The Balance of Container Traffic amongst European Ports

Final Report

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1 Introduction

The Ports of Antwerp, Rotterdam and Hamburg commissioned NEA to undertake an independent investigation of the likelihood and potential impacts of a change in the balance of traffic amongst European mainland seaports, using existing research-based methodologies.

The study addresses the following questions:

- How have the current distribution patterns developed
- To what extent are they optimised, and according to which criteria
- Under what conditions might distribution patterns change
- What would be the barriers to achieving a different pattern of distribution
- What would be the positive and negative consequences of a shift

1.1 Summary of Findings

This study set out to investigate the observation that seven ports located in the North of Europe have around four times the container throughput of the principal eleven ports competing along the Southern coastline of Europe.

A large and growing proportion (43%) of European container traffic is related to trade via Suez, principally with China, Japan, Korea and ASEAN countries. This traffic passes the Mediterranean ports en-route to the North. Potentially time and cost can be saved by diverting traffic from North to South, and yet, in a market where there are many competing ports and few restrictions in terms of port selection, shipping companies are still concentrating the largest volumes in the North.

The analysis concludes that the current situation is efficient, and is explained by a persistent combination of maritime and inland factors:

Inland Factors

- Europe’s economic geography. Depending on the indicator used, the distribution of economic activity suggests a natural split of 65-70% within the Northern half.
- Europe’s physical geography. The Alps and the Rhine waterways form a natural barrier and a natural corridor respectively, extending the catchment area of the Northern ports towards Switzerland and Austria.
- Europe’s multimodal transport infrastructure. The Northern ports currently make good use of inland waterway and rail access into the contestable hinterland. In the South, rail transport from ports towards the centre is still at a low level. Relatively high tolls and charges on Alpine crossings make road costs higher from the South than from the North.

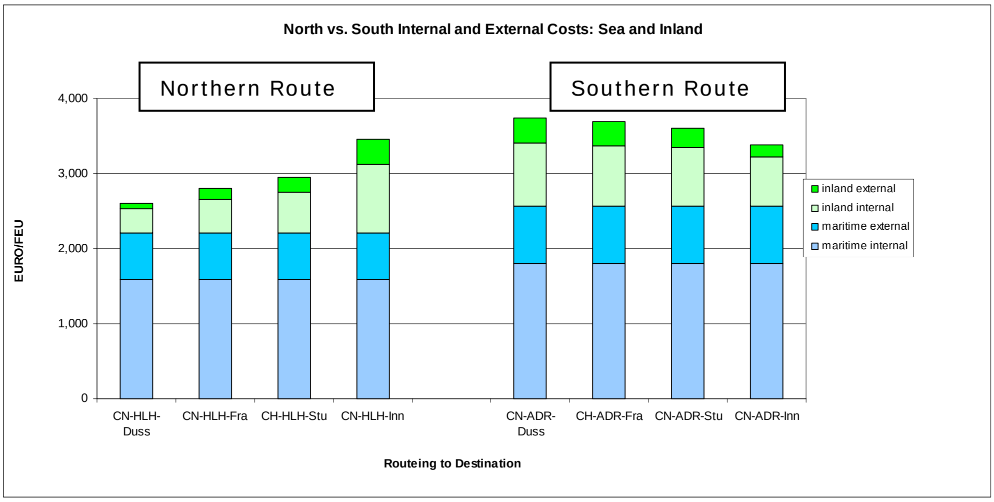
Maritime Factors

- Large container vessels. These are lowering costs and increasing capacity between Northern ports and the Far East. Clustering of activity, scale economies and deep water at the North European main-ports permits the use of ships with the lowest unit costs available.
- Low maritime costs. Combined with a competitive process that has led to an over-supply on the Asia-Europe trade route, it is currently cheaper to send a container from China to the Hamburg-Le Havre (HLH) Range than to the Southern ports.
- Scale economies within the HLH range also results in the attraction of container cargo for the Baltic area. East to West linkages are as important in explaining port traffic concentrations as North to South linkages.
- In the South, there is a clear distinction between transhipment hubs and continental gateways. In the North these roles are typically combined, further enhancing scale effects.

Externalities

- Including external costs within the optimisation of traffic distribution does not change the picture radically because internal and external cost drivers are similar, i.e. distance, modal split, fuel economy, scale and load factors.
- Inland, the Northern ports have an advantage because of the multi-modal networks, and at sea because of the large ships which are also less polluting in terms of CO_2 per tonne kilometre. This advantage counts throughout the full 20,000 kilometre journey between China and Western Europe.
- Considering both internal costs and external costs, the North European ports have an advantage as far as the Southern German border.
- Measures to protect environmentally sensitive regions such as the Alpine Arc re-emphasise the demarcation of the northern and Southern hinterlands.

Figure 1.1 Total of internal and external, land and sea costs for an Asia-Europe container delivered to a range of European cities



Source: NEA

Future Developments

- It is likely that the largest structural change will occur within the North Eastern Adriatic ports. Organic economic growth in this region (Slovenia, Croatia, and Hungary), resulting from better infrastructure and economic integration will improve scale economies, and inland links towards Hungary will help Adriatic ports to gain share. This will bring the North to South ratio back to 75:25.
- In the North, market growth, even under pessimistic growth assumptions is likely to be still strongly positive in absolute terms. Thus there is a continuing need for high capacity multimodal links.
- The prospect of yet-larger ships and yet-larger container terminals in the North will tend to reinforce the status-quo in the core markets of Central Europe.

Policy Directions

- The findings of the study indicate that on the maritime side, market forces are already playing an important role in bringing incentives for low transport costs and lowering carbon emission rates per TEU. It shows that attention should focus on technology, fuels, and load factors as well as port selection.
- On the inland side, the study tends to confirm and support the direction of the TEN-T core network policy, with the development of long distance multimodal corridors concentrating the flows between the main gateway ports and the inland centres of population and industry.

- Ports in the Hamburg-Le Havre range are generating large and growing proportions of European barge and rail traffic, and the clustering effect provides critical mass to permit frequent, high capacity inland links.

- In the Southern ranges, there are many medium-sized ports with shorter and mainly road-based inland connections, so the scale effects are less significant.
- This suggests a continued need for transhipment (sea to sea) hubs in the Mediterranean. In this way the scale advantages on the long distance voyages can be obtained, in combination with feeders to bring the cargo close to its final destination.
- South East European regions, especially Hungary and Slovakia remain relatively inaccessible from the main maritime trade routes. Better rail connections from Slovenia and Croatia would be attractive for freight services.
- Achieving the EC white paper targets for rail and waterway modal shares on longer distance routes can be assisted by ensuring capacity on port-inland intermodal connections throughout Europe.
- Engineering a North to South shift through intervention is limited by the availability and cost of rail infrastructure in the Alpine region. In future, the additional rail capacity offered on the Mont Cenis, Lotschberg, Gotthard and Brenner routes is likely to be needed for additional modal shift to rail within intra-European flows rather than for reducing maritime traffic around the Atlantic Arc.

2 Background

Europe is currently engaged in a debate about medium to long-term trends in long distance traffic, modal shares and the impact upon climate change and economic development. One important sector is the Asia-Europe container market, which has grown significantly as a result of a specific form of globalisation, in which a high proportion of new manufacturing investment has shifted to China. A growing volume of Europe-related freight traffic is now directed via Suez.

Historically, Transatlantic routes, short-sea traffic, and other trade routes have been more prominent, but if current trends continue, the dominance of the Suez-based traffic will increase. This has had three implications:

- Growth in European container traffic,
- Growth in the container ship sizes, since Suez is relatively unconstrained, and
- Growth in maritime traffic via the Mediterranean.

Potentially, European transport policy can adapt to this trend in order to maximise the economic and external benefits. In the 2011 EC White Paper, Article 392, referring to short sea shipping, states (emphasis added) that:

> *"A European infrastructure policy for ports should pay particular attention to ensuring the availability of ports well connected to the land transport system along the entire EU coastline. For such an approach to allow over time a more balanced distribution of entry and exit flows into the European transport system, ports would also need to improve further the availability, quality and reliability of their services as developed above in Section 0 above."*

The suggestion of an adverse degree of imbalance within the European networks for port related cargo, raises the possibility that attempts might be considered to "re-balance" the system, but as yet it is not clear what would constitute an imbalance. Although these statements refer to short sea shipping, it would not be possible to develop hinterland projects for short sea traffic without also influencing distribution of ocean cargo as well.

The challenge is therefore to investigate what might be understood by achieving more balance. Balance could be interpreted as the achievement of a superficial symmetry either within or between coastal ranges, but instead, an alternative view based upon a broader range of criteria might be offered.

In terms of Asia-Europe container flows it is necessary to examine and to optimise the combination of maritime and inland transport, treating port choice as a potential variable, to understand the logic of the status-quo, and the potential impacts of future changes.

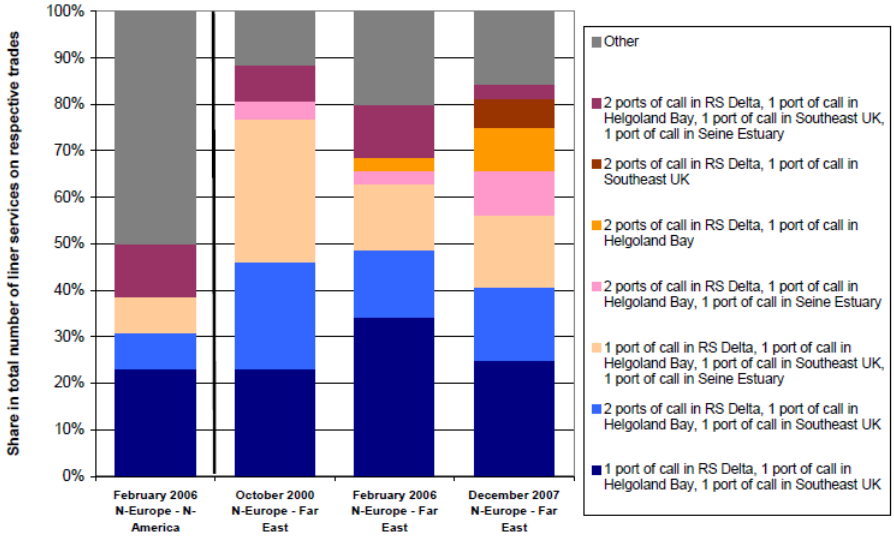
At a micro level, the mathematics appears straightforward. Munich to a Benelux port is 830km by road whereas Munich to an Adriatic port is around 550km. The sailing distance between Italy and the Rhine delta is 2,600 nautical miles (4815 kms). A Chinese box destined for Munich could save 280 land kms and 4815 sea kms by switching from North to South.

While such examples appear to lend *prima facie* support for the likelihood and benefit of a North to South shift, they cannot be used to provide conclusive evidence of market failure since they do not explain why transport companies freely choose current distribution patterns. Single origin-destination examples also do not provide the complete picture because shipping lines operate hub and spoke networks rather than point to point services. The analysis therefore needs to be systems-based[1] rather than case-based.

This requires an analysis of maritime as well as inland transport and distribution systems, and therefore the examination of typical calling patterns by the major carriers on the Asia-Europe trade-lane.

It is evident that in the main Europe-related trade lanes (Far East and North America) that the shipping lines are using large vessels, and making relatively few calls. See Notteboom (2009)[2].

Figure 2.1 Relative importance of port calling patterns on the North Europe - Far East and North Europe-North America trade lanes (in%)



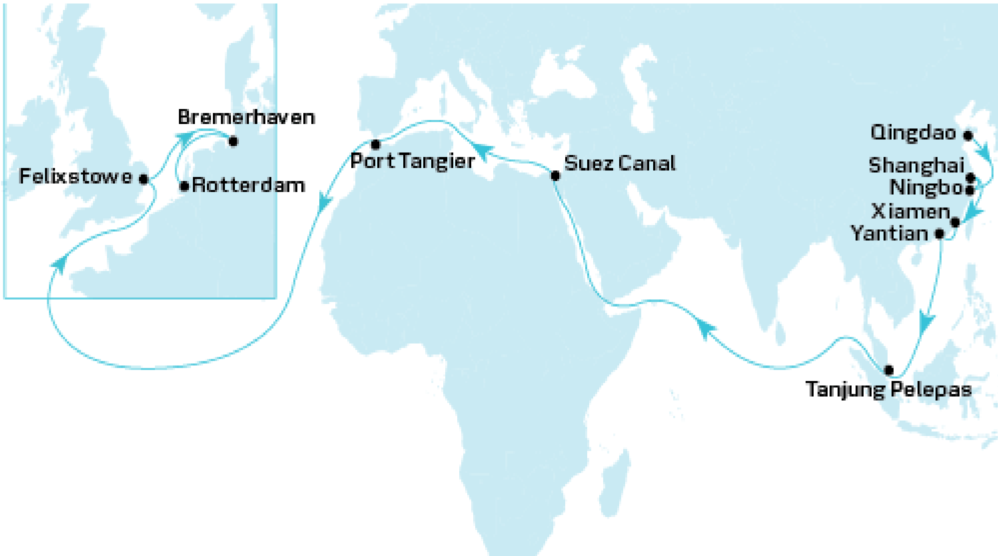
Source: Notteboom (2009)

[1] System - a complex whole; a set of things working together as a mechanism or interconnecting network. (OED definition)

[2] Notteboom, T. (2009), Economic analysis of the European seaport system, Antwerp: ITMMA.

Far Eastern containers typically arrive in Europe via Suez on large, dedicated container vessels. To maximise the benefits of scale, the numbers of port calls are relatively low and concentrated at the beginning and end of the rotation. In Figure 2.1 the lines analysed in December 2007 on the Far East route were typically making at least three calls in Northern Europe; one in the Rhine-Scheldt delta, one in North West Germany and one in the UK. A typical example from Maersk Line, the largest carrier on this route, is shown below. (Other call patterns from other lines are analysed in more detail later in the report). In this Maersk service, containers bound for Europe are collected from four Chinese ports and then from Tanjung Pelepas in Malaysia.

Figure 2.2 Typical Asia-Europe Liner Service, Maersk, AE7



After Suez, the ships in this Maersk schedule deliver cargo destined for Mediterranean European and African countries at the hub port of Tangier in Morocco, and then continue to the North Sea to deliver the North European cargo at Felixstowe (UK), Bremerhaven (DE) and Rotterdam (NL). Other carriers offer similar calling patterns, alternatively calling at Antwerp, Hamburg and Southampton for example in North Europe.

There are four important characteristics of these call patterns :

1. Once the ship has left Yantian, it makes relatively few calls until it reaches North Europe.
2. There is minimal diversion from the shortest possible sailing route between the end points, Shanghai and Bremerhaven.
3. The total number of port calls is low, with just two calls at transhipment hubs in Morocco and Malaysia replacing series of direct calls for example in the ASEAN and Mediterranean regions.
4. The transhipment hubs selected, Tanjung Pelepas and Tangier are both modern, efficient terminals, operated by APM Terminals (AP Moller-Maersk Group), and capable of handling the largest container vessels.

This example indicates that container lines, who operate in a competitive environment, with a high degree of control over their maritime operations, are attempting to optimise their networks, and not to maximise the number of direct port to port connections. Hubs in the Mediterranean and South East Asia provide access to regional networks. Like airline networks, these container networks show a high degree of specialisation and evolution. External actions that might aim to influence port choice must therefore also consider the wider maritime network implications as well as hinterland effects. Chapter 6 of this report investigates in more detail how carriers on the Asia-Europe trade-lane deploy vessels to serve different regions of Europe.

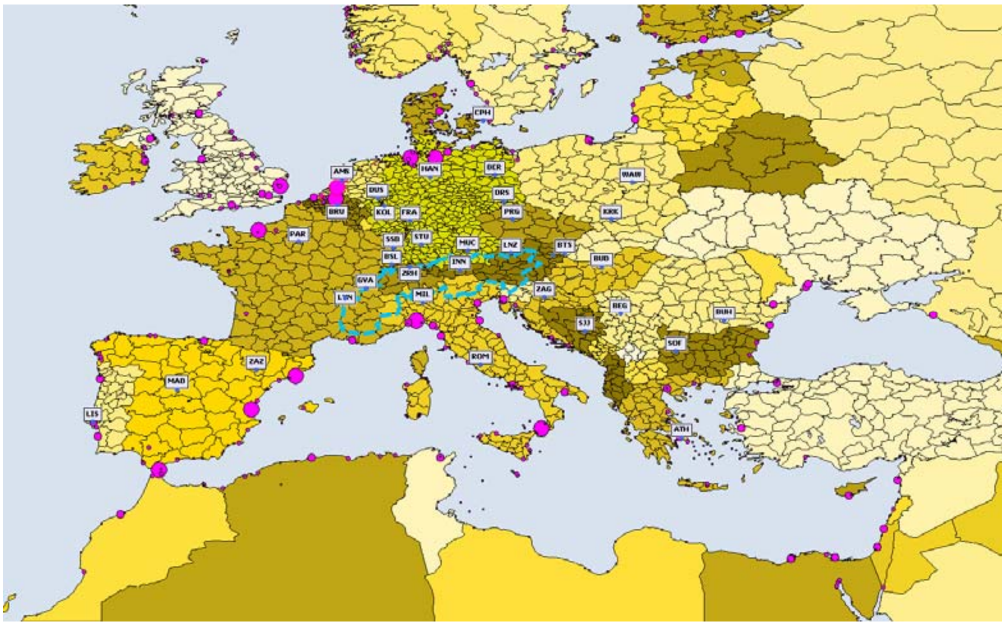
Thus, it is necessary to consider how much it costs to divert away from the long distance sea lanes, and what is the trade off between port selection and ship size.

3 Scope of Study

3.1 Geographical Scope

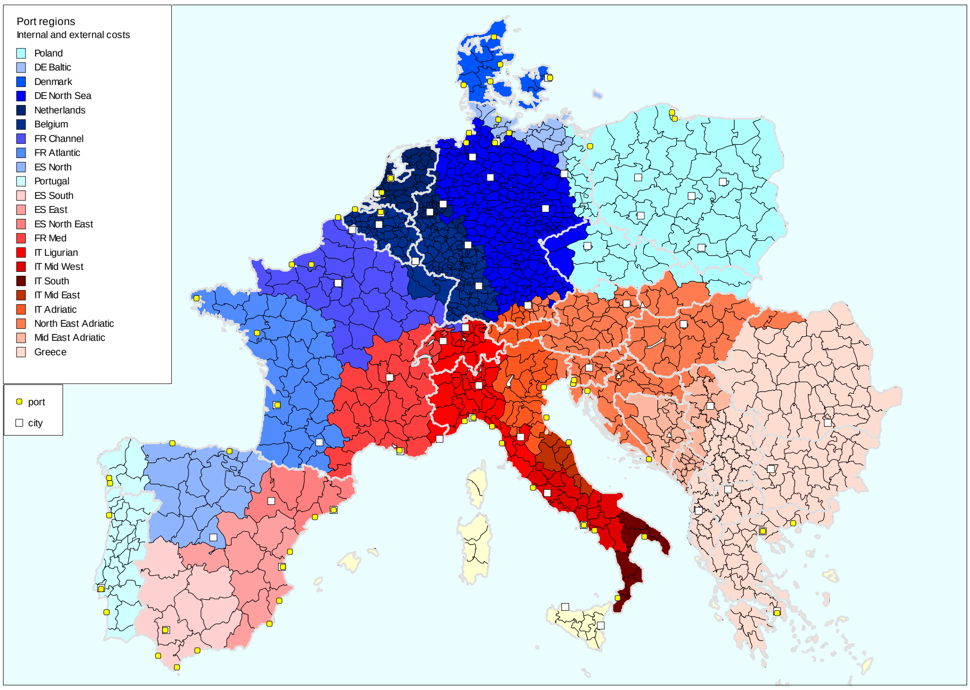
The main focus is upon the balance of traffic between the Northern range of ports and the Mediterranean coastline. Other coastal areas including the Southern Baltic coast, and the Aegean, are relevant, because of overlapping hinterlands, but are not the central issue of this study. Development of traffic within the British and Nordic regions also need some consideration in the traffic analysis since these add weight to the "centrality" of the North West continental ports, and provide a permanent incentive to bring large ocean going vessels into the North Sea area. This overview of demand by European country, including Britain and Scandinavia is provided in section 4.5.

Figure 3.1 Container Port Traffic in Europe, 2008



The hinterland analysis is limited to the Continental area, by defining two main coastal ranges, the Northern Range and the Southern Range. Hinterland flows in regions such as Britain and Sweden are not considered at all, so this section refers only to the Continental area, covering the whole European continent as far east as Poland and Romania. Thereafter the study will focus primarily on the central core of this range.

Figure 3.2 Continental Hinterland Territories



This map (above) has been constructed by defining 22 port ranges. The choice of these ranges corresponds broadly with the main clusters of container handling ports, national borders and natural breaks in the coastline. The ranges stretch from Poland in the North East to Portugal in the South West to Greece in the South East. The ports indicated in the maps are those with recorded container traffic. The coastal range labelled "Greece" also encompasses the coast of Albania, but the predominant container ports in this range are Greek.

Each range has been classified either as North European or South European, with blue colours signifying a Northern range and red colours a Southern range. See map legend.

The European continent has then been broken up into NUTS3 administrative regions, and each region is assigned to one of the port ranges on the basis of the lowest accessibility cost (estimated internal and external costs). A blue region is therefore one which is closest to a Northern port, and the shade of blue indicates which port range is closest. Under these assumptions, where the whole territory from Portugal to Poland is included, the Atlantic coastline as far as Portugal is treated as part of the Northern range. In this way the North-South choice for regions in central Spain are shown in a similar fashion. Black Sea ports were not included – this could potentially improve and broaden the methodology.

However, although a broad area has been defined, the main focus will be upon the central part of the European continent.

The purpose here is to define an initial set of territories as a reference point for the statistical analysis, with every region assigned unambiguously to a coastal range based on a specific criterion. Additionally it is important to start with a large and comprehensive range of ports, rather than following the more traditional approach of viewing Antwerp, Rotterdam, and Hamburg's competition as limited to the Hamburg-Le Havre range. Clearly there is an overlap between the Northern and Southern hinterlands.

It should be noted that these are maps showing relative accessibility. They are not estimates of actual hinterlands. It can be expected that any given port is likely to win traffic from the regions assigned to it by this calculation, but these should not imply that real hinterlands are so highly demarcated.

3.2 Trade Lanes

Primary focus is upon deep sea (ocean) routes in general, and the Europe-Far East routes in particular. The analysis will not concentrate exclusively upon the Europe-Far East services, as the North and South Atlantic routes also help to determine the location of hubs and the achievement of critical mass for intermodal services. Isolating the Europe-Far East route over-simplifies and distorts the situation.

3.3 Cargo sectors

Primary focus of this study is on container services.

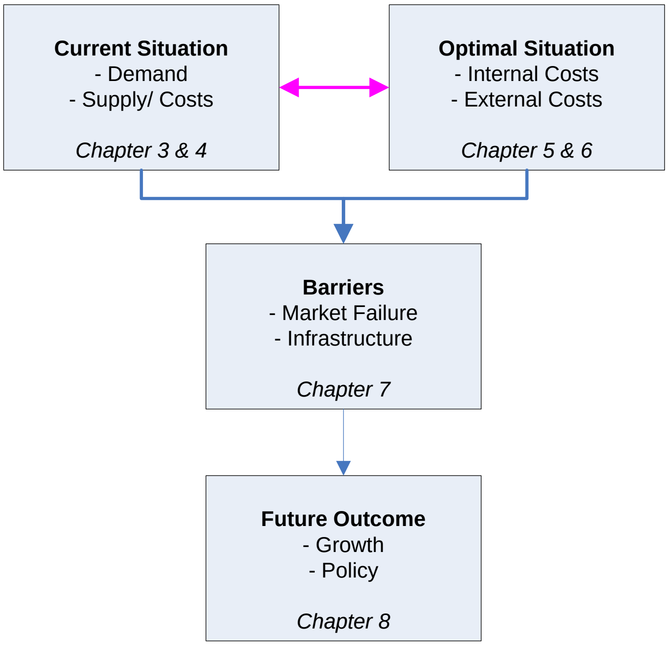
3.4 Time horizon

The study is based upon a time horizon up to 2030.

3.5 Approach

The study was carried out by testing the current situation to see whether existing distribution patterns could be explained quantitatively on the basis of demand patterns and transport networks and costs. Then, an attempt has been made to estimate an optimised distribution, in which both internal and external costs are considered. By comparison it has been possible to understand the importance of either market barriers or barriers arising from public infrastructure provision. Then, by considering market evolution the future development, and policy implications are analysed.

Figure 3.3 Study Approach



One hypothesis is therefore that the current situation is not optimal, that barriers exist, preventing the achievement of a greater degree of efficiency, and these must be solved by new investment or regulation in order to achieve desired policy objectives in future.

An alternative hypothesis is that the current situation is close to or autonomously moving towards to the optimal situation, and that new policy is only needed to prevent barriers occurring in future due to the natural evolution of demand and supply.

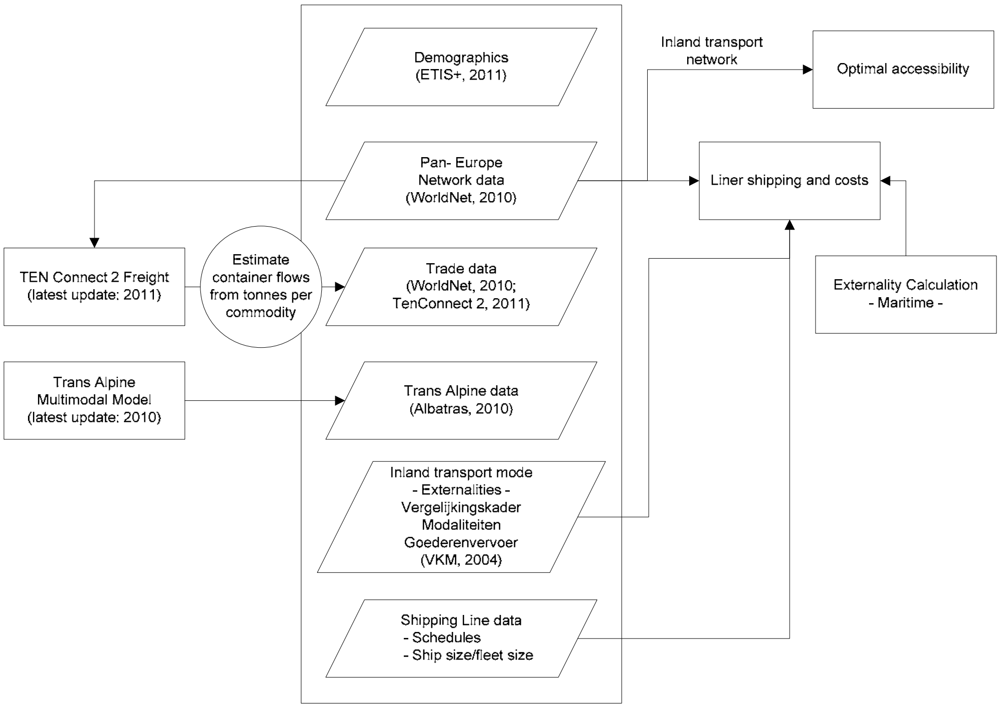
The study has been carried out between July and September 2011, by using quantitative transport modelling techniques in conjunction with market research, involving shipping lines currently active in the Asia-Europe market.

The methodology involves a combination of inputs from previous studies. However, certain elements are new, having been adapted for the container sector.

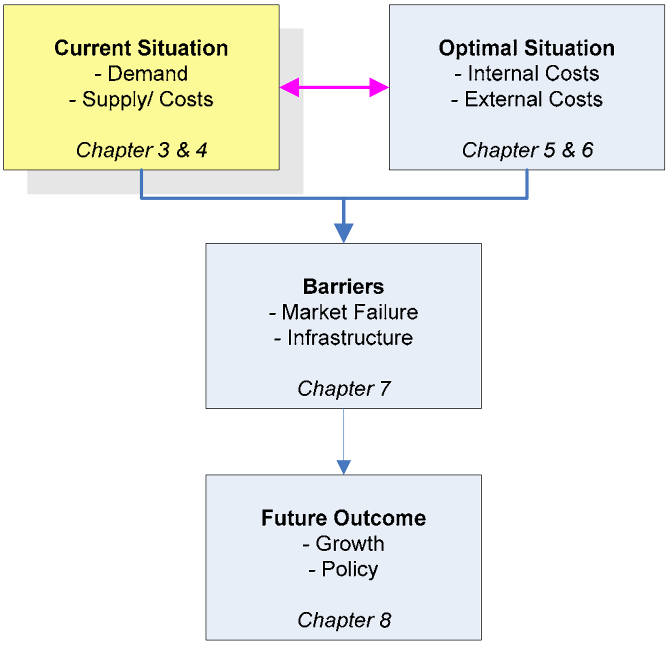
European freight flow, port traffic and network data are derived primarily from WORLDNET and related projects. Transalpine flows and forecasts are derived from the TAMM (Transalpine) model, as used in the ALBATRAS project. Inland externalities are calculated from the Vergelijkingskader Modaliteiten (VKM) study.

The main new additions are the estimations of maritime costs within the WORLDNET framework, based on plotting realistic ship rotations, and the combination of internal and external costs in order to calculate optimised accessibility levels. External costs of maritime transport are also now estimated.

Figure 3.4 Applied Methodologies



4 Current Situation Analysis

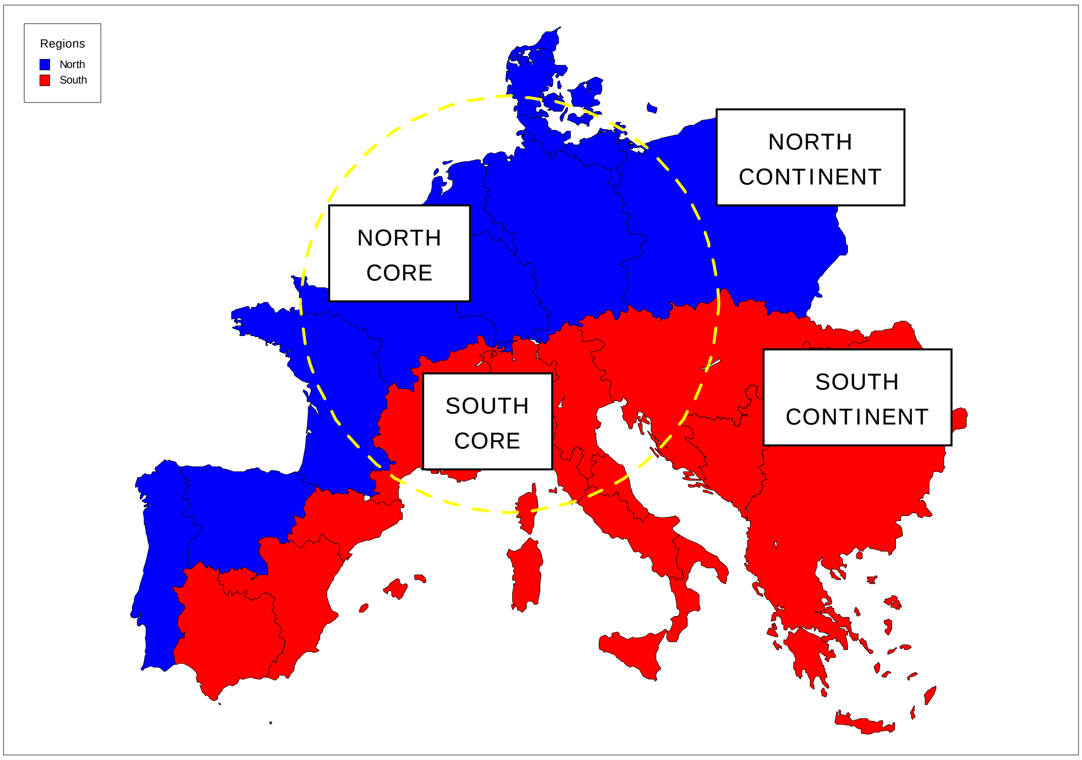


The first objective is to determine the logic of the existing transport routeing and distribution patterns, and to investigate whether there are distortions pointing to areas of market failure.

The following analysis is based upon a definition of port territories within Europe. The continental area is split North-South based upon total internal and external cost, and a core set of regions (inside the yellow circle) is superimposed in order to highlight the central regions forming the main hinterlands of Antwerp, Rotterdam, and Hamburg in the North and the Mediterranean/Ligurian and Adriatic ports in the South as far West as the Spanish border and as far East as Croatia. There is no standard demarcation of central Europe – the encircled area allows the North-South comparison to be focused upon a central area, leaving out the peninsular regions. However it is noted that competition exists from outside the circular area.

The initial objective is to compare the port shares with the underlying social, economic and trade activity in order to establish a set of North-South benchmarks.

Figure 4.1 Definition of European Territories



4.1 Demographics Profile

- Population is balanced between the broader North and South continental territories.
- Within the central core, the population is weighted 69:31 towards the North.
- The core regions account for 54% of the total continental population.

Figure 4.2 Distribution of Population, by hinterland region, 2005

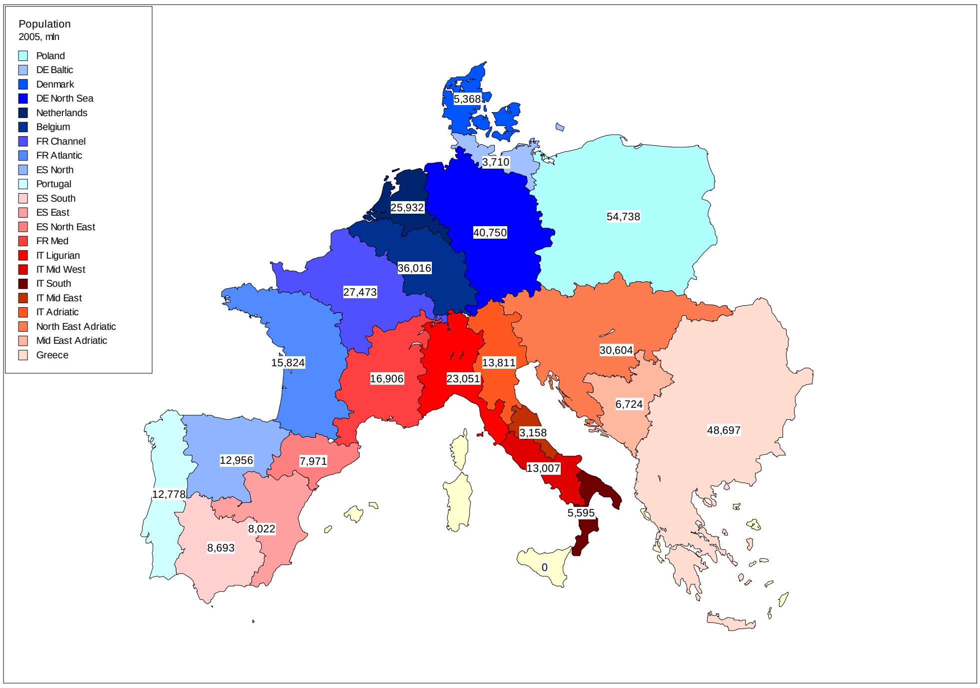
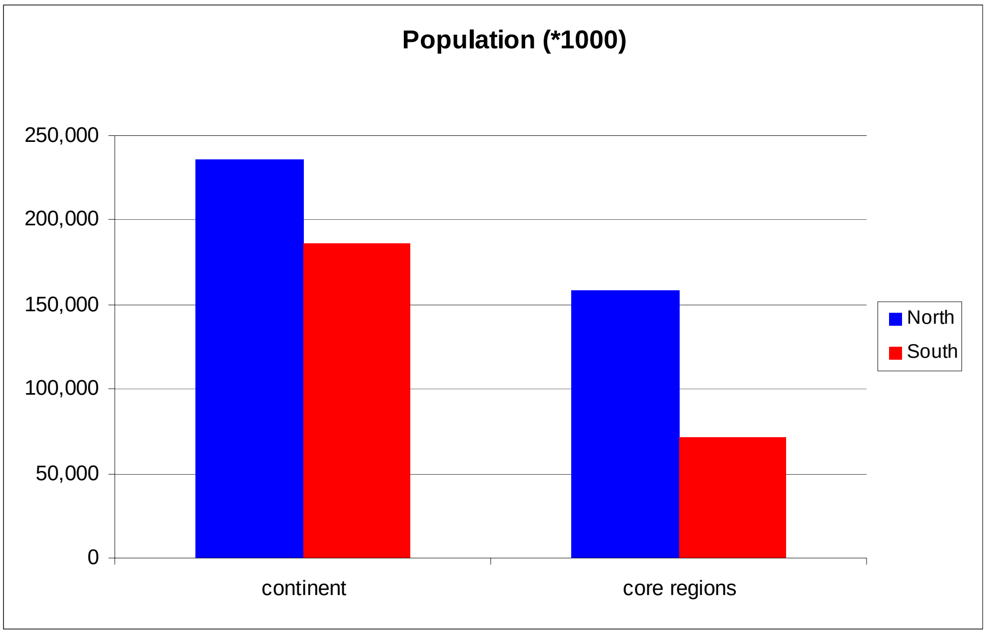


Figure 4.3 Population Shares, 2005



Source: ETISplus

Table 4.1 Population Shares, 2001

Shares of Population	*Percentage*
North Continent Share	56%
South Continent Share	44%
North Core Share	69%
South Core Share	31%
Core/Continent	54%

4.2 Economic Profile

- Economic activity, as measured in GDP is weighted 63:37 towards the North continental territories.
- Within the central core, the economy is weighted 69:31 towards the North.
- The core regions account for 71% of total continental economic activity.

Figure 4.4 Distribution of Economic Activity, by hinterland region, 2005

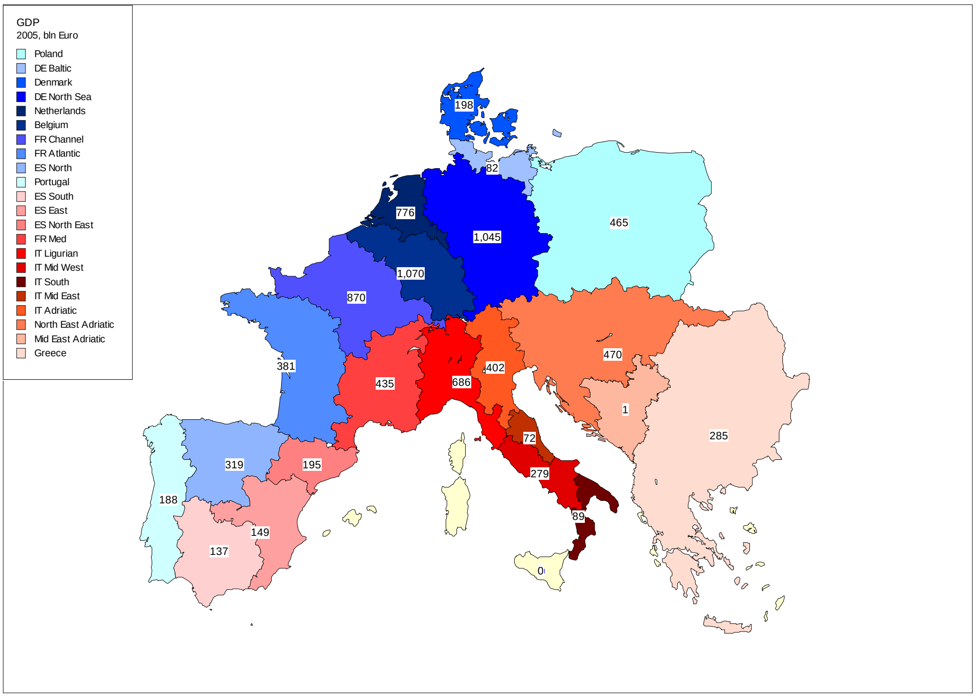
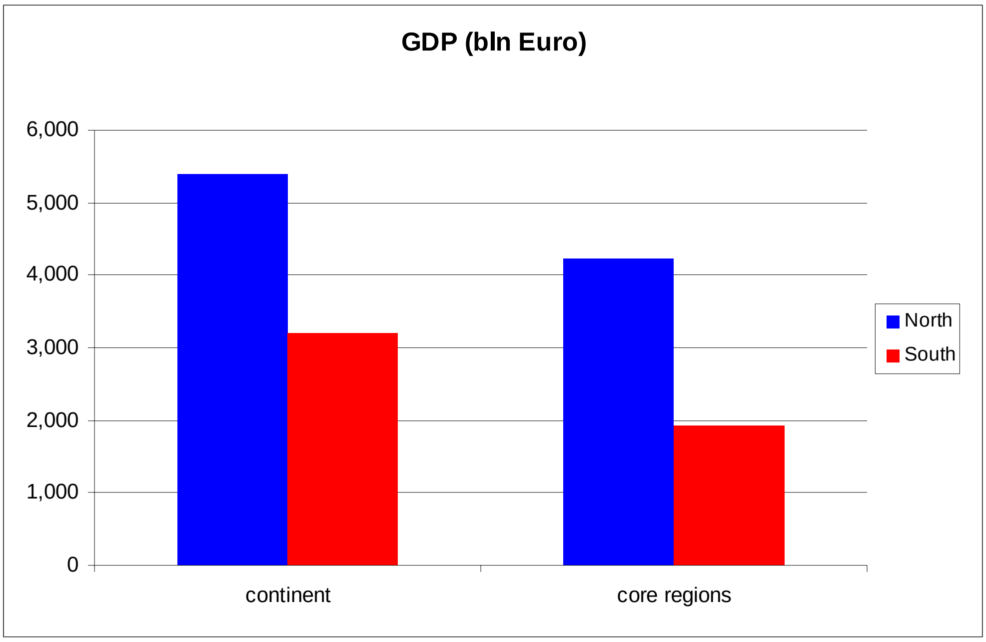


Figure 4.5 Economic Shares, 2005



Source: ETISplus

Table 4.2 Economic Shares, 2005

Shares of Economy	*Percentage*
North Continent Share	63%
South Continent Share	37%
North Core Share	69%
South Core Share	31%
Core/Continent	71%

4.3 Containerised Tonnages

- In the busier, import direction the regions of the North continent account for 63% of containerised trade, approximately in line with the economic weighting.
- Also, in the import direction, the regions of the North core account for 72% of containerised trade, higher than the economic share.
- In the export direction, although the volumes are smaller, the North-South weightings are similar to the import direction.

Volumes are based on the estimated regional matrices for the year 2005, initially used for the WORLDNET study. Since 2005, container volumes grew rapidly until the downturn in 2008 and 2009. However, trade growth figures for the Asia-Europe container flows indicate that the countries in the North and the South both grew at similar rates over this period, with the Southern countries growing slightly faster on average in both directions. See Table 4.9 and Table 4.10.

Methodologies for estimating container flows are derived from existing databases and models. See overview in Figure 3.4.

Figure 4.6 Distribution of Containerised Tonnes, by hinterland region, 2005

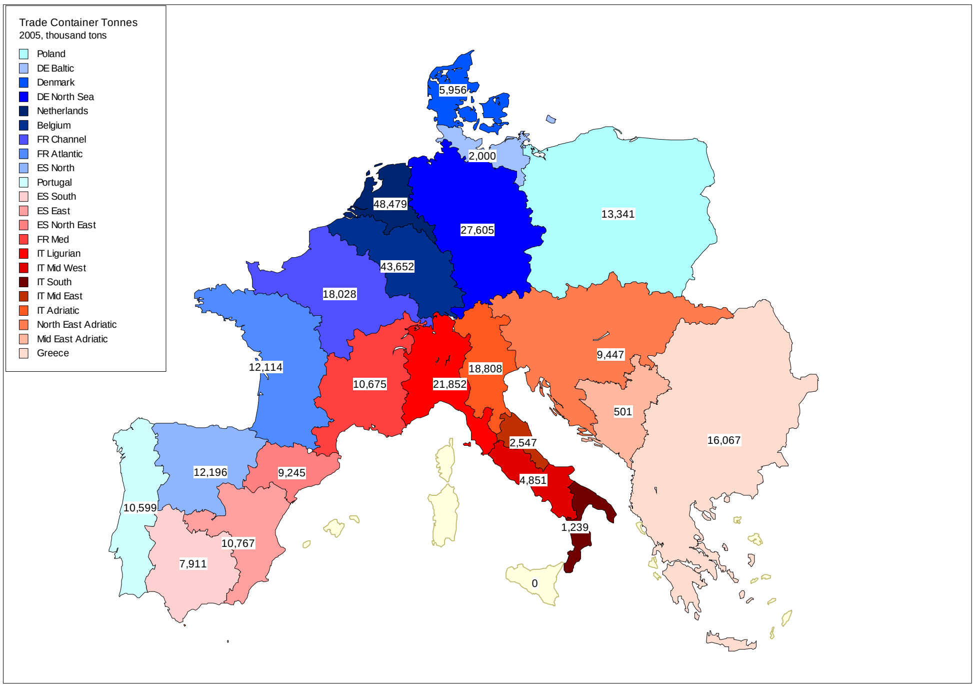
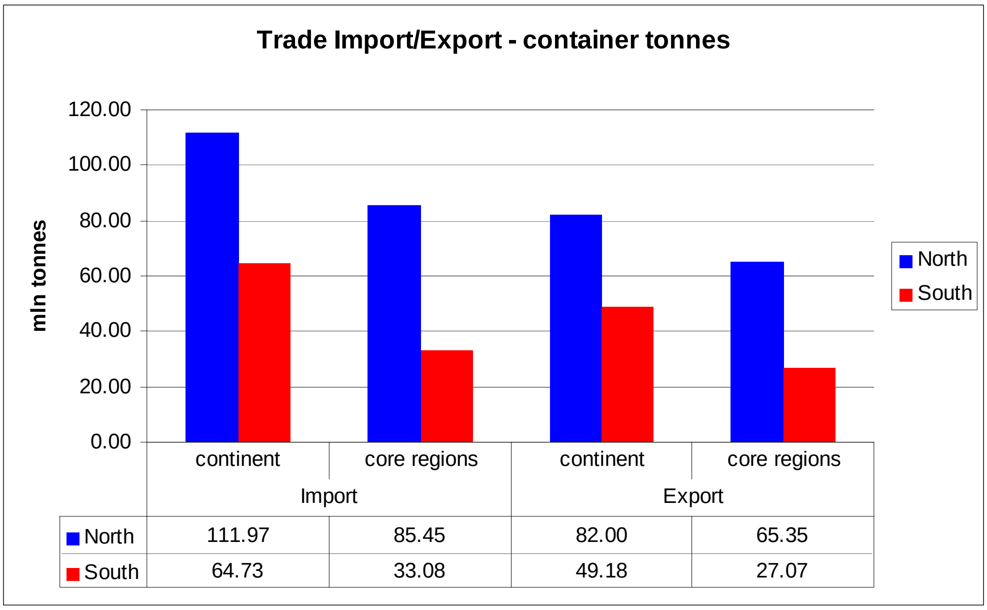


Figure 4.7 Estimated Containerised Tonnage Imported and Exported, 2005



	Import: continent	Import: core regions	Export: continent	Export: core regions
North	111.97	85.45	82.00	65.35
South	64.73	33.08	49.18	27.07

Source: WORLDNET

Table 4.3 Containerised Trade Shares, 2005

Shares of Containerised Trade	*Import Percentage*	*Export Percentage*
North Continent Share	63%	63%
South Continent Share	37%	37%
North Core Share	72%	71%
South Core Share	28%	29%
Core/Continent	67%	70%

4.4 Containerised TEU

- With container flows translated into TEU, including empties, the import and export directions are approximately in balance.
- The North continent accounts for 65% of import demand.
- The North share of the core region is 72%.

Figure 4.8 Distribution of Containerised Traffic, by hinterland region

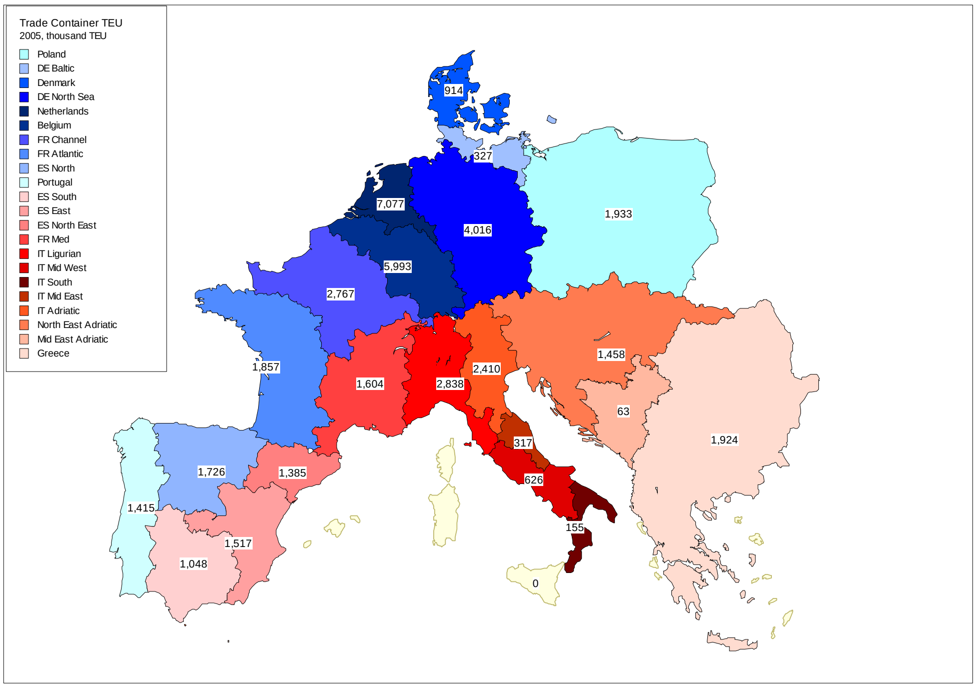
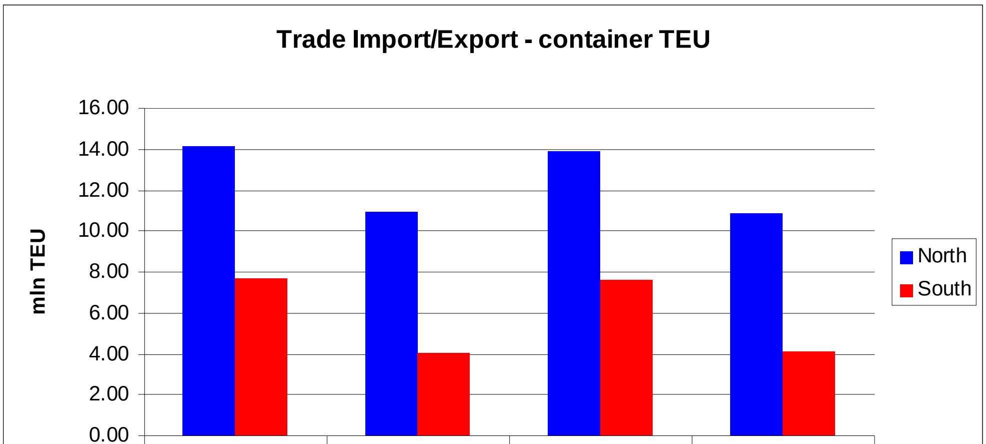


Figure 4.9 Estimated TEUs Imported and Exported, 2005



	Import continent	Import core regions	Export continent	Export core regions
North	14.12	10.93	13.91	10.86
South	7.70	4.05	7.65	4.12

Source: WORLDNET

Table 4.4 Containerised TEU Shares

Shares of Containerised TEU	***Import Percentage***	***Export Percentage***
North Continent Share	65%	63%
South Continent Share	35%	37%
North Core Share	72%	71%
South Core Share	28%	29%
Core/Continent	69%	69%

4.5 European Containerised Trade, 2009

4.5.1 Europe-Far East Market

An analysis has been made estimating the volume of containerised traffic moving between Asia and Europe, based on trade flows. It is possible to analyse the flows by year (1999-2009), direction (Asia-Europe, Europe-Asia), and by countries of origin and destination.

The objective was to estimate the balance of cargo by European destination for a ship arriving via Suez.

Four country-based European regions are defined:

Table 4.5 European Trade Regions

Region	*Definition*
North Continent	All North Continent countries including France, Belgium, Netherlands, Germany, Denmark, Poland, Slovakia, Czech Republic, Luxembourg and Austria. (Switzerland as a non-EU countries is not included)
South Continent	Portugal, Spain, Italy, Slovenia, Greece, Bulgaria, Romania, Cyprus, Hungary, Malta. (Former Yugoslavian countries and Albania excluded)
Baltic (East and North)	Finland, Lithuania, Estonia, Latvia, Sweden (Norway and Russia are excluded)
UK Ireland	UK and Ireland

Table 4.6 Asian Trade Regions

Region	*Definition*
Gulf/Middle East	Arabian countries South and East of Suez. (Does not include Mediterranean countries e.g. Lebanon)
Indian Subcontinent	Mainly India, Pakistan and Sri Lanka.
South East Asia	Mainly Malaysia, Indonesia, Thailand, Philippines.
Australasia/Oceania	Australia, New Zealand, Fiji, Tonga etc.
China Sea	China, Taiwan, Hong Kong etc
North East Asia	Japan and Korea

Table 4.7 Estimated Containerised Trade, TEU (mln) Asia to EU Europe

	Estimated. Loaded TEU (mln)	
By Asian Region	**2009**	**Share**
Gulf/Mid East	1.916	17%
Indian Subcontinent	0.926	8%
S.E. Asia	2.118	19%
Australasia/Oceania	0.946	8%
China Sea	4.608	41%
Japan Korea	0.745	7%
TOTAL	11.259	100%
By European Region	**2009**	**Share**
North Continent	5.685	50%
South Continent	3.504	31%
Baltic North and East	0.299	3%
UK/Ireland	1.772	16%
TOTAL	11.259	100%

From Asia to Europe, it is estimated that 11.259 million TEU were carried in 2009, of which almost half came from the North East Asian group containing China, Japan, and Korea. This would be equivalent to three 10,000 TEU vessels passing Suez every day.

Half of the containers are bound for the North Continent, 31% for the South Continent, and the remaining 19% for the North-West (UK/Ireland) and North-East (Nordic/Baltic) regions. This implies that about 70% of the traffic will pass the English Channel, either for transhipment at one of the main continental hubs, or for a direct call in England or the Baltic Sea.

Table 4.8 Estimated Containerised Trade, TEU (mln), EU Europe to Asia

	Estimated. Loaded TEU (mln)	
By Asian Region	**2009**	**Share**
Gulf/Mid East	2.085	21%
Indian Subcontinent	1.476	15%
S.E. Asia	1.447	15%
Australasia/Oceania	0.373	4%
China Sea	3.370	35%
Japan Korea	0.983	10%
TOTAL	9.734	100%
By European Region	**2009**	**Share**
North Continent	4.941	51%
South Continent	2.266	23%
Baltic North and East	1.117	11%
UK/Ireland	1.410	14%
TOTAL	9.734	100%

In the opposite direction, volumes are generally lower, due to a persistent trade imbalance. However, the geographical shares are similar with 45% of Asia bound trade destined for China, Japan and Korea. By European region, 51% of cargo is from the Northern continental countries, but only 23% of loaded containers returning to Asia are from the South, so the total volume passing the English Channel is 76%.

4.5.2 Growth in Containerised Asia-Europe Market

Repeating the analysis for 1998 and 2004 shows the growth trend in the market. In the busy (European import) direction, growth averages 6.4% per annum. South Europe is the fastest growing region, but the margin of growth between North and South is low. Thus, the shares of traffic by region have remained remarkably constant.

Table 4.9 Estimated Containerised Tonnage(mln), Asia to Europe, '98 to '09

Asia to Europe	*1998*	*2004*	*2009*	*Growth*
North Continent	21.315	37.956	42.635	6.5%
South Continent	12.588	14.646	26.278	6.9%
Baltic North and East	1.083	1.916	2.241	6.8%
UK/Ireland	7.720	13.428	13.290	5.1%
TOTAL	42.707	67.946	84.443	6.4%

More variation is apparent in the export (Europe to Asia) direction. Overall growth rates are higher, and the two smaller regions (UK and Baltic) have grown at the fastest rate. The South continent has grown by almost 1% a year faster than the North, but in absolute numbers, the North has remained in the lead.

Table 4.10 Estimated Containerised Tonnage(mln), Europe to Asia, '98 to '09

Europe to Asia	*1998*	*2004*	*2009*	*Growth*
North Continent	16.813	30.338	37.060	7.4%
South Continent	7.084	10.576	16.991	8.3%
Baltic North and East	3.229	6.669	8.380	9.1%
UK/Ireland	3.725	8.381	10.576	10.0%
TOTAL	30.850	55.965	73.008	8.1%

4.6 Other European Deep Sea Container Markets

Using the WORLDNET database (estimated only for 2005) it is possible to estimate container flows for a larger number of European countries and by world region in order to show the proportion of Suez related traffic compared to total containerised demand. Volumes are estimated for the central regions of continental Europe and for the whole of Europe by a set of world areas corresponding to the main trade lanes. Volumes are estimated including empty containers.

Table 4.11 WORLDNET Trade Regions

Region	*Definition*
Central Europe	France, Belgium, Netherlands, Germany, Denmark, Poland, Slovakia, Czech Republic, Luxembourg, Austria, Switzerland, Bosnia, Slovenia, Italy, Hungary, Croatia, Serbia, Montenegro
Other Europe/Med	Portugal, Spain, Greece, Bulgaria, Romania, Cyprus, Malta, Finland, Lithuania, Estonia, Latvia, Sweden, Norway, UK and Ireland, Belarus, Ukraine + North Africa + Turkey and Other non-European Mediterranean.
Asia Oceania	Gulf, Indian Ocean, Far East and Oceania
Sub Saharan Africa	All Africa excluding Mediterranean
C&S America	Caribbean, Central America and South America
N America	USA, Mexico and Canada

Table 4.12 WORLDNET Trade Regions, Total TEU, Import and Export, 2005

	Central Europe		*Total Europe*	
	TEU (mln)	*Share*	*TEU (mln)*	*Share*
Europe	6.4	20%	9.9	18%
Asia Oceania	13.8	**42%**	23.3	**43%**
Sub Saharan Africa	2.6	8%	4.6	9%
C&S America	3.2	10%	5.8	11%
N America	6.4	20%	10.7	20%
TOTAL	32.4	100%	54.3	100%

4.7 Port Traffic Shares

Taking into consideration the distribution of cargo demand in Europe, we estimate that the regions of the North continent would account for 65% of demand, and within the central core area, the Northern regions would account for 72% of cargo generation and attraction. Such expectations can be compared with port handling statistics.

Figure 4.10 Containerised Tonnes 2008, Total Handling Including Transhipment

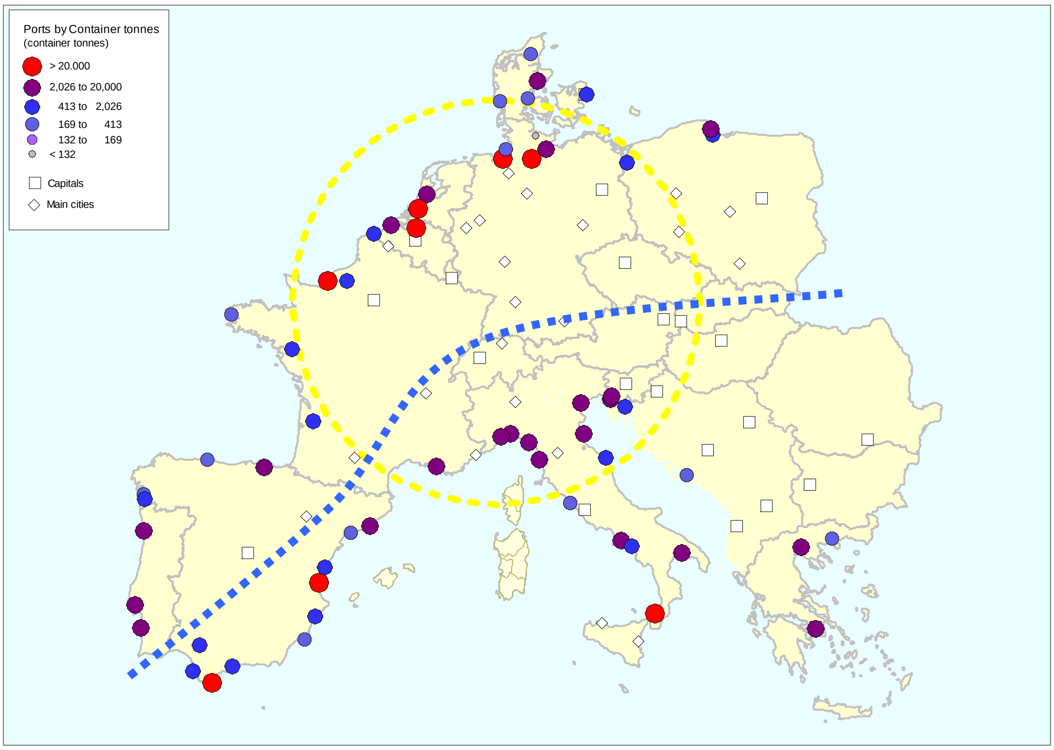


Figure 4.10 shows all the container ports (in colour) within the selected countries, and the location of the main European cities. There are sixty container ports in the map, accounting for 535 million containerised tonnes, or 66 million TEU, including sea to sea transhipment. After sea to sea transhipment is excluded, we estimate that European ports handle 344 million tonnes of containerised cargo (import and export together), or 44 million TEU. Only continental ports are included in these figures.

There are several important categories within these statistics:

- Deep-sea import/export cargo – the main focus of this study; containers arriving (in the case of imports) from outside Europe into a European port and then moving into the hinterland by road, rail or waterway.
- Short-sea import/export cargo – containerised intra-European and intra-Mediterranean trade.
- Transhipment – containers that arrive in a port by sea, and then leave on another container ship. Transhipment usually provides a link between ocean-going mother ships and regional feeder services. Such regional (e.g. Mediterranean or Baltic) feeder services, which bring extra-European trade into the ultimate point of unloading in Europe need to be distinguished from short-sea flows.

Most container ports handle a mix of these categories, but this study focuses on deep-sea container flows, the first or final points of import and export, and the hinterland which can be addressed from these port locations. Therefore when considering the balance of cargo, it is first necessary to exclude the other categories, particularly transhipment which involves large numbers of container moves. Overall, we estimate that within the continental port selection made for this study, that two thirds of total container movements are import/export rather than transhipment.

Short-sea import/export container volumes are harder to estimate per port. Short sea unit loads are carried on both container and roro services. The presence of short sea traffic in the overall statistics therefore creates a margin of uncertainty, when comparing North/South port traffic shares with the North/South deep-sea trade flows.

Table 4.13 Summary of European Container Volumes, 2008

	Containerised Tonnes (million)	*Total TEU (million)*	*Containerised Tonnes (million) Excluding T/S*	*TEU (million) Excluding T/S*
60 Container Ports	535	66	344	44

Throughput excluding transhipment has been estimated with the following ratios Table 4.14 derived from European research projects – the sources are shown below the table. In reality the sea to sea transhipment volumes are variable over time, so conservative estimates have been made for the Hamburg-Le Havre range ports.

Ports in the Rhine-Scheldt area such as Rotterdam, Antwerp and Zeebrugge have a relatively high proportion (75-80%) of import/export container handling, representing traffic to and from the hinterland. The two main German ports, Hamburg and Bremerhaven have higher shares of sea-sea transhipment traffic e.g. for the Nordic and Baltic areas.

In the Mediterranean the roles of hub and gateway tend to be split. There are a number of specialist transhipment hubs such as Algeciras (ES) and Gioia Tauro (IT). These are located close to the primary East-West shipping lanes and do not interact greatly with inland transport networks. Two of the main West Mediterranean ports, Valencia (ES) and Barcelona (ES) have a similar function to the HLHR ports, with a mix of import/export and transhipment. Otherwise, the more northerly Ligurian and Adriatic ports act primarily as import/export ports. The specialisation is an important feature of container distribution within this region.

Table 4.14 Proportions of Hinterland Traffic Per Container Port

	Share of Hinterland TEU
ROTTERDAM	75%
ANTWERP	80%
HAMBURG	54%
BREMERHAVEN	39%
VALENCIA	66%
ALGECIRAS	15%
GIOIA TAURO	5%
LE HAVRE	71%
BARCELONA	62%
GENOA	87%
ZEEBRUGGE	80%
LA SPEZIA	85%
MARSEILLES	96%
The Rest	95%

Sources: ITMMA, 2009, "Economic Analysis of the European Seaport System"; University of Cagliari, 2003, "Location as a Matter of Attraction for Hub Ports".

With the adjustment for transhipment, the port traffic figures are now more comparable with the 307 million tonnes of containerised trade and 43 million TEU estimated from the 2005 trade statistics. Both sets of results are summarised below.

Table 4.15 Summary of European Container Volumes, 2008

	Containerised Tonnes (million)	*Total TEU (million)*	*Containerised Tonnes (million) Excluding T/S*	*TEU Excluding T/S Million*
Trade Total 2005			**307.89**	**43.37**
Port Statistics 2008	535	66	**344**	**44**
Northern Ports	342	43	235	29
Southern Ports	191	23	107	14
Northern Core	330	41	223	28
Southern Core	54	7	49	7
Northern Ports	64.1%	65.2%	68.6%	67.9%
Southern Ports	35.9%	34.8%	31.4%	32.1%
Northern Core	86.0%	84.7%	82.0%	80.3%
Southern Core	14.0%	15.3%	18.0%	19.7%

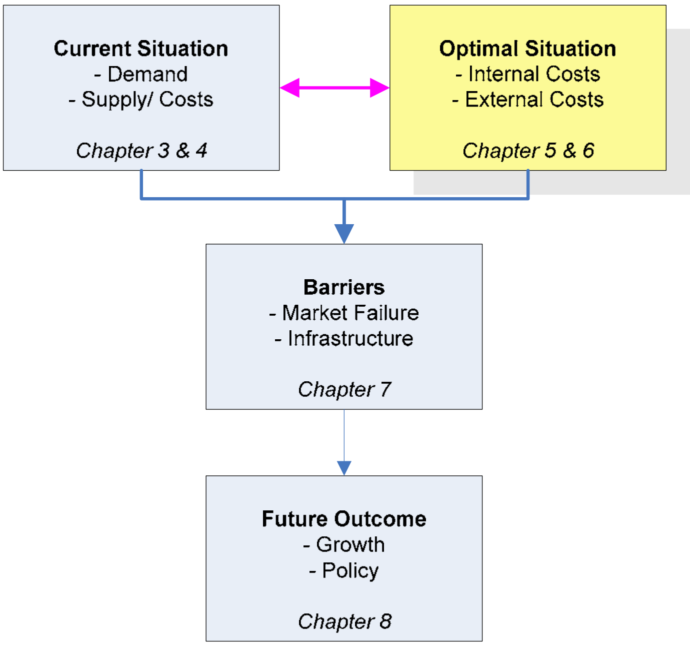
Comparing port statistics and trade statistics, the apparent tonnage difference of 36 million (11%) is mainly explained by the growth between 2005 and 2008. The difference in the ratio of tonnes per TEU is explained by the margin of error within the conversion from trade tonnes to TEU. This could potentially be an underestimate of the number of empty container loads generated, or by the difference between net tonnes and gross tonnes per TEU.

Port statistics indicate that if transhipment is excluded that Northern ports have a share of 67.9%, and within the core area, the share is 80.3%. Thus it appears that the Northern and Southern ports shares are close to those estimated from the natural hinterland areas. However, these differences between the flow based analysis and the port traffic based analysis are within the margins of error of the estimation processes, so the analysis and assumptions relating to the hinterland traffic generation are now examined in more depth.

The analysis is carried out in two steps, which are later combined, to allow a comparison to be made with the current situation and a modelled optimal traffic distribution solution:

- Step 1: Hinterland Optimisation
- Step 2: Maritime Optimisation

5 Hinterland Optimisation



For any European region, and any single definition of distance or impedance, there exists a port which is objectively closest to the cargo source. Therefore a theoretical system optimal can be found where all cargo is routed via the nearest suitable port and hinterland tonne kilometres become minimised. In reality there are complexities. Not all ports offer the same connections for all cargo types and all destinations. Nevertheless, by focusing upon deep sea containers, and the current choice of main gateway ports, an optimisation can be approximated.

However, distance is not the only possible indicator. Transport companies would typically seek to optimise according to (internal) cost, and public policy requires the inclusion of transport externalities.

Using a detailed multimodal network model it is then possible to compare different system optima, based upon different criteria e.g. distance, transport cost, transport time (especially important for time sensitive, high value cargo), and also estimated external costs.

Such optimisations can then be compared.

The object is two-fold. First to see how well a theoretical optimisation based on internal cost explains current distribution patterns, and second, to determine whether the internalisation of external costs radically alters the perspective. Here, the NEA location-allocation and network models were used to show cargo distributions optimised in terms of different criteria e.g. internal cost, external cost (including CO_2), total cost, and emission costs.

Such calculations can take into account regional differences e.g. higher externalities, different train configurations (train length and number of engines) and higher road user charges in the Alpine region[1].

In this way it is possible to avoid the over-simplified assumption that if the Southern ports expand their market share within the contestable European hinterland, that average inland distances will fall, and that externalities (especially greenhouse gases) will decrease. Even if average distances would fall, given a North to South shift, it is not necessarily true that externalities fall, due to:

- Different inland modal split
- Different road conditions (gradients)
- Different railway operations (numbers of locomotives per unit of cargo)
- Sensitivity of natural environment close to the transport arteries (local factors)

There is a need, therefore, to make a thorough comparison between a range of different criteria, including at least:

- Distance
- Internal Transport Cost
- Emissions
- All (conventional) externalities, including emissions
- Internal plus External Cost

Thus different combinations of criteria have been used. Emissions are counted in each of the last three tests. Internal transport costs are used in the second and last tests.

5.1 Overview of Optimisation Methodology

In reality it is difficult either to observe or to fully optimise port hinterland regions. They are likely to be highly overlapping, and may not even be contiguous regions.

Notteboom and Rodrigue (2005)[2] demonstrate that due to the existence of specific high-frequency low-cost connections by rail or barge, there will be inland destinations with strong associations with given seaports, and thus that actual hinterland shapes may not be continuous regions. See Figure 5.1.

In this study accessibility has been calculated based on network connectivity alone, i.e. and not upon the existence or performance of the intermodal services operating there. This is partly due to lack of comprehensive information on intermodal services, and partly due to the non-permanent nature of these services.

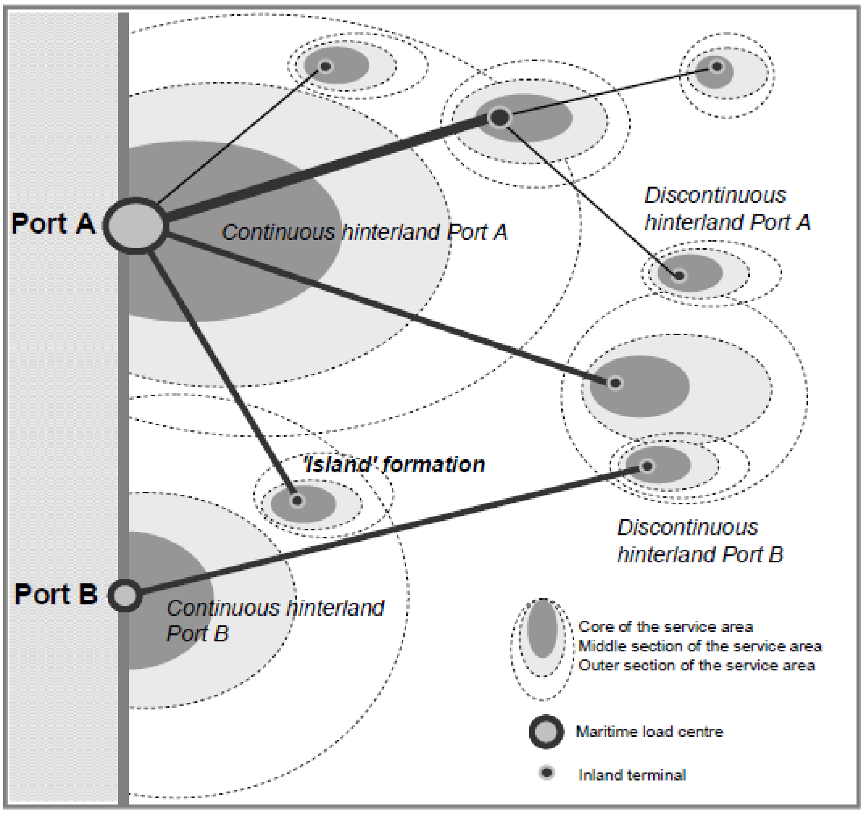
[1] Methodologies from ASSET can be used. See (e.g.) http://www.asset-eu.org/doc/Crossing.htm

[2] Notteboom, T., Rodrigue, J-P. (2005) Port regionalization: toward a new phase in port development, Maritime policy and management, 32:3, 297-313.

In principle, any port with sufficient volume and a rail or waterway connection could offer intermodal services inland. Distance is a permanent factor, the availability of navigable waterway infrastructure or rail links are fixed in the short and medium term, but efficient transport corridors are not fixed beyond the medium term. If these were taken into account, it would tend to extend the competitive reach of the Northern range ports, but this might exaggerate the size of the Northern region for the medium term and beyond.

More qualitative factors such as reliability and efficiency also affect port choice in reality, but these have been excluded from the analysis for similar reasons. While it might be possible to benchmark quality for the current situation, it cannot be considered as an absolute geographic advantage.

Figure 5.1 Discontinuous hinterlands and corridor-based 'island' formation.



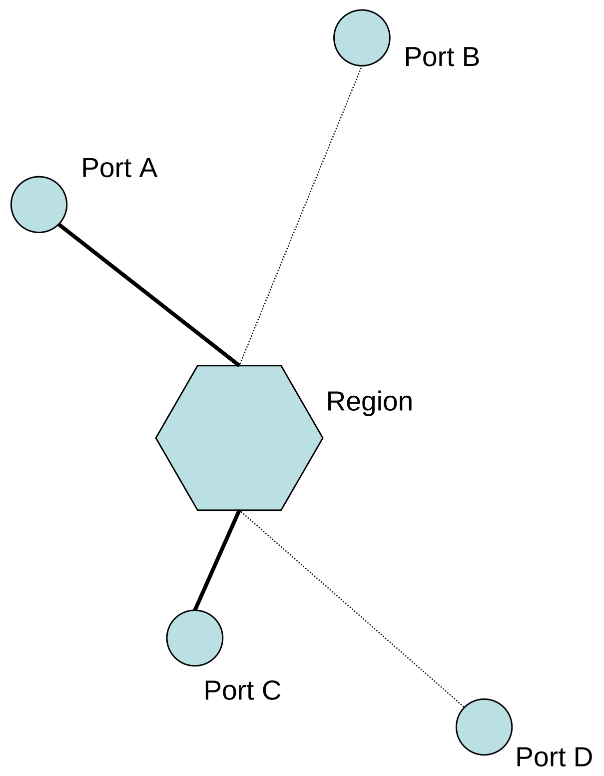
Source: Notteboom and Rodrigue (2005)

For this section of the analysis, *optimisation* implies an assignment of a region to a coastal range based on a given criterion. This allows us to calculate how much traffic a port range would win if all flows were directed to their nearest ports, and therefore under conditions of minimal inland transport. However, these are not meant to show actual hinterlands, and they should not be considered the best possible hinterlands since in practice, different shippers apply different accessibility criteria.

Furthermore, at the borders of the estimated regions, the differences in distance or cost are small, so in reality many regions are able to direct traffic to more than one port with minimal diversion costs.

To estimate volumes associated with the given port ranges, the traffic data has been examined at a NUTS3 regional level. The transport cost between each region and each container port has been analysed, and the most accessible North European and South European port has been estimated.

Figure 5.2 Diagrammatic Example of Accessibility Calculation



Thus, to demonstrate the calculation being made, the region in the diagram is associated with port A in the North and port C in the South, according to a given accessibility formula e.g. distance, transport cost, or external cost. In this example the closest northern port is A, the closest southern port is C, and the optimal port choice is C. Diverting from C to A incurs a cost.

The main issue then is how to calculate the accessibility. In the most straightforward example (see Figure 5.2) road distance is used. A network model has been used to generate realistic road routes.

The optimisation is then extended, so that accessibility is measured in terms of estimated transport costs (internal costs). Here, the choice of modes is considered, and the costs are weighted equally across the modes. Thus if road, rail and waterway are available, the accessibility figure is the average of the cost by the three modes.

If only two modes (road and rail) are available, the accessibility level is the average of these two. Several alternative methods exist, such as using the minimum cost, or a weighted average based on real inland mode shares. Under the methodology used here, all ports are considered to be accessible by road, the majority (both North and South) are considered connected by rail, even if rail is not currently used to a great degree, but waterway connections are mainly found in the Northern range.

If minimum costs were used, it would tend to exaggerate the accessibility of the waterway connected ports, and if real mode shares were used it would tend to ignore the potential for increasing inland rail flows in future.

To make these calculations, road tolls, including those applied in Switzerland and Austria as a heavy goods fee are used. Also because waterway services offering lower costs are generally only available from the Northern range, the impact of changing the accessibility criteria from distance to cost is to extend the captive area of the Northern ports southwards towards the Alpine arc.

The next step is then to use the same model to estimate externalities. In the literature there are many different treatments of externalities, so an attempt has been made to adapt these for the current purpose.

The main sources are:

1 IMPACT, Handbook on estimation of external costs in the transport sector. Produced within the study "Internalisation Measures and Policies for All external Cost of Transport", IMPACT, 2008, Maibach et al. (INFRAS, CE-Delft).

2 Vergelijkingskader Modaliteiten 1.4b, NEA in association with STERC, TransCare, 2001 to 2004. A study for the Ministerie van Verkeer en Waterstaat (DGG/AVV).

3 ASSET, Assessing Sensitiveness to Transport, Alpine Crossing, ECOPLAN, 2009. This study, in turn, uses inputs from ECOPLAN and INFRAS (2208), Externe Kosten des Verkehrs in der Schweiz. On behalf of Swiss Federal Office for Spatial Development and Federal Office of the Environment, Bern.

In this current analysis, externalities are calculated for:

- Noise
- Accidents
- Emissions (including climate change)

Therefore externalities arising from congestion are not included as a separate item, but the speeds in the transport cost model (internal costs) are lowered to take this into account, and all track charges, road tolls and fuel taxes are included in the internal costs.

Key variables are:

- the mode of transport,
- the type of vehicle, and
- the degree of loading

Three modes are considered: road (HGV), rail and inland waterway (barge). For road, the heaviest category (>20T) is used. For rail, a diesel train pulling container wagons is used. For barge, the Rijn/Europa category is used. All of these are chosen to be suitable for analysing interurban container movements inland.

Externalities have been monetised into Eurocents per vehicle kilometre, and these are then harmonised per FEU[1] (forty foot equivalent unit). The main source is the Vergelijkingskader Modaliteiten database, but comparisons were made with IMPACT to cross-reference the assumptions. The results of the two studies are broadly comparable at this level, although there are many underlying differences in the calculation method.

Table 5.1: Assumed Externality Rates (Eurocents per Vehicle)

	HGV	**TRAIN**	**BARGE**
Noise	1.47	23.15	0.00
Accidents	16.42	24.66	1.60
CO_2	4.89	93.42	479.67
SO_2	0.13	11.04	46.97
NO_X	11.81	332.85	1342.43
PM_{10}	3.89	74.74	574.28
NMVOC	0.27	2.89	30.37
CO	0.04	0.70	5.27
Emissions	**21.04**	**515.64**	**2478.99**
Total Eurocents per Vehicle	**38.93**	**563.45**	**2480.59**
FEU/Vehicle	1.00	35.00	125.00
Externalities, Eurocents per FEU	**38.93**	**16.10**	**19.84**

The outcome is therefore that the total externality arising from road transport is assumed to be 38.93 Eurocents per FEU-km, of which just over half is related to emissions.

[1] One FEU (forty foot equivalent) container unit equals two TEUs (twenty foot equivalents), and is approximately equal to a standard 12 metre road trailer.

Rail and waterway produce lower externalities, and according to these train and barge configurations have a similar overall external cost per FEU-km.

For trans-alpine traffic, additional assumptions are required in order to reflect higher rates of externality within mountainous regions. We assume this only applies to road transport, and only for the categories, noise and emissions. ASSET states that a factor of 5 (500%) is needed to compare externalities in the Alpine area with low altitude transport. However, since this only applies to a short part of the inland journey, we have applied a simple pro-rata increase of 80%. The high altitude sections of the main Alpine crossings are typically 200-400km, but a journey via these crossings may be over 1000km[1].

5.2 Overview of Results

Optimisations have been estimated according to different criteria:

- Road Distance
- Internal Transport Cost
- Emissions
- Total External Cost
- Full Optimisation (all internal and external costs)

The optimised port hinterland territories according to each optimisation are shown in the following pages.

The indicators are calculated between points in the network to provide estimates of port to region accessibility. Each region and each port is defined at a single point in the network per region. Since each region has a radius depending upon its size, and since the ports typically cover several kilometres, there is a margin for error of about 25-50km per case. This can be quite significant for short distance comparisons. The separation of territories between adjacent coastlines ranges is therefore subject to these precision variations, and to a greater extent than the separation of northern and southern territories.

[1] Assuming impedance rate of 1 unit per km, total impedance for 100km journey via Alps with 200km high altitude stretch is 800+(200*5)=1800. 1800 is 80% higher than 1000.

Figure 5.3 Road Distance Based Optimisation

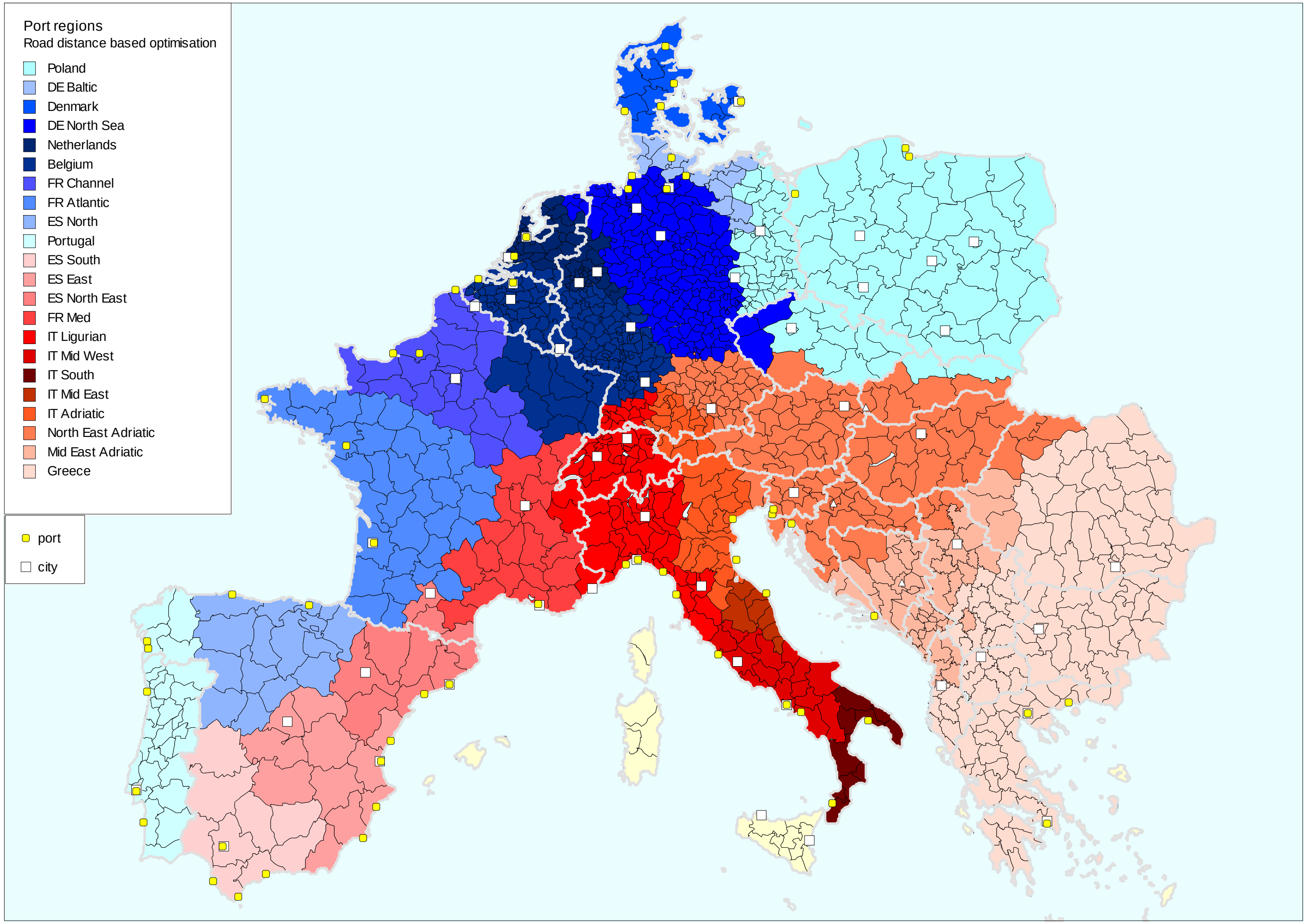


Figure 5.4 Internal Transport Cost Based Optimisation

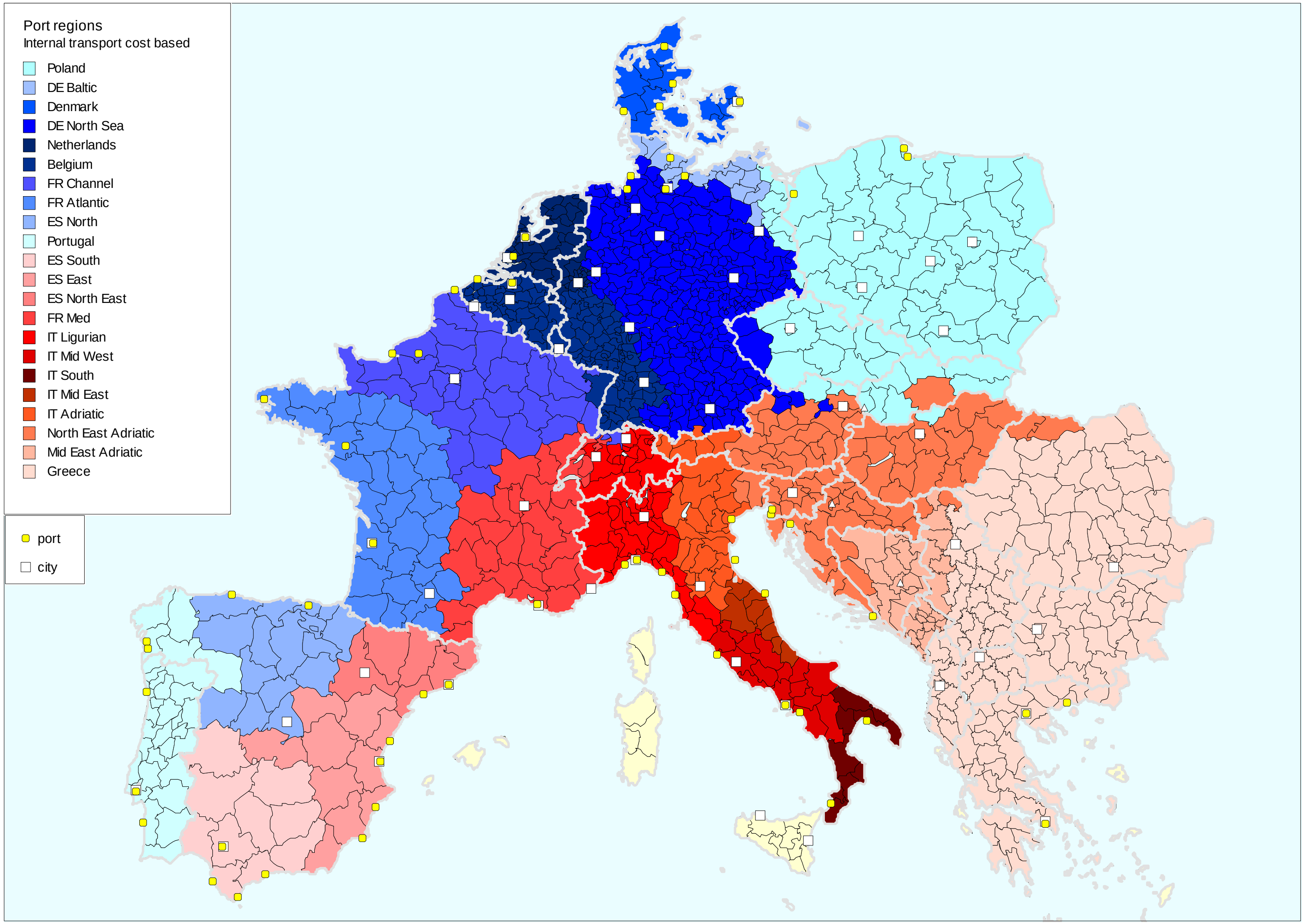


Figure 5.5 Emissions Based Optimisation

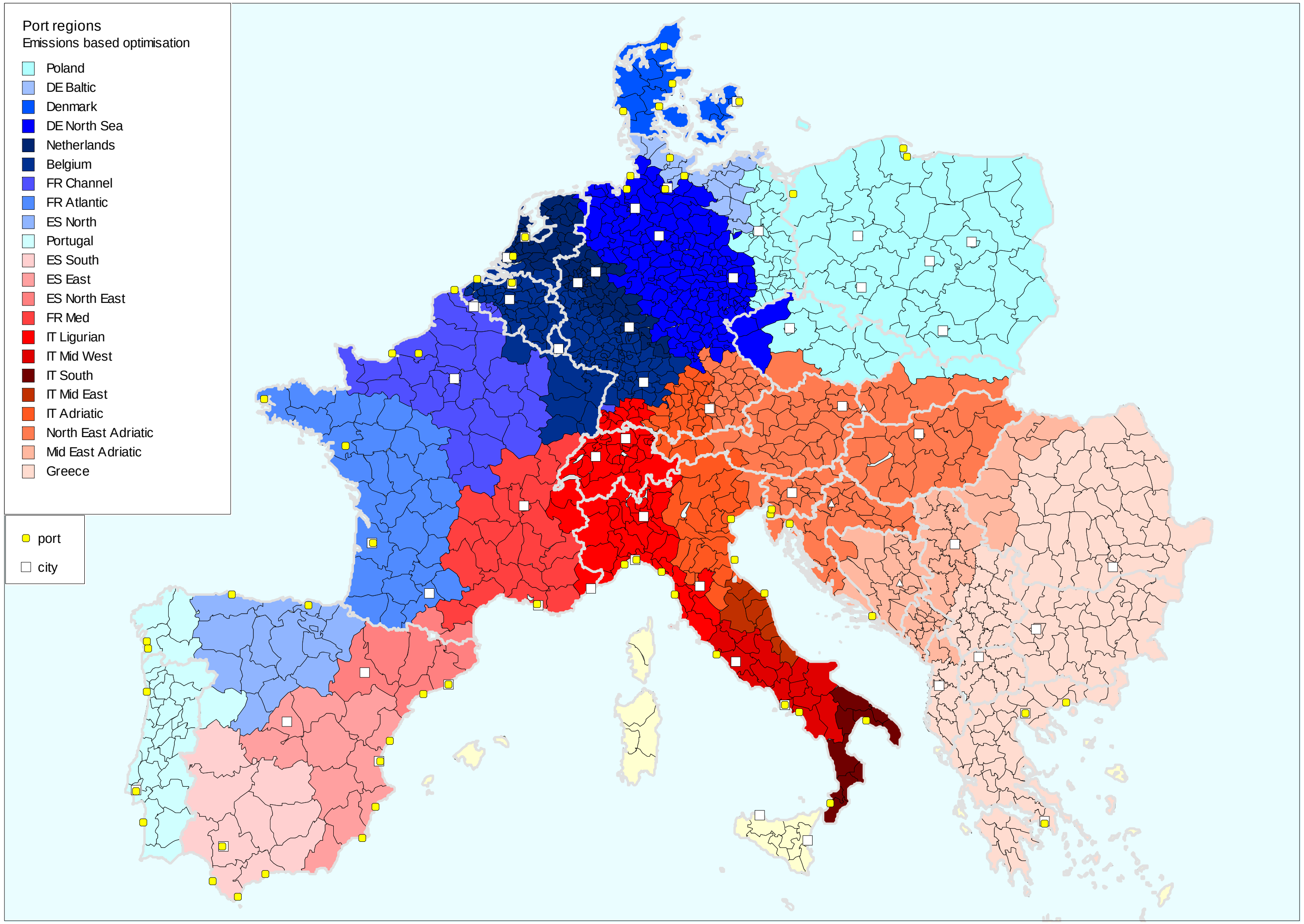


Figure 5.6 Externality Based Optimisation

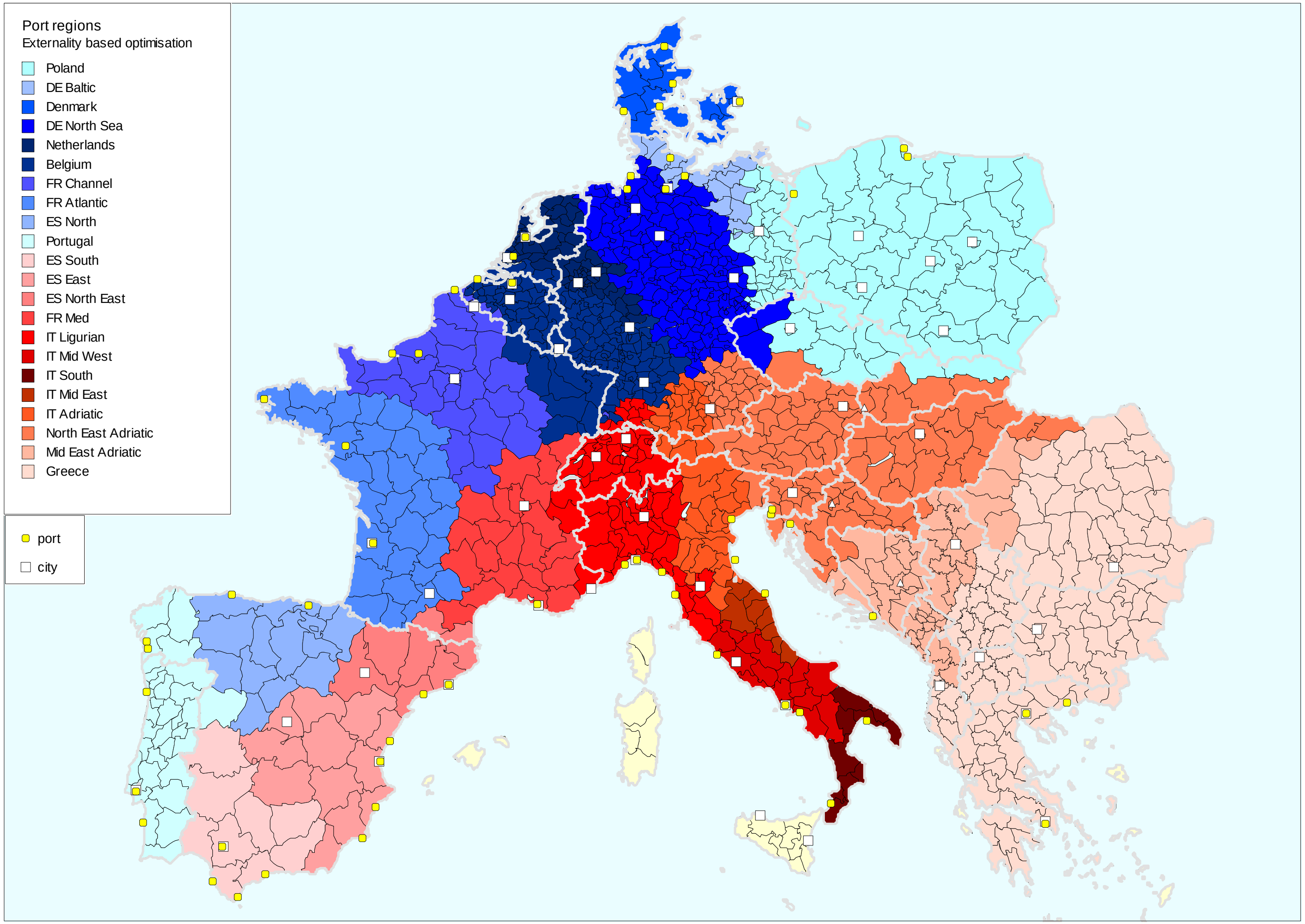
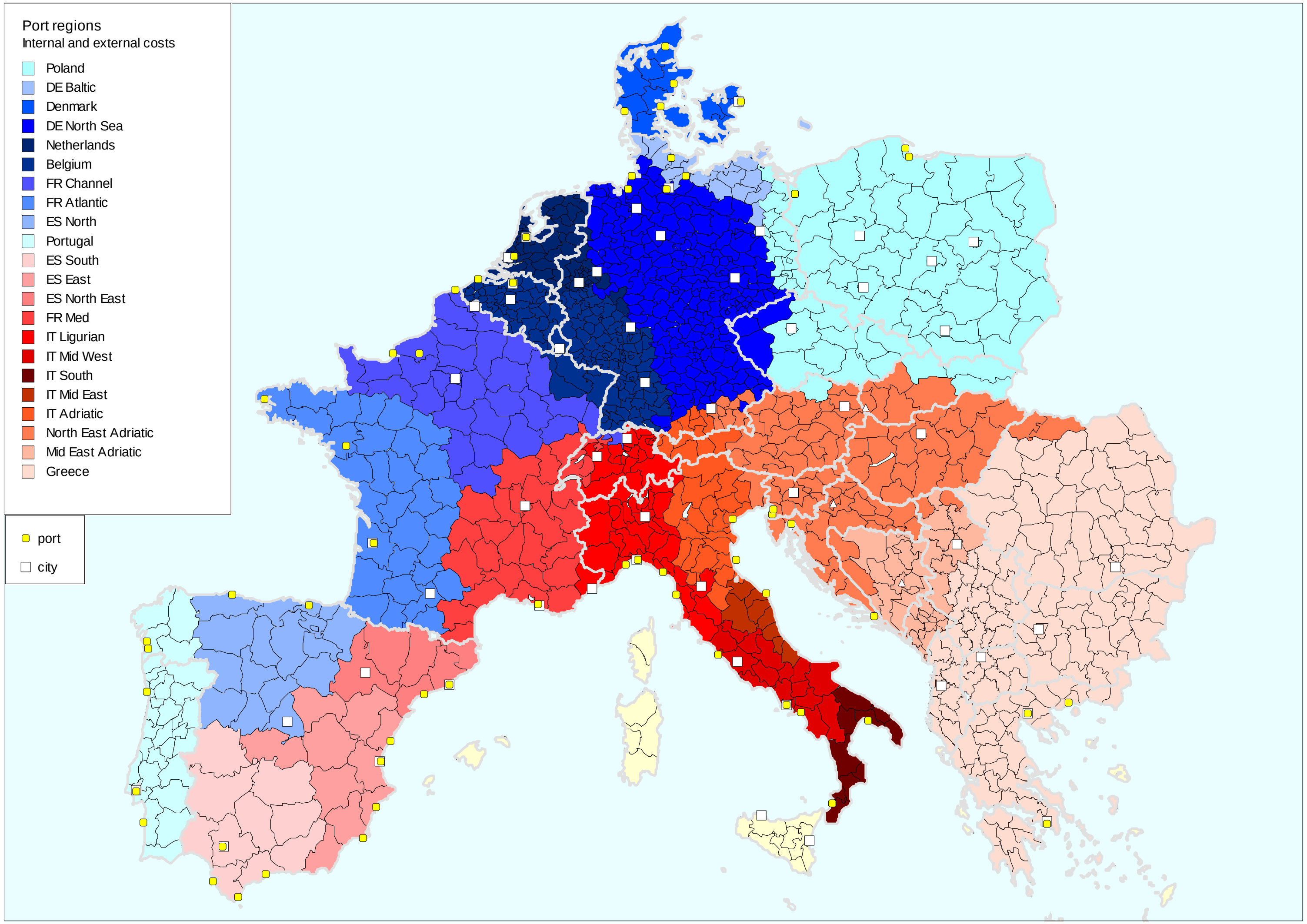


Figure 5.7 Full Optimisation - Internal and External Costs Combined



Using these calculations, it is possible to analyse the North-South balance based upon each of these optimised region sets.

Overall, there is a degree of conformity between the maps generated according to the different indicators.

Distance and external cost based optimisations produce similar results, while the maps that use internal cost criteria extend the sizes of the Northern hinterlands towards the Swiss and Austrian borders. The full optimisation is also similar to the internal cost optimisation because internal costs are greater than external costs per km.

A summary of the results is shown below.

5.2.1 North-South Shares based on Distance Optimisation

	Import		*Export*	
Container TEU %	continent	core regions	continent	core regions
North	61%	70%	60%	69%
South	39%	30%	40%	31%

5.2.2 North-South Shares based on Internal Cost Optimisation

	Import		*Export*	
Container TEU %	continent	core regions	continent	core regions
North	65%	70%	65%	70%
South	35%	30%	35%	30%

5.2.3 North-South Shares based on External Cost Optimisation

	Import		*Export*	
Container TEU %	continent	core regions	continent	core regions
North	62%	67%	61%	67%
South	38%	33%	39%	33%

5.2.4 North-South Shares based on Emissions Optimisation

	Import		*Export*	
Container TEU %	continent	core regions	continent	core regions
North	62%	67%	61%	66%
South	38%	33%	39%	34%

5.2.5 North-South Shares based on Full Internal and External Optimisation

	Import		*Export*	
Container TEU %	continent	core regions	continent	core regions
North	65%	69%	65%	69%
South	35%	31%	35%	31%

5.3 Summary of North South Balances

The tables above are compared directly in Table 5.2 (whole continent) and Table 5.3 (core region) with the socio-economic indicators, and with actual port handling.

Table 5.2 Summary of North South Balances for Continental Region

	North	*South*
GDP	63%	37%
POPULATION	56%	44%
TEU-KMS	61%	39%
TEU-INTERNAL COST	65%	35%
TEU-EXTERNAL COST	62%	38%
TEU-EMISSSIONS	62%	38%
TEU-FULL OPTIMISATION	**65%**	**35%**
Actual Port Handling	**68%**	**32%**

The implication of these results is that at a continental level, including all regions from Iberia to Poland, the distribution of port traffic and the distribution of cargo generation match closely. *Therefore the north and south port shares match closely with what would be expected under optimised conditions.*

It is estimated that 68% of import/export container handling is in the Northern range, and that 65% of cargo generated would select a Northern port either on the basis of transport costs or a combination of transport and external costs. This estimation takes into consideration the availability of different hinterland transport modes.

While this is an important conclusion, it potentially obscures more complex patterns underneath. Therefore it is also useful to look at the central area alone.

Table 5.3 Summary of North South Balances for Core Region

	North Core	*South Core*
GDP	68.8%	31.2%
POPULATION	69.0%	31.0%
TEU-KMS	70.2%	29.8%
TEU-INTERNAL COST	69.9%	30.1%
TEU-EXTERNAL COST	67.1%	32.9%
TEU-EMISSSIONS	67.0%	33.0%
TEU-FULL OPTIMISATION	**69.0%**	**31.0%**
Actual Port Handling	**80.3%**	**19.7%**

When only the central core regions are considered, the situation does change. At face value both the actual North-South port traffic balance and the optimised inland balances shift from 65:35 to 80:20 and 70:30 respectively.

This result needs therefore to be explored in more detail. The findings are analysed in the subsequent sections of this report. We demonstrate that the core region balance is influenced by a combination of additional factors, including:

- Scale effects in maritime transport that occur to a greater degree in the centre of the Northern range.
- East to West shifts, particularly from Poland and the Baltic area towards Germany.
- A probable degree of underestimation of transhipment in Northern ports.
- The tendency of carriers to seek back-loads where a trade imbalance exists, favouring the Northern range.

- Specific bottlenecks in the inland connections from Slovenian and Croatian ports, helping to enlarge the Northern shares in East Austria, Slovakia and even Hungary.

The relationships between port volumes, optimised hinterlands, and actual hinterlands are now investigated in more depth. Differences in actual and optimal hinterlands for these containerised volumes are termed “traffic shifts”. These are quantified and shown graphically for all the continental regions. Then in chapter 6 the maritime influences upon the port demand are examined in more detail.

5.4 Contestable Regions and Regional Traffic Shifts

Traffic shifts have been examined by comparing the TEU handled per coastline range against the TEU allocated according to the optimised territories. For this purpose, the full optimisation is used, taking into account both internal and external costs.

The steps are illustrated below:

Figure 5.8 shows the framework for the analysis, containing the locations of the main container ports (circles), the fully optimised regions for the selected coastal ranges, and the major cities.

Figure 5.9 shows the regions which are estimated to be battlegrounds for the Northern and Southern ports. These have been estimated by comparing the costs from the region in question to the nearest Northern and Southern ports, and expressing these quantities as a ratio. A red region indicates that the difference in cost is less than 25%.

Figure 5.10 shows the differences between the port traffic handled in each coastline range, and the expected traffic generated within its immediate catchment area. A positive number indicates that the ports are handling more traffic than generated within their captive region, and negative number means that traffic is lost to other coastline ranges.

Figure 5.8 Framework

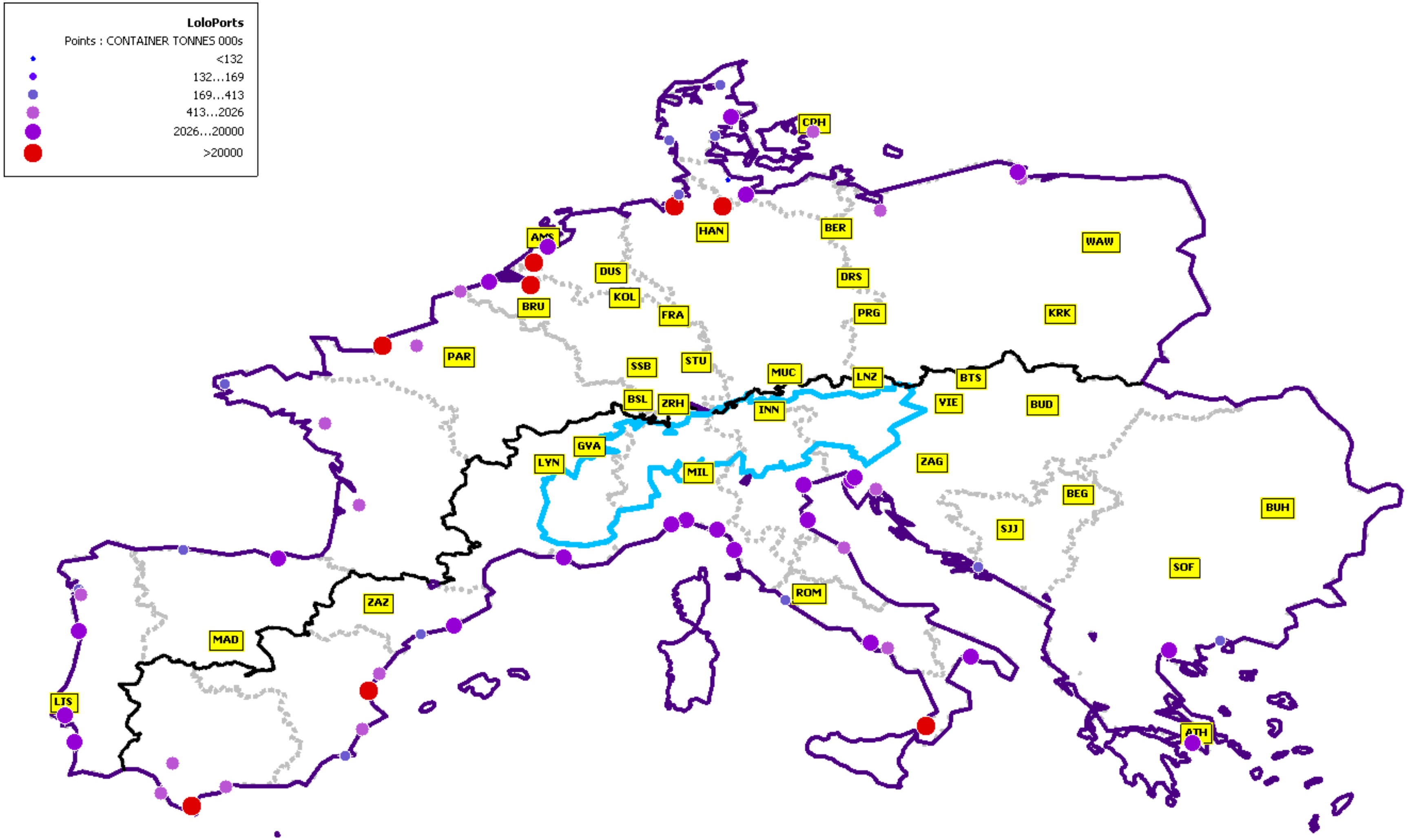


Figure 5.9 North South Battlegrounds

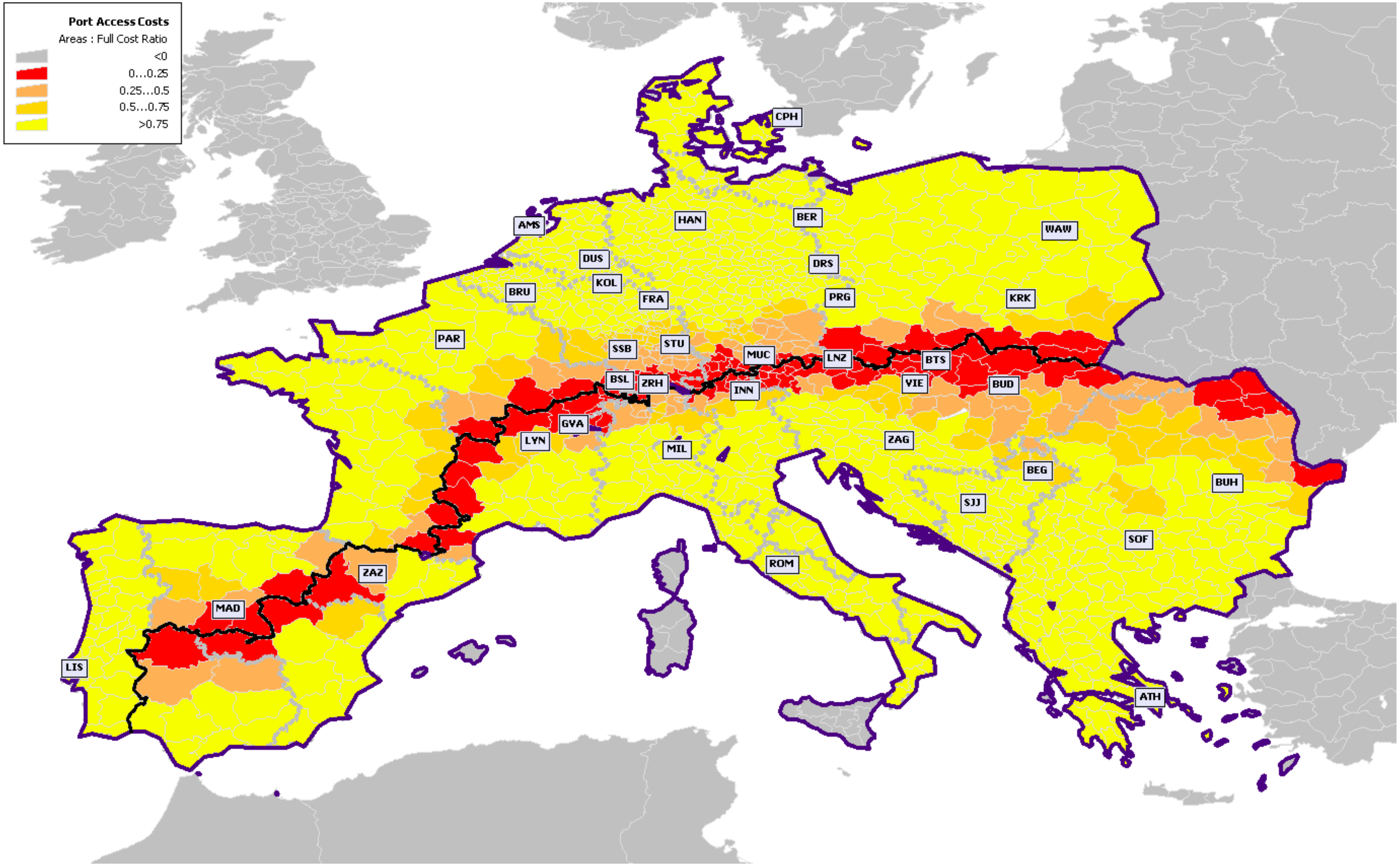


Figure 5.10 Balance Sheet of Traffic Shifts by Coastal Range (million TEU gained or lost)

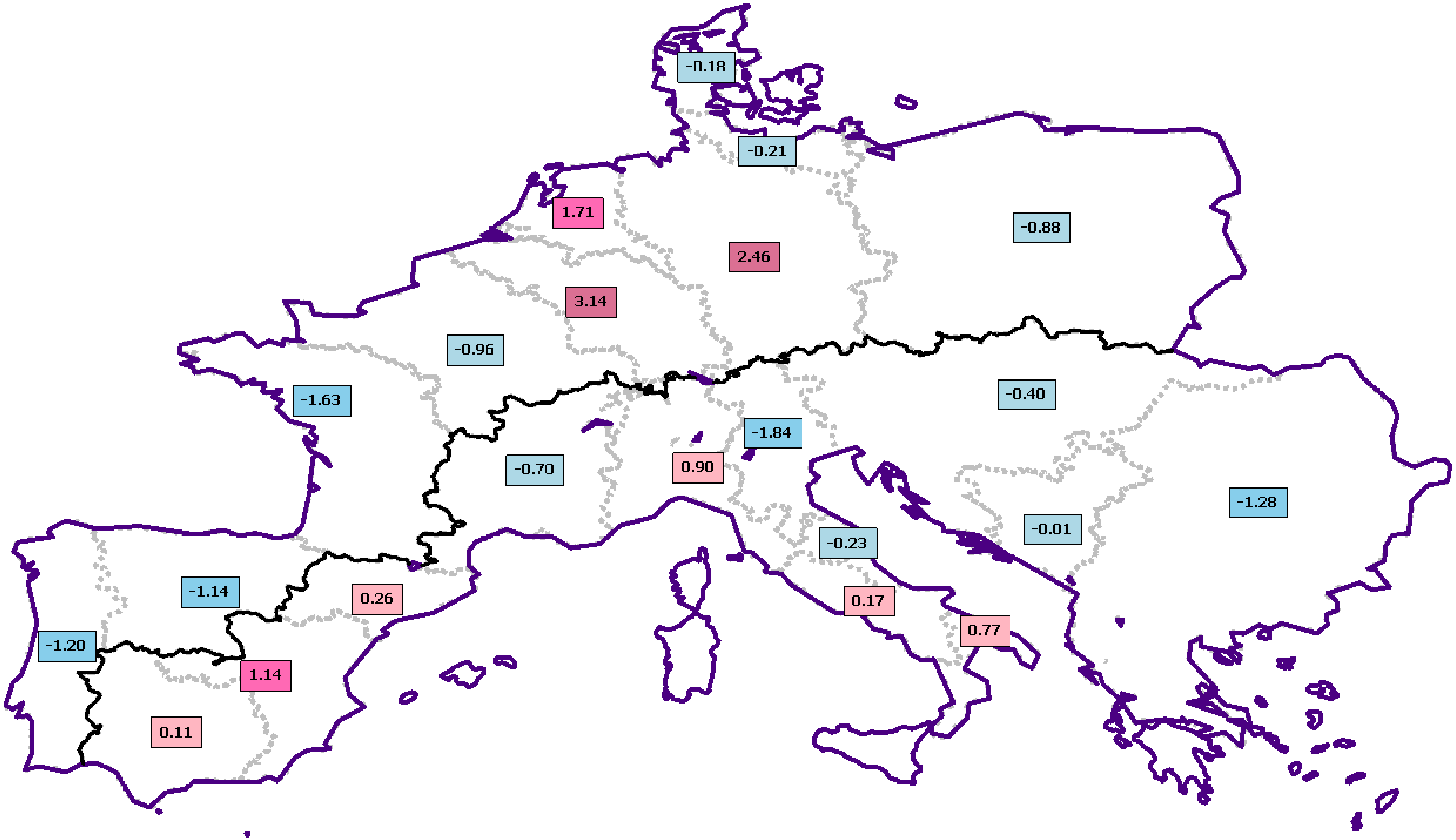
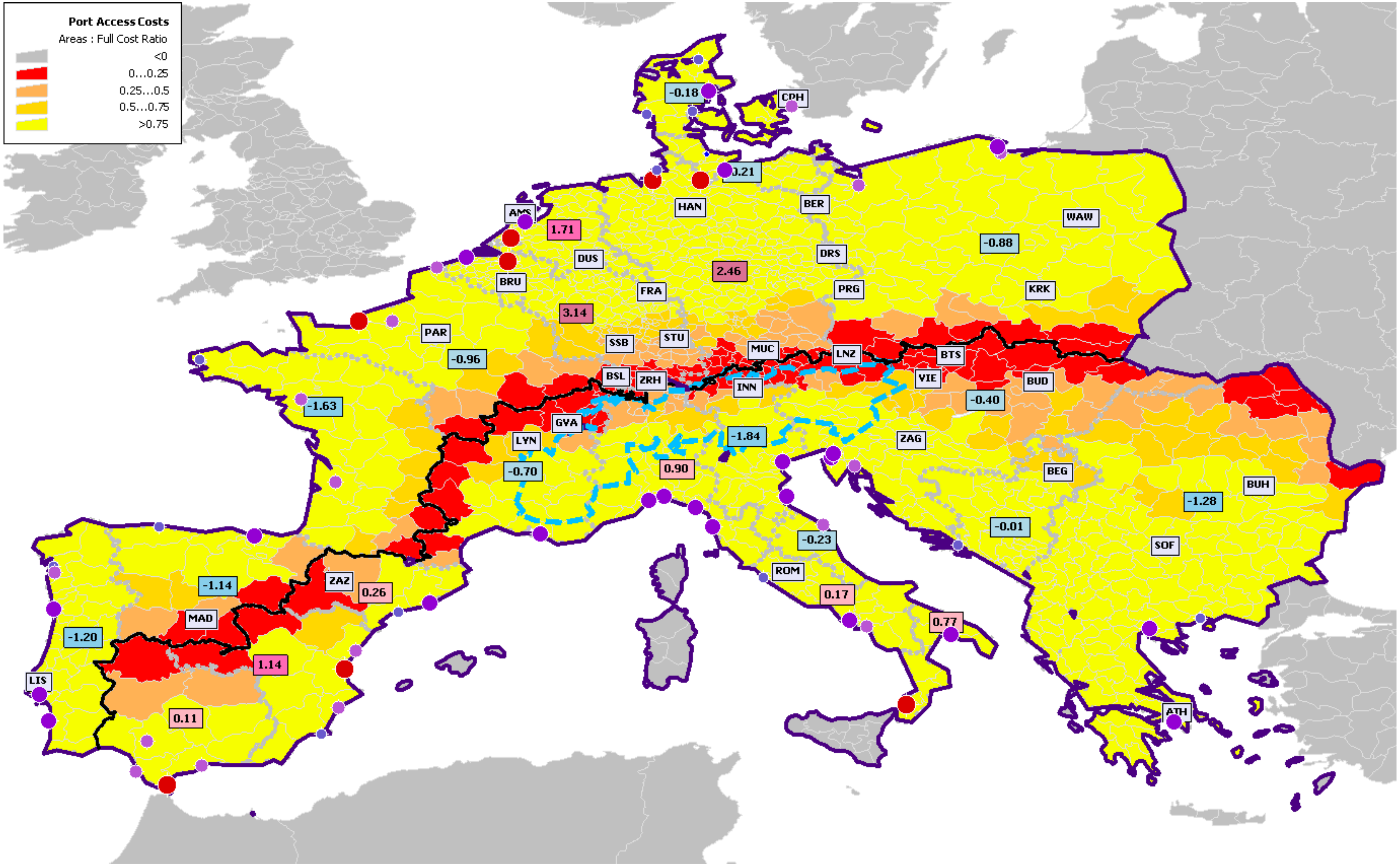


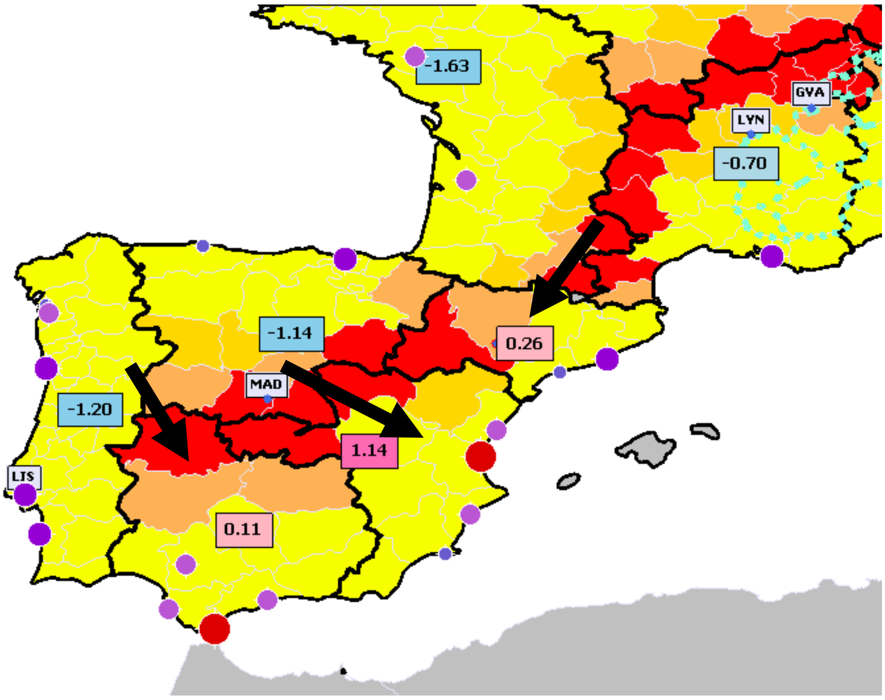
Figure 5.11 North South Balance of European Container Cargo



5.4.1 Iberian Peninsula

In the Western Continent, the shifts appear to be mainly from North to South, from the central Spanish regions towards the Mediterranean ports. These are indicated by the black arrows below.

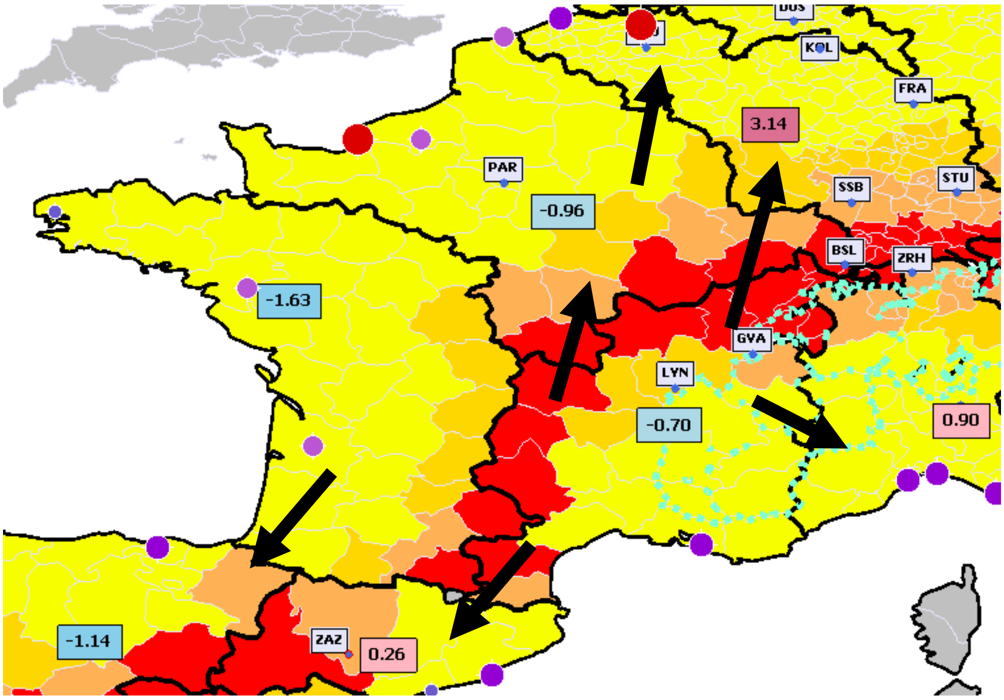
Figure 5.12 Iberian Peninsula Traffic Shifts



5.4.2 France

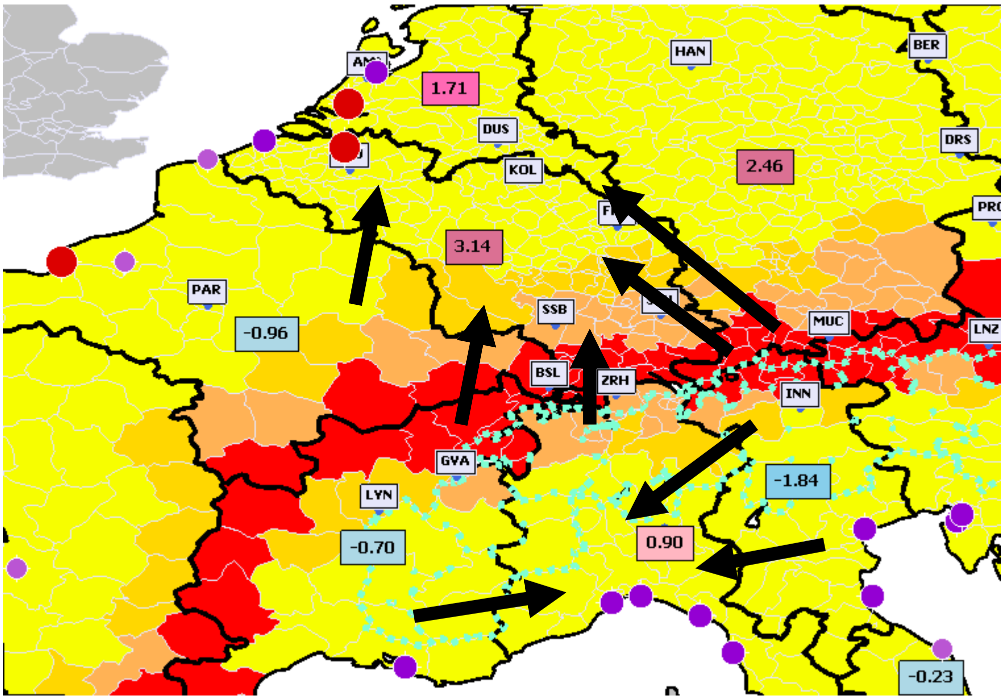
All of the French territories show negative shifts, implying that traffic is lost to Spanish, Italian, and Belgian ports. Apart from the South West region it appears likely that there is a South to North shift, particularly in the region just north of Lyon.

Figure 5.13 France, Traffic Shifts



5.4.3 Central Europe

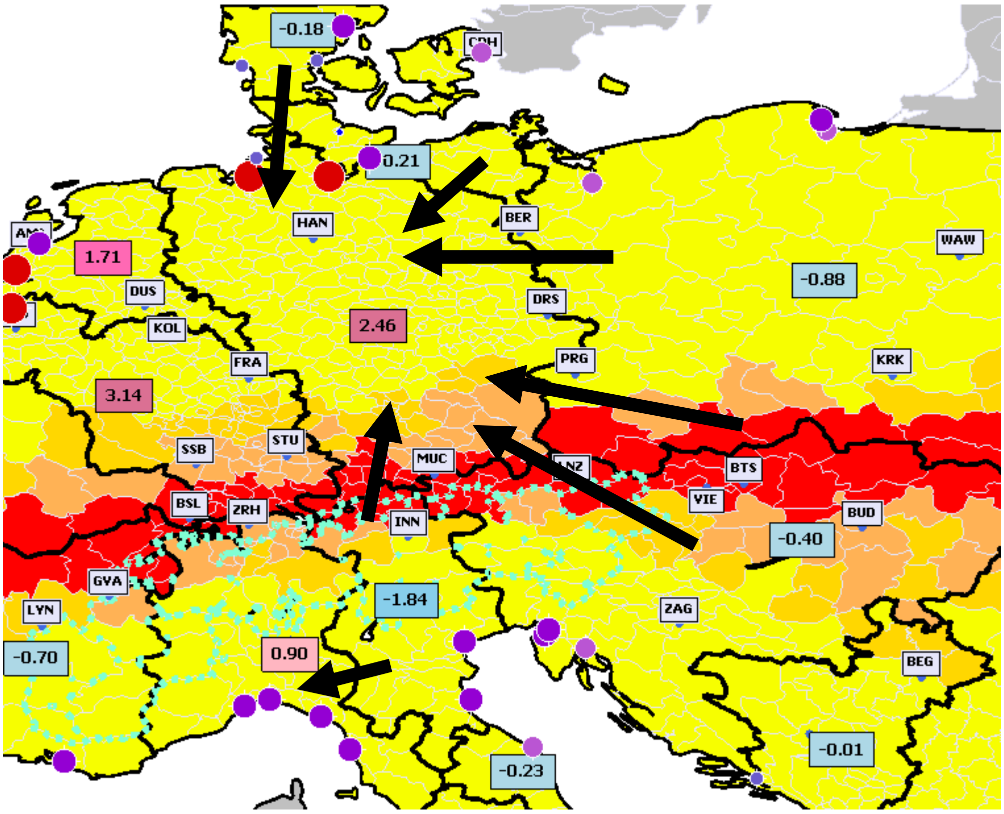
Figure 5.14 Central European Traffic Shifts



In the central band both the Northern and Southern ports appear to gain traffic from their neighbours. In the South, most of the gains appear to be from the East and West, whereas in the North, traffic is gained on all sides. North East French traffic goes to the Belgian range, and both the Dutch and Belgian ports appear to win traffic from Switzerland, Austria and Southern Germany.

5.4.4 Eastern Continent

Figure 5.15 Eastern European Traffic Shifts



East of the Netherlands the shifts appear to be more marked, due to the relatively low volumes currently being attracted to the ports East of Kiel and Trieste.

Western German ports gain traffic from Denmark, Eastern Germany, Poland, the Czech Republic, Austria, and even further South-East towards Budapest. Although Budapest is comfortably inside the catchment area of the North East Adriatic ports (Rijeka, Koper and Trieste) it is close to a red battleground indicating that there is a relatively low penalty involved in switching from South to North.

Austrian cargo routeing provides a good example. Data has been obtained from the Austrian trade press (www.verkehr.co.at). Although Austria is within close range of the Southern ports, the major German, Dutch and Belgian ports all have significant shares of Austrian seaborne trade. In 2009, Rotterdam was the largest import port for Austria and Hamburg the largest export port. Now, Koper has taken the lead in 2010, but other Southern ports are at a low level.

Table 5.4 Austrian Seaborne Imports by Port of Entry

	Imports, 000 Tonnes	
	2010	**2009**
Koper	3,296	2,025
Rotterdam	2,865	3,250
Hamburg	1,136	897
Antwerp	1,008	952
Constanta	557	237
Bremerhaven	92	85
Rijeka	33	36
TOTAL	8,988	7,483
North Share	57%	69%

Source: Seehafenbilanz, 2011

Table 5.5 Austrian Seaborne Exports by Port of Exit

	Exports, 000 Tonnes	
	2010	**2009**
Hamburg	1,716	1,504
Koper	1,651	1,324
Bremerhaven	1,147	1,050
Antwerp	952	878
Rotterdam	695	820
Rijeka	227	251
Constanta	35	12
TOTAL	6,422	5,839
North Share	70%	73%

Source: Seehafenbilanz, 2011

5.5 Conclusions Based upon Hinterland Analysis

- If all continental maritime containers were transported via the optimal port of loading or unloading, the distribution of cargo amongst the Northern and Southern ports would remain broadly similar to the existing pattern.

- At a continental level, there is little evidence to support the hypothesis of market failure leading to an excess of traffic via Northern ports.

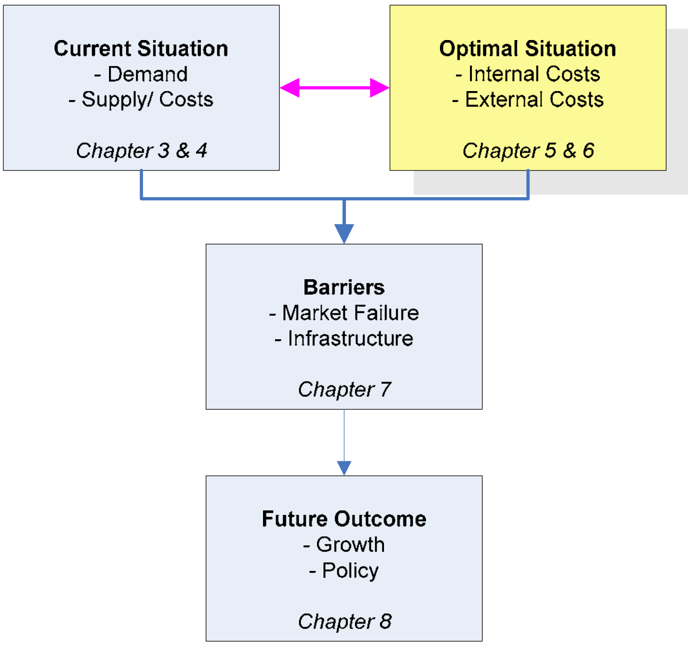
- When particular continental regions are highlighted, the relationship between traffic generation and port volumes can be explained by the sizes of the natural hinterland and by traffic shifts.

- There is no single e.g. South to North pattern of traffic shifts. East West shifts are as important as North South shifts.

- The key battleground areas for North and South ports have been mapped as a line running from Madrid, along the Northern perimeter of the Alpine region, extending East towards Bratislava.

- As will be explained in the next section, the decisive factor within these battle ground regions is maritime transport cost. Scale effects in container shipping suggest that within the central core (approximately Geneva to Vienna and Budapest) carriers will route traffic via Northern ports, and this is explaining the current North South balance.

6 Maritime Optimisation



So far only hinterland costs have been considered. However, maritime factors also influence port choice and arguments in favour of a North-South shift also depend upon the potential for reducing financial costs and externalities within the maritime networks.

Considering the Europe-Far East trades, containers arrive in Europe via Suez. It is evident that the sailing distance from the entrance of the Suez Canal at Port Said is considerably closer to the Barcelona-Rijeka range of ports than to the Le Havre-Hamburg range. Approximately 4000 km could be saved from an Asia-Europe sea journey if a Southern port is selected instead of a Northern port. There is a need to explain current calling patterns and to consider potential optimisations.

6.1 Ship Deployment

In order to investigate distribution patterns, it is necessary to start from an understanding of liner shipping operations.

Containers arrive in Europe on scheduled container services following rotations (loops) of regular port calls. The competing shipping companies offering capacity on the main trade lanes such as Asia-Europe operate hub and spoke networks, and they attempt to optimise the whole system, and not any single port to port link. An analogy could be made with the difference between main intercontinental airlines (mainly hub and spoke) and low cost carriers (mainly point to point).

It is an unrealistic over-simplification to consider only the journey segment between Suez and the European continent for this analysis, as if to assume that European cargo is all transhipped at Port Said. Transhipment at a Mediterranean hub involves a port call, and therefore additional cost. A large proportion of European container cargo arrives via direct calls as well as via feeder networks, and the proportion differs by region.

A number of examples are illustrated from the current CMA-CGM schedules. They show that four different coastal ranges (North Europe, West Med, Adriatic and Black Sea) are covered separately.

Figure 6.1 CMA-CGM, North European Service – French Asia Line 1 (FAL1)

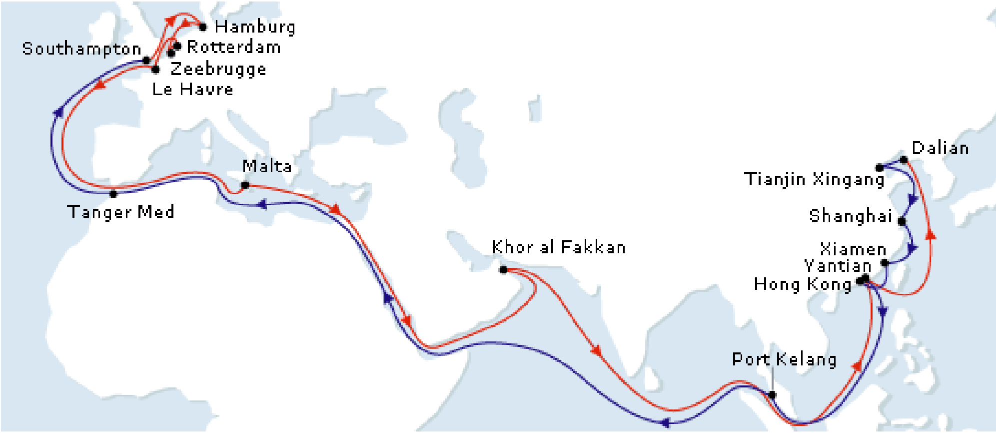
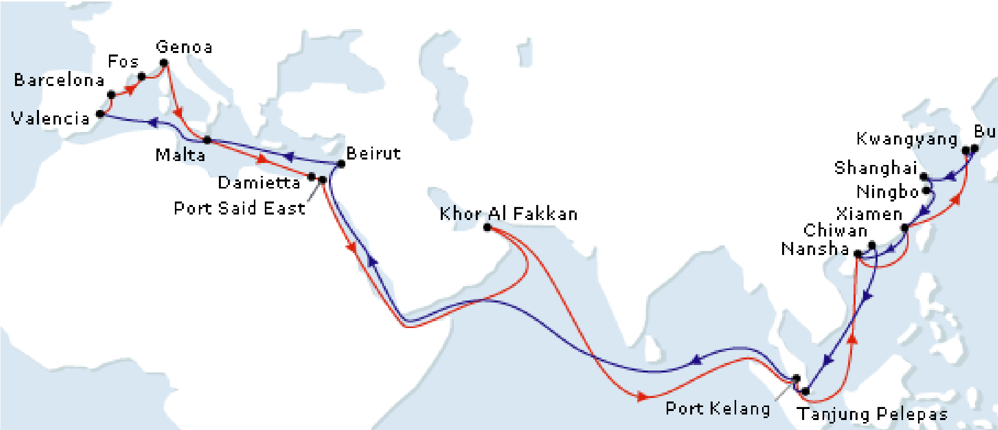


Figure 6.2 CMA-CGM, Adriatic Service, Phoenician Express

Figure 6.3 CMA-CGM Black Sea Service, Bosphorus Express

Figure 6.4 CMA-CGM West Mediterranean Service, Mediterranean Club Express



Each of these services consists of a set of ships calling at a regular sequence of ports. The cargo for Europe is therefore sorted according to destination at the point of origin e.g. Shanghai and the containers are transported directly to the European gateways. They all pass Suez, but the ships do not terminate there.

The ships arriving in the North differ from the ships arriving in the South, and the schedules which they adhere to are different too. If ship sizes, speeds, ages and load factors are different, then the financial costs and external costs per km are also different. Moreover, these costs are incurred over the full length of the round-trip voyage (from China/Korea/Japan to Europe) and not just on the minor sections between Suez and the European gateways.

A comparison is made below between these four services:

Table 6.1 Comparison of Service Characteristics, CMA-CGM, Asia Europe

	N EUR	***West Med***	***Adriatic***	***Black Sea***
	FAL1	**MEX**	**BEX2**	**BEX**
Round Trip Days	70	77	63	77
Frequency per Year	52	52	52	52
Ports of Call	16	23	16	19
Fleet	10	11	9	11
Ship Size (TEU)	11388	8400	6572	6552
Year Built	2009	2010	2010	2010
Speed (knots)	25	24	24	26

Each of the four services offers a weekly frequency, based on fleets of up to eleven ships performing port rotations lasting 63 to 77 days per round trip.

Thus each ship performs approximately five round trips per year. Each service uses new ships, with approximately the same sailing speed.

However, there are important differences between these schedules:

- The ships on the North European service have almost double the cargo carrying capacity of the Adriatic and Black Sea ships; 11388 TEU versus 6552 TEU.
- Despite the longer distance to the Northern range, the round trip time for the North European service (70 days) is lower than either the West Med or the Black Sea services (77 days). This is related to the lower number of port calls per rotation and the relative efficiency of these calls – a higher proportion of the payload is exchanged per call.

Two observations can be made:

- Once a shipping service has been set up, the majority of costs are fixed per vessel per year. The capital costs, crew costs and fuel costs are decided. The average cost per container carried depends largely on the capacity utilisation, and relatively little marginal cost is incurred per container.
- Given that CMA-CGM (along with most of their rivals) offer a weekly frequency on all four routes, there are no barriers to prevent a shipper switching a container from a North European to a Mediterranean service. This implies that there are strong competitive pressures and a high potential for optimisation.

Whereas companies such as CMA-CGM and Hyundai Merchant Marine run direct services to the Adriatic from the Far East, others use feeder services.

Figure 6.5 NYK Adriatic Service, ADS1

In the case of NYKLine (part of the Grand Alliance) containers for Adriatic are brought to the Italian hub port of Taranto, and then transhipped to either Trieste, Ravenna or Ancona.

Figure 6.6 NYK Adriatic Service, ADS2

The accompanying ADS2 service provides a similar set of connections to Venice, Koper and Rijeka.

Table 6.2 Feeder Service in the Adriatic

	Adriatic
	ADS
Round Trip Days	7
Frequency per Year	90
Ports of Call	4
Fleet	2
Ship Size (TEU)	1700
Year Built	2000
Speed (knots)	20.5

* Characteristics based upon Mary Schulte Vessel.

A feeder network allows the shipping line to carry containers to the Mediterranean on the largest available ships, and to drop them off at hub ports such as Taranto which have deep water (14.3m) and which minimise diversion en-route to Northern Europe.

Thus, the containers are brought efficiently on large ships to Europe, but the trade-off is that there is an extra port handling cost at the transhipment hub, additional delay waiting for the feeder, and the need to use a small vessel for the final leg of the journey.

Whereas the North European calls can be made using the largest available container ships, the Adriatic calls will involve the use of either a medium sized ship for a direct call, or a large ship plus a feeder ship for the indirect service.

Three service patterns have been identified:

1. Main Intercontinental Services using large (>10,000 TEU) ships.
2. Secondary Intercontinental Services using medium (4,000-10,000 TEU ships).
3. Feeder Services using smaller (1,000- 3,000 TEU ships).

Northern European gateways and Mediterranean hubs (e.g. Taranto, Tangier, Algeciras and Gioia Tauro) are typically served by category 1. South European gateways (e.g. Koper, Venice) are served by a combination of categories 2 and 3.

The key factors behind this decision are:

- Volume/Scale – larger vessels can only be justified if they can be filled.
- Port Capacity – depth of water and terminal handling capacity impose a constraint on vessel size.
- Diversion – shipping lines wish to avoid detours from the main coastal lanes through the Mediterranean.
- Number of port calls – more calls help to fill the ship, but cost time and distance.

Thus it is likely that for the foreseeable future, traffic growth in South East Europe, better port facilities and better inland connections will encourage the use of direct calls over feeders, and that gradually ship sizes and load factors would increase, helping to reduce costs.

6.2 Liner Shipping Costs

Using the main characteristics of the ship deployment patterns found in the market it is possible to attempt an estimate of maritime costs, and therefore to exemplify the difference in maritime transport cost between a North European or a South European port call.

Studies such as SONORA[1] compare the North/South transport economics on the basis of the distance from the Suez canal to the European gateway port, and thus conclude that the nearer Southern ports offer lower costs and lower externalities. However, although it is possible today to operate schedules as

[1] SoNorA – South North Axis, 0.5.4.8 – Venice Port Authority Business Case – New EU Freight Corridors in the area of Central Europe, Prepared by Transport, Territory and Logistics Research Unit of University IUAV of Venice.

SONORA envisages where European containers would be transhipped at Mediterranean hubs such as Port Said, the major carriers on the Asia-Europe trade lane often choose not to organise their transport this way. In the circumstances it seems preferable to compare alternatives based on typical practices.

Since the different coastline areas are served using different service configurations, these differences need to be reflected across the full extent of the voyages, and not limited to the European legs. Without considering the operational structure of the container services (frequencies, port calls and ship selection) it is not possible to comment on the potential cost savings quay to quay.

Thus instead, a schedule-based analysis has been made using a more standard approach. Similar approaches have been applied in many other models and studies including:

- LINCOST[1] – MDS-Transmodal, UK.
- Components of Liner Service Costs - Martin Stopford[2].
- EPEC[3] Consortium – GHK Consultants.

During this study, the cost estimates made by NEA have also been shown to a number of the main shipping lines currently offering Asia-Europe schedules, for the purpose of validation.

Four different call patterns have been modelled, based upon a simplification of the services listed in Table 6.1 above. The costs of these services are based upon applying text-book ship cost assumptions within NEA's worldwide network models, so the outcomes are generic, and should not to be attributed to any specific company's operations.

Table 6.3 Modelled Liner Services

	Service Frequency	*Voyage Length (km)*	*Voyage Length (Days)*	*Number of Ships*
1. Asia – North Europe	Weekly	43,422	66	9
2. Asia – West Med	Weekly	35,832	59	8
3. Asia – Adriatic	Weekly	32,918	50	7
4. Adriatic Feeder	Twice Weekly			

[1] Garratt M, LINCOST Model. See: http://www.mdst.co.uk/articles/transport_models___forecasting/lincost
[2] Stopford M, "Maritime Economics", Second Edition, Page 352, Based on inputs from Drewry Shipping Consultants.
[3] EPEC Consortium, Preparatory Study for an Impact Assessment of the Future Guidelines on State Aid of Port Infrastructure, 2008, on behalf of DGTREN.

For the three long distance services (1-3 in the table above), a similar pattern of port calls has been assumed East of Suez, so that most of the differences arise from the European call patterns and not the port calls in Asia. This results in shorter voyage lengths, and fewer ships for the West Med and Adriatic routes, compared to the current CMA-CGM schedules (for example). This simplification makes it possible to compare the effect of varying the European calling pattern alone. On the shorter Adriatic route, the distance saved allows the shipping line to reduce the fleet from 9 ships to 7 ships and still provide a weekly service.

Port to port distances have been calculated directly from a network model routeing the ships via Suez, and the sailing speeds and port dwell times have been set to approximate known schedules. For example, CMA-CGM's FAL1 schedule shows a fifteen day sailing time on the main Asia-Europe link between Port Klang (Malaysia) and Tangier (Morocco), for a distance of 6,758 nautical miles, implying an average sailing speed of 18.77 knots (nautical miles per hour). The sailing speed has an important effect upon fuel consumption, round trip voyage time and emissions.

A second set of model runs was carried out as a sensitivity analysis to demonstrate that the differences in the Asian calling patterns do not affect any of the later conclusions.

Results are calculated using a sensitivity analysis for a range of ship sizes and load factors, and expressed as the full cost per TEU carried, covering:

- Capital costs (purchase and financing)
- Crew costs
- Fuel – main engine and auxiliary fuel
- Port dues and terminal handling costs
- Insurance, maintenance, administration
- Container costs

In the sensitivity analysis, five ship sizes and three load factors have been used for each service.

In our central scenario, we select:

- Asia-Far East: 12,500 TEU vessel and 75% load factor
- Asia-West Med: 8,500 TEU vessel and 75% load factor
- Asia-Adriatic: 6,500 TEU vessel and 65% load factor.

Full results are shown below, with the main scenario settings highlighted in bold.

Table 6.4 Liner Service Cost Analysis

Asia-North EUR	*Cost (US$) Per TEU*	*Load factor*		
	Ship Size (TEU)	*0.65*	*0.75*	*0.85*
	4,500	1,866	1,646	1,477
	6,500	1,618	1,431	1,288
	8,500	1,464	1,297	1,170
	10,500	1,356	1,204	1,087
	12,500	1,275	**1,133**	1,025
Asia-Adriatic	*Cost (US$) Per TEU*	*Load factor*		
	Ship Size (TEU)	*0.65*	*0.75*	*0.85*
	4,500	1,476	1,308	1,179
	6,500	**1,287**	1,144	1,034
	8,500	1,169	1,041	944
	10,500	1,086	970	881
	12,500	1,025	916	834
Asia-West Med	*Cost (US$) Per TEU*	*Load factor*		
	Ship Size (TEU)	*0.65*	*0.75*	*0.85*
	4,500	1,716	1,516	1,363
	6,500	1,490	1,320	1,190
	8,500	1,350	**1,199**	1,083
	10,500	1,252	1,114	1,008
	12,500	1,179	1,050	952

In any given cell (e.g. 4,500 TEU, 65% load factor), the highest costs are found in the North European service, with the West Mediterranean service next, and the Adriatic service having the lowest cost. This outcome arises because the distances and the number of ships required are higher for the North European services, all things being equal. However, the differences are relatively small (around US$300 per TEU) because at a global scale, the extra distance from Italy to Spain to Germany is relatively small compared to the main part of the voyage across the Indian Ocean to China.

Furthermore, when the adjustments for ship size and load factor are made it then appears that the final quay-to-quay costs for all three services are quite similar, implying that the combination of scale and port capacity in the North and West of Europe, permitting the use of larger ships, compensates for the additional distance to these ports.

Taking into account realistic ship sizes, as well as the load factor adjustment for the Adriatic route, we estimate that the costs of the North European service and the West Mediterranean service are very similar (within US$100 of each other), while the Adriatic service costs an additional US$100 - $150 per TEU.

6.3 Estimates of Maritime Carbon Dioxide Emissions

Using the same liner service modelling approach we have calculated emissions of carbon dioxide at sea. The literature on maritime emissions is at an earlier stage of understanding in comparison with inland modes, so NEA has made calculations for specific container ships, where good technical data on fuel consumption was available. Fuel consumption estimates are then calculated within the liner shipping model, so as to be consistent with the cost calculations, and these are converted into grams of pollutants and monetised quantities.

Standard averages for CO_2 emissions in shipping can be found in the report "Measuring and Managing CO_2 Emissions" prepared by Heriot Watt University (UK) on behalf of the European Chemical Industry Council, quoting figures from the UK's Department for Environment Food and Rural Affiars (DEFRA) and from the BSR/Clean Cargo study. A figure of 11.5 grams of CO_2 per tonne kilometre is quoted, approximately equal to 100 grams of CO_2 per TEU km.

In comparison with inland transport modes, this is a low rate of CO_2 emission, five to ten times lower than road for example.

Table 6.5 Averages of grams of CO_2 per tonne kilometre, by mode

Grams of CO_2 per tonne kilometre	*Lower bound*	*Upper bound*
Road	59	109
Rail – Electric	1.8	19
Rail – Diesel	21	55
Waterway	28	35
All Maritime	5	20
Large Container Ship	11.5	

Source: Heriot Watt University, quoting mainly UK and EU sources

It is not to be neglected however, because it is being applied over long distances. Using average emission rates a sea journey of 20,000 kms, such as China to Europe implies an average of 2000 kilograms of CO_2 per TEU carried. However, schedule characteristics, engine specifications and ship size influence the level of emission, so this has been modelled in more detail for the Asia-Europe route.

Three ships were examined in detail; Maersk Salalah, Maersk Damietta and Emma Maersk.

Table 6.6 Ships Analysed

	Year Built	*Dwt (t)*	*TEU*
Maersk Salalah	2008	102,367	8379
Maersk Damietta	2008	68,463	5085
Emma Maersk	2006	156,907	15,550

The calculations used were adapted from "EcoTransit World – Ecological Transport Information Tool for Worldwide Transports – Methodology and Data" (2010, IFEU Heidelberg, Öko-Institut, IVE / RMCON). Specific fuel consumption (g/kWh) was calculated from available vessel characteristics, combined with the required engine power per TKm. This results in a vessel specific fuel consumption expressed in g/Tkm. This consumption rate is then combined with emission factors, resulting in CO_2/CH_4/N2O/NO_x emission rates for the vessel's main engine.

Table 6.7 CO_2 Emissions from Main Engines

	Maersk Salalah	*Maersk Damietta*	*Emma Maersk*
Fuel Consumption at NCR (tonnes/day)	245	160	350
Specific fuel consumption [g/kWh]	165.25	180.10	171.00
Required Engine power per TKm [kWh/TKm]	0.0183	0.0164	0.0140
Vessel specific fuel consumption [g/TKm]	3.0305	2.9592	2.3869
Main engine emission [g/Tkm]			
CO_2 produced consuming HFO	9.4382	9.2161	7.4339

Comparing the Emma Maersk to the smaller (and newer) Maersk ships, the rate of CO_2 emission per tonne kilometre is 21% lower.

Comparing a North Europe service with a shorter Adriatic service (see Table 6.3) a shipping company needs to have nine ships deployed on North Europe compared to seven ships on the Adriatic route in order to maintain a weekly frequency. Nine E class ships produce a similar level of CO_2 emissions to seven smaller ships, per tonne kilometre. Therefore the *scale compensates for the distance*. If higher load factors can be achieved on the North Europe services because of the trade patterns, and more equal trade balance, the North Europe service becomes the less polluting alternative.

Table 6.8 CO_2 Emission Analysis

Asia-North EUR	*CO_2 Kg Per TEU*	*Load factor*		
	Ship Size (TEU)	*0.65*	*0.75*	*0.85*
	4,500	2605	2257	1992
	6,500	2167	1878	1657
	8,500	1895	1642	1449
	10,500	1705	1478	1304
	12,500	1563	**1354**	1195
Asia-Adriatic	*CO_2 Kg Per TEU*	*Load factor*		
	Ship Size (TEU)	*0.65*	*0.75*	*0.85*
	4,500	1987	1722	1520
	6,500	**1653**	1433	1264
	8,500	1446	1253	1106
	10,500	1301	1127	995
	12,500	1192	1033	912
Asia-West Med	*CO_2 Kg Per TEU*	*Load factor*		
	Ship Size (TEU)	*0.65*	*0.75*	*0.85*
	4,500	2329	2018	1781
	6,500	1937	1679	1482
	8,500	1694	**1468**	1296
	10,500	1524	1321	1166
	12,500	1397	1211	1068

The implication is similar to the cost calculation. In any given cell e.g. 4,500 TEU ship with 65% load factor, the highest emissions occur on the North European service, followed by the West Med, followed by the Adriatic. However, when realistic scale effects are taken into consideration, the order is reversed.

6.4 Estimates of Emissions of NO_x and SO_2

In order to estimate the full external cost of maritime transport it is necessary to include valuations for NO_x and SO_2. We rely here upon the work of the MARTRANS organisation, who have created an open calculator for ship air emissions.[1]

They provide rates of pollutant emissions per quantity of bunker fuel consumed. These are:

- CO_2 Emission: 3.17 tonnes of CO_2 per tonne of bunkers consumed (close to figure of 3.11 estimated by NEA)
- SO_2 Emission: Related to sulphur content of fuel, which is now regulated. For fuel which has 1.5% sulphur content, the emission rate is 1.5 * 0.02 = 0.03 tonnes of SO_2 per tonne of bunker fuel consumed.
- NO_x Emission: 0.087 to 0.057 tonnes of NO_x per tonne of bunkers consumed, depending upon the speed of the engines. We have selected 0.057 for medium speed engines.

Valuation (monetisation) of the emissions is based on the same Vergelijkingskader Modaliteiten estimates as used for inland transport. These are however close to the TREMOVE-based figures used by ITMMA and TM-Leuven[2] in their 2010 analysis of low sulphur fuel carried out for ECSA.

Figure 6.7 Rates of Emission and Valuation

Pollutant	*Pollutant Kg/Fuel Kg*	*Applied €/Kg*	*TREMOVE €/Kg*
CO_2	3.11	0.05	0.032 – 0.008
SO_2	0.03	4.51	2.678 – 6.620
NO_x	0.057	7.42	7.436 – 12.535

Thus we have applied a higher valuation on carbon emission, but a lower-bound figure for NO_x.

[1] Christos A. Kontovas and Harilaos N. Psaraftis, 2009, “An Open Online Calculator for Ship Air Emissions”, Laboratory for Maritime Transport, National Technical University of Athens, Greece. http://www.martrans.org/documents/2009/air/TRB%20Kontovas%20Psaraftis%20.pdf

[2] T. Notteboom, ITMMA, E. Delhaye, K Vanherle, TML, 2010, “Analysis of the Consequences of Low Sulphur Fuel Requirements”, commissioned by European Community Shipowners’ Association (ECSA)

6.5 Freight Rates

Table 6.9 Freight Rate Quotes from Chinese Ports

		20' FCL ($USD)	*40' FCL ($USD)*	*40HQ' FCL ($USD)*
DALIAN	HAMBURG (DE)	850	1600	1700
	ROTTERDAM (NL)	850	1600	1700
	ANTWERP (BE)	850	1600	1700
	LE HAVRE (FR)	825	1650	1750
DALIAN	SOUTHAMPTON (UK)	825	1650	1750
	DUBLIN (IE)	1600	2800	2900
	GOTEBORG (SE)	1000	1930	2030
	GDYNIA (PL)	1290	2130	2330
DALIAN	BARCELONA (ES)	1100	2150	2200
	VALENCIA (ES)	1120	2170	2220
	MARSEILLES-FOS (FR)	800	1500	1500
	GENOA (IT)	1100	2150	2200
DALIAN	VENICE (IT)	1020	1940	2040
	KOPER (SI)	1190	2300	2400
DALIAN	AMBARLI (TR)	1280	2300	2300
	CONSTANTA (RO)	1350	2500	2600
DALIAN	TANJUNG PELAPAS (MY)	630	730	730
	YOKOHAMA (JP)	200	400	400

Source: http://en.shippingchina.com/ (obtained 5-Aug-2011)

Freight rates obtained using a web search on the Shipping China site provide a comparison of current prices from Chinese ports. At the time of writing, Asia-Europe freight rates are low due to the combination of new capacity being introduced and lower than expected market demand. In 2010, the Shanghai Shipping Exchange's China Containerised Freight Index (CCFI) stood approximately 20% higher than current rates. Several companies interviewed commented that the quoted rates are only the basic rates charged without surcharges such as Bunker Adjustment Factors and Currency Adjustment Factors, and that current rates are lower than the longer-term average. Therefore it is not the aim to match the cost model to these rates, but rather to compare differentials between coastline areas.

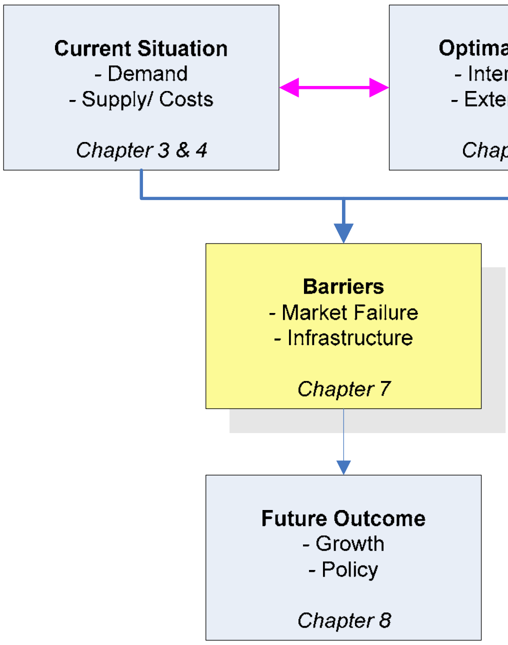
Comparing the quoted rates across the different regions it is clear that distance is not a good benchmark for prices, and that the modelled cost analysis, taking into account scale economies is a more reliable indicator for final prices. It is interesting to note that prices between Dalian in North-East China and the Hamburg-Le Havre ports are currently lower than the West Mediterranean, Adriatic or Black Sea ports. In Northern Europe the other ports receiving direct calls such as Southampton also show low rates, with a large step up in price to (nearby) feeder destinations such as Dublin and Gdynia.

On the basis of these quoted rates, approximately USD$ 200 is saved per TEU by calling at one of the main Northern gateways, compared to a call in a competing Southern port.

6.6 Conclusions from Maritime Analysis

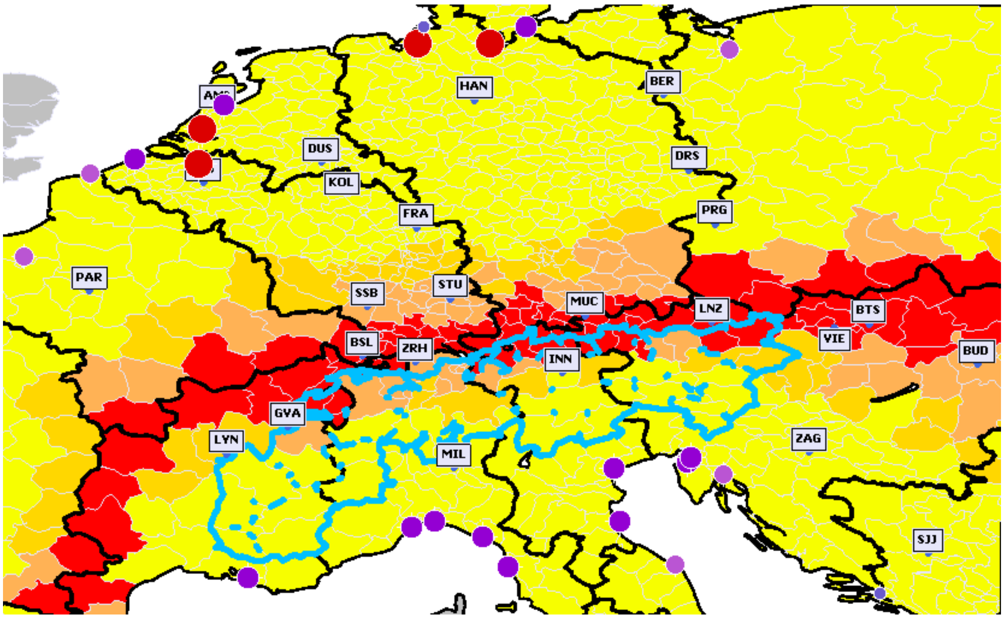
- The hypothesis that shorter sailing distances between Mediterranean ports and East Asian ports ought to create a competitive advantage relative to Northern ports is not supported by this analysis.
- Instead, volume and scale create efficiencies which, being applied to the entire service and not just the European calls, out-weigh the cost of the voyage around the Atlantic coast of Europe.
- In the North, the lines can combine scale (largest available ships) with direct calls in the Hamburg Le Havre range. In the South the lines use well-located hubs (Egypt, Malta, Morocco, Southern Italy, Southern Spain) plus feeders, or medium to large sized mother ships for direct calls. They encounter a compromise therefore, either by adding a feeder leg, or by limiting the vessel size.
- Competitive dynamics in the shipping industry play an important role. Large ships and high load factors offer lower unit costs. Companies have a strong incentive to introduce new ships and to fill them, leading to cycles of low rates and over-capacity. Consequently shippers have a choice. It is therefore reasonable to expect efficient network operations and efficient port choices.
- Cost modelling exercises based on realistic shipping schedules indicate that maritime costs are similar for Northern and Southern port calls. However, the use of ships greater than 11,000 TEU on North European services confers a cost advantage on these routes.
- External cost modelling analyses show that the scale and load factor apply in a similar fashion. Despite the longer voyages, the ability to use larger ships on northern routes, is a compensating factor. With higher load factors, the northern routes offer lower externalities per tonne kilometre.

7 Barriers



Analysis of port traffic and hinterland traffic generation suggests that the Central European market is split along the Alpine arc, with the main contestable area lying just to the North of the Alpine belt. Cities such as Basel, Zurich, Munich and Linz are found within the contestable (red) area. For the Southern ports to increase their market share it is to be expected that more traffic related to these cities would be won by Italian and Slovenian ports. This implies that more port related traffic would need to cross the Alps.

Figure 7.1 Alpine Region and Contestable Hinterland



A North to South shift therefore has important capacity and cost implications within Alpine corridors. To make a simple comparison, the busiest Alpine route (Brenner pass) handles an annual freight volume of 50 million tonnes (all categories); the port of Rotterdam alone handles 430 million tonnes. Relatively little traffic across the Alps is port related; most is Italian intra-EU trade and the transport links on the main Alpine crossings have limited capacity. A substantial North-South shift would therefore have implications on routes already identified as European bottlenecks.

Given plans by Alpine transit countries to mitigate the damage within the sensitive natural environment, there is doubt over the feasibility or universal desirability of creating substantial additional transit traffic, with the prospect of strong traffic pricing actions in future (see ALBATRAS[1]).

7.1 Alpine Freight Traffic Analysis

Data for Transalpine traffic is derived from the Alpenquerender Gutervervehr Survey carried out jointly by the French, Swiss and Austrian transport ministries. The most recent complete survey is available for 2004.

In 2004, 207 million tonnes of freight[2] crossed the Alps. Of this, 147.04 million (71%) tonnes crossed by road, 21.48 million (10%) by rail (combined transport), and 39 million by other rail modes (conventional wagons and rolling motorway).

[1] See http://www.zurich-process.org/key-bodiesresults/the-present-structure/3-working-groups/heavy-vehicle-transport-management-instruments/.
[2] Includes all Alpenbogen C crossings and Tarvisio.

Inland container flows from seaports would use either road or combined transport, so these two modes are examined in more detail.

Current volumes across the Alps are split by crossing point and by transport mode. The precise locations of these crossing points is shown in Figure 7.2.

Table 7.1 Transalpine Road Traffic, 2004, Million tonnes

Road (mln tonnes) – both directions, 2004, million tonnes					
Via France	***MT***	***Via Switzerland***	***MT***	***Via Austria***	***MT***
FR2 Mont-Blanc tunnel	5.16	CH1 Gr. St. Bernhard	0.61	AT1 Reschen	1.97
FR3 Fréjus/Mont-Cenis tunnels	16.76	CH2 Simplon	0.67	AT2 Brenner	31.14
FR4 col du Montgenèvre	0.33	CH3 Gotthard	9.88	AT3 Felbertauern	0.91
FR5 Ventimiglia A8	18.00	CH4 San Bernardino	1.33	AT4 Tauern	12.18
				AT5 Schoberpass	14.64
				AT6 Semmering	5.64
				AT7 Wechsel	8.76
				AT9 Tarvisio	19.07
Total FR	**40.25**	**Total CH**	**12.50**	**Total AT**	**94.30**
Total Alpine crossings	**147.04**				

The major road flows are through France and Austria, with traffic tending to avoid the Swiss routes because of strict measures to restrict HGV transit flows. In 2001, the 28 tonne weight limit was replaced by a distance based heavy goods fee of approximately 65 eurocents per vehicle kilometre, around 170 Euros per Alpine crossing. In Austria, a similar policy is now being adopted with current toll rates at around 35 eurocents per vehicle kilometre. Tariffs at the French Frejus and Mont Blanc tunnels are in the region of 270 Euros per HGV trip.

On the Western side, containers arriving at Genoa would naturally travel North towards Zurich along the Gotthard crossing. In 2004, the total road volume on the Gotthard corridor was 9.88 million tonnes.

On the Eastern side, traffic from Venice or Trieste would naturally follow the Brenner, Tauern and Schober routes northwards. In 2004, the crossings carried 58 million tonnes.

By rail, there are 9.66 million tonnes of freight using combined transport (containers and swap-bodies) via the Gotthard. A further 6 million tonnes of combined transport goes via the Austrian corridors.

Table 7.2 Transalpine Rail-Combined Transport- Traffic, 2004, Million tonnes

Rail Combined Transport (mln tonnes) – both directions, 2004, MT					
Via France	***MT***	***Via Switzerland***	***MT***	***Via Austria***	***MT***
FR3 Fréjus/Mont-Cenis tunnels	2.56	CH2 Simplon	2.56	AT2 Brenner	4.66
FR5 Ventimiglia A8	0.00	CH3 Gotthard	9.66	AT4 Tauern	0.80
				AT5 Schoberpass	0.59
				AT6 Semmering	0.66
Total FR	**2.56**	**Total CH**	**12.22**	**Total AT**	**6.71**
Total Alpine crossings	**21.48**				

Source: NEA, AQGV 2004

It is not possible to identify how much Transalpine freight is port-related, but it is possible to narrow down the estimate by looking at the cargo origins and destinations.
Table 7.3 shows the volumes generated by or attracted to either the Italian coastal regions or the Belgian, Dutch or German coastline. These quantities therefore include an unspecified (but significant) quantity of intra-Europe flows, but the volume of deep-sea container traffic crossing the Alps cannot exceed these figures.

Because rail figures are broken down by train category, we can be confident the traffic identified as CTR (combined transport) is containerised cargo. However it will include intra-European flows e.g. UK-Italy as well as deep sea.

Table 7.3 Coastal traffic on Alpine Crossings, 2004, (Thousands of Tonnes)

*(*1000 ton)*		***North/South bound***	***Road***	***CTR***	***TOTAL***
Italy coastal	from Italy	NB	7,007	151	7,159
	to Italy	SB	8,047	348	8,395
	Total		15,054	499	15,554
Germany coastal	from Germany	SB	889	26	916
	to Germany	NB	810	22	832
Netherlands coastal	from NL	SB	3,296	1,065	4,361
	to NL	NB	1,884	748	2,632
Belgian Coastal	from BE	SB	2,857	2,502	5,359
	to BE	NB	1,905	1,746	3,651
			11,642	6,109	17,751

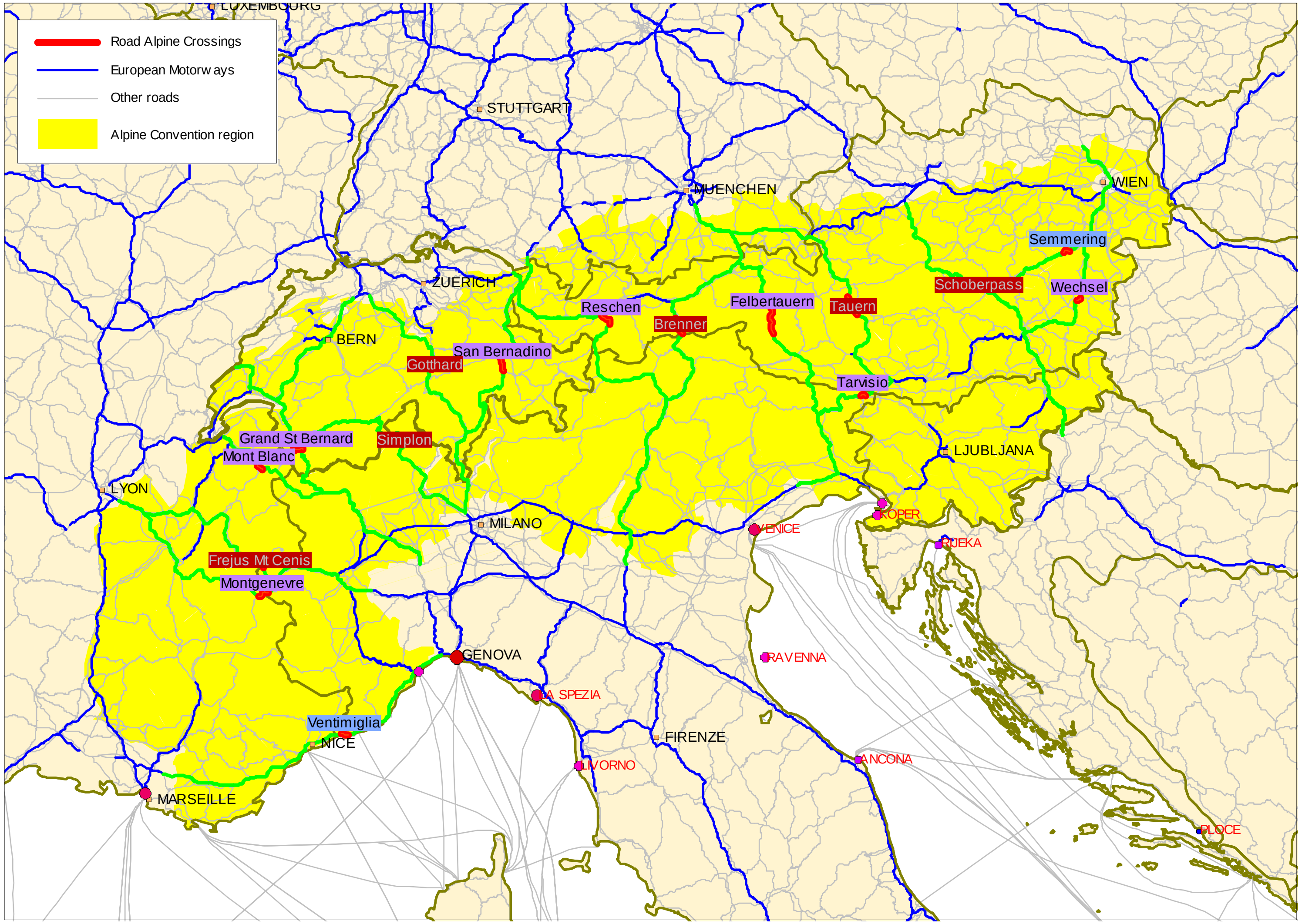
Source: AQGV Survey. (CTR= Combined Transport)

Out of a total of 207 million tonnes crossing the Alps, only 15.554 million originate from or are destined for Italian coastal regions, and only 0.499 million tonnes of these are using combined transport services.

From or to Northern port regions, the volume is estimated to be 17.751 million tonnes per annum, of which 6.109 million tonnes use combined transport on rail.

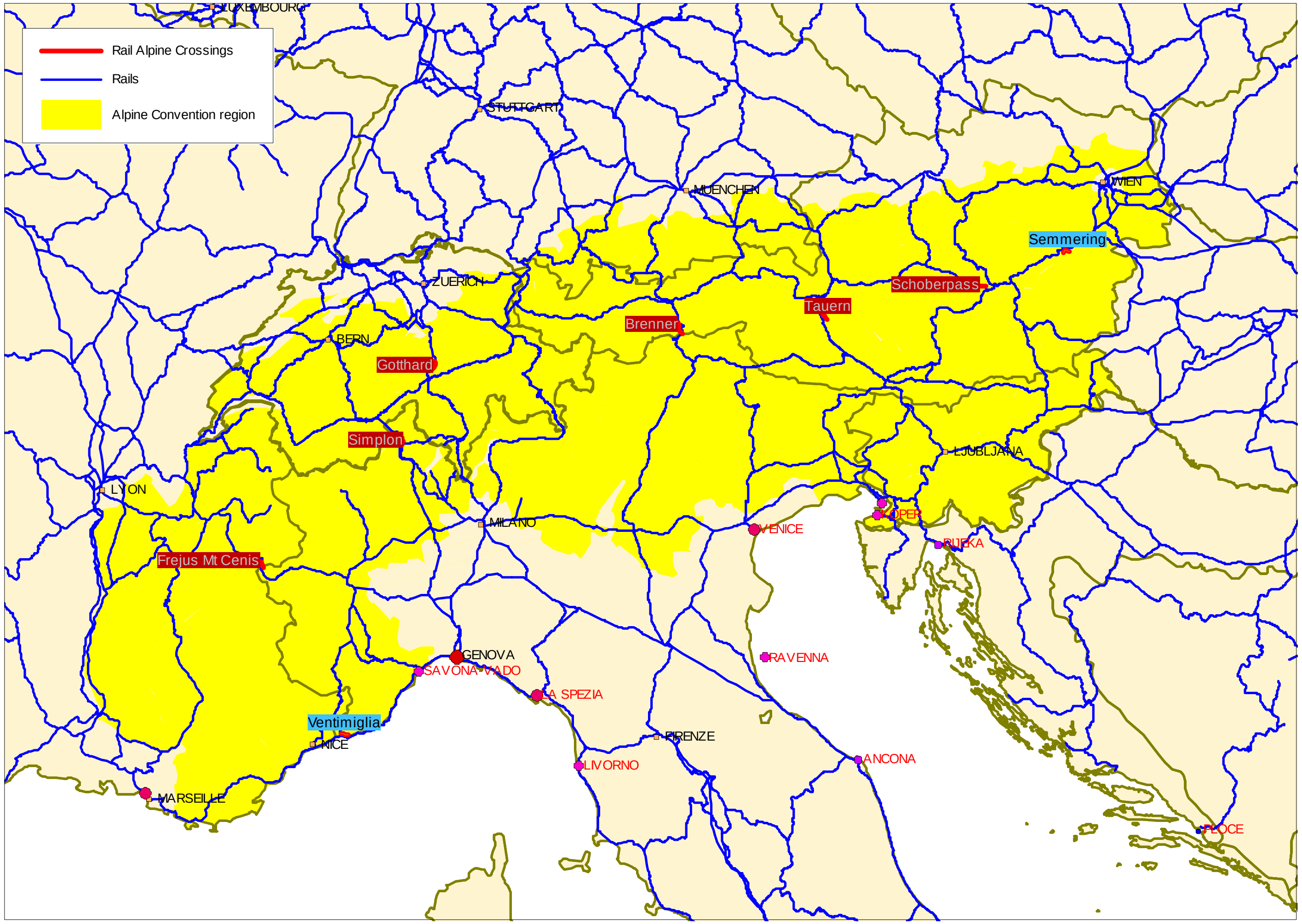
Overall it is estimated that only 3% of road transport across the Alpine belt or about 4.5 million tonnes is containerised.

Figure 7.2 Road Network through Alpine Convention region



Source: NEA

Figure 7.3 Rail Network through Alpine Convention region



Source: NEA

Red crossings have road and all rail modes,

Blue crossings have road, combined transport and conventional rail

Purple crossings are road only.

7.2 Future Developments on Alpine Routes

Transalpine transport policy for heavy goods traffic, as set out by transport ministers of the Alpine countries in the Zurich Declaration (see section 14) is oriented towards limiting the number of HGVs transiting the environmentally sensitive areas, and towards encouraging the use of rail transport. Heavy investments are being made in the Alpine base tunnels in order to provide future capacity for rail. In the meantime, new pricing instruments for road are being proposed, including ACE (Alpine Crossing Exchange), AETS (Alpine Emissions Trading Scheme) and TOLL+ (a modulated toll scheme). Such schemes aim to achieve higher levels of modal shift, while at the same time reducing the need to subsidise rail services. Future rail services on the base tunnel routes will permit the use of longer, heavier trains which can compete with road transport.

The most radical pricing scheme under discussion is the Alpine Crossing Exchange (ACE) which sets a finite limit on the number of HGV transit permits, and allows the permits to be traded under a cap-and-trade scheme. Transit prices therefore rise to the level needed to achieve a given level of road transport.

As stated in the ALBATRAS final report:

> *The roots of the Alpine Crossing Exchange go back to the year 1994, when the Swiss citizens voted in favour of an initiative with the objective to protect the Alps from the negative effects of transit traffic. The legal basis was set in article 84 of the Swiss Constitution, requiring the Swiss government to shift transit traffic from road to rail and levelling the capacity of the transit routes in the Alpine region within 10 years*[1]*.*

In practice, the policy requires the number of HGV crossings on Swiss routes to be cut from the current 1.2 million per annum to 650,000 per annum. Thus an absolute reduction in road freight of 50% is required. Given that volumes across the Alps are expected to grow by 25% by 2020, and at least 30% by 2030 the required transfer from road to rail is very high.

In ALBATRAS[2], using a scenario in which an ACE scheme is applied to the whole Alpine Arc, a set of forecasts has been made for mode and route choice. To illustrate the outcome, a single scenario involving the use of the Alpine Crossing Exchange is summarised below:

[1] Article 84 of the Swiss Constitution on the Alpine transit traffic and Article 196 (1) Transitional provision to Art. 84 (http://www.admin.ch/ch/e/rs/101/index.html)
[2] ECOPLAN, RAPP,NEA, HERRY , 7 January 2011,.

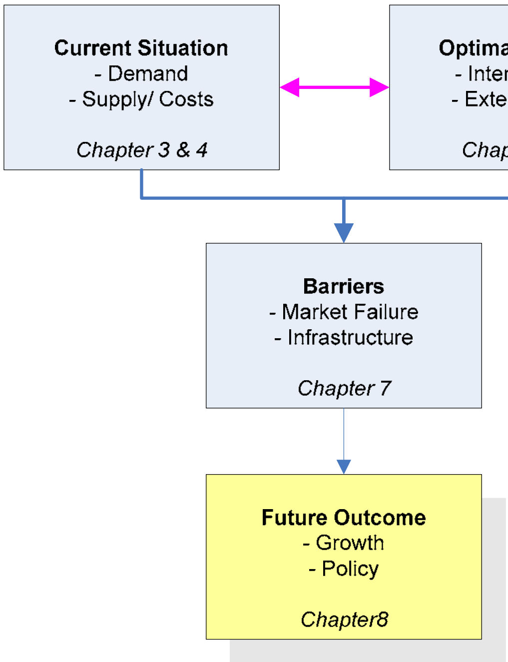
Table 7.4 Transalpine Forecast 2030 (Albatras Study)

	CTR	*WL*	*RM*	*RAIL*	*ROAD*	*TOTAL*
2004	21	36	5	62	145	207
2030	43	95	12	149	119	267
Diff (mT)	+22	+59	+7	+87	-26	+60
Diff (%)	105%	151%	140%	140%	-18%	29%

Source: ALBATRAS, Scenario ACE R 2030 low. P263 final report.

Under this low growth scenario, total transit traffic grows to 267 million tonnes by 2030, only 29% more than the 2004 figure over a period of 25 years. The ACE is adopted on all the crossings between Ventimiglia and Tauern, reducing the number of lorry crossings by 18% compared to today. Under these assumptions, rail volumes have to increase by 140%, equivalent to 87 million tonnes per annum. To achieve this shift it is estimated that the price of the permits would rise by EUR 215-200 per crossing, in addition to existing tolls.

8 Future Perspectives



An analysis is made in this section showing the potential impact of a shift from North to South, sufficient to bring the North-South shares into line with economic activity. It is based on the central European core regions defined earlier in this report. Four steps are outlined:

1. Current situation
2. Forecast of container volumes to 2030, including impact of autonomous shift towards South East.
3. Impact on volumes of an additional shift from North to South.
4. Impact on shares of an additional shift from North to South.

1. Step one: current shares of the competing ports within the core continental region.

Note that the analysis is based upon deep-sea direct container figures only, and that in the first step the sea-to-sea transhipment flows are subtracted. This convention is also applied to the forecasts shown in the subsequent steps.

Table 8.1 Port Market shares within Core Region

		2008	*2008*	*2008*
		TOTAL TEU (mln)	TEU without transhipment (mln)	Shares
North Core			**28.0**	**80%**
Of which:	HAM, BRE	15.0	7.5	27%
	RTM	10.7	8.5	30%
	ANT, ZEE	12.3	8.7	31%
	LHV, DNK	2.7	2.0	7%
	Other		1.3	5%
South Core			**7.0**	**20%**
Of which:	GEN,LAS,LIV,SAV	4.0	3.6	51%
	VEN, RAV	0.6	0.6	9%
	TRI, KOP, RIJ	0.9	0.9	13%
	FOS	0.8	0.8	11%
	Other		1.1	16%
TOTAL			**35.0**	**100%**

2. Step two: forecast of volumes to 2030.

Table 8.2 Forecast 2030 Port Market shares within Core Region

		2030	*2030 All Routes*	*2030 Suez Routes*
		Shares	TEU (mln)	TEU (mln)
North Core		**78%**	**64.5**	**35.3**
Of which:	HAM, BRE	27.8%	17.9	9.8
	RTM	31.4%	20.2	11.1
	ANT, ZEE	32.1%	20.7	11.3
	LHV, DNK	5.6%	3.6	2.0
	Other	3.1%	2.0	1.1
South Core		**22%**	**18.2**	**10.0**
Of which:	GEN,LAS,LIV,SAV	50%	9.2	5.0
	VEN, RAV	8%	1.4	0.8
	TRI, KOP, RIJ	15%	2.7	1.5
	FOS	11%	2.1	1.1
	Other	16%	2.9	1.6
TOTAL		**100%**	**82.7**	**45.2**

Step two contains a forecast of traffic up to 2030, with an estimate of how much is Suez related. In this study, no attempt is made to estimate changes in market shares within the coastal ranges; only the effect of differential trade growth in different European regions. This shows an autonomous shift in the Southern port range due to faster economic and trade growth in the South.

The forecast figures in Table 8.2 use a flat rate of growth of 4.0% per annum for all ports in the core areas, applied only to non-transhipment traffic. Therefore we do not attempt to forecast shifts between nearby competitors, nor changes in transhipment patterns.

In the 2010 ISL study “Prognose der Containerumschlagpotenziale des Hamburger Hafens[1]” predicts that total container volumes in the Hamburg-Le

[1] ISL, 2010, “Prognose der Containerumschlagpotenziale des Hamburger Hafens” on behalf of the Hamburg Port Authority. Bremen, October 2010. Tab 41. p105.

Havre range will reach 90.1 million TEU in 2025, of which 34.5 million are transhipment[1]. The remaining 55.6 million TEU can be compared with the 64.5 million TEU shown above for 2030. In the ISL study there is no forecast of 2030.

The study also predicts a volume of 25.3 million TEU in 2025 for Hamburg alone, of which 11.3 million TEU are transhipment. The remaining 14 million TEU can be compared with the figure of 17.9 million shown above (calculated for 2030, and combining Hamburg and Bremerhaven).

Rotterdam's Haven Visie 2030[2] shows a range of container forecasts from 225 million tonnes of containerised cargo (low growth scenario) in 2030 to 360 million tonnes (global economy scenario). If sea to sea transhipment remains at 75%, these figures suggest a range of TEU volumes from 16.9 million TEU (low growth) to 27 million TEU (global economy). These figures can be compared with the figure of 20.2 million TEU shown in Table 8.2.

No recent official forecasts for 2030 container volumes in Antwerp were available at the time of writing for comparison.

[1] Optimistic Economic Forecast, Basis Scenario.
[2] Haven Visie 2030, Port Compass. Port of Rotterdam.

3. Step three: impact of an additional shift from North to South.

Table 8.3 Forecast 2030 Port Market volumes within Core Region – with N>S Shift

		North to South Shift	*2030 All Routes*	*2030 Suez Routes*
		TEU (mln)	TEU (mln)	TEU (mln)
North Core		**-2.0**	**62.5**	**33.3**
Of which:	HAM, BRE	-1.0	16.9	8.8
	RTM	-0.5	19.7	10.6
	ANT, ZEE	-0.5	20.2	10.8
	LHV, DNK	0.0	3.6	2.0
	Other	0.0	2.0	1.1
South Core		**2.0**	**20.2**	**12.0**
Of which:	GEN,LAS,LIV,SAV	0.0	9.2	5.0
	VEN, RAV	0.5	1.9	1.3
	TRI, KOP, RIJ	1.5	4.2	3.0
	FOS	0.0	2.1	1.1
	Other	0.0	2.9	1.6
TOTAL		**0.0**	**82.7**	**45.2**

Step three is to include the assumption that there is an additional shift to the Southern range, mainly in the North East Adriatic area, following the expectations of shipping lines that modernised port facilities and improved inland connections from Koper to Hungary and Slovakia would help to create more critical mass for these routes. This is assumed to be a shift of 2 million TEU from North to South.

4. Step four – estimation of resulting North South shares following shift.

Table 8.4 Forecast 2030 Port Market shares within Core Region – with N>S Shift

		2030 All Routes	*2030 Suez Routes*	*2008-2030 Volume Increase*
		Shares	Shares	TEU (mln)
North Core		**76%**	**74%**	**34.5**
Of which:	HAM, BRE	20%	19%	9.4
	RTM	24%	23%	11.2
	ANT, ZEE	24%	24%	11.5
	LHV, DNK	4%	4%	1.6
	Other	2%	2%	0.7
South Core		**24%**	**26%**	**13.2**
Of which:	GEN,LAS,LIV,SAV	11%	11%	5.6
	VEN, RAV	2%	3%	1.3
	TRI, KOP, RIJ	5%	7%	3.3
	FOS	3%	3%	1.3
	Other	3%	3%	1.8
TOTAL		**100%**	**100%**	**47.7**

Step four, is the final conclusion that if market growth continues, and that existing rail infrastructure plans for Slovenia, Croatia and Hungary are completed, the North-South share will find equilibrium at around 75:25. In such circumstances, the largest volume increases are still to be found in the Northern ports, and the largest share increases to be found in the South.

9 Summary and Conclusions

European transport policy seeks to balance internal and external costs, taking into account both inland and maritime transport. DG-CLIMA states that the European Union is committed to an international effort to reduce greenhouse gases from shipping, given that 40% of international shipping is related to European economic activity.

The 2011 White Paper[1] states in its first paragraph:

> *"Transport is fundamental to our economy and society. Mobility is vital for the internal market and for the quality of life of citizens as they enjoy their freedom to travel. Transport enables economic growth and job creation: it must be sustainable in the light of the new challenges we face. Transport is global, so effective action requires strong international cooperation."*

Port policy influences economic development, and shipping is a relatively sustainable form of transport.

The question addressed within this study is whether existing patterns of cargo distribution within long distance container shipping, one of the important growing freight markets, are efficient.

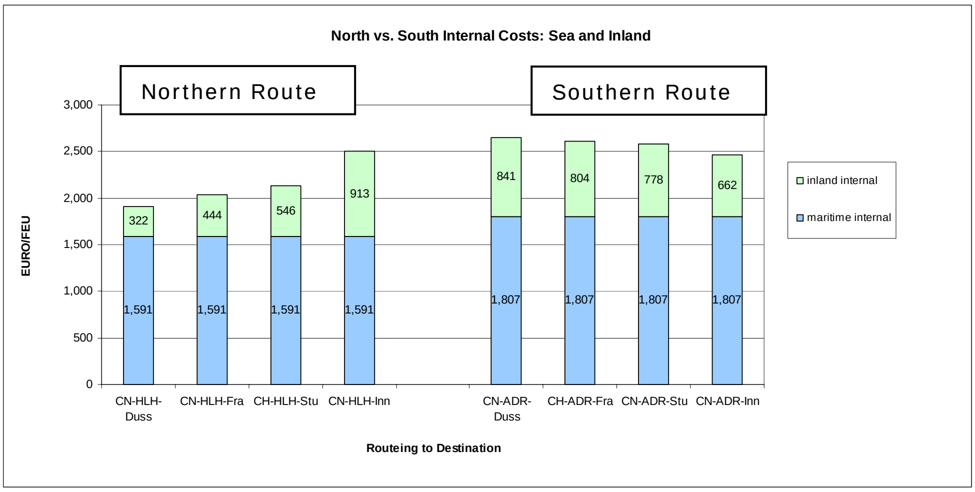
The answers can be summarised in figures comparing the internal and external costs, for Northern and Southern routes, for a series of European destinations. They conclude that market incentives, which lead to a clustering of port volumes in the Northern range are consistent with economic and social objectives.

In the following figures, internal and external costs by land and sea are compared for a Chinese container transported to four European destinations; Dusseldorf, Frankfurt, Stuttgart and Innsbruck.

Despite longer sea distances, the point of equality is found close to the Northern edge of the Alpine arc. The ability to offer scale in shipping, critical mass in ports and effective multimodal inland transport offsets distance.

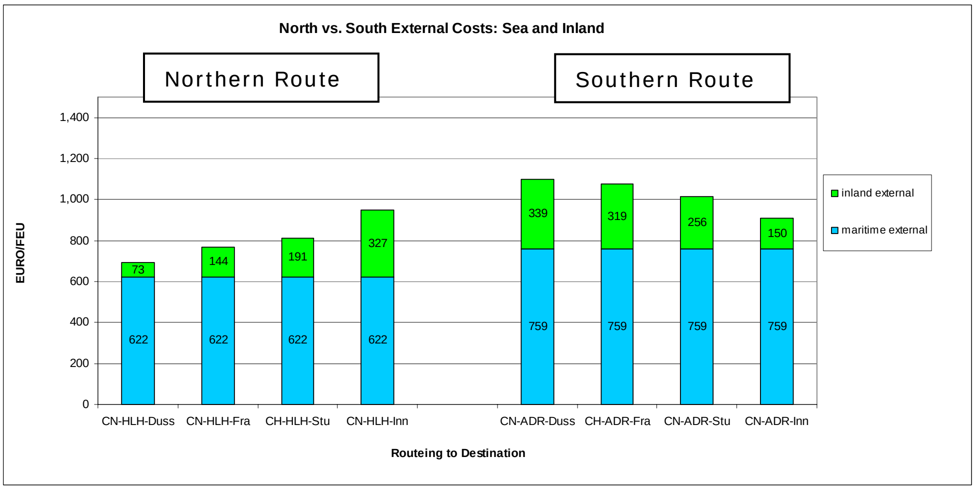
[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0144:EN:NOT

Figure 9.1 Internal costs for a range of European cities



Source: NEA

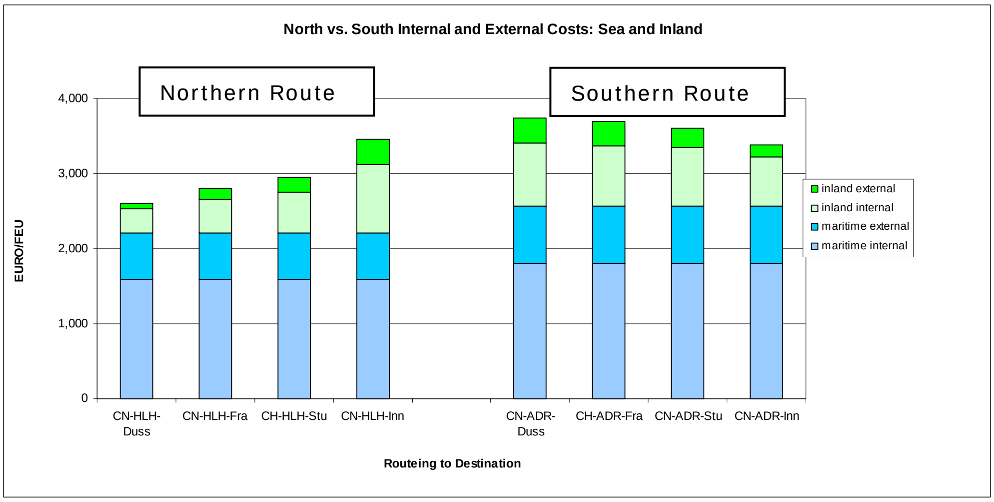
Figure 9.2 External costs for a range of European cities



Source: NEA

In the left side of the chart, costs are estimated for containers shipped from China via a North European port. The four bars show how the costs change as the inland destination shifts southwards from Dusseldorf to Frankfurt to Stuttgart to Innsbruck. On the right hand side, the port of entry is assumed to be an Adriatic port.

Figure 9.3 Total land and sea costs for a range of European cities



Source: NEA

Figure 9.3 summarises all the maritime and inland external and internal costs estimated within this study.

Several observations can be made:

- Overall, the maritime internal and external costs are low given the long distances involved. In each case, a sea journey of around 20,000 km is being modelled.
- Given current valuations of externalities, internal costs outweigh external costs.
- Internal and external costs are correlated; both react positively to distance, and negatively to load factors and scale.
- Load factors and scale effects can be significant enough to outweigh distance; this is the main reason why the analysis shows lower overall costs via the Northern range.
- Load factors and scale operate on both intercontinental maritime and inland/feeder networks.
- Concentrated flows at major hub ports help these scale and load factor effects to be realised.

This study suggests that within this specific sector of the freight market there has been a broadly rational evolution, without major barriers or conflicts between economic interests and sustainability. Although Europe's external trade has shifted markedly towards Asia and thus towards Suez, its internal economic geography and transport infrastructure has changed only gradually, and the greater responsiveness of maritime transport appears to be the decisive factor.

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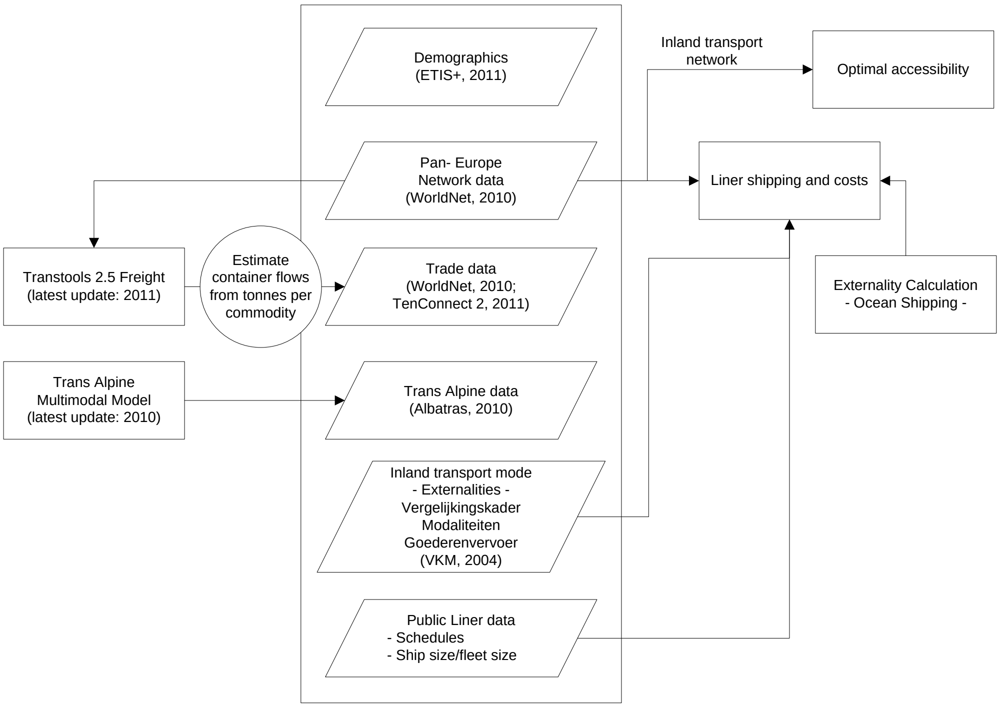
10 ANNEX: Model Methodologies

Figure 10.1 Data and models



Source: NEA

11 ANNEX: Estimation of Externalities

Assumptions for monetising hinterland externalities:

	HGV	**TRAIN**	**BARGE**
Noise	1.47	23.15	0.00
Accidents	16.42	24.66	1.60
CO_2	4.89	93.42	479.67
SO_2	0.13	11.04	46.97
NO_X	11.81	332.85	1342.43
PM_{10}	3.89	74.74	574.28
NMVOC	0.27	2.89	30.37
CO	0.04	0.70	5.27
Emissions	**21.04**	**515.64**	**2478.99**
Total Eurocents per Vehicle	**38.93**	**563.45**	**2480.59**
FEU/Vehicle	1.00	35.00	125.00
Externalities, Eurocents per FEU	**38.93**	**16.10**	**19.84**

CO_2 –carbon dioxide
SO_2 – sulphur dioxide
NO_X – nitrous oxide
PM_{10} – soot particles of a diameter less than 10 micrometres.
NMVOC – non-methane volatile organic compounds
CO – carbon monoxide.

12 ANNEX: Analysis of Trade Flows via Suez

Asia to Europe		***Containerised Tonnage***			***Estd. Loaded TEU***
European Region	**Asian Region**	**1998**	**2004**	**2009**	**2009**
North Continent	Mid East	2.961	5.599	6.432	0.858
	Indian Subcontinent	1.473	2.559	3.300	0.440
	S.E. Asia	4.797	7.120	7.225	0.963
	Oceania	4.813	4.277	3.602	0.480
	China	5.215	14.261	18.795	2.506
	NE Asia	2.056	4.139	3.281	0.437
	TOTAL	21.315	37.956	42.635	5.685
South Continent	Mid East	2.062	2.288	6.414	0.855
	Indian Subcontinent	1.283	1.253	1.936	0.258
	S.E. Asia	3.185	3.351	5.988	0.798
	Oceania	2.533	1.332	1.478	0.197
	China	2.289	5.239	9.013	1.202
	NE Asia	1.236	1.183	1.449	0.193
	TOTAL	12.588	14.646	26.278	3.504
Baltic	Mid East	0.016	0.046	0.060	0.008
	Indian Subcontinent	0.058	0.114	0.139	0.019
	S.E. Asia	0.214	0.262	0.362	0.048
	Oceania	0.322	0.518	0.353	0.047
	China	0.297	0.771	1.146	0.153
	NE Asia	0.176	0.206	0.180	0.024
	TOTAL	1.083	1.916	2.241	0.299
UK/Ireland	Mid East	0.204	0.464	1.465	0.195
	Indian Subcontinent	0.772	1.446	1.570	0.209

Asia to Europe		***Containerised Tonnage***			***Estd. Loaded TEU***
	S.E. Asia	1.994	2.542	2.308	0.308
	Oceania	1.730	2.365	1.665	0.222
	China	1.847	5.451	5.606	0.747
	NE Asia	1.174	1.161	0.675	0.090
	TOTAL	7.720	13.428	13.290	1.772
TOTAL				84.443	11.259

Europe to Asia		***Containerised Tonnage***			***Estd. Loaded TEU***
European Region	Asian Region	1998	2004	2009	2009
North Continent	Mid East	3.649	6.327	7.682	1.024
	Indian Subcontinent	1.651	2.775	5.538	0.738
	S.E. Asia	3.050	4.772	5.893	0.786
	Oceania	0.992	1.707	1.576	0.210
	China	4.599	10.268	12.398	1.653
	NE Asia	2.871	4.489	3.974	0.530
	TOTAL	16.813	30.338	37.060	4.941
South Continent	Mid East	2.923	3.602	4.863	0.648
	Indian Subcontinent	0.415	0.779	1.935	0.258
	S.E. Asia	0.721	1.168	2.036	0.271
	Oceania	0.661	0.849	0.659	0.088
	China	1.599	3.014	6.200	0.827
	NE Asia	0.764	1.166	1.299	0.173
	TOTAL	7.084	10.576	16.991	2.266
Baltic	Mid East	0.926	1.592	2.183	0.291
	Indian Subcontinent	0.160	0.394	1.232	0.164
	S.E. Asia	0.353	0.845	1.014	0.135
	Oceania	0.304	0.398	0.257	0.034
	China	0.679	1.800	2.515	0.335
	NE Asia	0.805	1.639	1.180	0.157
	TOTAL	3.229	6.669	8.380	1.117
UK/Ireland	Mid East	0.860	1.136	0.911	0.122
	Indian Subcontinent	0.417	1.351	2.364	0.315
	S.E. Asia	0.647	1.933	1.907	0.254
	Oceania	0.368	0.364	0.309	0.041

Europe to Asia		***Containerised Tonnage***			***Estd. Loaded TEU***
	China	0.861	2.748	4.166	0.555
	NE Asia	0.571	0.848	0.918	0.122
	TOTAL	3.725	8.381	10.576	1.410
TOTAL				73.008	9.734

13 ANNEX: Transalpine Freight Flows

Alpine crossing freight traffic – 2004

(mln tonnes)	*road North to South*	*road South to North*	*rail CTR North to South*	*rail CTR South to North*	*rail other types North to South*	*rail other types South to North*
AT1 Reschen	1.12	0.85	-	-	-	-
AT2 Brenner	16.45	14.69	2.89	1.77	4.19	1.33
AT3 Felbertauern	0.60	0.31	-	-	-	-
AT4 Tauern	6.25	5.92	0.49	0.30	4.08	3.16
AT5 Schoberpass	8.08	6.56	0.31	0.27	2.42	2.36
AT6 Semmering	2.92	2.72	0.33	0.33	7.41	1.50
AT7 Wechsel	4.84	3.92	-	-	-	-
AT9 Arnoldstein /Tarvisio	10.78	8.29	-	-	-	-
CH1 Gr. St. Bernhard	0.31	0.30	-	-	-	-
CH2 Simplon	0.35	0.32	1.29	1.27	3.30	0.95
CH3 Gotthard	4.57	5.31	5.82	3.84	4.94	1.51
CH4 San Bernardino	0.67	0.66	-	-	-	-
FR2 Mont-Blanc tunnel	2.84	2.32	-	-	-	-
FR3 Fréjus/Mont-Cenis tunnels	8.62	8.14	1.39	1.17	3.00	0.70
FR4 col du Montgenèvre	0.20	0.13	-	-	-	-
FR5 Ventimiglia A8	9.26	8.74	-	0.00	0.49	0.04
Total	**77.87**	**69.18**	**12.53**	**8.96**	**29.83**	**11.55**

Source: AQGV 2004

	ROAD TONNAGE by TYPE OF TRUCK BODY													
	Unknown	1 Tanker or silo	10 Others	2 refrigerating vehicle	3 other box	4 Canvas top	5 Open platform, dump truck or stake	6 Equipment to carry container with container	7 Equipment to carry container with swap body (only in 2004)	8 Equipment to carry container, empty	9 Car transport vehicle			
ALP CRO	ton	ton	ton	ton	ton	ton	ton	ton	ton	ton	ton	TOTAL	Containers	Container Share
AT1	0	210,803	18,139	394,493	119,878	791,602	408,068	22,322	787	0	0	1,966,093	23,110	1.2%
AT2	1,648,099	3,728,203	54,718	4,585,046	1,660,389	19,392,590	1,115,777	223,251	47,751	22,155	308,647	32,786,627	293,158	0.9%
AT3	0	70,363	5,530	31,917	32,464	688,648	81,716	0	0	0	944	911,582	0	0.0%
AT4	978,586	1,113,279	120,308	1,453,736	682,572	8,054,112	427,079	149,746	34,555	1,106	138,976	13,154,055	185,407	1.4%
AT5	536,806	1,186,178	137,136	794,686	949,126	9,451,188	1,568,590	253,939	211,805	2,947	80,661	15,173,062	468,690	3.1%
AT6	0	800,219	42,424	179,151	619,525	2,939,349	908,262	125,027	5,587	0	20,211	5,639,757	130,615	2.3%
AT7	0	1,071,814	46,735	865,505	738,908	4,544,271	1,243,041	146,522	17,286	4,994	80,646	8,759,723	168,803	1.9%
AT9	0	2,035,268	122,643	866,230	1,938,534	12,198,042	1,374,677	259,435	76,046	0	200,723	19,071,597	335,481	1.8%
CH1	610,282	0	0	0	0	0	0	0	0	0	0	610,282	0	
CH2	1,903,808	0	0	0	0	0	0	0	0	0	0	1,903,808	0	
CH3	10,362,989	0	0	0	0	0	0	0	0	0	0	10,362,989	0	
CH4	1,330,670	0	0	0	0	0	0	0	0	0	0	1,330,670	0	
FR2	0	364,286	21,070	8,080	351,689	3,849,891	547,070	5,553	3,181	537	6,997	5,158,352	9,270	
FR3	0	975,421	205,619	1,830,374	917,376	9,626,499	1,666,831	0	2,020	49,689	1,482,695	16,756,523	51,708	
FR4	0	39,370	284	1,614	4,367	84,977	202,183	172	0	0	455	333,422	172	
FR5	0	2,013,540	181,595	2,699,905	689,275	10,905,096	1,091,796	93,350	31,442	6,573	288,379	18,000,952	131,365	
TOTAL	17,371,240	13,608,744	956,199	13,710,737	8,704,103	82,526,266	10,635,091	1,279,318	430,460	88,000	2,609,334	151,919,493	1,797,778	

Proportions of road traffic via Transalpine Crossings by vehicle type, including containers. This information is not given for Swiss Corridors.

14 ANNEX: Declaration of Zurich, 30-11-2001

Ministers of Transport

- Federal Republic of Germany
- Republic of Austria
- Republic of France
- Republic of Italy
- Swiss Confederation

Joint Declaration concerning the Improvement of Road Safety Particularly in Tunnels in the Alpine Region (30 November 2001)

Preamble
In the presence of the Chairman of the Council of Ministers of Transport of the European Union and the Vice-President of the European Commission, the Ministers of Transport of the Republic of Austria, the Republic of France, the Federal Republic of Germany, the Republic of Italy and the Swiss Confederation (or their representatives),

> considering that transport is a capital element in the lives of the citizens of Europe and of the European economy and that it is important to place Europe's citizens firmly at the heart of transport policy, inter alia, ensuring a high level of safety for them,
>
> while recognizing the primordial role of transport infrastructures for transalpine services with a view to achieving the completion of the internal market and establishing an efficient trans-European transport network,
>
> stressing the need for **balance in the development of the various transport modes**, particularly in the area of the Alps, **while bearing in mind the specific features of that environment, in particular the fragility of the balance between the economy, society, man and his natural environment**,
>
> conscious of the increasing risks of the transalpine transport of goods by road through tunnels, which mean that additional efforts must be made to ensure safety both in terms of infrastructure and vehicles and in terms of the efficiency of emergency and management services, driver training and compliance with regulations, the establishment of effective and concerted checks to ensure that compliance, information for users, means of communicating with them in the event of an accident and the definition of appropriate rules for traffic in tunnels,
>
> deploring the tragic accidents that have occurred recently in Alpine road tunnels, which demonstrate the need for immediate action to improve user safety, particularly in tunnels,

noting that high-quality rail transport has undeniable advantages for society compared with road transport on long-distance services or services through areas where transit is difficult such as major mountain massifs,

desirous of undertaking all possible **measures to control the carriage of goods by road through these areas where transit is difficult, while at the same time encouraging the transfer of goods from the roads to less polluting transport modes, particularly the railways**, to the benefit of the environment and the economy,`

considering that a clear improvement in transport in the Alpine region, leading to sustainable development as recommended by the Göteborg Council in June 2001, requires a number of deliberate and coordinated decisions to be taken which will have short, medium and long-term effects and that these measures are described in the programme contained in the annex to the White Paper on European transport policy to the year 2010: time to decide,

have agreed to achieve the above objectives and to implement the measures described below.

See: http://www.zurich-process.org/fileadmin/data/webcontent/Webcontent/Sonstige_Dateien/Declaration_of_Zurich_en_2001.pdf