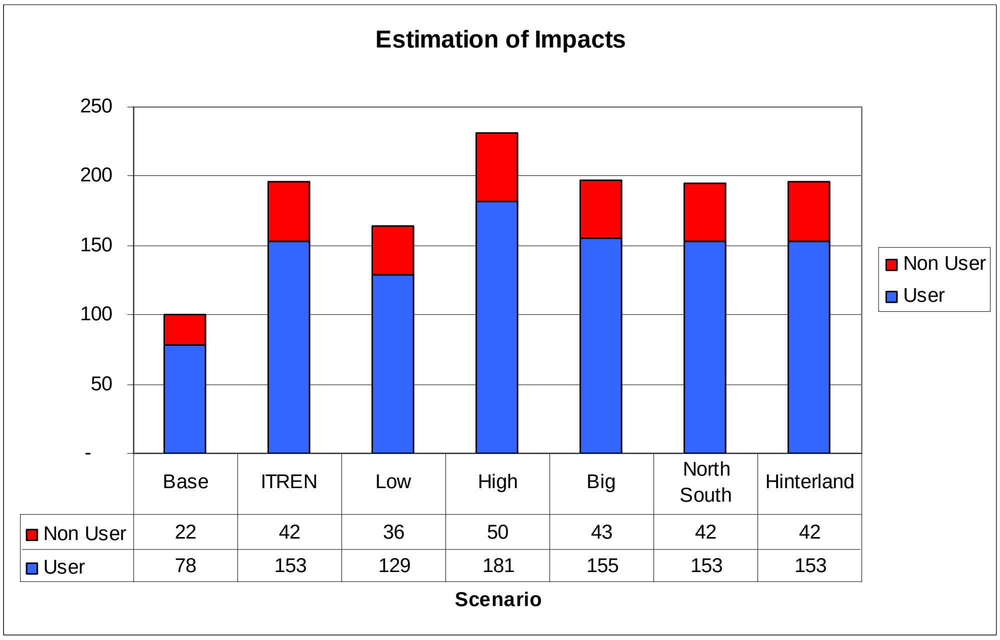
In HINTERLAND PRICING some care is needed in the interpretation. The tables only show the impacts of port related traffic, so the shift from land based chains to sea based chains is not visible. This is estimated to amount to 225 million tonnes, implying a 5% gain for maritime transport (see section 6.1), and an additional decrease of 70,000 million inland tonne kilometres, making a net decrease of 65,000 million tonne kilometres. The apparent increase in inland tonne kilometres must be offset against an equivalent decrease in the volume of non-maritime flows.

With this caveat, there is otherwise a shift towards waterway transport and a shift away from rail.

8.4 Evaluation

Above all the main impact foreseen between the base year and 2030 is the increase in port related traffic, and the associated increase in inland traffic volumes. This affects all European regions and all inland modes of transport. However due to the regional shifts, road and rail modes are predicted to grow slightly faster than inland waterways.

Figure 8-1: Evaluation of Scenarios



For the policy related sensitivity analyses the impacts are at a much smaller scale. They can be summarised as follows:

Table 8.7 Summary of Policy Effects

Scenario	*Main Action*	*Main Positives*	*Main Negatives*
BIG SHIPS	Increase in the attractiveness of largest ports.	Shift away from CO_2 intensive modes. Greater 'massification' offering potential for lower unit costs in ports and hinterlands.	Overall increase in inland traffic volumes. Biggest ports may not be nearest ports.
NORTH-SOUTH	Increase in the attractiveness of South European ports.	Overall decrease in tonne kms due to shorter inland hauls.	Shift from rail and waterway to road. Less 'massification' so lower potential for cost savings in intermodal transport. Greater reliance upon links in mountainous regions.
HINTERLAND PRICING	Increase in inland transport costs.	Overall decrease in inland transport. Modal shift from land to sea, and from rail to waterway.	Decreases in door to door times are likely.

9 Conclusions

“Ports and their connections within the TEN-T” is intended to provide a quantitative foundation for the successful incorporation of port related traffic streams into the planning of the TEN-T networks. To this end it has attempted to quantify existing traffic patterns, to forecast them, to consider exogenous, market-based, and policy-based variables, and to make recommendations.

Our analysis, conducted jointly by NEA, ITS, Significance and TNO, relies upon a combination of data (mainly trade data and port data), research methods (mainly TRANS-TOOLS, WORLDNET and ITREN-2030) and existing modelling tools (TRANS-TOOLS, WORLDNET and TNO-WCM).

Within the project scope a recommendation has been made in relation to the choice of ports for a future European core network. The recommendation for the core network is based entirely upon the Consultants’ research, and therefore does not represent a commitment on the part of the European Commission. It covers the number of ports as well as the actual port selection. As far as possible the selected port nodes are distinct ports. In thirteen cases the nodes are pairs of ports, and in two cases there are groups of ports clustered around specific waterways.

The resulting selection is designed to address several objectives. On the one hand it should be a shortlist allowing planning efforts to be focused upon the main cargo gateways for the European networks. On the other hand it should be large enough to ensure accessibility from all inland regions, taking into account growth patterns, and the established patterns of inland distribution.

The final recommendation for the choice of core ports consists of 57 ports, port pairs or port groups. Together they account for combined traffic of 2.5 billion tonnes, some 65% of the total traffic handled by European ports.

The economic analysis, traffic flow modelling, specialist modelling and impact assessment provide support for a core network concept in which seaports play a key role.

It demonstrates:

1. That the most prominent development in the central ITREN-2030 scenario in the maritime sector over the next twenty years will be volume growth. Total growth in port volumes, after allowing for an expected reduction in crude oil traffic will amount to 650 million tonnes, an increase of 16.25% over the present day volume of 3.9 billion tonnes. The container sector is expected to grow most rapidly, approximately doubling in volume over the modelled time horizon.

2. There will be a larger increase in hinterland tonne kilometres, due to changing traffic patterns. An increase of 94% in hinterland tonne kilometres is predicted covering road, rail and waterway modes. The scale of the increase is 600,000 million tonne kilometres.

3. Distribution of port traffic around the European coastline will change, but not radically. Overall there will be a moderate gain in share for the South European ports as a consequence of trade patterns shifting, but the established patterns of port choice will remain. In 2030, the main coastal ranges will still be the Hamburg-Le Havre range and the Western Mediterranean, with a combined share of 60%.

4. Taking points 1,2, and 3 together; trade growth, higher hinterland traffic growth, and a broadly constant pattern of distribution, the concept of a geographically defined core network containing the main European gateway ports can be supported. The additional focus offered by a core network provides the basis for developing low cost, multimodal hinterland connections, and for relieving traffic bottlenecks. Incorporating ports into a core network recognises the importance of the maritime sector within the overall mix of long distance transport.

5. Policies or market-led initiatives to redistribute cargo can be effective in terms of their contribution to reducing external costs, but the effects at a European level are somewhat marginal in response to feasible supply-side changes. At a national level, certain re-distributive effects may be significant.

6. Instead, policies addressing the main traffic flows, and the main growth sectors within their existing distribution networks have greater potential. This study has indicated the main inland routes which will be affected by changes in the maritime sector. It is recommended that these results are considered as a defined set within the elaboration of the internal core network.

7. Port related flows are relatively important traffics for rail freight and waterway networks. A core network that includes seaports is a positive step towards increasing the contribution of rail and waterway networks. The Southward and Eastward shifts in cargo generation, combined with the continued dominance of Western ports elevates the requirements for (in particular) rail and short-sea feedering. However, under all foreseen circumstances, road transport receives the largest impact.

References

Containerisation International, March 2010, European Ports -2009 a year to forget. Informa publications.

Croatian Ministry of the Sea, Transport and Infrastructure. Available at: http://www.mmpi.hr/default.aspx?id=666

EastMed-MoS (2009): Elaboration of the East Mediterranean Motorways of the Sea Master Plan. Available at: http://www.eastmed-mos.eu/public/page/areadownload-deliverable.asp?L=MT&

European Sea Ports Association (ESPO), 2004-5, Factual Report on the European Port Sector.

EUROSTAT, 2010, Statistics in Focus, 11/2010, General economic crisis hits European port activity.

Government of the Republic of Croatia. June 2008. The future of TEN-T in Croatia and priority projects of European interest in the framework of this TEN-T Network: Chapter 21 'Trans-European Networks', Zagreb.

International Energy Agency, 2009, World Energy Outlook.

ISI-Fraunhofer et al (2010), ITREN-2030, a study on behalf of DG-MOVE, under the 6th Framework Research Programme.

ITMMA-University of Antwerp, 2009, Economic analysis of the European Seaport System, a report commissioned by ESPO, serving as input for the discussion on the TEN-T policy.

Lloyds Register – Fairplay Research. September 2008. OPTIMAR: Benchmarking strategic options for European Shipping and for the European Maritime Transport system in the horizon 2008-2018.

MDS-Transmodal, 2006, UK Port Demand Forecasts, a study commissioned by the UK Department for Transport.

MDS-Transmodal in association with DTZ Pieda, 2006, Container Port Transhipment Study, a study commissioned by the UK Department for Transport.

MDS-Transmodal, 2010, World Cargo Database. Trade forecasts published by Containerisation International, Informa Publications.

Ministerie van Verkeer en Waterstraat, 2008, Zeehavens als Draaischijven naar Duurzaamheid.

NEA, 2004, Analyse Maritieme Goderenstromen in de Hamburg-Le Havre Range. A study commissioned by the National Ports Council (Havenraad) of the Netherlands.

NEA et al. July 2008. Improvement of Maritime Links between TRACECA and TENs Corridors, Final Report.

NEA et al (2009), WORLDNET, a study on behalf of DG-MOVE, under the 6th Framework Research Programme.

Oliveira, Luis Valente de. July 2009. Annual Activity Report September 2008-June 2009. Priority Project 21: Motorways of the Sea, Brussels.

Rodriques, A. 2008. WEST-MoS. Summary Market Study. Available at: http://westmos.eu/dl/01_Alvaro_Rodriguez_WEST_MOS_Seminar.pdf

Research unit. Transport, Territory Logistics. University IUAV of Venice. New UE freight corridors in the area of Central Europe

SEETO. December 2009. South East Europe Core Regional Transport Network Development Plan: Five Year Multi Annual Plan 2010 to 2014, Volume 1.

SEETO. December 2009. South East Europe Core Regional Transport Network Development Plan: Five Year Multi Annual Plan 2010 to 2014, Annexes.

Significance, 2008, A model for maritime freight flows, port competition and hinterland transport.

Tetraplan A/S et al. (2009a). Traffic flow: Scenario, traffic forecast and analysis of traffic on the TEN-T, taking into consideration the external dimension of the Union. Bottlenecks.

Tetraplan A/S et al. (2009b). Report on Transport Scenarios with a 20 and 40 Year Horizon. Final Report.

TNO, 2008, Worldwide Container Model. Association for European Transport Conference 2008.

TNO et al, (2005), TRANS-TOOLS, TOOLS for TRansport Forecasting ANd Scenario testing.

United Nations Economic Commission for Europe (2009). Hinterland Connections of Seaports. Report prepared by Dr Alan Woodburn, University of Westminster, UK.

WEST MED Corridors. June 2009. http://www.westmedcorridors.com/2/upload/wmctent.pdf

WSP (2007). The Northern Transport Axis. Pilot for the analytical support framework to monitor the implementation of the infrastructure and “soft” measures proposed by the High Level Group

ANNEX 1: Traffic Assignments Per Scenario

European Port Traffic Flows on National Territory
2030 ITREN Scenario (Million Tonne Kms)

Sum of TKMS (millions)		**Hinterland Mode**				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	851	2,666	7,651		*11,168*
102	Belgium	11,666	5,352	28,620		*45,638*
103	Bulgaria	1,469	2,373	18,024		*21,866*
104	Switzerland	14	2,498	7,558		*10,070*
105	Cyprus	0	0	0		*0*
106	Czech Republic	89	565	4,096		*4,750*
107	Germany	37,709	52,517	146,132		*236,358*
108	Denmark	0	5,723	17,768		*23,491*
109	Estonia	0	1,210	933		*2,144*
110	Spain	0	1,548	74,616		*76,164*
111	Finland	0	11,744	6,109		*17,853*
112	France	27,415	19,794	94,149		*141,358*
113	Greece	0	309	13,138		*13,447*
114	Croatia	8	262	2,239		*2,510*
115	Hungary	1,011	336	2,669		*4,016*
116	Ireland	0	1,001	10,020		*11,021*
118	Italy	0	9,448	77,011		*86,459*
119	Liechtenstein	0	0	0		*0*
120	Lithuania	93	7,925	5,286		*13,304*
121	Luxembourg	36	180	224		*440*
122	Latvia	0	3,860	1,479		*5,340*
123	Malta	0	0	0		*0*
124	Netherlands	28,338	3,404	31,840		*63,582*
125	Norway	0	6,687	16,148		*22,835*
126	Poland	1,684	11,380	25,742		*38,805*
127	Portugal	0	60	4,994		*5,054*
128	Romania	1,400	6,940	21,970		*30,309*
129	Sweden	0	25,773	30,222		*55,995*
130	Slovenija	0	837	3,157		*3,993*
131	Slovak Republic	87	359	713		*1,160*
132	Turkey	0	3,765	97,161		*100,927*
133	UK	98	6,450	81,524		*88,071*
134	Azerbaijan	0	0	418		*418*
137	Bosnia	3	6	252		*262*
143	Andorra	0	0	0		*0*
145	Albania	0	4	1,354		*1,358*
146	Armenia	0	0	29		*29*
148	Serbia	1,664	962	1,321		*3,947*
149	Montenegro	0	87	222		*309*
151	Macedonia	0	228	432		*660*
152	Belarus	0	4,773	4,908		*9,681*
153	Ukraine	26	20,470	56,696		*77,193*
154	Moldova	10	598	3,314		*3,921*
Maritime					25,747,094	*25,747,094*
Grand Total		*113,671*	*222,095*	*900,141*	*25,747,094*	*26,983,001*

European Port Traffic Flows on National Territory
2030 LOW Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	645	2,244	6,982		*9,871*
102	Belgium	10,213	4,585	25,388		*40,185*
103	Bulgaria	1,082	1,004	10,150		*12,235*
104	Switzerland	11	2,039	6,409		*8,459*
105	Cyprus	0	0	0		*0*
106	Czech Republic	57	389	3,602		*4,048*
107	Germany	32,458	44,135	130,563		*207,155*
108	Denmark	0	5,822	15,255		*21,077*
109	Estonia	0	940	766		*1,705*
110	Spain	0	1,335	65,877		*67,212*
111	Finland	0	6,940	5,451		*12,391*
112	France	23,142	16,375	84,040		*123,558*
113	Greece	0	243	10,783		*11,026*
114	Croatia	6	205	1,784		*1,995*
115	Hungary	783	264	2,339		*3,385*
116	Ireland	0	812	8,827		*9,639*
118	Italy	0	8,651	70,141		*78,791*
119	Liechtenstein	0	0	0		*0*
120	Lithuania	78	5,854	3,890		*9,822*
121	Luxembourg	27	162	199		*388*
122	Latvia	0	2,569	1,124		*3,693*
123	Malta	0	0	0		*0*
124	Netherlands	25,065	2,998	27,459		*55,523*
125	Norway	0	5,428	13,544		*18,972*
126	Poland	1,231	4,927	22,056		*28,214*
127	Portugal	0	55	4,387		*4,441*
128	Romania	1,033	5,127	16,061		*22,221*
129	Sweden	0	21,292	25,299		*46,592*
130	Slovenija	0	667	2,570		*3,237*
131	Slovak Republic	67	231	634		*931*
132	Turkey	0	2,001	74,366		*76,367*
133	UK	87	5,441	71,229		*76,757*
134	Azerbaijan	0	0	347		*347*
137	Bosnia	2	6	195		*203*
143	Andorra	0	0	0		*0*
145	Albania	0	3	1,102		*1,104*
146	Armenia	0	0	25		*26*
148	Serbia	1,242	713	1,142		*3,098*
149	Montenegro	0	79	183		*262*
151	Macedonia	0	155	369		*524*
152	Belarus	0	2,290	3,660		*5,950*
153	Ukraine	22	15,729	43,317		*59,068*
154	Moldova	8	424	2,517		*2,949*
Maritime					22,054,750	*22,054,750*
Grand Total		*97,259*	*172,135*	*764,031*	*22,054,750*	*23,088,174*

European Port Traffic Flows on National Territory
2030 HIGH Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	1,012	3,111	9,096		*13,220*
102	Belgium	14,692	6,930	34,727		*56,349*
103	Bulgaria	1,649	2,594	19,188		*23,431*
104	Switzerland	16	3,167	9,815		*12,998*
105	Cyprus	0	0	0		*0*
106	Czech Republic	94	627	4,593		*5,314*
107	Germany	47,098	66,257	171,230		*284,585*
108	Denmark	0	6,564	19,687		*26,251*
109	Estonia	0	1,410	1,107		*2,517*
110	Spain	0	1,878	88,633		*90,511*
111	Finland	0	13,839	9,415		*23,254*
112	France	37,290	24,505	113,862		*175,657*
113	Greece	0	377	15,347		*15,724*
114	Croatia	9	286	2,516		*2,810*
115	Hungary	1,201	380	3,025		*4,606*
116	Ireland	0	1,234	11,795		*13,029*
118	Italy	0	11,351	93,528		*104,879*
119	Liechtenstein	0	0	0		*0*
120	Lithuania	114	8,861	6,251		*15,226*
121	Luxembourg	119	249	271		*640*
122	Latvia	0	4,554	1,916		*6,470*
123	Malta	0	0	0		*0*
124	Netherlands	36,869	4,144	39,169		*80,182*
125	Norway	0	8,151	20,248		*28,399*
126	Poland	2,149	13,267	31,113		*46,529*
127	Portugal	0	79	6,074		*6,153*
128	Romania	1,572	7,540	24,210		*33,322*
129	Sweden	0	29,803	36,543		*66,346*
130	Slovenija	0	985	3,712		*4,696*
131	Slovak Republic	104	384	799		*1,286*
132	Turkey	0	3,941	105,299		*109,239*
133	UK	122	8,123	100,003		*108,249*
134	Azerbaijan	0	0	437		*437*
137	Bosnia	3	7	286		*296*
143	Andorra	0	0	0		*0*
145	Albania	0	4	1,584		*1,588*
146	Armenia	0	1	31		*32*
148	Serbia	1,897	1,063	1,465		*4,425*
149	Montenegro	0	103	256		*359*
151	Macedonia	0	247	503		*751*
152	Belarus	0	5,458	6,374		*11,832*
153	Ukraine	30	22,418	62,265		*84,713*
154	Moldova	11	648	3,617		*4,275*
Maritime					30,565,156	*30,565,156*
Grand Total		*146,052*	*264,540*	*1,059,990*	*30,565,156*	*32,035,739*

European Port Traffic Flows on National Territory
2030 SA01 BIG Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	Territory	IWW	RAIL	ROAD	SEA	*Grand Total*
101	Austria	1,003	2,598	7,990		*11,591*
102	Belgium	12,435	5,730	28,618		*46,782*
103	Bulgaria	1,220	1,969	18,033		*21,221*
104	Switzerland	15	2,559	7,039		*9,612*
105	Cyprus	0	0	0		*0*
106	Czech Republic	89	580	4,854		*5,523*
107	Germany	41,918	53,973	150,292		*246,183*
108	Denmark	0	6,623	17,145		*23,768*
109	Estonia	0	1,449	863		*2,312*
110	Spain	0	1,897	75,588		*77,485*
111	Finland	0	13,085	6,154		*19,239*
112	France	28,071	20,759	92,721		*141,551*
113	Greece	0	306	12,851		*13,157*
114	Croatia	8	240	2,025		*2,273*
115	Hungary	764	346	2,576		*3,686*
116	Ireland	0	996	9,980		*10,975*
118	Italy	0	9,488	76,520		*86,009*
119	Liechtenstein	0	0	0		*0*
120	Lithuania	92	8,121	5,505		*13,718*
121	Luxembourg	38	206	213		*457*
122	Latvia	0	4,283	1,330		*5,613*
123	Malta	0	0	0		*0*
124	Netherlands	30,119	3,622	32,209		*65,950*
125	Norway	0	6,602	16,137		*22,739*
126	Poland	1,715	12,458	27,400		*41,573*
127	Portugal	0	48	4,975		*5,023*
128	Romania	1,188	6,686	21,616		*29,490*
129	Sweden	0	28,169	29,416		*57,585*
130	Slovenija	0	812	2,875		*3,686*
131	Slovak Republic	75	416	787		*1,278*
132	Turkey	0	3,145	97,087		*100,231*
133	UK	90	6,913	81,859		*88,863*
134	Azerbaijan	0	0	420		*420*
137	Bosnia	3	8	250		*261*
143	Andorra	0	0	0		*0*
145	Albania	0	4	1,310		*1,314*
146	Armenia	0	1	30		*31*
148	Serbia	1,253	919	1,219		*3,391*
149	Montenegro	0	89	215		*304*
151	Macedonia	0	205	432		*637*
152	Belarus	0	4,773	5,049		*9,822*
153	Ukraine	26	19,898	56,364		*76,288*
154	Moldova	10	498	3,275		*3,783*
Maritime					25,799,176	*25,799,176*
Grand Total		*120,133*	*230,474*	*903,218*	*25,799,176*	*27,053,000*

European Port Traffic Flows on National Territory
2030 SA02 NORTH SOUTH Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	876	2,622	8,308		*11,805*
102	Belgium	11,120	4,965	27,526		*43,611*
103	Bulgaria	1,671	1,899	19,022		*22,592*
104	Switzerland	14	2,513	7,070		*9,597*
105	Cyprus	0	0	0		*0*
106	Czech Republic	89	518	4,150		*4,756*
107	Germany	36,887	49,021	139,202		*225,111*
108	Denmark	0	5,658	17,405		*23,063*
109	Estonia	0	1,301	851		*2,151*
110	Spain	0	1,496	75,992		*77,489*
111	Finland	0	11,593	6,132		*17,725*
112	France	25,805	17,847	94,673		*138,325*
113	Greece	0	278	13,689		*13,967*
114	Croatia	8	252	2,502		*2,762*
115	Hungary	1,078	314	2,890		*4,283*
116	Ireland	0	1,011	10,072		*11,083*
118	Italy	0	10,258	82,905		*93,163*
119	Liechtenstein	0	0	0		*0*
120	Lithuania	93	7,514	5,325		*12,933*
121	Luxembourg	34	188	217		*440*
122	Latvia	0	3,852	1,340		*5,192*
123	Malta	0	0	0		*0*
124	Netherlands	28,048	3,216	29,775		*61,040*
125	Norway	0	6,725	16,066		*22,790*
126	Poland	1,678	10,644	25,310		*37,632*
127	Portugal	0	52	4,989		*5,041*
128	Romania	1,565	6,832	22,892		*31,289*
129	Sweden	0	25,601	29,808		*55,409*
130	Slovenija	0	858	3,592		*4,450*
131	Slovak Republic	92	368	773		*1,233*
132	Turkey	0	2,926	98,387		*101,313*
133	UK	98	6,455	81,562		*88,114*
134	Azerbaijan	0	0	412		*412*
137	Bosnia	3	8	281		*292*
143	Andorra	0	0	0		*0*
145	Albania	0	4	1,325		*1,329*
146	Armenia	0	1	29		*29*
148	Serbia	1,811	930	1,346		*4,086*
149	Montenegro	0	78	218		*296*
151	Macedonia	0	237	418		*655*
152	Belarus	0	4,442	4,968		*9,410*
153	Ukraine	25	21,890	60,044		*81,959*
154	Moldova	10	619	3,454		*4,083*
Maritime					25,725,149	*25,725,149*
Grand Total		*111,005*	*214,985*	*904,921*	*25,725,149*	*26,956,060*

European Port Traffic Flows on National Territory
2030 SA03 HINTERLAND PRICING Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	886	2,660	7,979		*11,525*
102	Belgium	12,155	5,514	28,971		*46,641*
103	Bulgaria	1,625	1,546	17,823		*20,994*
104	Switzerland	18	2,490	7,071		*9,580*
105	Cyprus	0	0	0		*0*
106	Czech Republic	145	601	4,483		*5,229*
107	Germany	40,966	52,374	145,606		*238,946*
108	Denmark	0	5,364	17,837		*23,201*
109	Estonia	0	1,200	888		*2,088*
110	Spain	0	1,685	74,050		*75,735*
111	Finland	0	11,453	6,080		*17,533*
112	France	29,525	19,316	92,495		*141,336*
113	Greece	0	300	12,655		*12,955*
114	Croatia	9	236	2,289		*2,535*
115	Hungary	1,042	303	2,729		*4,074*
116	Ireland	0	1,034	9,686		*10,720*
118	Italy	0	9,535	77,595		*87,130*
119	Liechtenstein	0	0	0		*0*
120	Lithuania	108	7,580	6,021		*13,709*
121	Luxembourg	37	186	214		*438*
122	Latvia	0	3,635	1,486		*5,121*
123	Malta	0	0	0		*0*
124	Netherlands	30,012	3,411	31,464		*64,887*
125	Norway	0	6,780	16,440		*23,219*
126	Poland	1,769	10,655	27,595		*40,018*
127	Portugal	0	67	4,953		*5,020*
128	Romania	1,556	6,496	22,166		*30,218*
129	Sweden	0	24,940	30,358		*55,298*
130	Slovenija	0	873	3,261		*4,134*
131	Slovak Republic	89	367	770		*1,225*
132	Turkey	0	2,233	97,358		*99,591*
133	UK	119	7,085	81,632		*88,837*
134	Azerbaijan	0	0	439		*439*
137	Bosnia	3	7	275		*285*
143	Andorra	0	0	0		*0*
145	Albania	0	5	1,514		*1,519*
146	Armenia	0	0	32		*32*
148	Serbia	1,826	969	1,272		*4,067*
149	Montenegro	0	105	238		*343*
151	Macedonia	0	229	427		*656*
152	Belarus	0	4,394	5,189		*9,583*
153	Ukraine	29	19,092	58,783		*77,904*
154	Moldova	11	523	3,526		*4,061*
Maritime					26,050,761	*26,050,761*
Grand Total		*121,931*	*215,244*	*903,651*	*26,050,761*	*27,291,587*

ANNEX 2: Differences per Scenario Relative to Central ITREN Scenario

European Port Traffic Flows on National Territory

2030 LOW Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	Territory	IWW	RAIL	ROAD	SEA	*Grand Total*
101	Austria	-206	-422	-669	0	-1,297
102	Belgium	-1,453	-768	-3,232	0	-5,453
103	Bulgaria	-387	-1,369	-7,875	0	-9,631
104	Switzerland	-3	-459	-1,149	0	-1,611
105	Cyprus	0	0	0	0	0
106	Czech Republic	-31	-176	-495	0	-702
107	Germany	-5,252	-8,382	-15,569	0	-29,202
108	Denmark	0	99	-2,513	0	-2,414
109	Estonia	0	-270	-168	0	-438
110	Spain	0	-213	-8,739	0	-8,952
111	Finland	0	-4,804	-658	0	-5,462
112	France	-4,272	-3,418	-10,109	0	-17,800
113	Greece	0	-65	-2,355	0	-2,421
114	Croatia	-3	-57	-455	0	-515
115	Hungary	-228	-72	-330	0	-631
116	Ireland	0	-189	-1,193	0	-1,381
118	Italy	0	-797	-6,870	0	-7,668
119	Liechtenstein	0	0	0	0	0
120	Lithuania	-15	-2,071	-1,396	0	-3,482
121	Luxembourg	-9	-18	-25	0	-52
122	Latvia	0	-1,292	-356	0	-1,647
123	Malta	0	0	0	0	0
124	Netherlands	-3,273	-406	-4,381	0	-8,060
125	Norway	0	-1,259	-2,605	0	-3,863
126	Poland	-453	-6,453	-3,685	0	-10,591
127	Portugal	0	-5	-607	0	-613
128	Romania	-367	-1,813	-5,908	0	-8,088
129	Sweden	0	-4,481	-4,923	0	-9,404
130	Slovenija	0	-170	-587	0	-756
131	Slovak Republic	-20	-129	-79	0	-228
132	Turkey	0	-1,764	-22,795	0	-24,559
133	UK	-11	-1,009	-10,294	0	-11,314
134	Azerbaijan	0	0	-71	0	-71
137	Bosnia	-1	-1	-57	0	-58
143	Andorra	0	0	0	0	0
145	Albania	0	-1	-253	0	-254
146	Armenia	0	0	-3	0	-3
148	Serbia	-422	-249	-179	0	-850
149	Montenegro	0	-8	-39	0	-47
151	Macedonia	0	-72	-63	0	-136
152	Belarus	0	-2,484	-1,248	0	-3,731
153	Ukraine	-4	-4,741	-13,379	0	-18,124
154	Moldova	-2	-174	-796	0	-973
Maritime					-3,692,344	-3,692,344
Grand Total		-16,412	-49,960	-136,110	-3,692,344	-3,894,826

European Port Traffic Flows on National Territory

2030 HIGH Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	Territory	IWW	RAIL	ROAD	SEA	*Grand Total*
101	Austria	**161**	**446**	**1,445**	**0**	**2,051**
102	Belgium	**3,027**	**1,578**	**6,106**	**0**	**10,711**
103	Bulgaria	**181**	**221**	**1,163**	**0**	**1,565**
104	Switzerland	**2**	**669**	**2,257**	**0**	**2,928**
105	Cyprus	**0**	**0**	**0**	**0**	**0**
106	Czech Republic	**6**	**62**	**496**	**0**	**564**
107	Germany	**9,389**	**13,741**	**25,098**	**0**	**48,228**
108	Denmark	**0**	**841**	**1,919**	**0**	**2,761**
109	Estonia	**0**	**200**	**174**	**0**	**374**
110	Spain	**0**	**329**	**14,017**	**0**	**14,347**
111	Finland	**0**	**2,094**	**3,306**	**0**	**5,401**
112	France	**9,875**	**4,711**	**19,713**	**0**	**34,299**
113	Greece	**0**	**68**	**2,209**	**0**	**2,277**
114	Croatia	**1**	**23**	**276**	**0**	**300**
115	Hungary	**190**	**44**	**356**	**0**	**590**
116	Ireland	**0**	**234**	**1,775**	**0**	**2,009**
118	Italy	**0**	**1,903**	**16,517**	**0**	**18,420**
119	Liechtenstein	**0**	**0**	**0**	**0**	**0**
120	Lithuania	**21**	**936**	**965**	**0**	**1,922**
121	Luxembourg	**84**	**70**	**47**	**0**	**200**
122	Latvia	**0**	**693**	**437**	**0**	**1,130**
123	Malta	**0**	**0**	**0**	**0**	**0**
124	Netherlands	**8,530**	**740**	**7,329**	**0**	**16,599**
125	Norway	**0**	**1,464**	**4,100**	**0**	**5,564**
126	Poland	**466**	**1,887**	**5,371**	**0**	**7,724**
127	Portugal	**0**	**19**	**1,080**	**0**	**1,099**
128	Romania	**172**	**601**	**2,240**	**0**	**3,013**
129	Sweden	**0**	**4,029**	**6,321**	**0**	**10,350**
130	Slovenija	**0**	**148**	**555**	**0**	**703**
131	Slovak Republic	**17**	**25**	**85**	**0**	**127**
132	Turkey	**0**	**175**	**8,138**	**0**	**8,313**
133	UK	**24**	**1,673**	**18,479**	**0**	**20,177**
134	Azerbaijan	**0**	**0**	**20**	**0**	**20**
137	Bosnia	**0**	**1**	**33**	**0**	**35**
143	Andorra	**0**	**0**	**0**	**0**	**0**
145	Albania	**0**	**0**	**230**	**0**	**230**
146	Armenia	**0**	**0**	**3**	**0**	**3**
148	Serbia	**232**	**102**	**144**	**0**	**478**
149	Montenegro	**0**	**16**	**34**	**0**	**50**
151	Macedonia	**0**	**20**	**71**	**0**	**91**
152	Belarus	**0**	**685**	**1,466**	**0**	**2,151**
153	Ukraine	**4**	**1,948**	**5,568**	**0**	**7,520**
154	Moldova	**1**	**50**	**303**	**0**	**354**
Maritime					**4,818,062**	**4,818,062**
Grand Total		**32,382**	**42,445**	**159,849**	**4,818,062**	**5,052,738**

European Port Traffic Flows on National Territory

2030 SA01 BIG Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	152	-68	338	0	423
102	Belgium	769	378	-3	0	1,144
103	Bulgaria	-249	-404	8	0	-645
104	Switzerland	1	60	-518	0	-458
105	Cyprus	0	0	0	0	0
106	Czech Republic	1	15	757	0	773
107	Germany	4,209	1,456	4,160	0	9,825
108	Denmark	0	900	-623	0	277
109	Estonia	0	239	-71	0	168
110	Spain	0	348	972	0	1,320
111	Finland	0	1,341	45	0	1,386
112	France	656	966	-1,429	0	193
113	Greece	0	-3	-288	0	-290
114	Croatia	0	-23	-215	0	-237
115	Hungary	-247	10	-93	0	-330
116	Ireland	0	-5	-40	0	-46
118	Italy	0	40	-491	0	-451
119	Liechtenstein	0	0	0	0	0
120	Lithuania	-1	196	219	0	414
121	Luxembourg	2	26	-11	0	17
122	Latvia	0	422	-149	0	273
123	Malta	0	0	0	0	0
124	Netherlands	1,781	218	369	0	2,368
125	Norway	0	-86	-11	0	-97
126	Poland	31	1,079	1,659	0	2,768
127	Portugal	0	-11	-19	0	-31
128	Romania	-212	-254	-353	0	-819
129	Sweden	0	2,396	-806	0	1,590
130	Slovenija	0	-25	-282	0	-307
131	Slovak Republic	-12	57	73	0	118
132	Turkey	0	-621	-74	0	-695
133	UK	-7	464	335	0	791
134	Azerbaijan	0	0	2	0	2
137	Bosnia	0	2	-2	0	0
143	Andorra	0	0	0	0	0
145	Albania	0	0	-44	0	-44
146	Armenia	0	0	2	0	2
148	Serbia	-411	-43	-102	0	-556
149	Montenegro	0	2	-7	0	-5
151	Macedonia	0	-23	-1	0	-23
152	Belarus	0	0	141	0	141
153	Ukraine	0	-572	-332	0	-904
154	Moldova	0	-100	-38	0	-138
Maritime					52,082	52,082
Grand Total		6,462	8,378	3,077	52,082	70,000

European Port Traffic Flows on National Territory

2030 SA02 NORTH SOUTH Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	Territory	IWW	RAIL	ROAD	SEA	*Grand Total*
101	Austria	25	-44	656	0	637
102	Belgium	-546	-387	-1,094	0	-2,027
103	Bulgaria	202	-474	997	0	726
104	Switzerland	0	15	-488	0	-473
105	Cyprus	0	0	0	0	0
106	Czech Republic	0	-47	54	0	6
107	Germany	-822	-3,496	-6,929	0	-11,247
108	Denmark	0	-65	-363	0	-427
109	Estonia	0	91	-83	0	8
110	Spain	0	-52	1,376	0	1,324
111	Finland	0	-151	23	0	-129
112	France	-1,610	-1,947	524	0	-3,033
113	Greece	0	-31	551	0	520
114	Croatia	0	-11	263	0	252
115	Hungary	67	-22	221	0	266
116	Ireland	0	10	52	0	62
118	Italy	0	810	5,894	0	6,704
119	Liechtenstein	0	0	0	0	0
120	Lithuania	0	-411	39	0	-371
121	Luxembourg	-2	8	-7	0	0
122	Latvia	0	-8	-140	0	-148
123	Malta	0	0	0	0	0
124	Netherlands	-290	-188	-2,064	0	-2,542
125	Norway	0	37	-83	0	-45
126	Poland	-6	-735	-431	0	-1,173
127	Portugal	0	-8	-5	0	-13
128	Romania	165	-108	923	0	980
129	Sweden	0	-172	-414	0	-586
130	Slovenija	0	21	435	0	456
131	Slovak Republic	5	9	60	0	74
132	Turkey	0	-840	1,226	0	386
133	UK	0	5	38	0	43
134	Azerbaijan	0	0	-5	0	-5
137	Bosnia	0	2	29	0	30
143	Andorra	0	0	0	0	0
145	Albania	0	0	-29	0	-29
146	Armenia	0	0	0	0	0
148	Serbia	146	-32	25	0	139
149	Montenegro	0	-9	-4	0	-12
151	Macedonia	0	9	-14	0	-5
152	Belarus	0	-331	60	0	-271
153	Ukraine	-1	1,420	3,348	0	4,767
154	Moldova	0	21	140	0	162
Maritime					-21,945	-21,945
Grand Total		-2,666	-7,110	4,780	-21,945	-26,940

European Port Traffic Flows on National Territory

2030 SA03 HINTERLAND PRICING Scenario (Million Tonne Kms)

Sum of TKMS (millions)		Hinterland Mode				
WN3	**Territory**	**IWW**	**RAIL**	**ROAD**	**SEA**	***Grand Total***
101	Austria	35	-6	328	0	357
102	Belgium	489	162	351	0	1,003
103	Bulgaria	156	-828	-201	0	-872
104	Switzerland	4	-8	-487	0	-490
105	Cyprus	0	0	0	0	0
106	Czech Republic	56	36	387	0	479
107	Germany	3,256	-142	-526	0	2,588
108	Denmark	0	-359	69	0	-290
109	Estonia	0	-10	-45	0	-55
110	Spain	0	136	-566	0	-430
111	Finland	0	-292	-29	0	-320
112	France	2,110	-478	-1,654	0	-21
113	Greece	0	-9	-483	0	-492
114	Croatia	0	-26	50	0	24
115	Hungary	31	-33	60	0	58
116	Ireland	0	33	-334	0	-301
118	Italy	0	87	584	0	671
119	Liechtenstein	0	0	0	0	0
120	Lithuania	15	-345	735	0	405
121	Luxembourg	2	6	-10	0	-2
122	Latvia	0	-225	6	0	-219
123	Malta	0	0	0	0	0
124	Netherlands	1,674	7	-376	0	1,304
125	Norway	0	93	291	0	384
126	Poland	85	-725	1,853	0	1,213
127	Portugal	0	7	-41	0	-34
128	Romania	156	-444	197	0	-91
129	Sweden	0	-833	136	0	-697
130	Slovenija	0	37	104	0	141
131	Slovak Republic	2	8	56	0	65
132	Turkey	0	-1,532	197	0	-1,335
133	UK	22	636	109	0	766
134	Azerbaijan	0	0	21	0	21
137	Bosnia	0	1	23	0	24
143	Andorra	0	0	0	0	0
145	Albania	0	2	159	0	161
146	Armenia	0	0	3	0	3
148	Serbia	162	7	-50	0	119
149	Montenegro	0	18	16	0	34
151	Macedonia	0	1	-5	0	-3
152	Belarus	0	-379	281	0	-99
153	Ukraine	3	-1,378	2,086	0	711
154	Moldova	2	-75	213	0	140
Maritime					303,667	303,667
Grand Total		8,260	-6,851	3,511	303,667	308,587