WP 3.1

Multimodal Corridor System Report

Interreg Baltic Sea Region Project #R032 "Sustainable and Multimodal Transport Actions in the Scandinavian-Adriatic Corridor"

Work Package	WP3 Multimodal Transport
Activity	Report A3.1 Technical University of Applied Sciences Wildau Assessing multimodal capacities and flows along the Scandria® Corridor
Responsible Partner	TH Wildau
Authors	Lisa Hartmann, TH Wildau; Philip Michalk, TH Wildau
Contributors	Dino Keljaic, Region Örebro County; Mario Lembke, Rostock Port GmbH; Sorin Sima, Swedish Transport Administration Region South
Quality Control	Sven Friedrich, Infrastruktur & Umwelt; Sorin Sima, Swedish Transport Administration Region South

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Output Description (Application Form)

The report takes a complete approach to quantifying and visualizing freight flows in the Scandria® Corridor. The aim of the analysis is to gain knowledge about the existing transport volume in the Scandria® Corridor. From the results, recommendations for a modal shift to rail can be derived.

The output of A 3.1 is a Multimodal Corridor Status Report that provides information on available knowledge. Multimodal Corridor Status Report contain information about:

- Multimodal terminals, especially for the Swedish and NorthEast German part of the Scandria® Corridor;
- Multimodal services in the Scandria® Corridor;
- Freight flows through the Scandria® Corridor regions;
- Available information and complement missing information, especially for the Swedish and NorthEast German part of the Scandria® Corridor;
- Identify relevant freight flows that have a high potential to be carried out as multimodal services.

Additional Quality Criteria

What is the aim of the output?

The aim of the report is to gain knowledge about the existing transport volume in the Scandria® Corridor. From the results, recommendations for a modal shift to rail can be derived. Overarching aims are the long-term relief of road traffic for a CO_2-efficient transport system and the achievement of a wide acceptance and implementation.

What is the thematic / geographical scope of the output?

- **thematic scope** → Assessing multimodal capacities and flows along the Scandria® Corridor. The activity describes the state of the art knowledge on freight flows as well as map major ports and terminals in the corridor. It will also provide a comprehensive overview on running multimodal services as well as available information on potential for multimodal shift.
- **geographical scope** → Scandinavian and Mainland-Europe

Who is the output addressing (target group)?

The report is supposed to increase knowledge of:

- Regional and national decision makers about consequences that can be drawn for strategic decision making in infrastructure and transport policy
- National and regional administrations for transport infrastructure planning and logistics about freight flow dynamics in the Scandria® Corridor
- Multimodal service providers about relevant freight flows and shifting potentials

Index

1 Executive Summary

The development of transport volume and transport performance is increasingly criticized. Especially the significant growth of road transport poses environmental challenges. Combined transport is a core element of a CO_2-efficient transport structure.

Concerning this issue, this report is dealing with the recording and visualization of freight flows within the northern Scandria® Corridor. Orientation discussions, expert interviews and evaluation of various statistics of the Statistical Office of the European Union (Eurostat) as well as project-internal surveys are used to carry out and evaluate a holistic freight flow analysis involving the modes of transport water, road and rail.

The results and insights gained from this are bundled here. In future, political and research-specific recommendations for actions can be developed on the findings to ensure sustainable and transparent freight transports.

This report was prepared within the framework of the Scandria®2Act project, which deals with measures to foster sustainable and multimodal freight transport along the Scandria® Corridor. The aim of the study is to record the existing freight flows in order to analyze the potential for a modal shift in long-distance transport via the Baltic Sea, road and rail modes. Freight transports from Sweden to Northern Germany and Poland is of special interest.

The first chapters of the report serve for the thematic classification and explanation of the methodology of the obtained results (Chapter 2 – 4 the project internal surveys of Trafikverket Region South, Trafikverket Region West (STA survey) and ROSTOCK PORT GmbH (HERO survey) are explained and described. In addition, the interpretation of the STA survey, which is the base of the analysis, is presented.

The analytical part is divided into the different modes of transport and contains all the findings that are relevant for formulating the conclusions (Chapter 5 and 6). The results are quantified in detail in tabular form on the one hand and visualized in quantity-based flow diagrams (so-called Sankey diagrams) on the other hand.

Chapter 7 examines the utilization rates of the German Baltic Sea ports of Kiel, Lübeck and Rostock. The focus is on the potentials of the modal shift to rail based on a capacity level of the ports. Through expert statements by the ports, the theoretical total capacities of the Combined Transport terminals and the units actually handled were determined and put it in proportion.

All findings are bundled in conclusions (Chapter 8). These provide a comprehensive impulse for a CO2-efficient structuring of the Scandria® corridor. Decissionmakers as well as researching institutions should be addressed. The conclusions can serve on the one hand as a basis for further recommendations for actions and on the other hand as a platform for further projects.

The following figure summarizes the structure of the report.

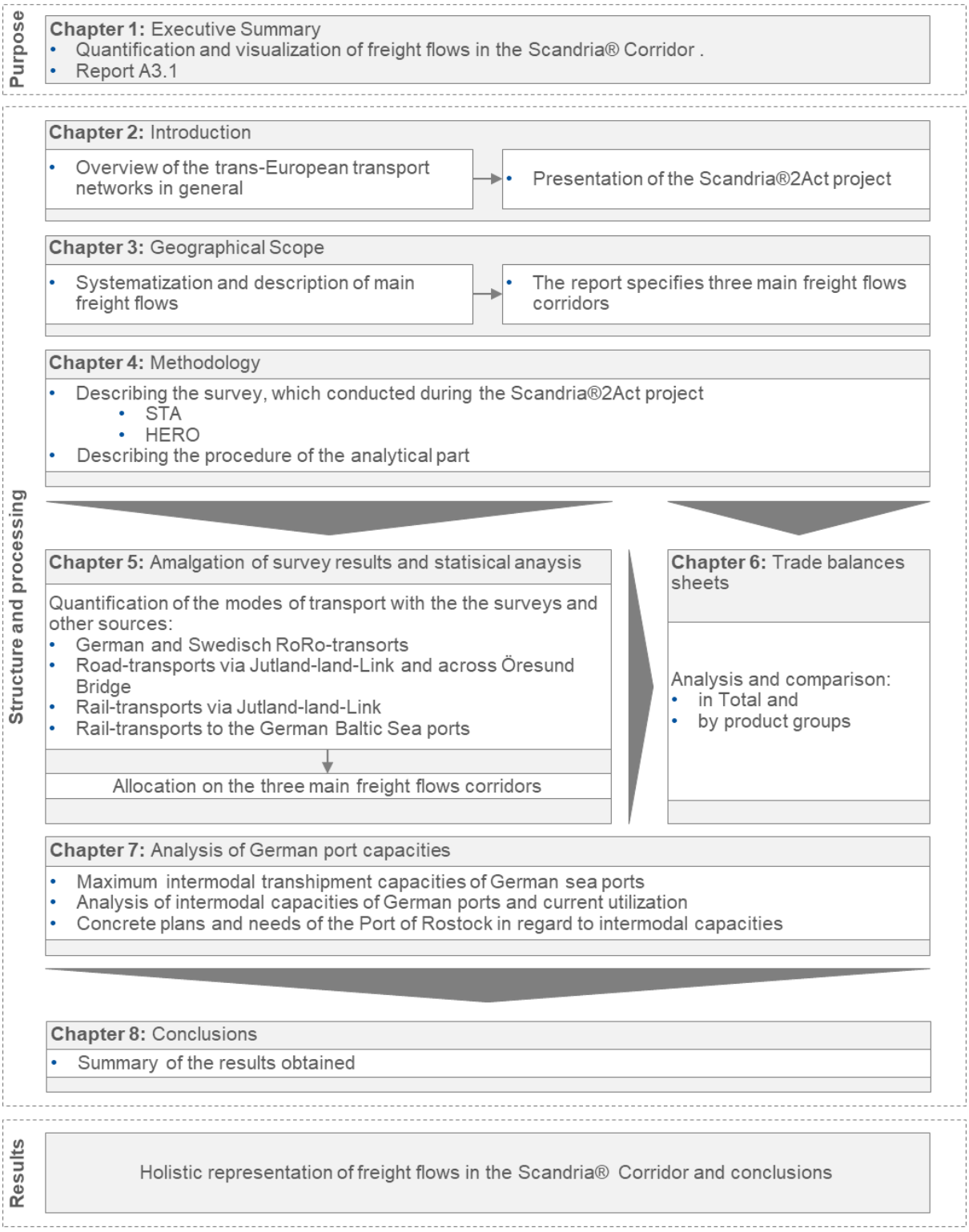


Figure 1 Structure of the report

2 Introduction

Today, mobility plays an important role in the human need chain. This need doesn't come from nowhere, but rather serves to satisfy a completely different need[1]: self-realization. According to Randelhoff (2011), the need for transport arises from the demand for a change of location to satisfy a primary need, resulting in a market-effective demand for transport.

The demand for transport will continue to rise in the long term, both because of the growing globalisation of the economy and the constant desire for human mobility. It´s therefore assumed that transport makes mobility possible, which opens up the opportunity for the economy and people to participate in exchange processes all over the world (cf. Federal Statistical Office (2013): Verkehr auf einen Blick [engl.: Traffic at a glance], p.4).

In the European Union (EU), freight transport is an essential part of transport volume and performance. In order to handle the immense volume of transport within the EU, politicians are faced with the question of economy and ecology for the realisation of freight transport. The focus here is on the political decisions for multimodal, intermodal or combined transport. The choice of a suitable mode of transport is a challenge. There is still a long way to go in respect of "intelligent solutions" for shaping freight transport.

A large number of transnational approaches have been encouraged by the EU Commission to implement the project, in which the roads are relieved by a modal shift to rail and ship. These include the so-called Scandria®2Act, a project for the green and innovative development of the Scandinavia-Adriatic (Scandria®) Corridor.

In the course of this report, a freight flow analysis was carried out which is to be incorporated into the Scandria®2Act project as a research aspect. The aim of the analysis is to gain knowledge about the existing transport volume in the Scandria® Corridor. From the results, political recommendations for a modal shift to rail can be derived. Overarching aims are the long-term relief of road traffic for a CO_2-efficient transport system and the achievement of a wide acceptance in politics.

2.1 The trans-European transport network (TEN-T)

Transnational projects require a high degree of international cooperation and must be regulated by a large number of restrictions.

The Trans-European Transport Networks (TEN-T) bond multi-billion projects for the creation of highly efficient transport networks, which are structured by the European Commission (EU Commission). The aim of the TEN-T networks is to close gaps in transport infrastructure and eliminate bottlenecks.[2]

The network is divided into two parts: an overall network (comprehensive) to be completed by 2050 and a core network to be completed by 2030.

The core network is divided into nine corridors:

- two north-south corridors,
- three in east-west direction and

[1] The term "need" is understood according to Maslow's pyramid of needs, a step-by-step model of human motivation.

[2] Federal Ministry of Transport and Digital Infrastructure. (2018). The trans-European transport network (TEN-T)

- four diagonal corridors, of which six pass through Germany, more than in any other Member State.

The following figure shows the core network corridors.

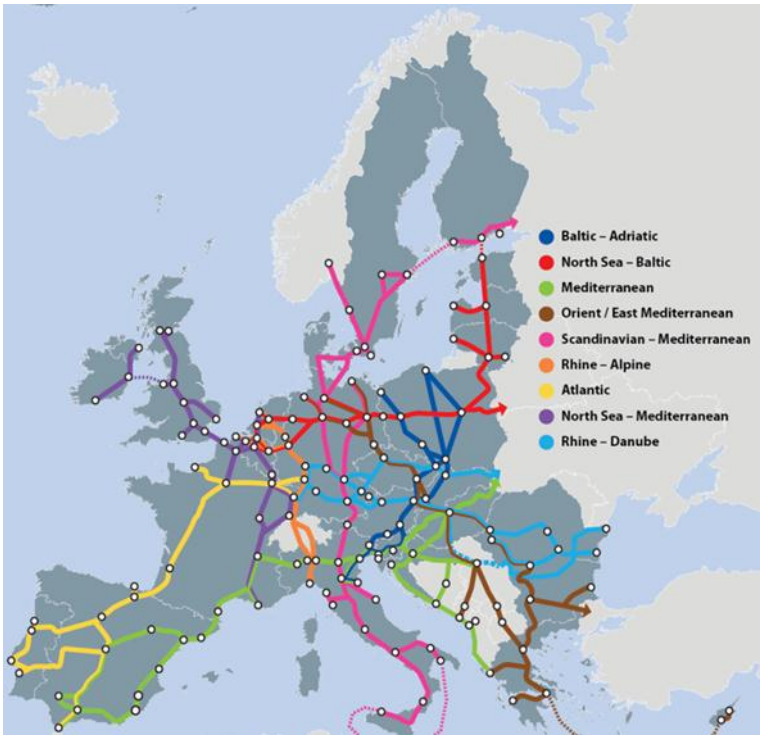


Figure 2 TEN-T Core Networks Corridors

2.2 Scandria®2Act

Scandria® is a cross-border research project that extends along the corridor from Scandinavia across the Baltic Sea to the Adriatic Sea: the Scandria® Corridor. As part of the Scandinavian-Mediterranean Transport Corridor, one of the nine core network corridors of the TEN-T core network. This corridor is one of the longest corridors. The project supported by 19 partners from five Baltic Sea countries (Germany (DE), Denmark (DK), Norway (NO), Finland (FI), Sweden (SE)).

The focus of the cooperation is on exploiting the development potential of the corridor, including in the fields of logistics infrastructure, and increasing the efficiency and sustainability of transport systems. This is done through increased transnational cooperation in the areas of logistics, transport planning, business, science and specialist policy. The aim is to create a powerful and CO_2-efficient corridor.

To achieve the strategic aims, the project is divided into four work packages (WP).

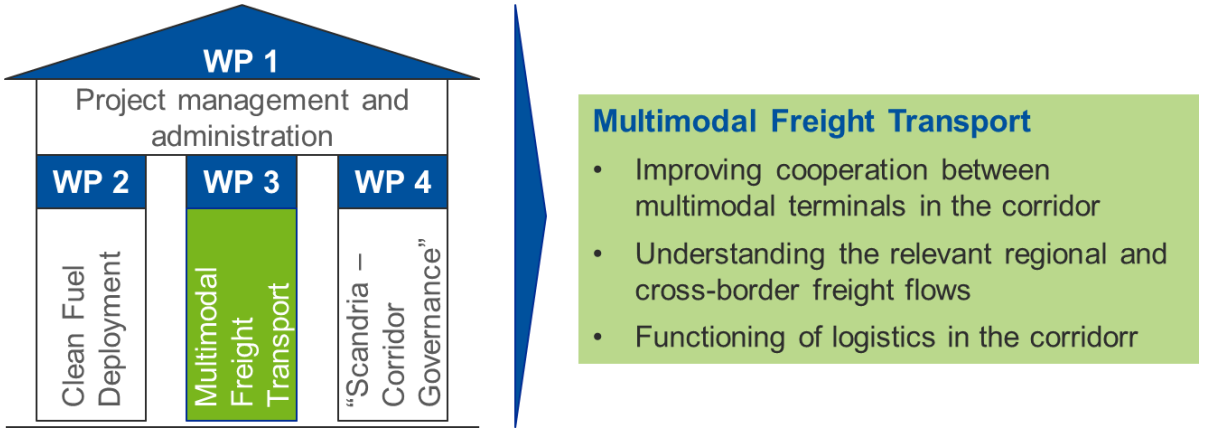


Figure 3 Workpackages and focus

Scandria® is an extensive, sustainable and forward-looking project that contributes to a European community. Here many potentials for country and economy are revealed, which will be used in the future and integrated into the corridor. In addition, Scandria® can demonstrate practical and successful results for international cooperation. Scandria® uses the intercultural aspects of transnational projects and turns challenges into opportunities, for example by combining the intercultural perspectives of the national partners: Sustainability for one of the most important corridors.

3 Geographical Scope

This chapter defines the main freight flows in the EU region. These depend on the direction in which the transports cross the Baltic Sea and represent the main barriers for all North-South transports to Scandinavia.

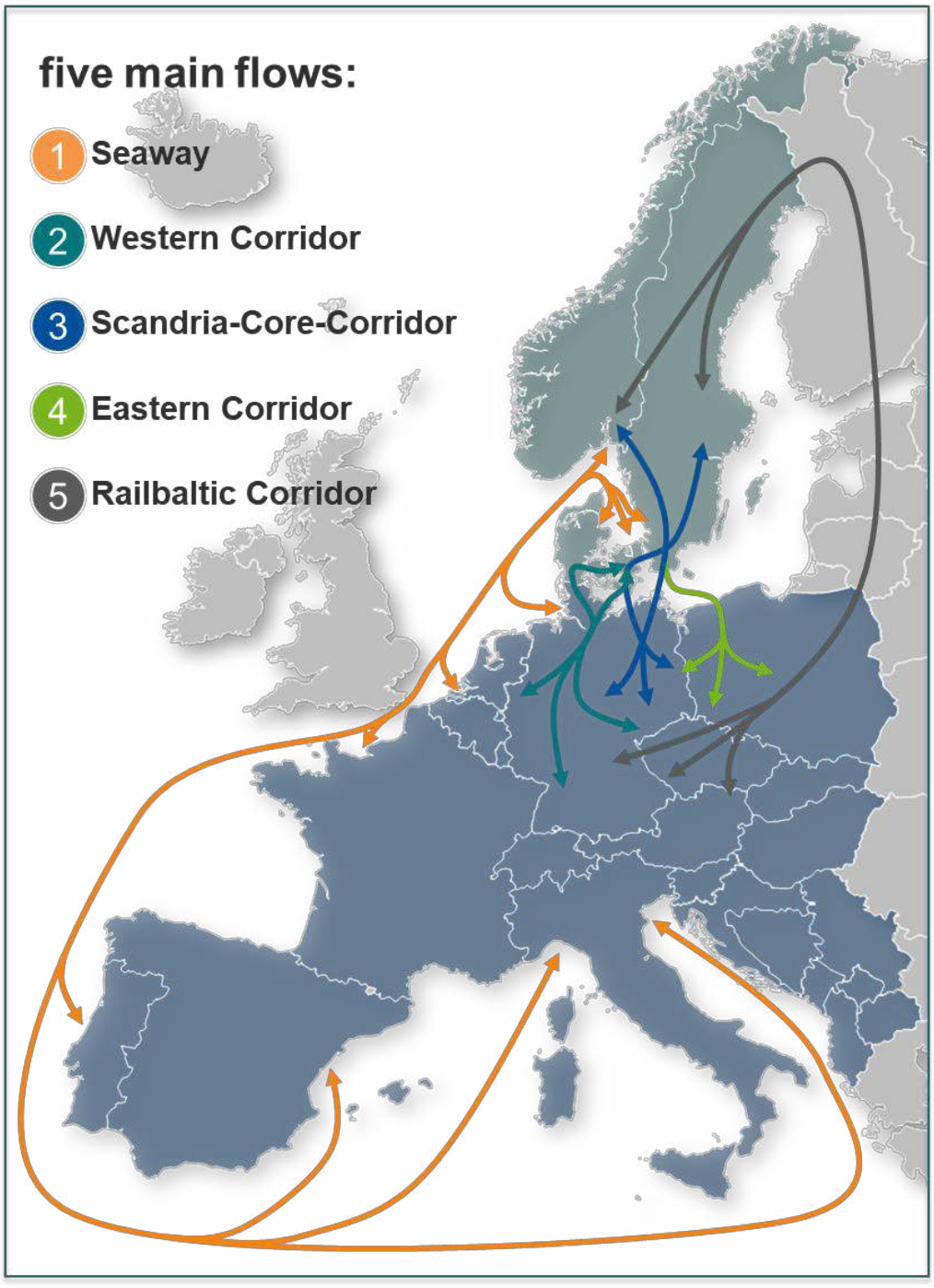


Figure 4 Geographical scope

These are described as follows:

No.	Name	Description and Defintion	Overlap with TEN-T Corridors
1	Seaway	Freight Flows from European ports along the Mediterranean, Atlantic and North-Sea coast to Scandinavian ports.	None
2	Western Corridor	Corridor is defined by using the Jutland land connection and the ports in Schleswig-Holstein to cross to Scandinavia	Scandinavian-Mediterranean Corridor (from Nuremberg on, only the western leg corresponds with flow No.2)
3	Scandria®-Core-Corridor	Corridor is defined by using the ports in Mecklenburg-Vorpommern to cross to Scandinavia	Scandinavian-Mediterranean Corridor (from Nuremberg on, only the eastern leg corresponds with flow Nr.3)
4	Eastern Corridor	Corridor is defined by using the ports in Poland to cross to Scandinavia	Baltic Adriatic Corridor and from Scandinavia on Northwards: Scandinavian-Mediterranean Corridor
5	Railbaltica Corridor	Corridor is defined by using land connection via the eastern Baltic states and ports to cross to Scandinavia	North-Sea-Baltic Corridor

The results are based on the German and Swedish carrier surveys at the ports, Finland is not taken into account. No surveys at Finnish ports have been used.

Therefor this report focuses the Western, Eastern and Scandria®-Core-Corridors.

4 Methodology

This chapter describes the procedure and framework conditions for the analysis. Different databases have been used to analyse the existing freight flows, which are systematically and logically combined. These include internal project data as well as high-quality public statistics and expert statements. This makes possible to monitorize the cross-border freight flows in the northern Scandria® Corridor.

4.1 Methodology of the surveys

Within the framework of Scandria®2Act-project, the partners conducted two surveys on freight transport. Trafikverket Region South and Trafikverket Region West interviewed carriers in Swedish ports (STA) and ROSTOCK PORT GmbH in Rostock port (HERO).

STA

During 2016, Trafikverket Region South and Trafikverket Region West conducted a survey of goods transport. Road freight through the RoRo-ports in the counties of Västra Götaland, Halland, Skåne and Blekinge as well as the Öresund Bridge was included. The survey was carried out within the framework of the Scandria®2Act-project for a harmonized corridor development.

The purpose of this study is to describe and analyze road freight transports, related to ferry operations, passing through RoRo-ports in the counties of Västra Götaland, Halland, Skåne and Blekinge as well as the road freights on the Öresund Bridge.

In two survey periods, carriers in the following ports were interviewed:

- Strömstad,
- Varberg,
- Helsingborg,
- Malmö
- Trelleborg,
- Ystad,
- Karlshamn and
- Karlskrona.
- Göteborg: Göteborg RoRo, Denmark terminal and Germany terminal,

The results of the port study are based on almost 2 500 interviews with truck drivers on 14 ferry lines. Furthermore, more than 3 300 observations have been carried through. In total, there are results for almost 4 000 vehicles. The interviews have been carried out on site in each port, in connection with the outbound transport from Sweden. The results of the Öresund Bridge are based on 166 telephone interviews with road freight companies in Denmark and Sweden that regularly use the Öresund Bridge. The questions in the interviews have mainly focused on points of origin and destination, which roads that have been used, type of goods and data about the vehicles and drivers.

The whole methodology and finings with reports and results are described in the extended version (in Swedish) “RAPPORT Kartläggning av lastbilstransporter i brohamnar längs syd- och västkusten”.

HERO

During 2016, ROSTOCK PORT conducted a survey of goods transport. The aim of the study was to identify the regions where the trucks going north on ferries to Gedser and Trelleborg are coming from. Additionally, information to understand the forwarding industries needs and about cargo flows have been collected as well. This has been done by interviews of truck drivers waiting for their ferry departure. The results of the port study are based on almost 3.000 observations on two ferry lines.

The disclosure of data will be handled confidentially at this point. A non-disclosure agreement doesn´t make the data public in detail. However, the results and findings from the survey are taken into

account in the conclusions. It´s agreed with ROSTOCK PORT to incorporate the data from the surveys to create an up-to-date Traffic flow Model for the corridor.

4.2 Methodology of the statistical analysis

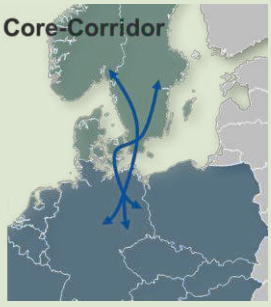
The results of the analysis of freight flows across the Baltic Sea are based on the survey of goods transport from 2016 (WP3.1-1 (STA)). The questions of the survey are combined in such a way that the following statement can be made:

→ Presentation of trade relations across the Baltic Sea.

In order to limit the topic, the focus will be on transport via the Jutland-land-link (road, rail) and via the Baltic Sea for the detection of possible relocations.

In the following, the term "vehicles" will be used. These include motor vehicles which, according to their design and equipment, are not intended for the carriage of passengers but for the carriage of loads (goods). This includes all vehicles >3.5t gross vehicle weight with/without trailer and semitrailers.

With reference to the geographical scope, the focus is on the following three main traffic routes:

Geographical Scope	Analytical aspects
	• RoRo transports from ports in Schleswig-Holstein: Kiel and Lübeck • Road-border-crossings over the Jutland-Land-Link → German-Danish border → German-Swedish border → Danish-Swedish border (via Öresund Bridge) • Rail-border-crossings over the Jutland-Land-Link • Specific rail hinterland transports from ports
	• RoRo transports in the Scandria®-Core-Corridor – from the ports in Mecklenburg-Vorpommern: Rostock and Sassnitz • Specific rail hinterland transports from ports
	• RoRo transports from Poland: Gdingen and Swinoujscie

For the preparation of the results, corridor independent work was initially carried out. In Chapter 5.4, the results are re-allocated to the corridors and visualized.

Processing of the STA – survey

From the STA – survey the following ports were considered for the analysis:

Swedish Ports	Destination	Country	Shipping company	Frequency
GOTHENBORG (DE)	Kiel	Germany	Stena Line	2 trips per day
MALMÖ	Lübeck		Finnlines	3 trips per day
GOTHENBORG (DK)	Frederikshavn	Denmark	Stena Line	6 trips per day
VARBERG	Grenaa		Stena Line	2 trips per day
HELSINGBORG	Helsingør		Scandlines HH Ferries	75 trips per day
KARLSKRONA	Gdingen	Poland	Stena Line	3 trips per day
YSTAD	Swinoujscie		Unity Line & Polferries	7 trips per day
TRELLEBORG	Lübeck	Germany	Stena Line	3-4 trips per day
	Sassnitz			2 trips per day
	Rostock		Stena Line & TT-Line	5-6 trips per day
	Swinoujscie	Poland	Unity Line & TT-Line	4 trips per day

Figure 5 Relevant ports for analysis

The STA – survey values are representative samples that are extrapolated to a basic population on the basis of well-founded values. The following input values are used to represent the basic population per port:

- Shippax data on ferry utilization (Gothenborg, Helsingborg, Varberg, Karlskrona)
- Eurostat data about transshipment performance (Malmö, Ystad) and
- Data from Port of Trelleborg (Trelleborg).

The results of the STA – survey provide a holistic picture of freight flows across the Baltic Sea.

The questionnaire is divided into three sections. The first two sections ask the respondents where they came from to the Swedish port and to which Swedish province they want to go and the other way round. The third section deals with the questions about future transports to the Swedish provinces. This section has not been further considered for this report because the sample of ports was too small.

In order to illustrate the freight flows, the following questions of the survey are interpreted as import and export.

Figure 6 Interpretation of survey questions

Sweden acts both as a target country and as a source country in the issue. Questions don´t provide any information about which country the freight originates from. Therefore, the orientation is based on the last country of loading.

The questions f:11 and f:23 ask the approximate filling rate of the truck, whereby the respondent could choose between "empty 0%, 25%, half full 50%, 75% and full 100%". Since the fill rate has no direct relation to the actual transport weight, only the empty runs (fill rate: 0%) were considered.

The following figure summarizes the database on which the analysis is based:

Swedish Ports	Sample of the survey	Basic population	Sources	Utilization rate of ferry	Emty trips	
					Import	Export
GOTHENBORG (DE)	62	85.045	Shippax	51%	6%	18%
MALMÖ	292	109.375	Eurostat*	60%	7%	13%
GOTHENBORG (DK)	269	149.940	Shippax	56%	7%	14%
VARBERG	192	42.263	Shippax	76%	1%	1%
HELSINGBORG	346	391.468	Shippax	44%	5%	26%
KARLSKRONA	200	124.773	Shippax	90%	3%	6%
YSTAD	300	80.875	Eurostat*	n.i.	2%	22%
TRELLEBORG	301	679.996	Port Trelleborg	64%	6%	14%

Legend:
* calculation from author according to Eurostat 2018 database (transship performance RoRo 2016)
n.i. no information

Figure 7 Database for analysis

Through the question "f17: What route did you take to Sweden?" a percentage of how many respondents export to Sweden via the analysed ferry routes could be recorded. The question looks at freight flows in only one direction. The respondents who used the ferry connections[3] across the Baltic Sea for transport during the survey are taken into account.

The responses of respondents who indicated that they had crossed the Öresund Bridge to Sweden were also taken into account. Chapter 5.2 describes it in more detail.

[3] In the survey it calls „this ferry route"

In the following, the results listed below are presented in tabular and graphical form:

- → Ranking of trading partners across the Baltic Sea, this means from where and to where they are transported to and from Sweden (total results). (see chapter 5.1.1 and 6)
- → Subdivision of ferry connections according to countries (Denmark, Germany, Poland) → which countries transport via which ports from/to Swedish ports. (see chapter 5.1.1)
- → Quantification of RoRo traffic across the Baltic Sea and potential transport weight; given in min- (8t) and max-scenario (26t). (see chapter 5.1.2)
- → Quantity-related visualization between mainland-Europe and Scandinavia (see chapter 5.1.2 and 5.4)

In addition, part of the survey has been used to analyse traffic on the road. These results are presented in Chapter 5.2.

During the survey, some drivers left questions unanswered. As a result of the partial responses, a certain percentage of the questions in the analysis sections were marked "no information" (n.i.). These indications appear in the tables, but not in the graphics. This also applies to "Other".

5 Amalgation of survey results and statistical analysis

In the following chapter, the freight flows within the Scandria2®Act project will be considered and analysed. The focus of the analysis is the acquisition of a holistic approach for the visualisation and quantification of freight flows and European-Scandinavian trade flows. For this purpose, the modes of transport and the analysis components are explained, taking into account the geographical conditions in the regions.

The results of the STA survey give a holistic picture of freight flows across the Baltic Sea. This way the trade relations and transport intensity in the Scandria® Corridor between countries have been quantified.

5.1 Analysis of RoRo-transports

First, the results of the Swedish hinterland transports at the ports, which were obtained through the STA survey, are presented. Next, the results of the German hinterland transports will be derived with the help of the STA survey. This is summarized in the chapters 5.1.1 and 5.1.2.

The results of the Swedish RoRo-transports contains a summarised description and conclusions of the most important results from the study **"Freight flow analysis from the ports and hubs in Southern and Western Sweden to the hinterland"**. Seven key statements are described below.

1. The RoRo-segment has seen a larger growth than the Swedish foreign trade

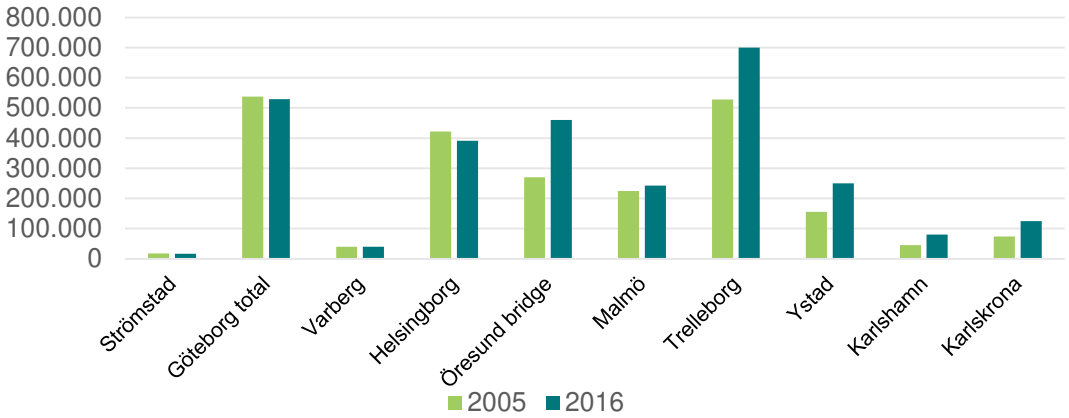


Figure 8 Total flow of traffic by truck and trailers and misc. RoRo freight (railway wagons excl.)[4]

In total, since 2005, the RoRo-volumes have increased by about 24 % in the studied ports in Skåne and Blekinge and decreased by 1 % in the ports in Halland and Västra Götaland.

2. Large shares of regional and international transit transports to/from RoRo-ports

This means that the share of traffic originating in or bound for the municipality or county in which the port is located and the share of transit traffic to other counties or outside Sweden are shown in the following figure.

[4] Source: Sveriges Hamnars statistik 2005 and 2016, Trafikanalys Sjötrafik. 2016

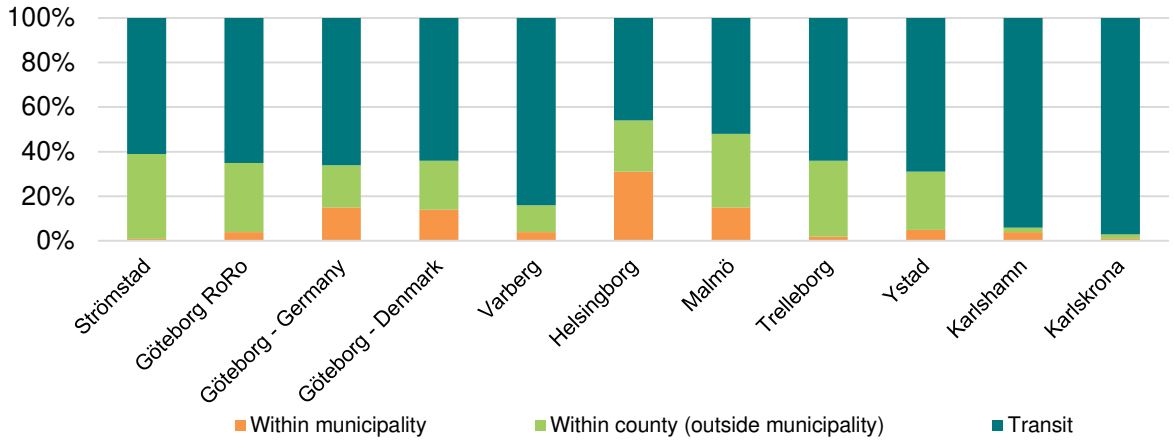


Figure 9 Share of traffic by region

The study shows that the points of origin or destination of the transport relations to an average of 70 % are found outside the county where the port is located. On average, 10 % of the transport relations start or finish in the same municipality as the location of the respective port.

3. The hinterland for a RoRo-port is largely determined by the steering and resting times

When the point of origin and destination are analysed on a NUTS2[5] level, the general conclusion is that the start or end point of the transport relation predominantly is located within the own or in the neighbouring NUTS2 region.

4. Three out of four vehicles are at least 75 % fully utilized

The loading rates are based on the direction of the transports, through harbours and on the Öresund Bridge.

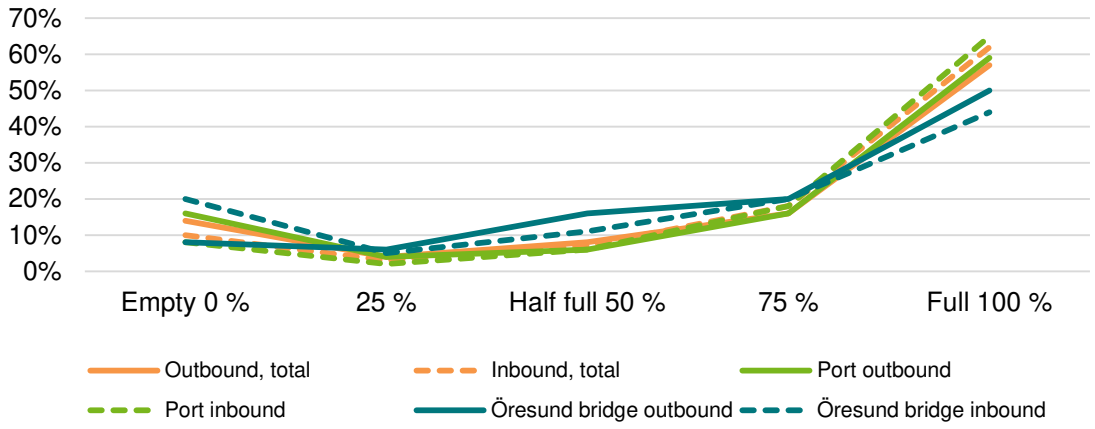


Figure 10 Loading rates

[5] NUTS = Nomenclature des Unités Territoriales Statistiques. NUTS is the regional division used in the EU for reporting statistics in Sweden.

The limitation for the vehicle's loading capacity varies between different types of goods, most often weight, volume or loading meters. The survey shows that more than 75 % of the vehicles are at least 75 % fully utilised (use of loading capacity). About 60 % of the transports are carried out with full load and about 10 % with no load. The share of transports with dangerous goods to/from the ports and on the Öresund Bridge in total is about 3 %.

5. A large share of truck drivers originate from other countries than Sweden

The distribution between the drivers' country of origin varies greatly between the ports of the study.

In many cases the country of origin of the driver, as well as of the vehicle, is one of the countries connected by the ferry line. In total, the share of truck drivers that originate from other countries than Sweden is very high. The most common country is Poland (more than 30 %), while the share of Swedish drivers is about 10%.

6. Vehicles are modern, but run on diesel

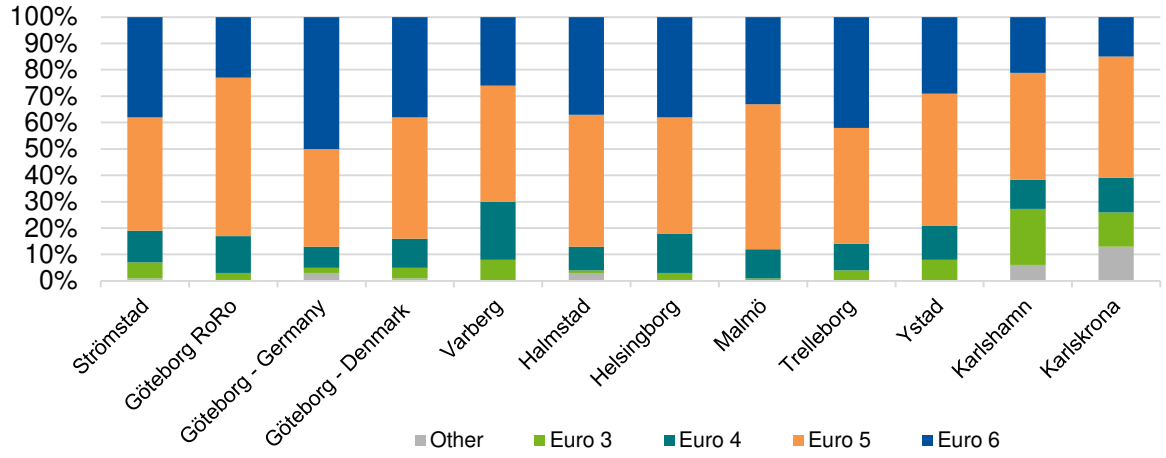


Figure 11 Distribution of Euro classes in each port

Only a very small percentage of the vehicles are run on alternative fuels (on average 1-2 %). Instead, diesel is the dominating fuel type (98-99 %). Distribution of Euro classes in each port. The study also shows that the vehicle fleet overall is relatively modern, with about 40 % of the vehicles produced in 2014 or later.

Out of the different types of vehicles, semi-trailer truck (up to 18.75 m) is by far the most common (84 %). However, on the Öresund Bridge truck with trailer (up to 25.25 m) is the most common configuration.

7. Low use of railway transport to and from the RoRo-terminals

Most of the studied ferry terminals (except for Strömstad and the Göteborg Denmark and Germany terminals) have the infrastructure for supporting the ferry and RoRo-operations with land transports on railway.

Nevertheless, the share of RoRo-units transported to the ferry terminals by railway is very low. In conclusion, it appears as if the railway solutions, even for distances of 300–600 km, struggle to compete with road transports, both in terms of time or cost. Thus, based on freight volume, there is a great potential to increase the share of freight transports on railway to the RoRo-ports.

Generally based on the results of this study it can be concluded that road freight within the RoRo-segment has had a strong development from 2005 to 2016, with a higher growth than the Swedish foreign trade overall. This suggests that goods transportation with truck and trailer is highly competitive for the distances relevant for Swedish export and import to and from Europe. In the same time we can assert that there is a great "potential" for transfer to rail and shipping and for an increase in alternative fuels.

The results of the port study are based on almost 2 500 interviews with truck drivers on 14 ferry lines. Furthermore, more than 3 300 observations have been carried through. In total, there are results for almost 4 000 vehicles. The results of the Öresund Bridge are based on 166 telephone interviews with road freight companies in Denmark and Sweden that regularly use the Öresund Bridge.

The ambition is that the results of the study are useful in national and regional infrastructure planning as well as for ports (usually owned by the municipalities), shippers and road freight companies.

Through the STA survey, it was also possible to present the traffic across the Baltic Sea to the German ports. Next, the results of the German hinterland transports will be presented.

Two different approaches were used for this analysis. Chapter 5.1.1 first looks at trade flows. This means (based on the STA – survey) that it was determined which country was represented and how often. In Chapter 5.1.2, port specific import and export scenarios were presented and quantified.

The results obtained from the following analysis are regarded as the RoRo hinterland transports.

5.1.1 Ranking of trading relations

The respondents who used the ferry connections across the Baltic Sea for transport during the survey are taken into account.

The ferry connections across the Baltic Sea have been considered in their totality and can be divided into:

- German – Swedish,
- Polish – Swedish and
- Danish – Swedish ferry connections in the Baltic Sea region.

The extrapolation of the survey sample showed that approximately 823 thousand vehicles pass through the analysed ferry routes each year. These are distributed among the countries as follows:

Vehicles per Year (descending)	%	vehicles
Poland	26%	217.126
Germany	25%	208.060
Denmark	12%	99.101
Other	10%	80.702
The Netherlands	8%	69.028
Norway	3%	26.950
Spain	3%	24.849
Italy	3%	22.969
Slovakia	2%	13.622
Austria	2%	12.998
Hungary	2%	12.864
Czech Republic	1%	9.663
France	< 1%	7.905
Bulgaria	< 1%	4.918
n.i.	< 1%	3.732
Estonia	< 1%	2.817
Finland	< 1%	2.399
Lithuania	< 1%	2.130
Ukraine	< 1%	932
Croatia	< 1%	375
Lativia	< 1%	375
Russia	0%	-

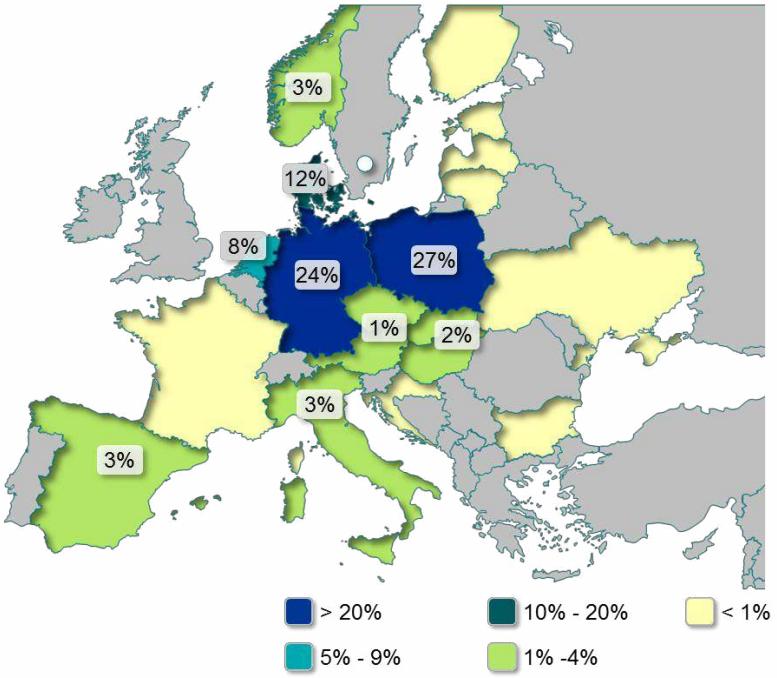


Figure 12 Country specific traffic across the Baltic Sea (I): total results from survey

The survey results show that Denmark, Germany and Poland are the countries that use the ferry connections across Baltic Sea most frequently. This is mainly due to the country's own transport network (road and rail) to the respective ports. Thus each country is also the highest ranking country in the country-specific analysis of ports (see slide: country specific traffic across the Baltic Sea (II-IV)).

Vehicles per Year (descending)	%	vehicles
Germany	36%	113.048
Poland	20%	64.861
The Netherlands	13%	40.205
Other	10%	31.828
Italy	4%	11.672
Spain	3%	9.648
Norway	3%	8.397
Denmark	2%	7.360
Austria	2%	6.277
Slovakia	2%	6.277
Hungary	2%	5.021
Czech Republic	1%	4.140
France	1%	3.634
Bulgaria	< 1%	1.746
Estonia	< 1%	1.255
Croatia	< 1%	375
Lithuania	< 1%	375
Lativia	< 1%	375
Ukraine	< 1%	375
Finland	0%	-
n.i.	0%	-
Russia	0%	-

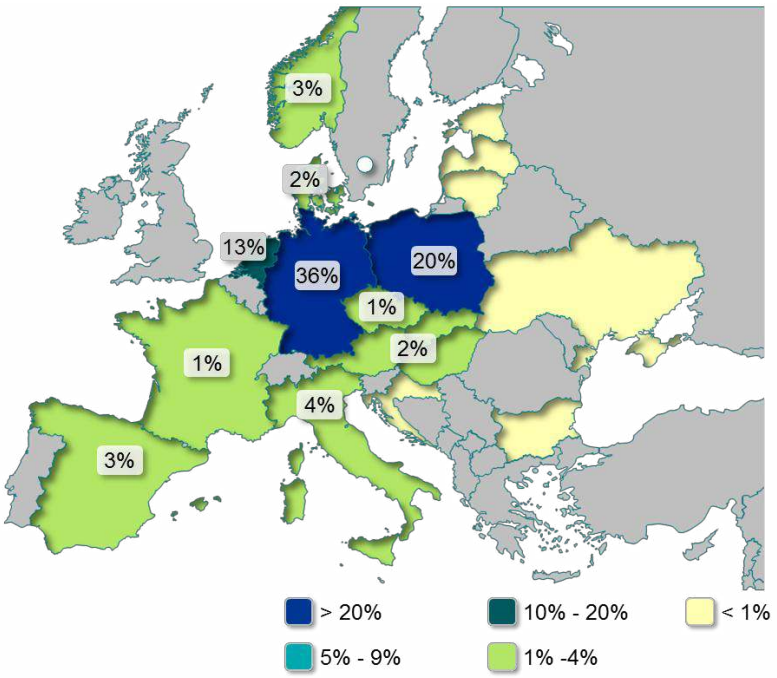


Figure 13 Country specific traffic across the Baltic Sea (II): via German ports

According to the survey, the Netherlands (turquoise marked) uses the Baltic Sea connections for the next higher share, with the majority being controlled via the German ports (see slide: country specific traffic across the Baltic Sea (I-II).

Vehicles per Year (descending)	%	vehicles
Denmark	50%	88.404
Germany	16%	29.149
Other	6%	11.334
Spain	6%	10.183
Poland	5%	8.901
The Netherlands	5%	8.477
Norway	4%	7.903
n.i.	1%	2.569
France	1%	2.263
Italy	1%	2.263
Finland	1%	2.129
Hungary	< 1%	1.131
Lithuania	< 1%	1.131
Bulgaria	< 1%	660
Ukraina	< 1%	557
Estonia	< 1%	557
Austria	0%	-
Czech Republic	0%	-
Crotaia	0%	-
Lativia	0%	-
Russia	0%	-
Slovakia	0%	-

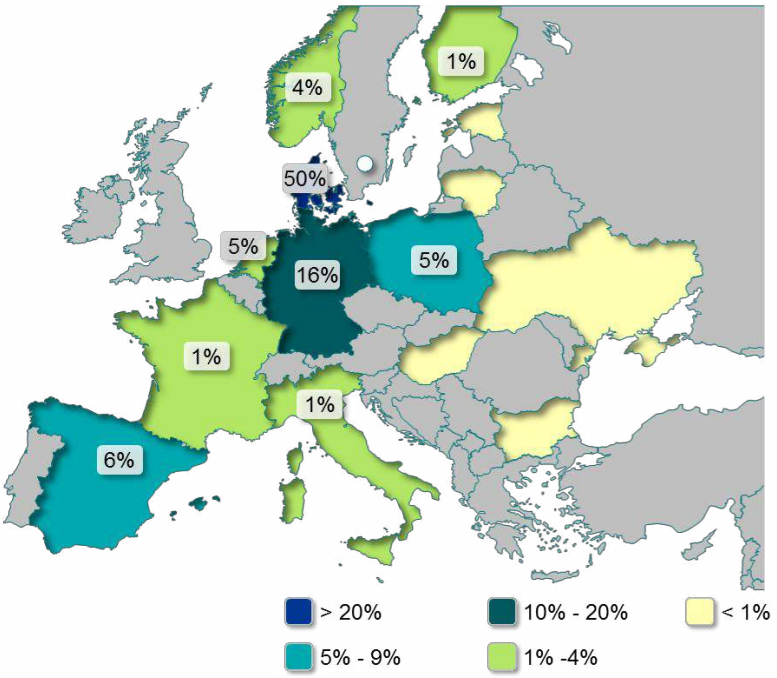


Figure 14 Country specific traffic across the Baltic Sea (III): via Danish ports

Vehicles per Year (descending)	%	vehicles
Poland	50%	122.199
Germany	15%	37.041
Other	12%	29.434
The Netherlands	5%	11.340
Norway	3%	8.398
Slovakia	2%	5.094
Italy	2%	4.981
Hungary	2%	4.910
Austria	2%	4.470
Czech Republic	2%	4.171
Soain	1%	2.767
Bulgaria	1%	2.511
n.i.	0%	1.163
France	0%	1.107
Denmark	0%	1.078
Lithuania	0%	624
Estonia	0%	553
Finland	0%	270
Crotia	0%	-
Lativia	0%	-
Russia	0%	-
Ukraina	0%	-

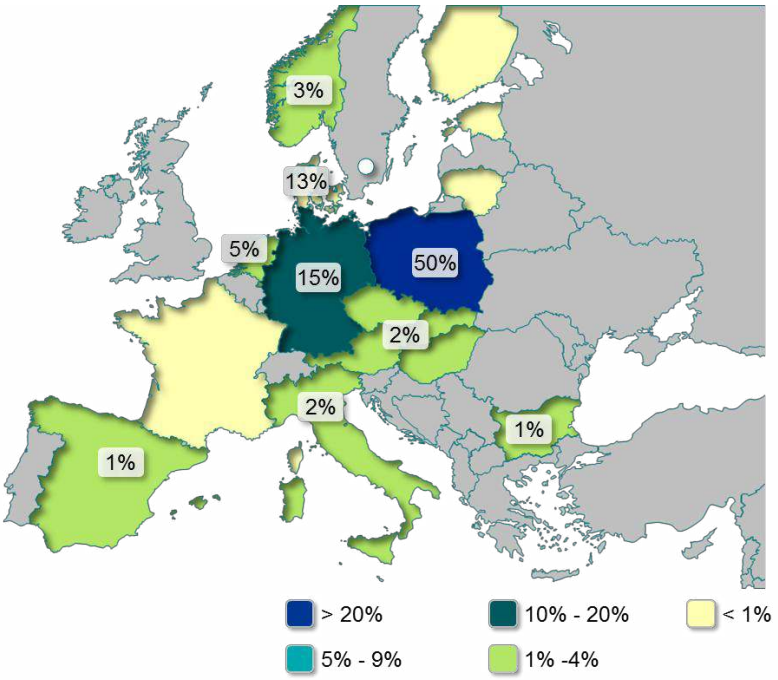


Figure 15 Country specific traffic across the Baltic Sea (IV): via Polish ports

Norway, Slovakia, Hungary, Austria, the Czech Republic and Italy have low trade intensity. The hinterland traffic of the German ports controls a part of the transports by rail to and from Italy, which is not shown here. This may be in correlation with Italy's small share from the survey.

5.1.2 Quantified results and quantity-related visualization from survey

This part of the report lists the quantifications of the individual ports. As the questionnaire only shows the Swedish import with regard to the route, the export data are assumed on the bases of the trade balances. The aim is to check how import and export differentiate. The import and export reports of the trade balances show a range between -1% - 8%.

	Export Scandinavia*		Import Scandinavia*	
	Export Y→X	Import Y→X	Export X→Y	Import X→Y
Tt	145.171	72.455	147.285	61.986

range Export → **-1%** **8%**

Legend:
* without Finland
X/Y Countries

Annexes 1A1 explains in detail how to deal with commercial balance sheets.

On this understanding it´s assumed that Scandinavia once exports 8% more to mainland Europe than imports and once imports 1% more to mainland Europe than exports.

After a comprehensive assessment of the traffic between mainland Europe and Scandinavia across the Baltic Sea was made, the results could be visualized. Sankey diagrams were chosen for the graphical representation of the quantity flows.

In the following, the quantifications per port are listed both in tabular and graphical form. The order is based on geographical components in chapter 5.1.1:

- German – Swedish,
- Polish – Swedish,
- Danish – Swedish ferry connections in the Baltic Sea region and
- Trelleborg total.

Gothenborg (DE)

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)						
BUL (Bulgaria)	2%	1.372	632	739	681	691
CZ (Czech Republic)						
CR (Croatia)						
D (Germany)	3%	2.743	1.265	1.479	1.362	1.382
DK (Denmark)	6%	5.487	2.530	2.957	2.724	2.763
E (Spain)						
EST (Estonia)						
F (France)						
FIN (Finland)						
H (Hungary)						
I (Italy)						
n.i.						
LT (Lithuania)						
LV (Latvia)						
N (Norway)	2%	1.372	632	739	681	691
NL (The Netherlands)	8%	6.858	3.162	3.696	3.404	3.454
Other	6%	5.487	2.530	2.957	2.724	2.763
PL (Poland)	6%	5.487	2.530	2.957	2.724	2.763
RUS (Russia)						
SK (Slovakia)						
UA (Ukraine)						
Σ	**34%**	**28.806**	**13.281**	**15.524**	**14.299**	**14.507**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)								
BUL (Bulgaria)	5.060	5.914	5.447	5.526	16.443	19.221	17.703	17.961
CZ (Czech Republic)								
CR (Croatia)								
D (Germany)	10.119	11.828	10.894	11.053	32.887	38.441	35.406	35.922
DK (Denmark)	20.238	23.656	21.788	22.106	65.774	76.883	70.812	71.844
E (Spain)								
EST (Estonia)								
F (France)								
FIN (Finland)								
H (Hungary)								
I (Italy)								
n.i.								
LT (Lithuania)								
LV (Latvia)								
N (Norway)	5.060	5.914	5.447	5.526	16.443	19.221	17.703	17.961
NL (The Netherlands)	25.298	29.570	27.236	27.632	82.217	96.103	88.516	89.805
Other	20.238	23.656	21.788	22.106	65.774	76.883	70.812	71.844
PL (Poland)	20.238	23.656	21.788	22.106	65.774	76.883	70.812	71.844
RUS (Russia)								
SK (Slovakia)								
UA (Ukraine)								
Σ	**106.250**	**124.195**	**114.389**	**116.055**	**345.311**	**403.634**	**371.766**	**377.179**

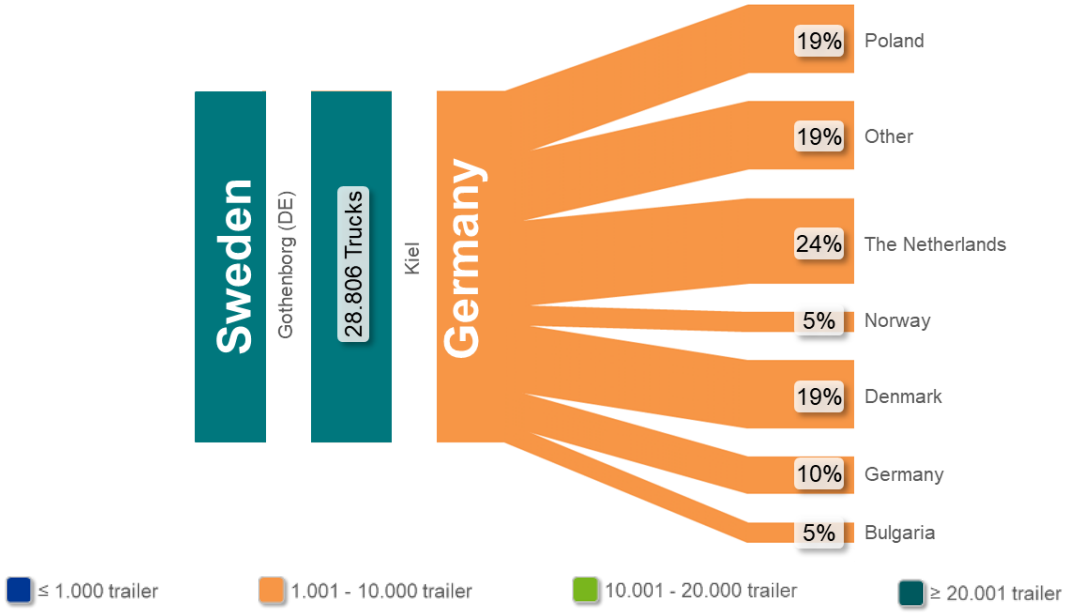


Figure 16 Results from survey Gothenborg – Kiel

In the STA – survey, 8% of respondents answered that their freight came to Sweden from the Netherlands via the Kiel – Gothenborg link. This corresponds to approx. 6,858 vehicles per year (see above vehicles per year, example: The Netherlands). In the total of 28,806 vehicles per year on this route, this makes up 24%. In the assumed minimum and maximum scenarios, this results in an import range of 25,298 Tt - 88,516 Tt and an export range of 27,623 Tt - 96,103 Tt where the potential transport volume moves (see above Potential weights (in 1,000 tonnes), example: The Netherlands).

Denmark and Poland have the next highest freight flows on this route with 19%, followed by Germany with 10%. It should be noted, however, that 19% of freight flows are carried by countries that were not surveyed in the survey (see "Other"). This could include, for example, the countries handled via the ARA ports.

The port of Kiel is located in the Western Corridor (Schleswig-Holstein), but with the exception of the Netherlands it is served via countries from the Scandria®-Core-Corridor (excluding “Other”).

In total, the potential freight flows consist of an **import range of 106,250 Tt – 371,766** Tt and an **export range of 116,055 Tt – 403,634 Tt**.

Malmö

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)						
BUL (Bulgaria)	0%	375	173	202	186	189
CZ (Czech Republic)	0%	375	173	202	186	189
CR (Croatia)	0%	375	173	202	186	189
D (Germany)	27%	29.966	13.816	16.150	14.875	15.091
DK (Denmark)	2%	1.873	864	1.009	930	943
E (Spain)	3%	3.371	1.554	1.817	1.673	1.698
EST (Estonia)						
F (France)	1%	1.124	518	606	558	566
FIN (Finland)						
H (Hungary)						
I (Italy)	0%	375	173	202	186	189
n.i.						
LT (Lithuania)	0%	375	173	202	186	189
LV (Latvia)	0%	375	173	202	186	189
N (Norway)	1%	749	345	404	372	377
NL (The Netherlands)	8%	8.241	3.799	4.441	4.091	4.150
Other	3%	3.746	1.727	2.019	1.859	1.886
PL (Poland)	0%	375	173	202	186	189
RUS (Russia)						
SK (Slovakia)						
UA (Ukraine)	0%	375	173	202	186	189
Σ	**48%**	**52.065**	**24.006**	**28.060**	**25.845**	**26.221**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)								
BUL (Bulgaria)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
CZ (Czech Republic)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
CR (Croatia)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
D (Germany)	110.529	129.197	118.997	120.729	359.219	419.891	386.739	392.371
DK (Denmark)	6.908	8.075	7.437	7.546	22.451	26.243	24.171	24.523
E (Spain)	12.435	14.535	13.387	13.582	40.412	47.238	43.508	44.142
EST (Estonia)								
F (France)	4.145	4.845	4.462	4.527	13.471	15.746	14.503	14.714
FIN (Finland)								
H (Hungary)								
I (Italy)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
n.i.								
LT (Lithuania)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
LV (Latvia)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
N (Norway)	2.763	3.230	2.975	3.018	8.980	10.497	9.668	9.809
NL (The Netherlands)	30.395	35.529	32.724	33.201	98.785	115.470	106.353	107.902
Other	13.816	16.150	14.875	15.091	44.902	52.486	48.342	49.046
PL (Poland)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
RUS (Russia)								
SK (Slovakia)								
UA (Ukraine)	1.382	1.615	1.487	1.509	4.490	5.249	4.834	4.905
Σ	**192.044**	**224.480**	**206.757**	**209.767**	**624.143**	**729.560**	**671.959**	**681.744**

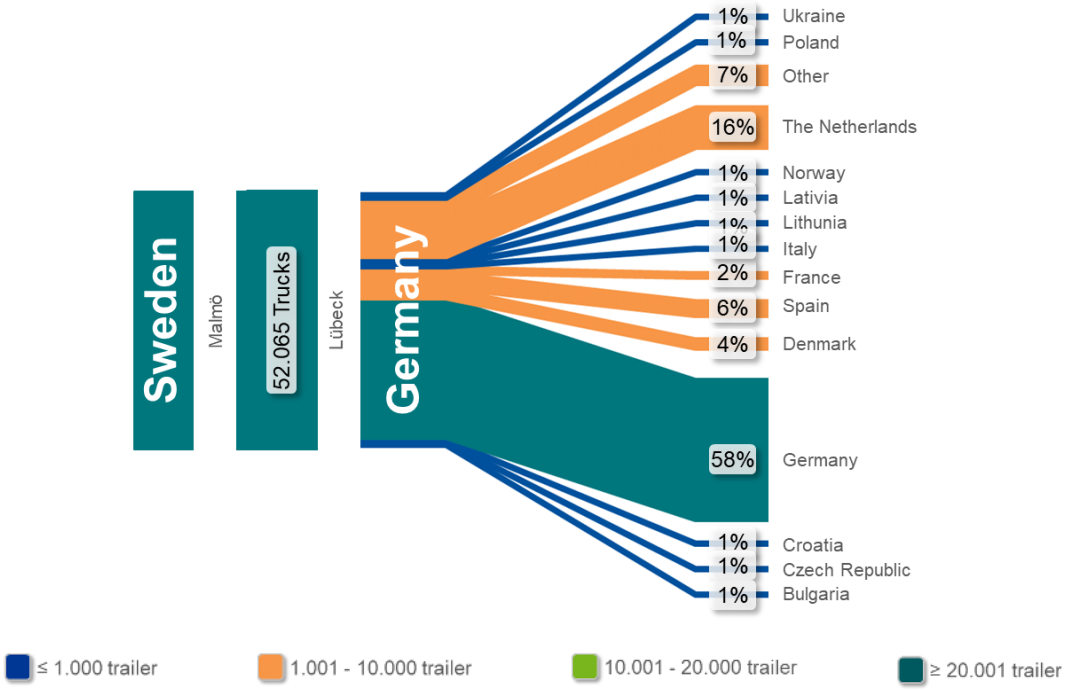


Figure 17 Results from survey Malmö – Lübeck

A higher share of German-Swedish connections is controlled via Lübeck – Malmö. The survey showed that 58% (29.966 trucks per year) come from Germany. The next highest shares are taken by The Netherlands with 16% and Spain with 6%.

The port of Lübeck is located in the Western Corridor (Schleswig-Holstein) and is served by a wide variety of countries. The Netherlands and Spain represent the western regions, while Lithuania and Latvia represent the eastern regions.

In total, the potential freight flows consist of an **import range of 192.044 Tt – 671.959 Tt** and **an export range of 209.767 Tt – 729.560 Tt**. This corresponds to a handling performance approx. 45% higher than on the Kiel – Gothenborg route.

Karlskrona

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)	1%	624	288	336	310	314
BUL (Bulgaria)	1%	624	288	336	310	314
CZ (Czech Republic)	1%	624	288	336	310	314
CR (Croatia)						
D (Germany)						
DK (Denmark)						
E (Spain)						
EST (Estonia)						
F (France)						
FIN (Finland)						
H (Hungary)						
I (Italy)						
n.i.	1%	624	288	336	310	314
LT (Lithuania)	1%	624	288	336	310	314
LV (Latvia)						
N (Norway)	3%	3.743	1.726	2.017	1.858	1.885
NL (The Netherlands)						
Other	12%	14.349	6.616	7.733	7.123	7.226
PL (Poland)	49%	61.139	28.189	32.950	30.348	30.790
RUS (Russia)						
SK (Slovakia)	1%	1.248	575	672	619	628
UA (Ukraine)						
Σ	**67%**	**83.598**	**38.544**	**45.054**	**41.497**	**42.101**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)	2.301	2.690	2.477	2.513	7.479	8.742	8.052	8.169
BUL (Bulgaria)	2.301	2.690	2.477	2.513	7.479	8.742	8.052	8.169
CZ (Czech Republic)	2.301	2.690	2.477	2.513	7.479	8.742	8.052	8.169
CR (Croatia)								
D (Germany)								
DK (Denmark)								
E (Spain)								
EST (Estonia)								
F (France)								
FIN (Finland)								
H (Hungary)								
I (Italy)								
n.i.	2.301	2.690	2.477	2.513	7.479	8.742	8.052	8.169
LT (Lithuania)	2.301	2.690	2.477	2.513	7.479	8.742	8.052	8.169
LV (Latvia)								
N (Norway)	13.807	16.139	14.865	15.081	44.872	52.451	48.310	49.013
NL (The Netherlands)								
Other	52.926	61.865	56.981	57.810	172.010	201.062	185.187	187.884
PL (Poland)	225.511	263.599	242.787	246.323	732.910	856.698	789.059	800.549
RUS (Russia)								
SK (Slovakia)	4.602	5.380	4.955	5.027	14.957	17.484	16.103	16.338
UA (Ukraine)								
Σ	**308.352**	**360.432**	**331.975**	**336.809**	**1.002.143**	**1.171.403**	**1.078.918**	**1.094.628**

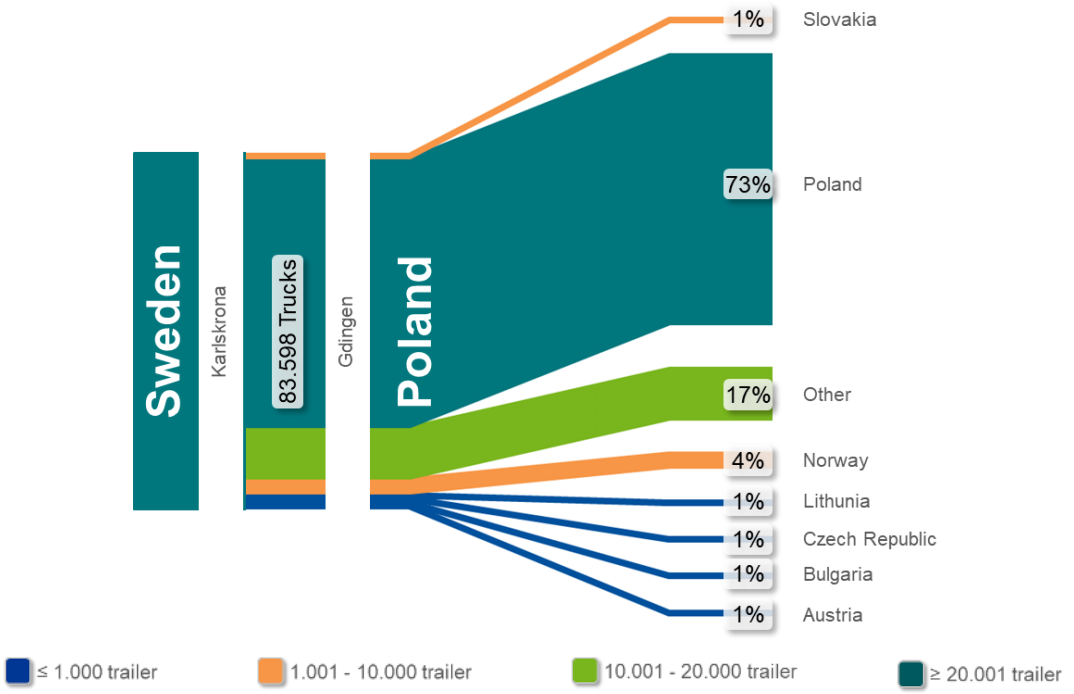


Figure 18 Results from survey Karlskrona – Gdingen

According to the analysis of all ports, this connection is the third strongest, after Helsingborg – Helsingør or Trelleborg (total). It can clearly be seen that 73% (61.139 trucks per year) consist of Polish freight content.

The spectrum of countries represented and the geographical location of the ports show that the freight flows here are primarily controlled via the Eastern Corridor.

In total, the potential freight flows consist of an **import range of 308.352 Tt – 1.078.403 Tt** and **an export range of 336.809 Tt – 1.171.408 Tt**.

Ystad

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)	1%	1.078	497	581	535	543
BUL (Bulgaria)	2%	1.887	870	1.017	937	950
CZ (Czech Republic)	2%	1.887	870	1.017	937	950
CR (Croatia)						
D (Germany)	2%	1.618	746	872	803	815
DK (Denmark)	1%	1.078	497	581	535	543
E (Spain)						
EST (Estonia)						
F (France)						
FIN (Finland)	0%	270	124	145	134	136
H (Hungary)	3%	2.696	1.243	1.453	1.338	1.358
I (Italy)						
n.i.	1%	539	249	291	268	272
LT (Lithuania)						
LV (Latvia)						
N (Norway)	2%	1.887	870	1.017	937	950
NL (The Netherlands)	0%	270	124	145	134	136
Other	6%	5.122	2.362	2.760	2.543	2.580
PL (Poland)	43%	35.046	16.158	18.887	17.396	17.650
RUS (Russia)						
SK (Slovakia)	1%	1.078	497	581	535	543
UA (Ukraine)						
Σ	**67%**	**54.456**	**25.108**	**29.348**	**27.031**	**27.425**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)	3.977	4.649	4.282	4.345	12.927	15.110	13.917	14.120
BUL (Bulgaria)	6.961	8.136	7.494	7.603	22.622	26.442	24.355	24.709
CZ (Czech Republic)	6.961	8.136	7.494	7.603	22.622	26.442	24.355	24.709
CR (Croatia)								
D (Germany)	5.966	6.974	6.423	6.517	19.390	22.665	20.876	21.179
DK (Denmark)	3.977	4.649	4.282	4.345	12.927	15.110	13.917	14.120
E (Spain)								
EST (Estonia)								
F (France)								
FIN (Finland)	994	1.162	1.071	1.086	3.232	3.777	3.479	3.530
H (Hungary)	9.944	11.623	10.705	10.861	32.317	37.775	34.793	35.299
I (Italy)								
n.i.	1.989	2.325	2.141	2.172	6.463	7.555	6.959	7.060
LT (Lithuania)								
LV (Latvia)								
N (Norway)	6.961	8.136	7.494	7.603	22.622	26.442	24.355	24.709
NL (The Netherlands)	994	1.162	1.071	1.086	3.232	3.777	3.479	3.530
Other	18.893	22.084	20.340	20.636	61.402	71.772	66.106	67.068
PL (Poland)	129.267	151.100	139.170	141.197	420.117	491.074	452.303	458.889
RUS (Russia)								
SK (Slovakia)	3.977	4.649	4.282	4.345	12.927	15.110	13.917	14.120
UA (Ukraine)								
Σ	**200.861**	**234.786**	**216.249**	**219.398**	**652.798**	**763.054**	**702.809**	**713.043**

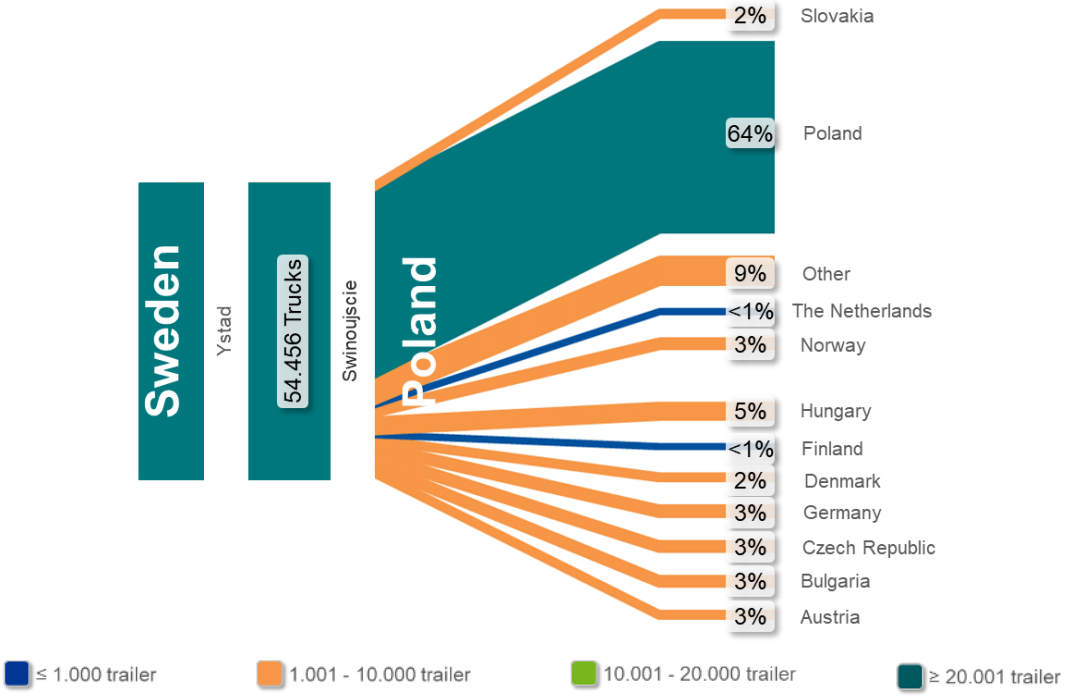


Figure 19 Results from survey Ystad – Swinoujscie

With 35.046 vehicles per year, Poland is also most strongly represented on this Polish-Swedish connection.

The port of Swinoujscie is close to the eastern German border. Due to its geographical location on the Scandria®-Core-Corridor, both countries of the Scandria®-Core-Corridor and the Western Corridor are represented. Also due to the geographical location, it is assumed that the 9% "Other" can consist of freight flows from Romania, for example.[6]

In total, the potential freight flows consist of an **import range of 200.861 Tt – 702.809 Tt** and **an export range of 219.398 Tt – 763.054 Tt**.

[6] This assumption is based on existing trade by trade balance (Eurostat: "EU trade by SITC since 1988"). The volume of trade between Romania and Sweden amounts to 238 149 Tt.

Gothenborg (DK)

Vehicles per vehicles

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)						
BUL (Bulgaria)						
CZ (Czech Republic)						
CR (Croatia)						
D (Germany)	1%	1.115	514	601	553	561
DK (Denmark)	33%	49.051	22.616	26.435	24.348	24.703
E (Spain)						
EST (Estonia)	0%	557	257	300	277	281
F (France)						
FIN (Finland)	0%	557	257	300	277	281
H (Hungary)						
I (Italy)						
n.i.	0%	557	257	300	277	281
LT (Lithuania)						
LV (Latvia)						
N (Norway)	1%	1.115	514	601	553	561
NL (The Netherlands)	0%	557	257	300	277	281
Other	3%	5.017	2.313	2.704	2.490	2.526
PL (Poland)	1%	1.672	771	901	830	842
RUS (Russia)						
SK (Slovakia)						
UA (Ukraine)	0%	557	257	300	277	281
Σ	**41%**	**60.756**	**28.013**	**32.744**	**30.159**	**30.598**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)								
BUL (Bulgaria)								
CZ (Czech Republic)								
CR (Croatia)								
D (Germany)	4.112	4.806	4.427	4.491	13.364	15.621	14.388	14.597
DK (Denmark)	180.925	211.483	194.786	197.622	588.006	687.320	633.054	642.272
E (Spain)								
EST (Estonia)	2.056	2.403	2.213	2.246	6.682	7.810	7.194	7.299
F (France)								
FIN (Finland)	2.056	2.403	2.213	2.246	6.682	7.810	7.194	7.299
H (Hungary)								
I (Italy)								
n.i.	2.056	2.403	2.213	2.246	6.682	7.810	7.194	7.299
LT (Lithuania)								
LV (Latvia)								
N (Norway)	4.112	4.806	4.427	4.491	13.364	15.621	14.388	14.597
NL (The Netherlands)	2.056	2.403	2.213	2.246	6.682	7.810	7.194	7.299
Other	18.504	21.629	19.921	20.211	60.137	70.294	64.744	65.687
PL (Poland)	6.168	7.210	6.640	6.737	20.046	23.431	21.581	21.896
RUS (Russia)								
SK (Slovakia)								
UA (Ukraine)	2.056	2.403	2.213	2.246	6.682	7.810	7.194	7.299
Σ	**224.100**	**261.951**	**241.269**	**244.782**	**728.326**	**851.339**	**784.124**	**795.542**

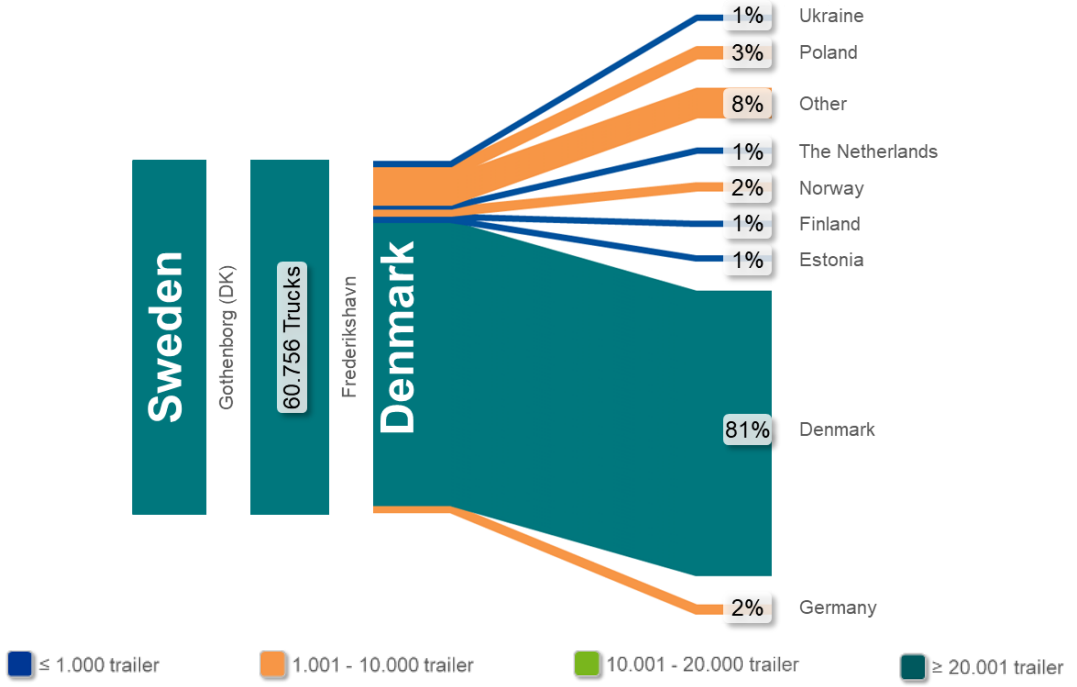


Figure 20 Results from survey Gothenborg – Frederikshavn

The intra-Scandinavian ferry connections are also primarily used by the Scandinavians. This is reflected in the Danish share of 81%.

In total, the potential freight flows consist of an **import range of 224.100 Tt – 784.124 Tt** and **an export range of 244.782 Tt – 851.339 Tt**.

Varberg

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)						
BUL (Bulgaria)	2%	660	304	356	328	333
CZ (Czech Republic)						
CR (Croatia)						
D (Germany)	2%	880	406	475	437	443
DK (Denmark)	21%	8.805	4.060	4.745	4.371	4.434
E (Spain)						
EST (Estonia)						
F (France)						
FIN (Finland)	1%	440	203	237	219	222
H (Hungary)						
I (Italy)						
n.i.	2%	880	406	475	437	443
LT (Lithuania)						
LV (Latvia)						
N (Norway)						
NL (The Netherlands)						
Other	2%	660	304	356	328	333
PL (Poland)	1%	440	203	237	219	222
RUS (Russia)						
SK (Slovakia)						
UA (Ukraine)						
Σ	**30%**	**12.767**	**5.886**	**6.881**	**6.337**	**6.430**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)								
BUL (Bulgaria)	2.436	2.847	2.622	2.661	7.916	9.253	8.523	8.647
CZ (Czech Republic)								
CR (Croatia)								
D (Germany)	3.248	3.796	3.496	3.547	10.555	12.338	11.363	11.529
DK (Denmark)	32.477	37.962	34.965	35.474	105.549	123.376	113.635	115.290
E (Spain)								
EST (Estonia)								
F (France)								
FIN (Finland)	1.624	1.898	1.748	1.774	5.277	6.169	5.682	5.764
H (Hungary)								
I (Italy)								
n.i.	3.248	3.796	3.496	3.547	10.555	12.338	11.363	11.529
LT (Lithuania)								
LV (Latvia)								
N (Norway)								
NL (The Netherlands)								
Other	2.436	2.847	2.622	2.661	7.916	9.253	8.523	8.647
PL (Poland)	1.624	1.898	1.748	1.774	5.277	6.169	5.682	5.764
RUS (Russia)								
SK (Slovakia)								
UA (Ukraine)								
Σ	**47.091**	**55.045**	**50.699**	**51.437**	**153.046**	**178.895**	**164.771**	**167.170**

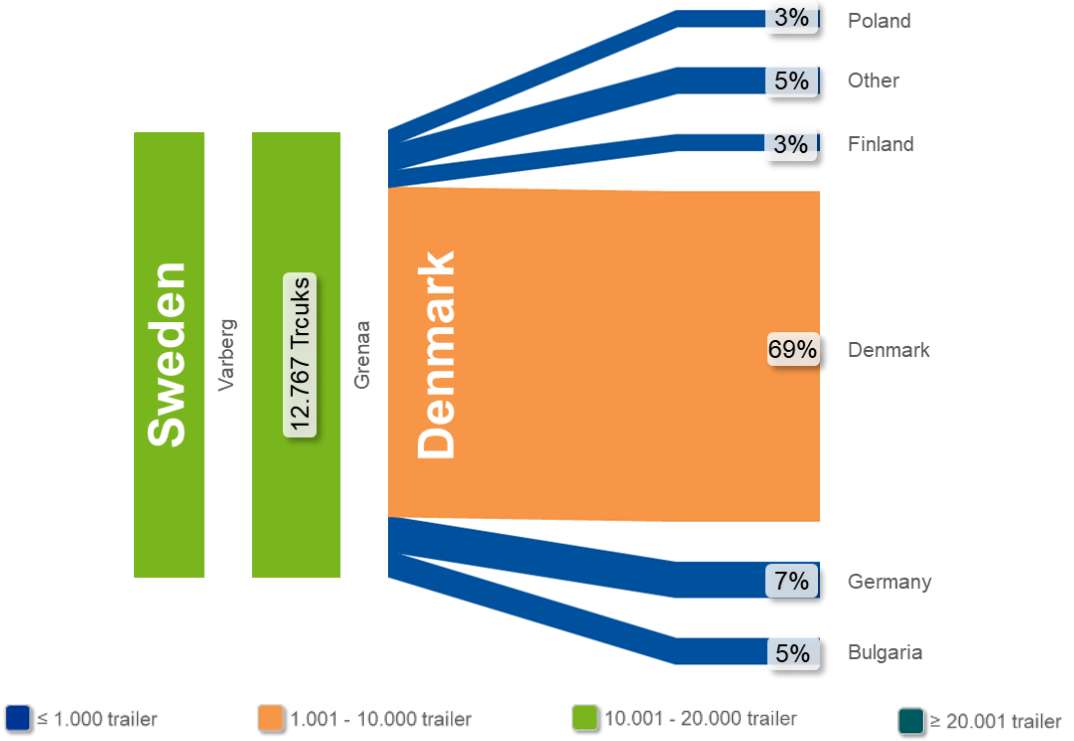


Figure 21 Results from survey Varberg – Grenaa

This ferry route has the lowest share of freight flows. This is because Grenaa is primarily a marina for Scandinavian sailors.

According to the evaluation presented, the ferry on this route has the second highest load factor with 76% on two departures per day (see Figure 7).

In total, the potential freight flows consist of an **import range of 47.091 – 167.170 Tt** and **an export range of 51.437 Tt – 178.895 Tt**.

Helsingborg

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)						
BUL (Bulgaria)						
CZ (Czech Republic)						
CR (Croatia)						
D (Germany)	7%	27.154	12.520	14.634	13.479	13.675
DK (Denmark)	8%	30.548	14.085	16.463	15.164	15.384
E (Spain)	3%	10.183	4.695	5.488	5.055	5.128
EST (Estonia)						
F (France)	1%	2.263	1.043	1.220	1.123	1.140
FIN (Finland)	0%	1.131	522	610	562	570
H (Hungary)	0%	1.131	522	610	562	570
I (Italy)	1%	2.263	1.043	1.220	1.123	1.140
n.i.	0%	1.131	522	610	562	570
LT (Lithuania)	0%	1.131	522	610	562	570
LV (Latvia)						
N (Norway)	2%	6.788	3.130	3.659	3.370	3.419
NL (The Netherlands)	2%	7.920	3.652	4.268	3.931	3.989
Other	1%	5.657	2.608	3.049	2.808	2.849
PL (Poland)	2%	6.788	3.130	3.659	3.370	3.419
RUS (Russia)						
SK (Slovakia)						
UA (Ukraine)						
Σ	**27%**	**104.090**	**47.992**	**56.098**	**51.669**	**52.421**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)								
BUL (Bulgaria)								
CZ (Czech Republic)								
CR (Croatia)								
D (Germany)	100.157	117.074	107.830	109.400	325.511	380.489	350.449	355.552
DK (Denmark)	112.677	131.708	121.309	123.076	366.200	428.050	394.255	399.996
E (Spain)	37.559	43.903	40.436	41.025	122.067	142.683	131.418	133.332
EST (Estonia)								
F (France)	8.346	9.756	8.986	9.117	27.126	31.707	29.204	29.629
FIN (Finland)	4.173	4.878	4.493	4.558	13.563	15.854	14.602	14.815
H (Hungary)	4.173	4.878	4.493	4.558	13.563	15.854	14.602	14.815
I (Italy)	8.346	9.756	8.986	9.117	27.126	31.707	29.204	29.629
n.i.	4.173	4.878	4.493	4.558	13.563	15.854	14.602	14.815
LT (Lithuania)	4.173	4.878	4.493	4.558	13.563	15.854	14.602	14.815
LV (Latvia)								
N (Norway)	25.039	29.268	26.958	27.350	81.378	95.122	87.612	88.888
NL (The Netherlands)	29.213	34.146	31.451	31.908	94.941	110.976	102.214	103.703
Other	20.866	24.390	22.465	22.792	67.815	79.269	73.010	74.073
PL (Poland)	25.039	29.268	26.958	27.350	81.378	95.122	87.612	88.888
RUS (Russia)								
SK (Slovakia)								
UA (Ukraine)								
Σ	**383.936**	**448.782**	**413.350**	**419.369**	**1.247.792**	**1.458.542**	**1.343.386**	**1.362.948**

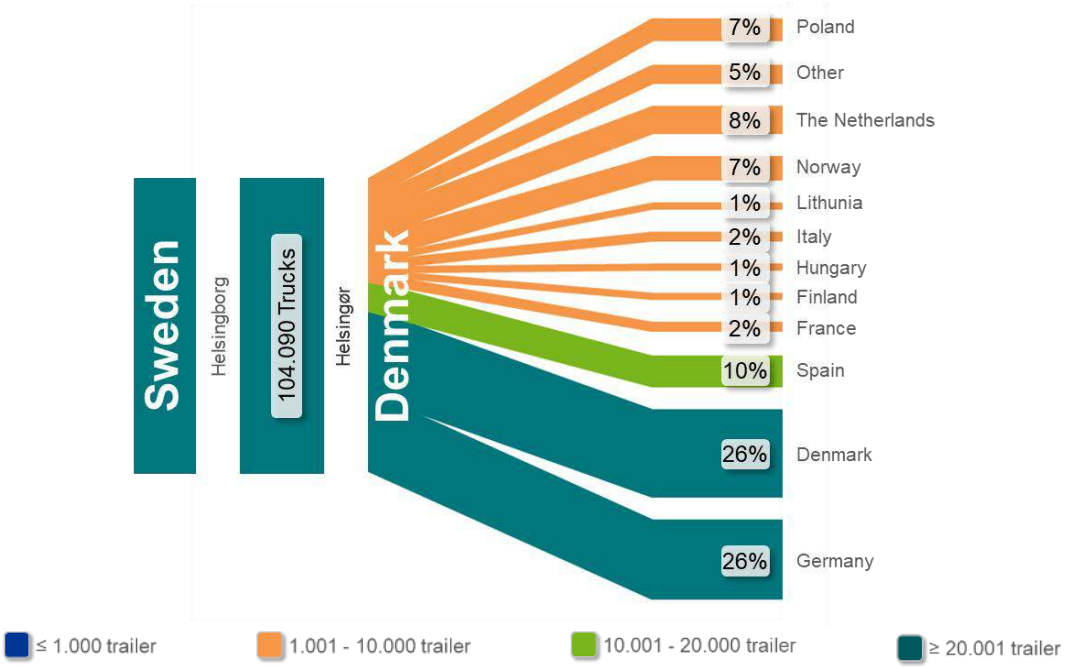


Figure 22 Results from survey Helsingborg – Helsingør

This ferry connection is a highly frequented route with the second highest freight flows in the evaluation. This connection (with up to 75 departures per day) and the Öresund Bridge are the main routes between Denmark and Sweden (see Figure 7, Figure 22 and Figure 25).

Germany and Denmark use this connection most. Spain (10%) and the Netherlands (8%) follow.

In total, the potential freight flows consist of an **import range of 383.936 – 1.343.386 Tt** and **an export range of** von **419.369 Tt – 1.458.542 Tt**.

Trelleborg

Vehicles per year

			min		max	
	survey*	total	Import	Export (+8%)	Import (+1%)	Export
A (Austria)	2%	11.296	5.208	6.088	5.607	5.689
BUL (Bulgaria)						
CZ (Czech Republic)	1%	6.777	3.125	3.653	3.364	3.413
CR (Croatia)						
D (Germany)	21%	144.584	66.662	77.922	71.769	72.814
DK (Denmark)	0%	2.259	1.042	1.218	1.121	1.138
E (Spain)	2%	11.296	5.208	6.088	5.607	5.689
EST (Estonia)	0%	2.259	1.042	1.218	1.121	1.138
F (France)	1%	4.518	2.083	2.435	2.243	2.275
FIN (Finland)						
H (Hungary)	1%	9.036	4.166	4.870	4.486	4.551
I (Italy)	3%	20.332	9.374	10.958	10.093	10.240
n.i.						
LT (Lithuania)						
LV (Latvia)						
N (Norway)	2%	11.296	5.208	6.088	5.607	5.689
NL (The Netherlands)	7%	45.182	20.832	24.350	22.428	22.755
Other	6%	40.664	18.749	21.915	20.185	20.479
PL (Poland)	16%	106.179	48.955	57.224	52.706	53.473
RUS (Russia)						
SK (Slovakia)	2%	11.296	5.208	6.088	5.607	5.689
UA (Ukraine)						
Σ	**63%**	**426.974**	**196.862**	**230.112**	**211.944**	**215.030**

Legend:
* means here all respondents who answered f:11 with "this connection"

Potential weights (in 1.000 tonnes)

	min effective load				max effective load			
	min		max		min		max	
	Import	Export (+8%)	Import (+1%)	Export	Import	Export (+8%)	Import (+1%)	Export
A (Austria)	41.664	48.701	44.856	45.509	135.408	158.278	145.782	147.904
BUL (Bulgaria)								
CZ (Czech Republic)	24.998	29.221	26.914	27.305	81.245	94.967	87.469	88.743
CR (Croatia)								
D (Germany)	533.299	623.372	574.155	582.516	1.733.221	2.025.960	1.866.004	1.893.176
DK (Denmark)	8.333	9.740	8.971	9.102	27.082	31.656	29.156	29.581
E (Spain)	41.664	48.701	44.856	45.509	135.408	158.278	145.782	147.904
EST (Estonia)	8.333	9.740	8.971	9.102	27.082	31.656	29.156	29.581
F (France)	16.666	19.480	17.942	18.204	54.163	63.311	58.313	59.162
FIN (Finland)								
H (Hungary)	33.331	38.961	35.885	36.407	108.326	126.622	116.625	118.324
I (Italy)	74.995	87.662	80.741	81.916	243.734	284.901	262.407	266.228
n.i.								
LT (Lithuania)								
LV (Latvia)								
N (Norway)	41.664	48.701	44.856	45.509	135.408	158.278	145.782	147.904
NL (The Netherlands)	166.656	194.804	179.424	182.036	541.632	633.112	583.126	591.618
Other	149.990	175.323	161.481	163.833	487.468	569.801	524.814	532.456
PL (Poland)	391.641	457.789	421.645	427.785	1.272.834	1.487.814	1.370.347	1.390.301
RUS (Russia)								
SK (Slovakia)	41.664	48.701	44.856	45.509	135.408	158.278	145.782	147.904
UA (Ukraine)								
Σ	**1.574.898**	**1.840.896**	**1.695.552**	**1.720.242**	**5.118.418**	**5.982.912**	**5.510.544**	**5.590.786**

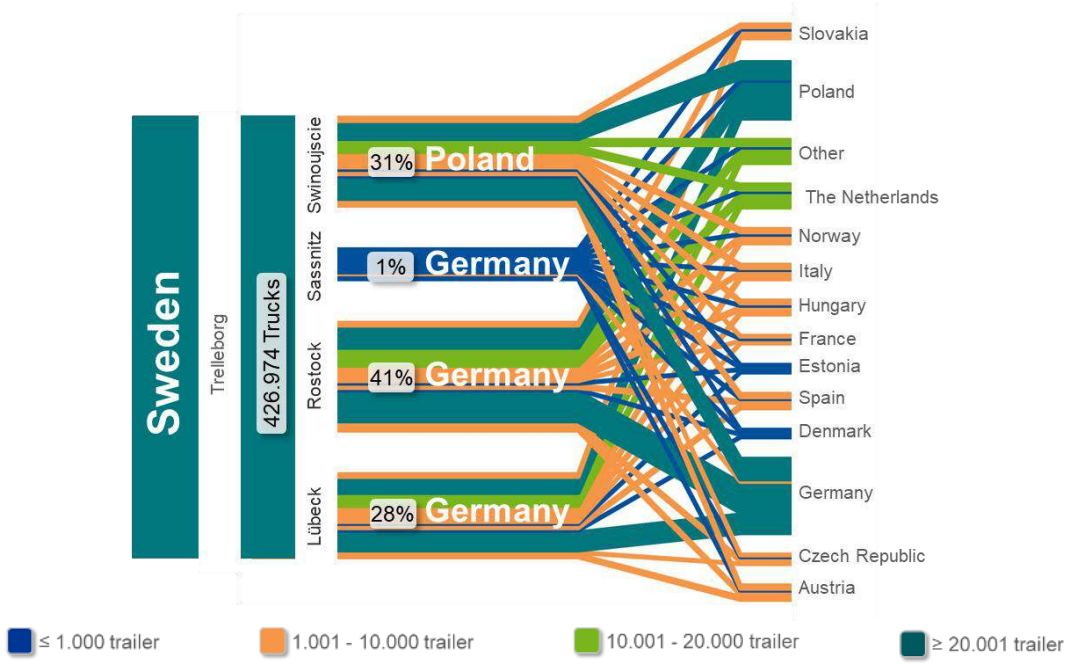


Figure 23 Results from survey Trelleborg total

In the present analysis, Trelleborg manages by far the highest freight flows with the four connections. If one compares the potential vehicles per year with the other Swedish ports considered, Trelleborg is leading with 52%.

Trelleborg is the largest ro-ro and ferry port in Scandinavia and combines the Western Corridor (Lübeck), Scandria®-Core-Corridor (Rostock and Sassnitz) and the Western Corridor (Swinoujscie) on the eastern border of Sweden. Up to 16 departures per day are organised on the connections, with an average ferry load factor of 64% (see Figure 6 und Figure 7).

In total, the potential freight flows consist of an **import range of 1.574.989 – 5.510.544 Tt** and **an export range of** von **1.720.242 Tt – 5.982.912 Tt**.

5.2 Analysis of road-transports

In order to achieve the strategic aims of the Scandria®2Act project, the road is to be relieved. For this purpose, the land connections were also analysed for the report.

The European transport route via Flensburg (Jutland-land-Link) generates international transports by road and rail between Germany and Denmark to Malmö and Helsingborg in Sweden. The Jutland-land-Link thus constitutes the Western Corridor.

The Scandria® project has already carried out analyses of road pollution in cooperation with the partner countries. As part of WP 3, the Technical University of Applied Sciences has presented the average annual traffic intensity for Germany and Scandinavia[7] through analyses of various national statistics[8] (see 1A3). Automatic counting points on motorways and national roads have been used for this purpose. At these counting points, the number of all passing vehicles is permanently recorded and then published.

For the Scandria® project, the counting points that represent cross-border traffic between Germany and Denmark are of interest. Four counting points were considered, which recorded the following import and export counts:

counting point nr.	counting point name	count in direction Denmark	count in direction Germany
1133	Böglum	54.612	60.578
1109	Ellund	1.541.381	1.613.219
1127	Gottrupel	157.540	140.585
1134	Wasserslebe	28.462	21.705
		1.781.995	**1.836.087**

	traffic in direction Germany		traffic in direction Denmark	
	min	max	min	max
Tt	14.689	47.738	14.256	46.332

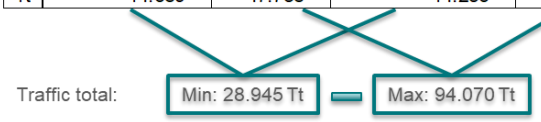


Figure 24 Potential weights on road via Jutland-land-link

The database was obtained via the Federal Highway Research Institute. These data provided information:

- direction (means in direction Germany/Denmark) und
- type of vehicle (here: truck > 3,5t zGG with/without trailer and semitrailers).

These direction-related hourly traffic data were filtered by vehicle type and summarised for the year 2016.

Taking into account questions f:11 and f:23 (see Chapter 5.1) of the questionnaire, an average of 9% of drivers reported empty trips. These are not included in the above chart. If the empty runs are included, the range is **26.239 Tt – 85.278 Tt**.

[7] No data on Finland could currently be obtained from the study. The traffic volume to Finland is therefore not included in the road load maps.

[8] The Federal Highway Research Institute and the Swedish authority Trafikverket have formed the data basis.

…via Öresund Bridge

With the help of the STA survey, it was also possible to gain insights into the traffic over the Öresund Bridge. The respondents to answer question f17: "What route did you take to Sweden?" could indicate if they crossed the Öresund Bridge into the country. As with the analysis of Baltic Sea traffic, it was possible to determine how many respondents per port chose this route. In addition, the Danish National Transport Authority has historicised the annual traffic volume since 2000 and publishes the counts. The documentation shows that 7.423.786 trucks passed the Öresund Bridge in the reference year 2016. This number serves as the basic population for the calculations. From this, an average percentage per country was calculated, multiplied by the total of all vehicles determined by the automatic counting points. This resulted in the following distribution of countries potentially using this transport route.

	trucks total
A (Austria)	81.737
BUL (Bulgaria)	131.995
D (Germany)	1.105.607
DK (Denmark)	3.365.663
E (Spain)	68.526
F (France)	88.769
FIN (Finland)	137.052
I (Italy)	48.911
n.i.	45.058
LT (Lithuania)	68.526
LV (Latvia)	68.526
N (Norway)	205.577
NL (The Netherlands)	1.003.770
Other	955.160
RUS (Russia)	48.911
	7.423.786

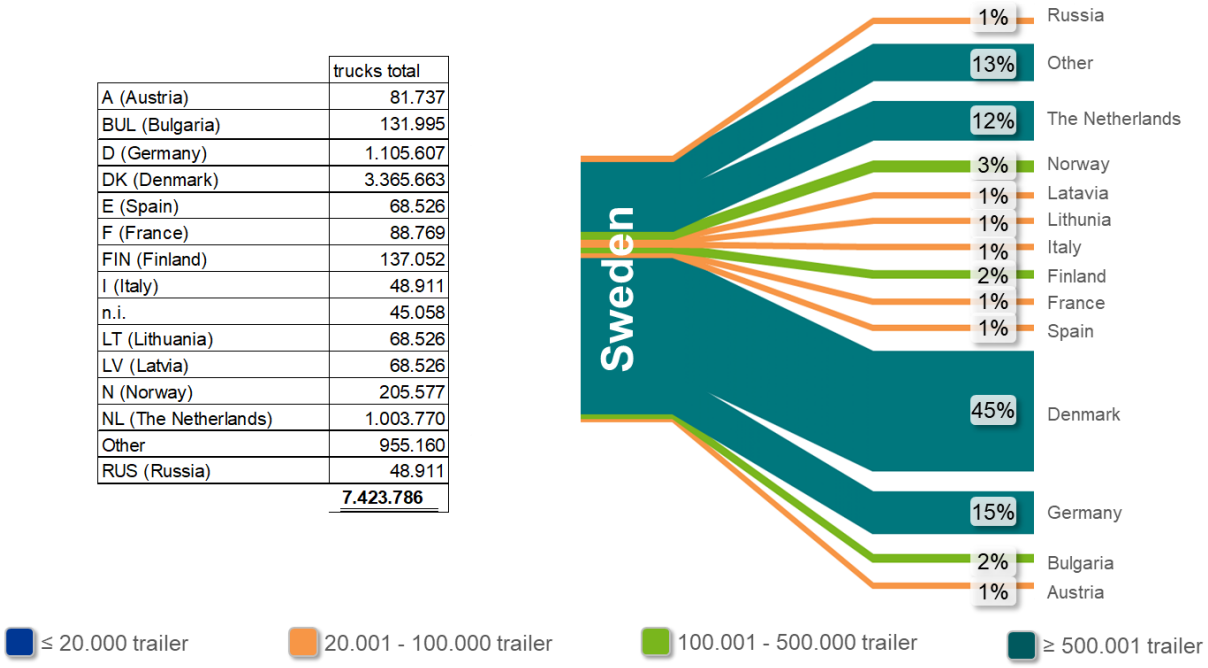


Figure 25 Potential distribution by road across the Jutland-land-link

This evaluation does not provide any information on how the traffic at the German-Danish border is distributed country-specifically, but is representative with the other evaluations.

5.3 Analysis of rail-transports

5.3.1 German rail transport

In this section of the report the potential height of the goods to be transported at the German Baltic Sea ports is determined. The used figures are based on statements by experts and employees of the operational business of the ports. In this way a clear picture of the relations and their frequencies[9] was created.

[9] The relations and departure frequencies from the official timetable differ in part from the statements made by the port employees. The timetables are updated every six months, which may result in

The ports of Rostock, Kiel and Lübeck are relevant for rail freight traffic. Sassnitz controls freight traffic principally via Rostock. Rail freight traffic is only diverted to Sassnitz in exceptional cases (e.g. construction work).

The destinations of the ports lead to Germany, the Czech Republic, Austria or Italy. Within Germany, the Czech Republic and Austria, the Europe-wide standard for the length of freight trains of max. 740 metres was assumed and for Italy a maximum total length of 570 metres[10]. The calculation is based on the fact that transports throughout Germany are organised by flat wagons with bogies for combined transport. To Italy, carrying wagons with bogies, so called double pocket wagons, are used for the transport of semitrailers.[11] Because in Germany the rail network is classified as D4 22.5t 8.0 t/m in this region, a load limit[12] of 67 t was set for the pocket wagon at a speed level of 100 km/h (route speed designation: S). The same route classification and speed level was assumed for the double pocket wagons, with a load limit of 100 tonnes. After defining the parameters, the results have been summarised in the following table.

connection		country	frequency per week	train length* [m]	trains per year	trailer/ container per year	weights per year [Tt]**	
							Min	Max
Rostock	Verona	IT	14	535	728	10.920	140	454
Rostock	Treviso	IT	2	535	104	1.560	20	65
Rostock	Wels	AT	1	734	52	1.768	11	37
Rostock	Brno	CZ	6	734	312	10.608	68	221
Rostock	Hamburg	DE	5	734	260	8.840	57	184
Rostock	Karlsruhe	DE	5	734	260	8.840	57	184
Rostock	Duisburg	DE	3	734	156	5.304	34	110
Rostock	Leipzig	DE	2	734	104	3.536	23	74
					1.976	**51.376**	**409**	**1.328**
Kiel	Trieste	IT	1	569	52	832	11	35
Kiel	Verona	IT	7	535	364	5.460	70	227
					416	**6.292**	**81**	**262**
Lübeck	Duisburg	DE	6	734	312	10.608	68	221
Lübeck	Ludwigshafen	DE	6	734	312	10.608	68	221
Lübeck	Hamburg	DE	5	734	260	8.840	57	184
Lübeck	Verona	IT	6	535	312	4.680	60	195
Lübeck	Novara	IT	1	535	52	780	10	32
					1.248	**35.516**	**262**	**852**

* incl. locomotiv 20 m
** utilization rate of the trains 80%
m meter
Min potential transport weight 8t per trailer/container
Max potential transport weight 26t per trailer/container
Tt 1.000 tonnes

differences from the actual values. The available results are based on the statements of the employees.

[10] The train length is shorter because traffic is controlled via the Alps.

[11] No clear statements have been made by the port employees about types or models of freight trains or trailers, so they must be assumed. Kiel provided the most detailed information. Here the port employee made statements about the type of wagon as well as the number of trailers. Kiel has only relations to Italy. The chosen double pocket wagon agrees with the expert opinions and has an overall length of max. 569 m (16 trailers x 34 metres).

[12] The load limit, the ABC raster, indicates the maximum permissible landing weight as a function of the line class and is clearly visible directly on the freight wagon. The maximum permissible mass to be transported is defined by the line class and speed.

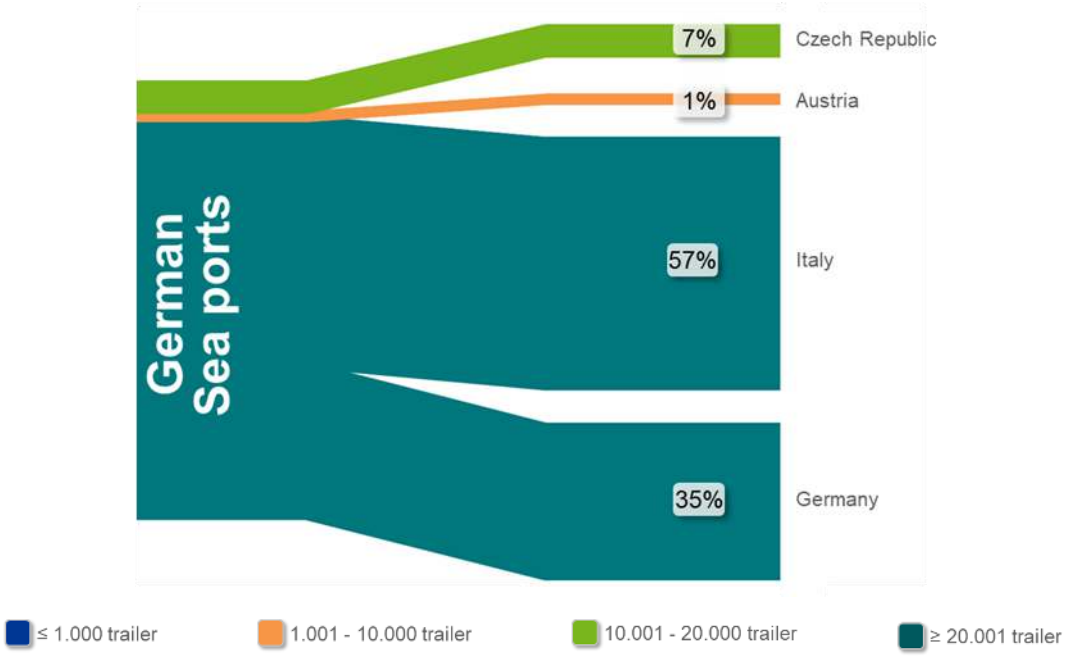


Figure 26 Rail traffic to the German Baltic Sea ports

The above-mentioned data give an overview of the transport volume by rail from the German Baltic Sea ports to the south regions, but they don´t provide any information on cross-border transport with Scandinavia. As described in this chapter, there is also a rail connection across the Jütland-land-link.

Only very rough statements are possible in this geographical section. The reason for this is the intransparency of the database with regard to the number of cross-border freight trains across the German-Danish border. No overview of the existing train connections to Denmark or Sweden could be found. Without knowing all train routes, it wasn´t possible to make specific requests to the timetables. Within the research period no representative data could be obtained by Deutsche Bahn Netz. even after repeated requests.

An exemplary presentation was based on the report of the Federal Statistical Office from 2017. This report states that the rail network in the German-Danish border region was burdened with 101 – 10.000 freight trains in 2015[13]. This results in the following values:

The figures show that traffic along the Jutland-land-link is very low. Looking at the maximum scenario, with 10.000 trains per year, the following percentage distribution of traffic volumes is obtained:

[13] Evaluations of this kind have not become known during the analysis. However, these statistics are considered representative because, according to the Federal Ministry of Transport and Digital Infrastructure, freight transport did not increase in 2016. In the area of "Railways - passenger, freight and combined transport", the Ministry recorded a decline of approx. 0.1% in traffic. Thus, it is assumed that the indicated range can be considered characteristic in this geographical section.

	trains	trailer/ container per year	weights per year [Tt]*	
			Min	Max
Min	101	3.737	24	78
Max	10.000	370.000	2.368	7.696

Legend:
* utilization rate of the trains 80%
Min potential transport weight 8t per trailer/container
Max potential transport weight 26t per trailer/container
Tt 1.000 tonnes

Figure 27 Rail traffic (maximum scenario)

The graphic clearly shows that Germany and Italy account for a very high proportion of freight flows to German Baltic Sea ports. This is correlated with the frequencies of departures.

The cross-border rail section is subject to the TSI line category[14] F1 and has no ETCS[15] level. Because the double-track, electrified rail network has almost reached its capacity limit (Ministry of Transport, Building and Housing. (2015). Verkehrstruktur im Jütlandkorridor – Deutsch-Dänische Verkehrskommission. p. 12 f. [engl. Transport structure in the Jütland corridor – German-Danish Transport Commission], only the train length can be varied under certain conditions. Since the TSI level classifies the route from Hamburg to Jutland-land-link with F1, train lengths of up to 1050 metres are possible.

5.3.2 Rail transport potential from the Örebro region

In this section of the report presents the potentials of modal shift in the Örebro Region (Sweden) which were presented in a full report – Fostering modal shift "**Scandria® Corridor Multimodal Service Offer**".

The main objective of the report was to analyses the potential of modal shift from road to rail between the Mälaren Valley and the ScanMed Corridor via the Örebro region. This included identification of company behavior and logistics practices of key business players (manufacturing, transport and logistics) involved in supply chain management between the Mälaren Valley and the ScanMed Corridor. The report explains this process as well as the result of the analysis.

[14] TSI – Technical specifications for interoperability are European standards that make it easier to plan and dispose of cross-border traffic. Telematics solutions in accordance with EU standards allow timetables and operational messages to be exchanged, coordinated and monitored.

[15] ETCS – European Train Control System is part of the future European standard.

The report consists of three main parts, namely data collection, exploratory study and market study. The market study, in turn, consists of four steps:

- Mapping of companies' characteristics and freight flows
- Modal Shift Evaluation Model
- Evaluation of freight flows per company
- Aggregation of flows (potential for modal shift)

The market study covered only the companies that were located and/or active within the Örebro region and their current flows. The geographical scope was such that only companies with supply chain activities between the Mälaren Valley and the ScanMed Corridor via the Örebro region were included.

Freight owners were interviewed- including mainly production units and warehouses – as well as forwarders and shippers, in order to get the full picture. To foster a modal shift not only private actors were interested in a better pricing and market share, but also public authorities and other organizations with environmental objectives were stakeholders.

A total of 280 different freight flows were collected through the market study. These flows range from domestic to intercontinental in scope and from fully loaded trains each week to a couple of pallets each month. An overall assessment of the likelihood for a specific cargo flow to be transported by or transferred to rail freight has been evaluated based on a group of parameters. The parameters were:

1. Commodity
2. Transport distance and infrastructure requisites
3. Order flexibility and reliability
4. Competition from other modes of transport
5. Company intention

The overall assessment was carried out by investigating the information for all the freight flows from the interviews and evaluating them according to the different parameters described above.

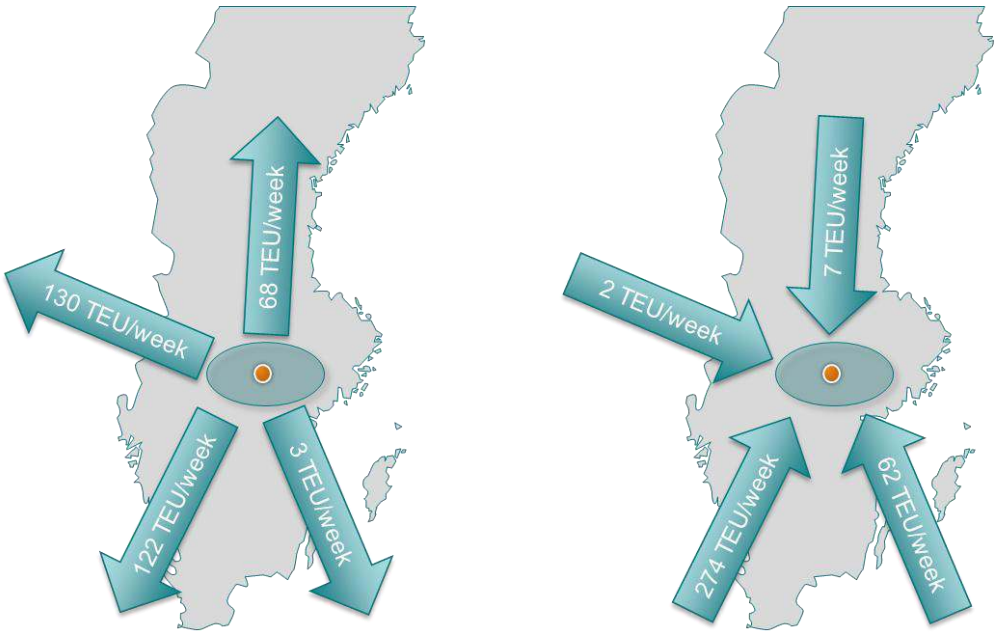


Figure 28 Rail transport from the Örbro region in TEU/week

The results showed that (assuming 80 TEUs/train) at least 2 trains/week would be possible for transports between the Region Örebro County and central Europe. This shows that there is a potential for a modal shift from road to rail to and from the Örebro region.

Different stakeholders have diverse interests for moving goods from road to rail. The interview study identified the specific market players that could make a greater impact on a modal shift. It became clear that goods owners and forwarders are the ones with the highest impact of making a change.

It is essential though, for all the actors that the price does not increase when shifting goods from road to rail. If this is not met it will be difficult to motivate companies to choose railway, as the environmental part is seldom (for not saying never) as highly ranked as the price. For the railway's market share to increase, it needs to be more attractive and able to meet the market demands. Otherwise, there might be a need for a subvention or similar.

5.4 Differentiation of freight flows by corridors

After the freight flows have been recorded in the previous chapters, they are assigned to the corridors described in Chapter 4.2. By means of the analysis a quantification and visualisation of the modal split in the Scandria® Corridor could be obtained. This is subdivided into:

- approx. 75-81% by road,
- approx. <1-8% by rail and
- approx. 17-18% by ferry.

The results are visualized in the following in quantity-based flow diagrams (so-called Sankey diagrams) and assigned to the main freight flows (Chapter 4.2).

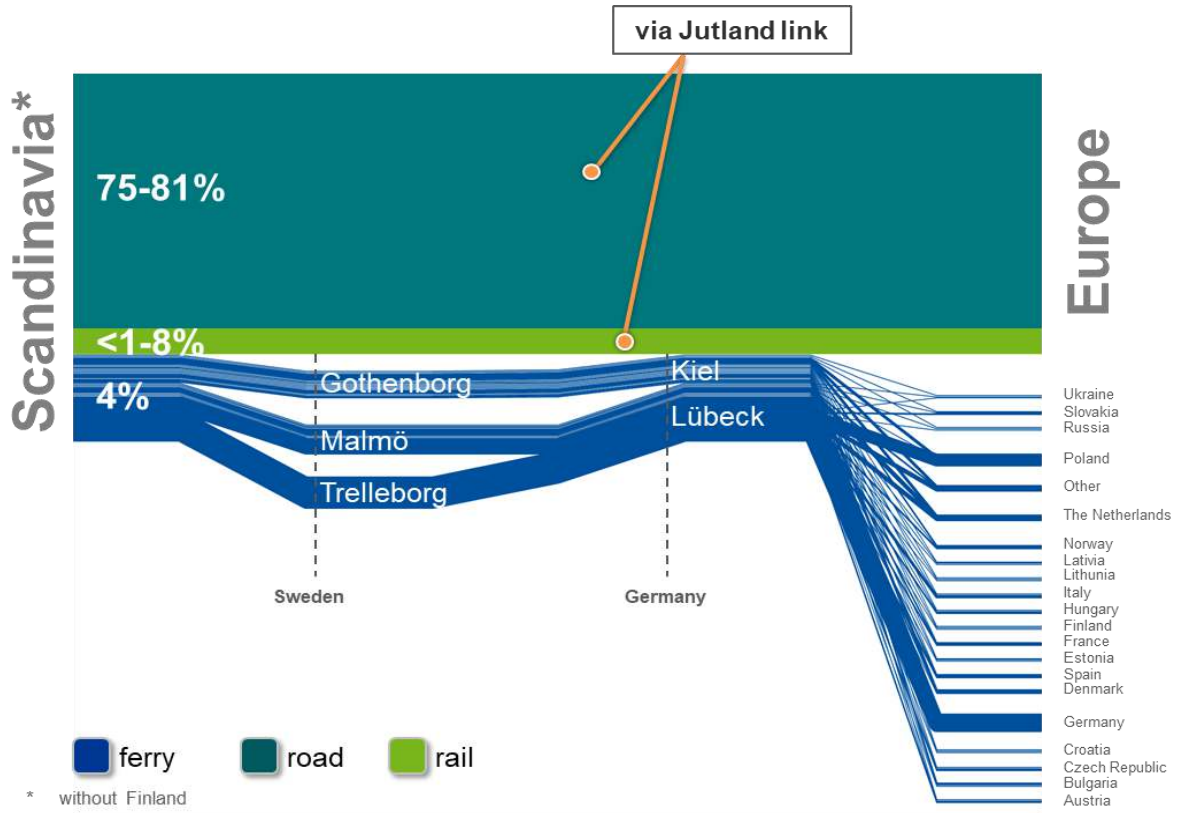


Figure 29 Western corridor: German-Scandinavian traffic

The Western Corridor includes all considered traffic modes. Over the German-Danish border, more than 3.6 million vehicles (trucks > 3.5t zGG with/without trailer and semitrailers) were recorded by the German counting points in 2016. These make up the total modal split of the road (see also Chapter 5.2).

Rail transport is very low in the modal split, which is due to capacity bottlenecks in the rail infrastructure (see also Chapter 5.3.1).

The ports of Kiel and Lübeck in Schleswig-Holstein account for approx. 4% of the approx. 18% modal split.

The largest share of vehicles using the German Baltic-Sea-Ports to ferry across to Scandinavia originates from Germany, followed by Poland and the Netherlands (cf. Figure 12). The large share of trucks from the Netherlands could be explained by the overseas-freight flows into the ARA ports. It is interesting to note, that the situation in Rostock looks different: The largest shares of vehicles using the port of Rostock are from Germany, Italy and Poland. This indicates a certain specialization of the Scandria®-Core-Corridor towards the south and the east of Europe, while the Western Corridor via Jutland-land-Link and the ports of Schleswig Holstein cover more of the west of Europe.

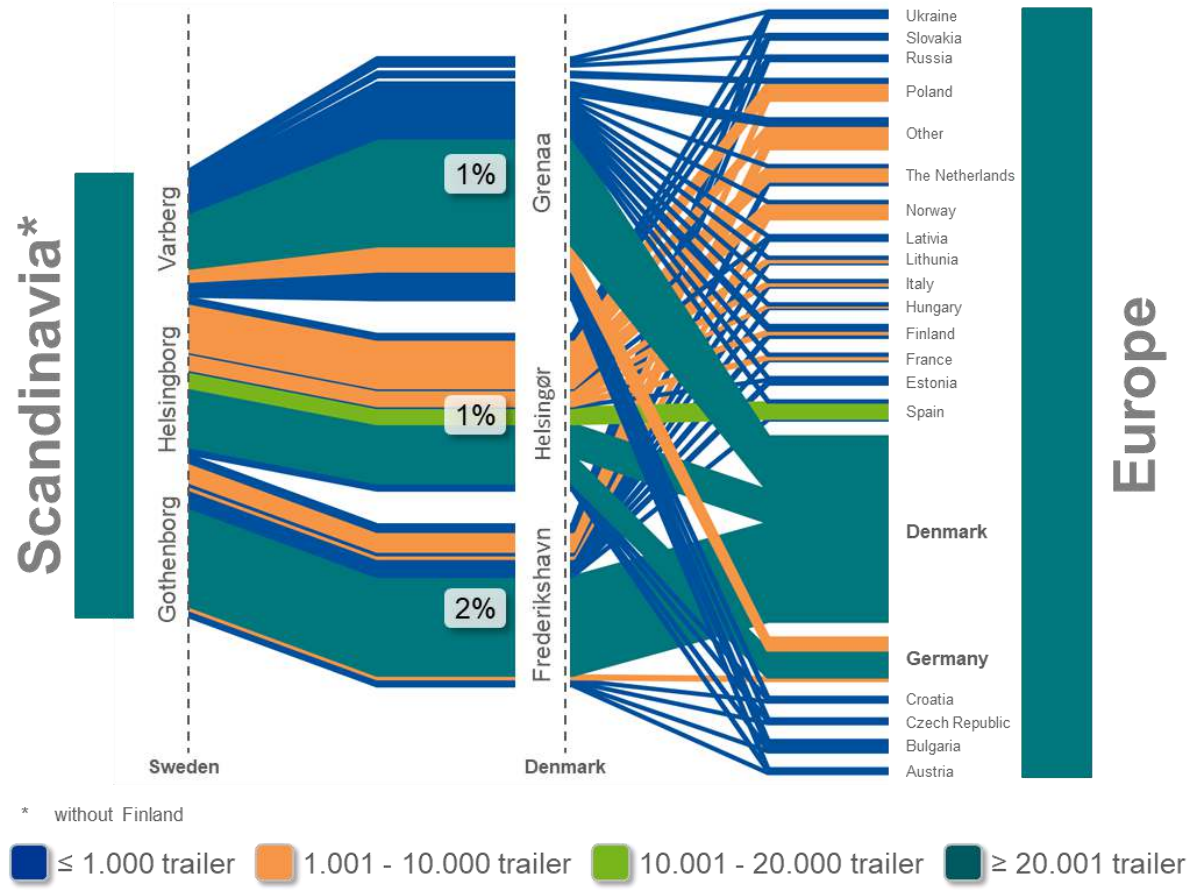


Figure 30 Western Corridor: intra-Scandinavian traffic

This graph shows the intrascandinavian traffic. This means here that the Danish-Swedish ferry connections that merge into the Scandria®-Core-Corridor are visualised. In addition, in Chapter 5.2, road traffic across the Öresund Bridge has already been described. The Western Corridor makes up approx. 4% of the approx. 18% of the modal split over the ferry.

In this illustration it can also be seen that the Western Corridor via Jutland-land-Link covers more of the west of Europe.

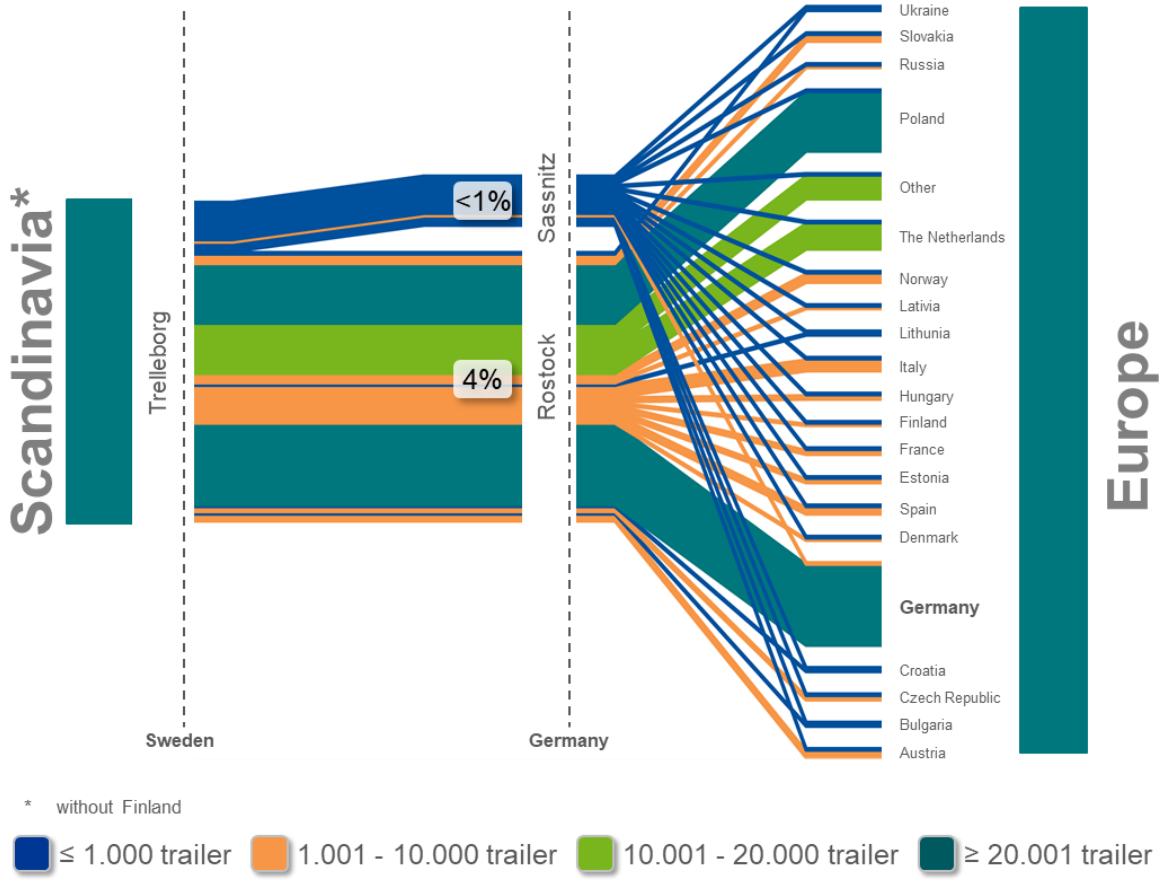


Figure 31 Scandria®-Core-Corridor

In the Scandria®-Core-Corridor approx. 4% of the 18% of the modal split is covered by the ferry. RoRo traffic is mainly controlled and handled via the port of Rostock.

As already mentioned, the Rostock survey showed that most vehicles come from Germany, Italy and Poland. The STA-survey here showed that the Italian share on the Rostock – Trelleborg connection was very low. The situation is different with the Netherlands. This can be based on two assumptions:

1. human errors have been made during the surveys, for example misunderstanding a question,
2. the western part of Europe is more represented than known before.

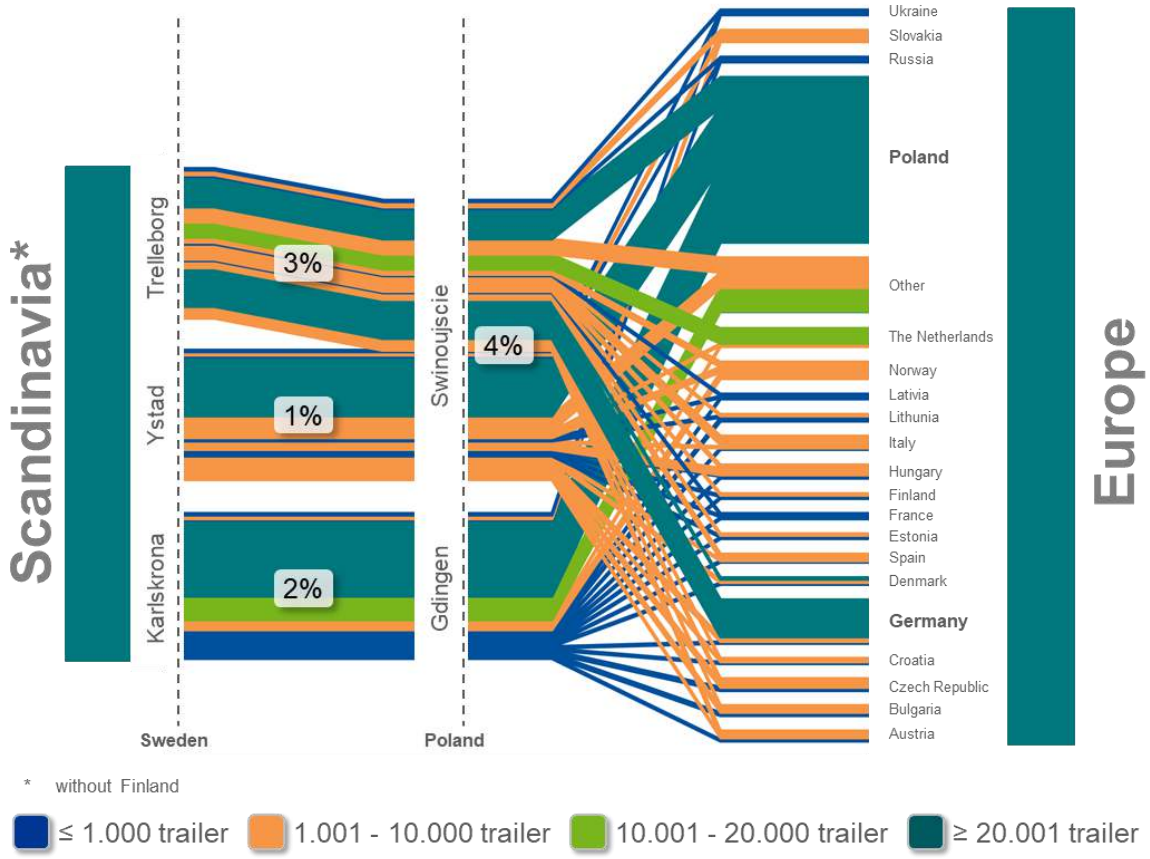


Figure 32 Eastern Corridor

With about 6% of the approx.18% of the modal split by ferry, the Eastern Corridor via the Polish connections makes up the largest part. However, it does not differ significantly.

The same assumptions as in the Scandria®-Core-Corridor can be made for the Eastern Corridor. It is interesting to note that the Netherlands also has a significant share via the Polish-Swedish connections.

6 Analysis and comparison with trade balances

In Chapter 5.1.2 it has already been mentioned that the trade balances of the countries are informative for the evaluation. For this reason, the trade balances are considered as a total and then broken down into RoRo-compatible product groups. The analysis of trade flows is based on the statistics "EU trade since 1988 by SITC"[16] of the Statistical Office of the European Union (Eurostat). This official source documents historical data from 1988 to 2017, quantifying trade between the reporting countries (reporters) and their partners in volume of trade in goods exports and imports in 100kg. In order to modify the trade flows between the countries to be considered, the countries are selected in the multidimensional table both as reporters and partners. The decision for the statistics according to SITC is based on the fact that the product groups have a high level of aggregation and make them internationally comparable. The classification provides information about:

- the raw materials used in production,
- the processing level,
- the intended uses of the goods,
- the importance of products in world trade, and
- technological change

and is grouped into ten main categories (0-9). The ten parts are divided again into 67 sections, which again are divided into 262 groups and 1,023 subgroups. Another reason for the decision to choose the statistics "EU trade by SITC" is that the SITC revision 4 takes into account numerous changes in the HS, whereby "(...) according to which currently more than 98% of world trade is recorded".[17]

It examines trade with Scandinavia. The report includes Denmark, Norway and Sweden. Finland is not included on the basis of data. It is assumed that the transport volume is partly controlled via the Baltic States (cf. Figure 4) and Sweden (via Stockholm). The countries taken into account are those that have reached more than 1% in Figure 12.

Although the data from the evaluations (Baltic Sea, road, rail; trade balance) cannot be combined, but the comparison suggests that a confirmatory trend is crystallizing.

6.1 Trade Balances sheets total

In the first step, the foreign trade of trade balances is considered independently of product groups. This means that the total trade in goods is represented within the following values. Like in Chapter 5.1.1, a ranking has been carried out here.

[16] SITC = Standard International Trade Classification

[17] The Federal Statistical Office. (2006). *Standard International Trade Classification (SITC, Rev. 4)*. Revision 4, of united Nations, edition 2006

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Germany	17.820	73.667
The Netherlands	9.018	45.461
Norway	10.042	24.590
Sweden	12.883	24.453
Denmark	8.595	18.353
Spain	2.866	7.014
Poland	4.451	6.671
Italy	2.140	4.539
Turkey	831	3.231
Austria	536	1.410
Chez Republic	450	870
Hungary	240	516
Slovakia	202	379
Bulgaria	78	117

Values in 1.000 tonnes

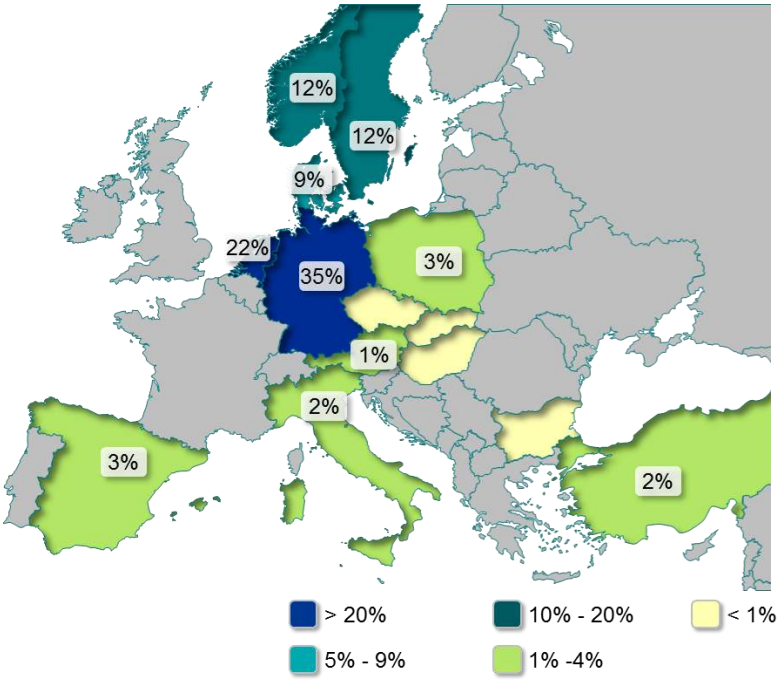


Figure 33 Country specific trade relations with Scandinavian

The analysis of the trade flows show that Germany is the largest Scandinavian trading partner regard to value and quantity.[18]

In addition, the statistics confirm the statement that Germany is a very export-oriented country. The statement is additionally confirmed by the "Ranking of trade partners in foreign trade with the Federal Republic of Germany in 2016" in Denmark, Finland, Norway and Sweden, which can be found within the first 30 positions (out of 239) in the area of imports, exports and turnover (imports + exports).(The Federal Statistical Office. (2017). Ranking of trade partners in foreign trade with the Federal Republic of Germany in 2016. Wiesbaden: Published 24.10.2017)

Intra-Scandinavian trade also accounts for a large proportion, which is inherently consistent with the previous evaluations and presentations.

The Netherlands is the second largest Scandinavian trading partner after the Max scenario. Looking at the trade balance in detail, the Netherlands has the highest level of trade with Sweden (47% of Scandinavian trade). The evaluations from Chapter 5 confirm this statement. Norway (30%) and Denmark (23%) follow.

Poland is less important in its relation to Germany, but due to its geographical location at the Baltic Sea it is important for the consideration of freight flows.

Spain has a higher level of trade in goods than Italy. For Italy, however, the assumption can be made that 14%-22% are controlled via the train connections to the German Baltic Sea ports (cf. Chapter 5.3).

[18] The statistics also show that the value of the goods in this case refers to € 42.3 billion - € 63.6 billion.

6.2 Trade Balances sheets by product groups

The concretisation of the product groups (PG) according to SITC consists of the following main categories:

Section 0	Food and live animals
Section 1	Beverages and tobacco
Section 2	Crude materials, inedible, except fuels
Section 3	Mine ral fuels, lubricants and related materials
Section 4	Animal and vegetable oils, fats and waxes
Section 5	Chemicals and related products, n.e.s.[19]
Section 6	Manufactured goods classified chiefly by material
Section 7	Machinery and transport equipment
Section 8	Miscellaneous manufactured articles
Section 9	Commodities and transactions not classified elsewhere in the SITC (cf. Standard International Trade Classification (SITC, Rev. 4)).

The selected countries (cf. Chapter 5) are also presented in min and max scenarios. After the transport matrices for each product group have been created, it is again clear that there are differences between the trade reports. These differences can be explained by the fact that the values are assessed by the countries. In addition, the level of detail is higher due to the breakdown into the PG, which means that the data can be classified more precisely. The breakdown by PG therefore provides a more accurate database.

Focus is placed on RoRo transports, which is why only those product groups are listed below that are also suitable for Combined Transport. This means that the analysis of the trade relationship is condensed to PG 0; PG 1, PG 6, PG 7, PG 8 and PG 9. Bulk goods (from PG 2, 3 & 4) and hazardous goods (from PG 5) are therefore excluded.

If the values of the balance sheets of mainland-Europe and the Scandinavian countries are combined, the following breakdown of the product groups results:

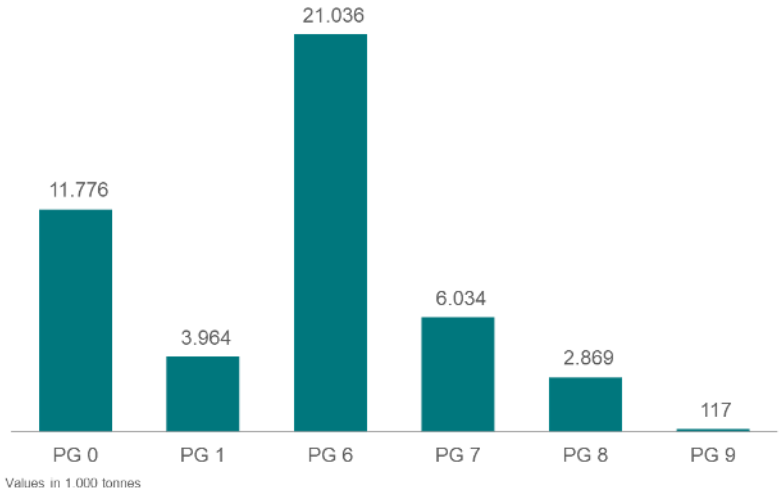


Figure 34 Distribution of product groups (maximum scenario)

[19] N.e.s. = not elsewhere specified

Definitions, notes and visualizations

PG 0

What?: Beverages and tobacco
goods circulation*: 26%

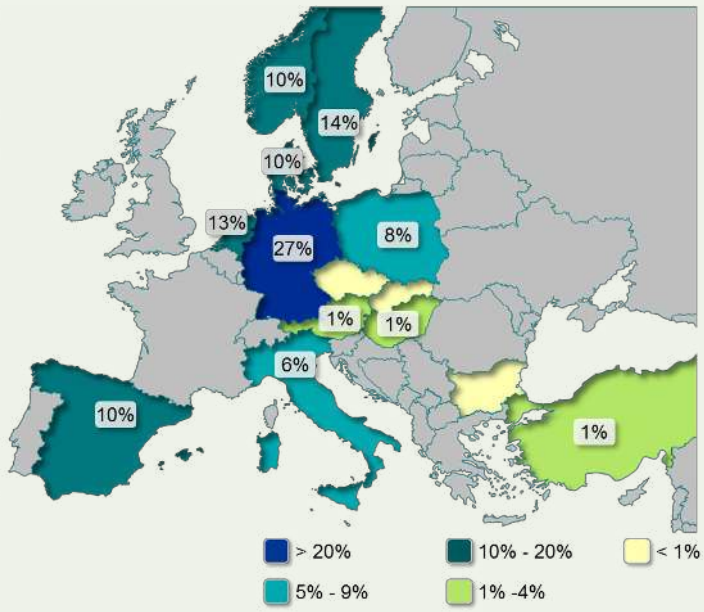
Notes:

- it is assumed that the Netherlands and Spain control much via the ARA ports as well as the industrial ports on the eastern Spanish coast.

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Germany	2.474	3.160
Sweden	877	1.686
The Netherlands	503	1.516
Norway	672	1.191
Denmark	818	1.168
Spain	477	1.144
Poland	562	926
Italy	299	661
Turkey	40	83
Austria	22	68
Hungary	14	63
Chez Republic	23	59
Slovakia	7	33
Bulgaria	10	18

Values in 1.000 tonnes



PG 1

What?: Food and live animals
goods circulation*: 9%

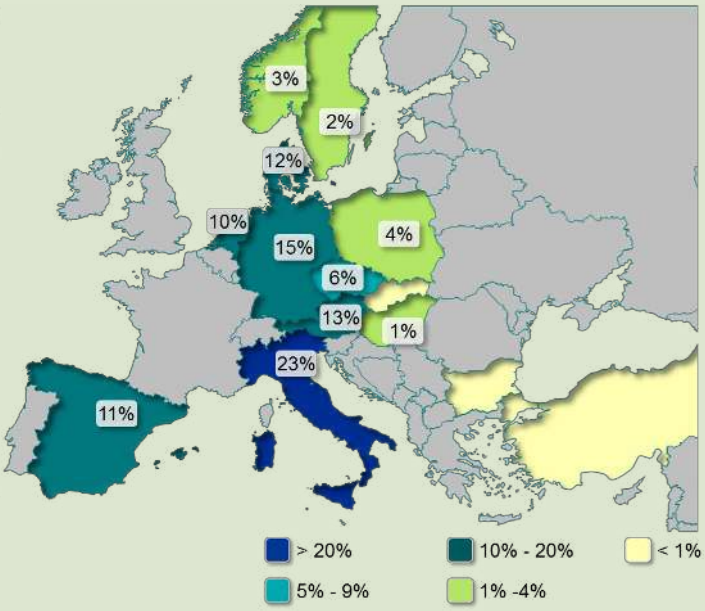
Notes:

- strict alcohol policy in Scandinavia for regulation of consumption

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Italy	43	928
Germany	170	593
Austria	1	524
Denmark	420	469
Spain	19	441
The Netherlands	16	391
Chez Republic	3	224
Poland	11	169
Norway	56	123
Sweden	18	67
Hungary	1	21
Bulgaria	< 1	7
Turkey	1	7
Slovakia	< 1	1

Values in 1.000 tonnes



Definitions, notes and visualizations

PG 6

What?: Manufactured goods classified chiefly by material
goods circulation*: 46%

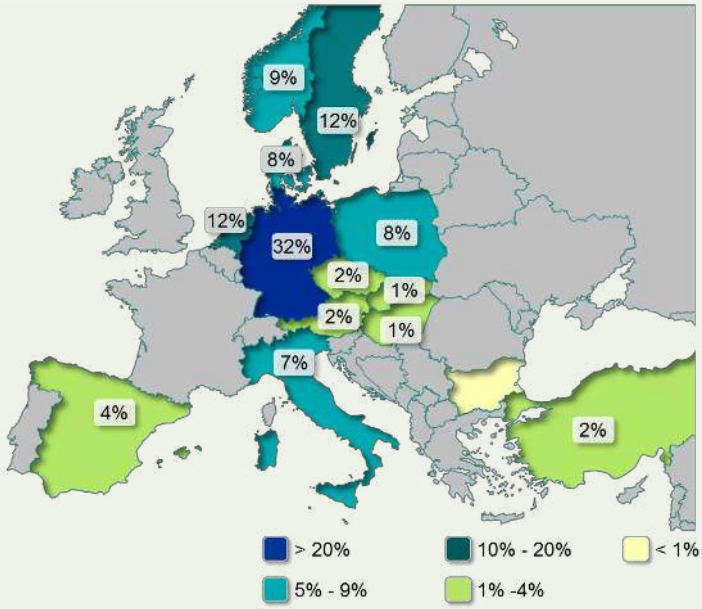
Notes:

- highest goods circulation in the analysis

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Germany	3.475	6.785
The Netherlands	846	2.625
Sweden	1.991	2.613
Norway	1.662	1.814
Denmark	1.028	1.694
Poland	1.137	1.667
Italy	410	1.408
Spain	257	843
Turkey	88	421
Chez Republic	169	415
Austria	220	403
Slovakia	67	169
Hungary	43	154
Bulgaria	10	25

Values in 1.000 tonnes



PG 7

What?: Machinery and transport equipment
goods circulation*: 13%

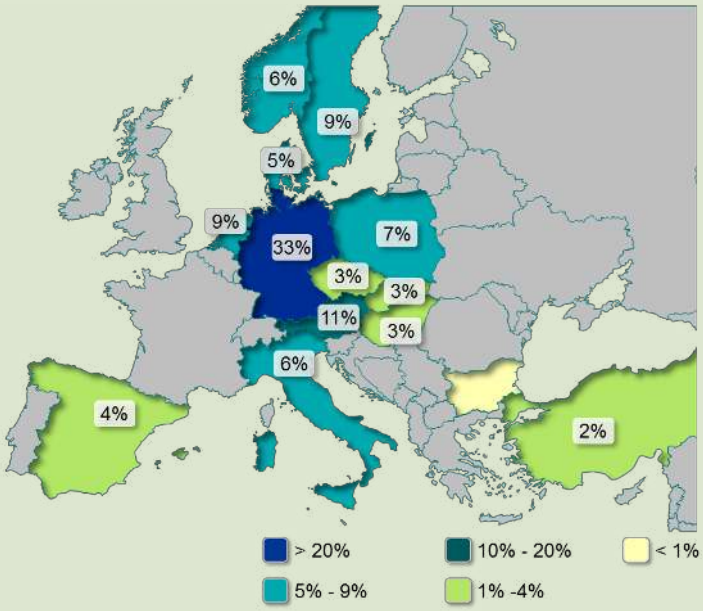
Notes:

- quite good German quality, means in general, the German mechanical engineering market is dominated by the Europe area

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Germany	503	1.965
Austria	33	677
The Netherlands	253	534
Sweden	243	526
Poland	155	439
Norway	134	367
Italy	96	336
Denmark	173	307
Spain	85	223
Hungary	29	185
Chez Republic	39	174
Slovakia	13	161
Turkey	45	127
Bulgaria	8	14

Values in 1.000 tonnes

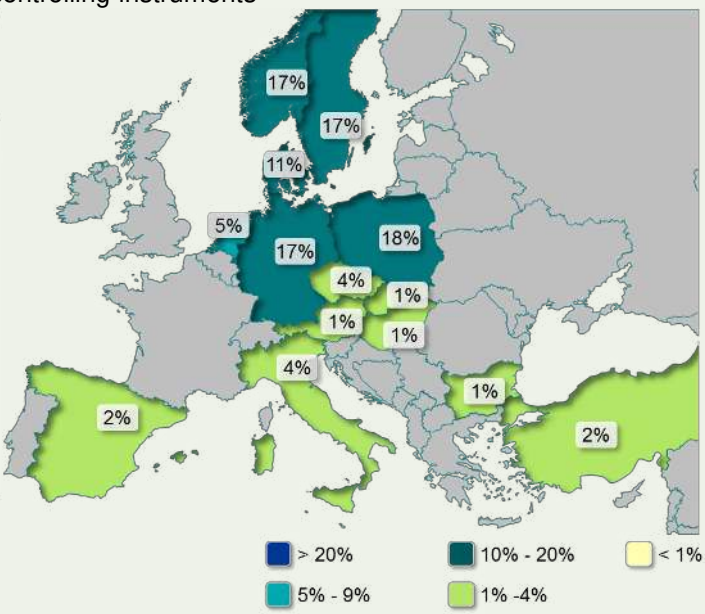


	Definitions, notes and visualizations
PG8	**What?:** Miscellaneous manufactured articles **goods circulation*:** 6% **Notes**: • For example Prefabricated buildings; sanitary plumbing, Travel goods, handbags, Footwear, Professional, scientific and controlling instruments

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Poland	76	515
Sweden	189	492
Germany	348	489
Norway	63	484
Denmark	158	320
The Netherlands	82	144
Italy	38	119
Chez Republic	13	106
Spain	22	47
Turkey	9	43
Slovakia	10	38
Austria	11	32
Hungary	8	25
Bulgaria	1	15

Values in 1.000 tonnes

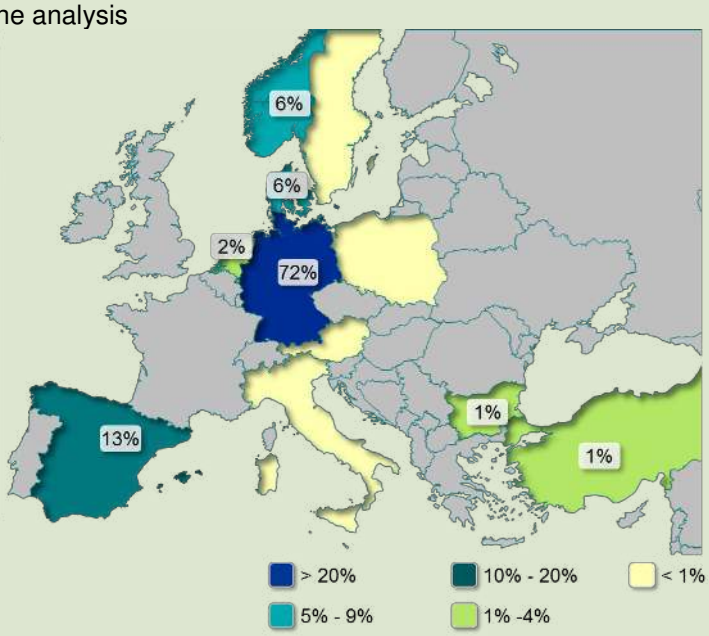


PG 9	**What?:** Commodities and transactions not classified elsewhere in the SITC **goods circulation*:** 0,3% **Notes**: • lowest goods circulation in the analysis

Trade relations with Scandinavian 2016
(descending Maximum scenario)

	Min	Max
Germany	< 1	84
Spain	n.i.	15
Norway	< 1	6
Denmark	< 1	6
The Netherlands	< 1	2
Bulgaria	n.i.	1
Turkey	< 1	1
Sweden	< 1	< 1
Italy	n.i.	< 1
Austria	n.i.	< 1
Poland	n.i.	< 1
Chez Republic	n.i.	n.i.
Hungary	n.i.	n.i.
Slovakia	n.i.	n.i.

Values in 1.000 tonnes



* goods circulation means here the ratio with all product groups from analysis

Figure 35 Results product groups

7 Analysis of German port capacities

This chapter considers the German Baltic Sea ports of Kiel, Lübeck and Rostock. As already mentioned in Chapter 5.3.1, these transhipment points are of central importance for multimodality in the Scandria® corridor. Expert interviews were conducted on this subject within the framework of the project.

First, the ports themselves were contacted in order to determine the current transhipment capacity at the ports. This was compared with the calculated maximum transhipment capacity in order to determine the key figure for the current transhipment performance. These values shall only be used as a reference value.

Port	Transhipment capacity 2018*	Calculated tras-shipment capacity*	Current utilization rate
Kiel (Schwedenkai)	23.500	50.000	**46%**
Lübeck (Skandinavienkai)	104.000	140.000	**74%**
Rostock	80.000	140.000	**57%**

* values in approx. units

Figure 36 Transhipment capacities Baltic Sea Ports

Measures to increase the capacity utilization rate at ports are manifold. Both the technical equipment with additional industrial trucks (e.g. Reach Steaker) and extensions to the Combined Transport systems at 720-750 metres are being considered or planned.

However, the port infrastructures are not the only components that influence the potential for shifting to rail. The expert interviews crystallized clear opinions on the attractiveness of combined transport. The participants of the interviews were leading experts who provided a comprehensive overall picture of barriers, challenges and political influences in the field of combined transport.

In order to create points of comparison within the expert interviews, each participant was given a discussion guide on thematic aspects in advance. Aspects about:

- Politics [influence, action, necessities],
- Infrastructure [Barriers, Cross-Border Requirements],
- Choice of means of transport [advantages, disadvantages, economic efficiency, mental barriers] and
- Logistics structures [processes, transport] were focused.

During the personal and telephone interviews, very individual conversations arose, which, however, have many conceptual overlaps.

All in all, the experts agree that no stable market for Combined Transport can develop without the influence of decision-makers. On the one hand, this is about transparency of the political measures themselves, and on the other hand it is about political incentives that have to be set. To create CO_2-efficient measures and a sustainable change in the transport system, a suitable strategy is necessary.

This interpretation is based on the experts' statements regarding the pursuit of continuous cost-minimized logistics. The pull-concept that prevails today controls demand-oriented production and aims at efficient and flexible processes within it. This creates challenges for cost-minimized transports. This is because small quantities have a significant influence on transport costs. This is correlated with the delivery time set for the customer. Fast product delivery is offered as a service level by the service offering and thus determines the customer's awareness of quality performance at the service provider.

This requires a fundamental paradigm shift both in logistics processes and at the customer. After receiving the report, it was written that multimodal human movement is a natural process. This understanding is transferable. This is because the advantages of the pull principle from the customer's point of view have a significant negative impact on the environment, as they are related to the choice of means of transport. The customer could be sensitised to green logistics (e.g. Green Label) through marketing strategies, thus reducing the pressure to deliver. Demand can be used to slow down processes in production and logistics. This in turn, increases the potential to redefine the internal bundling structures of shipments.

It is clear that of course this approach is not suitable for every company. However, there was a positive response from the experts on this topic. According to surveys (e.g. by P. Wittenbrink), the low bundling potential of freight transport by rail is increasingly being the reason why freight forwarders are deciding against it. Economic efficiency represents a high value in the overall system. Although freight forwarders favour the ecological aspect of rail transport, the majority are not prepared to pay more for it (Cf. Wittenbrink, P. (2015). Green Logistics – Konzept, aktuelle Entwicklungen und Handlungsfelder zur Emissionsreduktion im Transportbereich. p. 26.f [engl. Green Logistics – Concept, current developments and fields of action for emission reduction in the transport sector]). The central advantage of the mass efficiency of rail can´t be exploited due to a low bundling potential.

In addition to the logistics structures, the choice of means of transport correlates with the experience and assessments of freight forwarders. This is confirmed by the interviews. It can thus be assumed that subjectivity is correlated with the level of knowledge in the field of intermodal and Combined Transport. For example, freight forwarders are influenced by their feelings about flexibility, quality or reliability when deciding on the mode of transport. However, the fact that the road has a positive influence on these feelings is not only due to subjective perception, but much more to insufficient knowledge about the possibilities and costs of Combined Transport. This low level of know-how leads to the limited marketability of railways and ships. This is where mental barriers arise, which are promoted by strong competitive thinking and thus prevent intelligent integration into the transport system on the part of freight forwarders.

In general, the current means of knowledge transfer, such as brochures and workshops, as well as the restructuring of training programmes within the transport sector are addressed. The development of knowledge in order to understand Combined Transport holistically and to implement it with all its facets in later professional life requires extensive planning and system knowledge.

Initiatives such as Agora Verkehrswende – Smart Energy for Europe Platform (SEFEP) gGmbH, Allianz pro Schiene e.V. and the SGKV-Studiengesellschaft für den Kombinierten Verkehr e.V. have a positive effect on the mental promotion of the topic. Information events on Combined Transport are also offered at colleges and universities and should continue to be strongly promoted. According to some statements, the driver industry is facing a demographic conflict. The profession as a driver is no longer attractive enough to secure sufficient young talent. It can be assumed that personal interests (e.g. family, home) and financial incentives are not represented. There are no different with the job description of the locomotive driver.

In order to do justice to all interests and to implement the potential of Combined Transport via rail, the experts addressed the necessary involvement of decision-makers. As mentioned at the beginning of this chapter, the use of Combined Transport by decision-makers in the area of traffic turnaround must

be critically questioned. To this end, the reduction of road tolls is to be seen as a counterproductive political measure, while the Renewable-Energy-Act-tax is being increased. Particularly in the rail sector, no short-term solutions can be implemented. These require high planning and implementation work.

Several participants have cited Switzerland as an example of best practice. The Federal Environment Agency also published a comprehensive study in 2016 on financing options for a sustainable freight transport infrastructure and lists Switzerland's financing instruments (e.g. performance-based heavy goods vehicle levy or rail infrastructure fund) as best practices. Such levers could also be used in Germany as political incentives for Combined Transport.

The prioritisation of local rail passenger transport versus rail freight transport also underlies the infrastructural expansion of the railways. The increased need for train paths must be supported in order to avoid bottlenecks. Numerous statistics describe the growing volume of transport, which, however, can´t be handled by rail. The expansion of the rail network at identified bottlenecks could decouple rail freight transport from local rail passenger transport. However, decoupled rail freight transport could create further discussion potential (e.g. noise protection), which in turn would conflict with other political targets. As a result, numerous international projects, including the Fehmarn Belt crossing, are stagnating.

In summary, it is assumed that the integration of decision-makers for the expansion and advancement of Combined Transport is decisive. However, with regard to the decision bases, it should be noted that transport should not be made more attractive for all. This means that it can of course be assumed that, for example, a toll increase don´t necessarily make the road more attractive, but can have a significant impact on achieving the traffic turnaround.

8 Conclusions

This report has captured the current freight flows in the Scandria® Corridor. By sequentially observing the corridor, the modal split was quantified and visualized. The following is a concise summary of the conclusions of the analyses of all participating partners. The summary of the analysis results in precise conclusions should enable the reader of the report to obtain a result-oriented summary.

8.1 General Conclusions:

- Modal split in the northern Scandria® Corridor:
  - approx. 75-81% by road,
  - approx. <1-8% by rail and
  - approx. 17-18% by ferry
- The results of the evaluated trade balance sheets confirm the analysis results obtained from the freight carrier survey.
- Only 1-2% of all road-freight-vehicles using the port- and ferry-system use alternative fuels. Diesel is still the dominating fuel type.
- The range of the hinterland for a RoRo-port is largely determined by the steering and resting times.

8.2 Scandinavian part of the Scandria®-Core Corridor

- The RoRo-segment in Swedish ports has seen a larger growth than the Swedish foreign trade. This could be an indicator for a growing importance of inner-European trade.
- The modal share of rail-transport from and to Scandinavian ports is still rather low.

8.3 German part of the Scandria®-Core Corridor:

- Rail-transport still only makes up a very small share of transports between continental-Europe and Scandinavia. According of the Federal Statistical Office, rail transport in German-Danish border traffic is limited to a range of 0,08%-7,69%.
- The Berlin Brandenburg region constitutes an important node in the European transport-system. Due to its location between old and new European member states and its location in the crossing point of three trans-European corridors, the region has a certain development potential.
- On the other hand Berlin is growing fast, which puts a certain strain on the transport system. A strongly growing freight transport demand will increase this strain further.
- The Berlin-Brandenburg region is mainly a demander of goods and does export much less tonnage, then it imports.
- The main transport flow through Berlin-Brandenburg region is oriented in an east-west-direction.
- There are still available rail-transport-capacities on the rail-network of the German part of the Scandria®-Core-Corridor between Berlin and Rostock.
- An extension of the railway infrastructure to accommodate 740m long trains in the German part of the Scandria®-Core-Corridor would decrease rail-transport-costs in the corridor and could lead to an increase of the rail-modal-split.
- The largest share of trucks using the German Baltic-Sea-Ports to ferry across to Scandinavia originates from Germany, followed by Poland and the Netherlands. The large share of trucks from the Netherlands could be explained by the overseas-freight flows into the ARA ports. It is interesting to note, that the situation in Rostock looks different: The largest shares of trucks using the port of Rostock are from Germany, Italy and Poland. This indicates a certain

specialization of the Scandria®-Core-Corridor towards the south- and the east of Europe, while the Western Corridor via Jutland-land-Link and the ports of Schleswig Holstein cover more of the west of Europe.

8.4 Potential for modal shift

The research indicated that the multimodal terminals in the northern Scandria® corridor are endeavouring to enable modal shift. Both the technical equipment with additional industrial trucks (e.g. Reach Steaker) and the expansion of the combined transport systems to 720-750 metres are being considered or planned. However, the consensus of the expert interviews (cf. Chapter 7) largely indicates that the attractiveness of the railways is insufficient.

It is necessary to focus on the complete transport chain, its links and potentials. These include the logistics structure, the competitiveness of rail compared to road and the actual infrastructure. But also the mental barriers on the part of the operative business play a crucial role. The lack of transparency of the cost structures for Combined Transport is not advantageous for smaller companies, because the lack of knowledge about effective and efficient possibilities means a considerable additional expenditure of time and therefore costs.

From these points of view, the following recommendations can be derived which support a future modal shift:

- Creation of bundling potentials against the cost-minimal logistics philosophy;
- Deceleration of the pull principle by sensitization of the customer;
- focus on Best Practices to make rail transport more competitive (e.g. Switzerland, see Report UBA[20]);
- Support for infrastructure expansion, e.g. by passing and alternative tracks;
- Partial decoupling of rail freight transport from local passenger transport at bottlenecks;
- Creation of transparency in the cost structures for Combined Transport;
- Increasing knowledge about Combined Transport through public relations work and restructuring of training and educational programmes.

In order to continue to focus on rail transport for a CO_2-efficient solution, cooperation such as here in Scandria®2Act and other initiatives, e.g. Shift2Rail, exist. It is advisable to encourage further cooperation such as these, so as to increase the capacity of the European rail system and the quality of service while reducing life-cycle costs. This will help to improve the competitiveness of the rail industry and respond to tomorrow's changing transport needs.

[20] UBA – Umwelt Bundesamt; Report (2016). Finanzierung einer nachhaltigen Güterverkehrsinfrastruktur – Anforderungen und Rahmenbedingungen für eine zukunftsorientierte Entwicklung des Güterverkehrs – eine systematische Analyse auf der Grundlage eines Ländervergleichs (Teilvorhaben ohne Luftverkehr). *[engl.: Federal Environment Agency; (2016). Financing a sustainable freight transport infrastructure - Requirements and framework conditions for a future-oriented development of freight transport – A systematic analysis based on a comparison of countries (sub-projects excluding air transport)]*

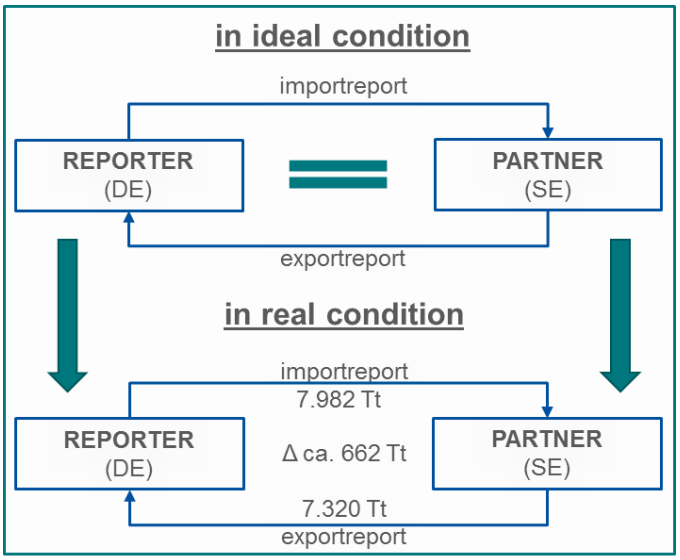
Annexes

A1. Explanation of the procedure with the trade balances

„EU trade by SITC“ – This official sources documents historical data from 1988 to 2017 quantifying trade between the reporting countries (reporters) and their partners in exports and imports volumes of goods.

In order to be able to modify the trade relations between the above-mentioned countries in matrix form, the countries are selected in the multidimensional table both as reporters and partners. Here the imports and exports are focused by country weight.

Ideally, the reporters' import reports should be identical to the partners' export reports and vice-versa. However, after a first look at the statistics, it quickly becomes clear that the values of the imports and exports of the countries differ from each other. See the following diagram:



Reasons for these differences are the different recording of imported and exported goods of the respective countries. Although the Harmonised System for the Description and Coding of Goods provides codes for the registration of products and classifications in order to record imports and exports and to determine import and export duties, it cannot always be carried out 100% (e.g. capacity bottlenecks at customs stations). Therefore, the trade balance values of each country are based on valuations of fixed values.

A2. Loading of the rail network of the railways by freight trains 2015

Statistisches Bundesamt,
Anhang zur Fachserie 8, Reihe 2.1

Verwaltungsgrenzen:
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A3. Road load map – Germany and Scandinavia (M. Jung: Average Daily Road Traffic. 09.2017)