GoA 3.3 Fostering multimodal shift

Fehmarnbelt / Øresund case study: “Feasibility study for direct railway freight services between Hamburg and Scandinavia”

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

Work Package	Work Package 3 Multimodal Transport				
Activity	3.3-2 Fehmarnbelt / Øresund case study				
Responsible Partner	PP 20 Logistics Initiative Hamburg				
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Output Description (Application Form)

The services developed in A 3.3 (Fostering modal shift) will be compiled in a Scandria®Corridor Multimodal Service Offers.

The Scandria®Corridor Multimodal Service Offer will be made accessible for all interested stakeholders. They will be presented in a professional manner (i. e. as brochure or webportal) to national and regional administrations in order to support them in decisionmaking considering modal shift incentives.

The results will also be presented to multimodal service providers, cargo owners or forwarders. Therefore, relevant opportunities will be used, either by direct contact of the partners, via the relevant logistics networks or where appropriate via external events, like logistics fairs. All stakeholders will have access to the relevant results.

The intention is to nondiscriminatorily identify business partners, that are interested in running the developed multimodal services.

It is intended that at least two services developed by the project will be operated by private service providers in consequence.

This feasibility study (GoA 3.3-2) is contributing to the main output of GoA 3.3.

Additional Quality Criteria
(for all outputs)

Questions to be answered:

- ***What is the aim of the output?***
  This feasibility study (GoA 3.3-2) is contributing to the main output of GoA 3.3. It aims to show the current situation on goods transport between Hamburg and Scandinavia on the ScanMed corridor over the different available transport modes, identify and show the role on railway cargo transport on this corridor and – as the key objective – elaborating findings and recommendations how to strengthen this mode of transport in the future in order to achieve modal shift effects from lorry/road transport towards more sustainable rail transport.

- ***What is the thematic/geographical scope of the output?***
  The thematic scope is covering the feasibility of modal shift from road to rail (or short-sea shipping) in cargo transport. The geographical scope covers the ScanMed corridor area from Hamburg towards Scandinavia, precisely covering Germany and Denmark towards Sweden and Norway.

- ***Who is the output addressing (target group)?***
  Stakeholders and businesses with relevance to the mentioned transport and logistics chains [e. g. (multimodal) transport service providers], regional and national administrations and decision makers within the respective geographical scope.

- ***How the output shall be used by the target group?***
  Change behaviour of (multimodal) transport service providers by providing information on feasible multimodal transport opportunities. Raise awareness among regional and national decision makes and administrations on potential barriers and constraints towards increasing the development and usage of multimodal transport solutions on the respective corridor.

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1 Executive Summary

This study has been elaborated and conducted within the framework of the EU INTERREG BSR project Scandria2Act by the project Partner Logistics Initiative Hamburg. The project lasted from May 2016 to April 2019 (36 months).

For further information about the project as well as further studies and outputs created by the project, please visit https://www.scandria-corridor.eu/index.php/en/projects/scandria2-act.

Scope and Objectives

The feasibility study aims to show the current situation on goods transport between Hamburg and Scandinavia on the Scan-Med corridor over the different available transport modes, identify and show the role on railway cargo transport on this corridor and – as the key objective – elaborating findings and recommendations how to strengthen this mode of transport in the future in order to achieve modal shift effects from lorry/road transport towards more sustainable rail transport.

Infrastructure and connectivity analysis

The study contains an analysis of the infrastructure and connectivity about above-mentioned geographical scope. It shows the status of the infrastructure and defines constructive bottlenecks and capacity issues. Furthermore, major infrastructure plans and projects are examined. The analysis revealed no major bottlenecks for short sea or feeder respectively ro-ro or ferry services on the corridor. Both the connectivity situation as well as the infrastructure are assessed to be suitable and generally meeting requirements of users. Another situation occurs for the rail infrastructure. The utilization limit of the Jutland route – currently the only available direct rail link connecting Germany and Scandinavia – is nearly reached. However, it is expected that after the Fehmarnbelt Fixed Link has been put into service, transit traffic will largely be relocated to this new direct link, thereby relieving the Jutland route significantly. Apart from this, further bottlenecks on the railway network infrastructure between Northern Germany and Sweden (via Denmark) are identified in the study. A bigger issue are the Bottlenecks in terms of interoperability existing with regard to train lengths. Trains from Germany to Sweden and vice versa cannot operate as direct links. Concerning the Road infrastructure, requirements are met for the relevant road network of the corridor. But it is worth mentioning that “there are significant congestion problems on the road network around most large cities during peak-periods.”[1] To cover the most important infrastructure project on the Scan-Med corridor with regard to the Baltic Sea region the study sets its focus on the Fehmarnbelt fixed link on the co-called “Vogelfluglinie”. The tunnel – opening set for the year 2028 – is built to supplement both rail- and road infrastructure. Furthermore selected infrastructure projects with regard to rail and road infrastructure upgrades on the relevant corridor between Germany and Scandinavia (via Denmark) are shown.

Freight and modal split analysis

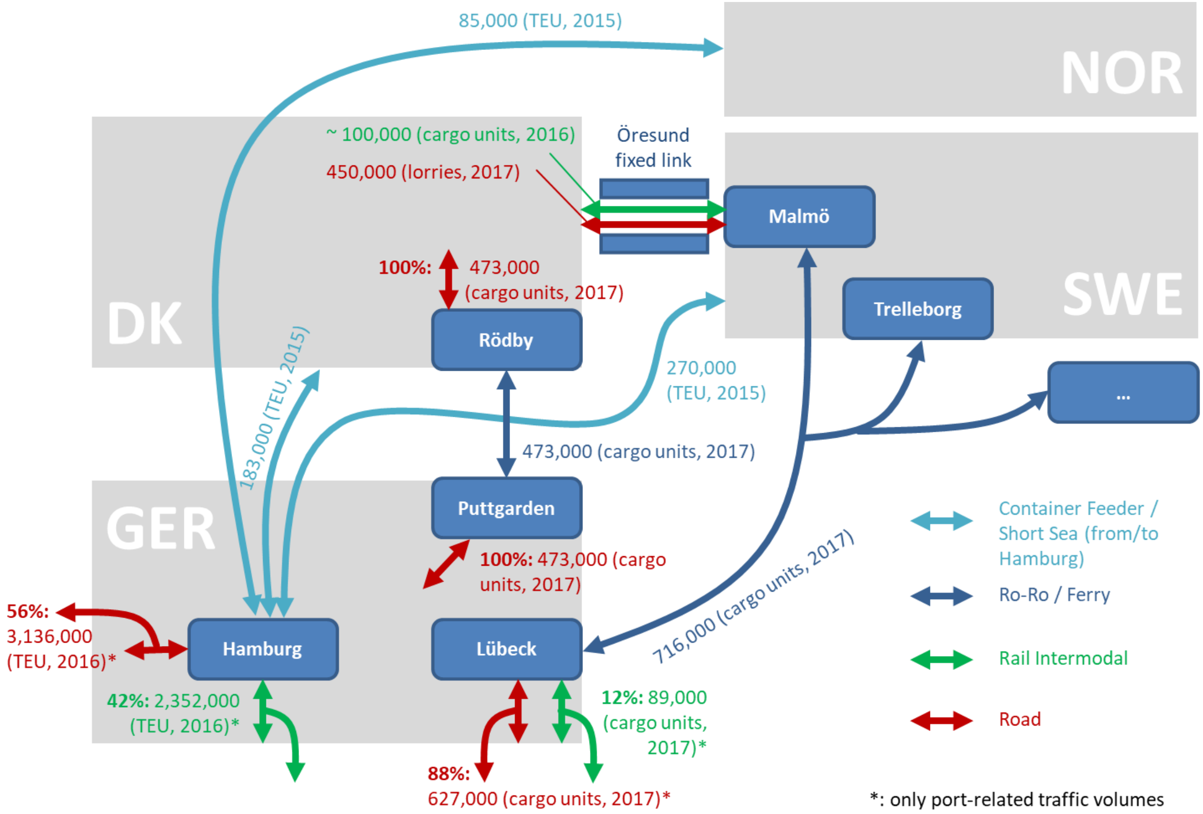
Furthermore, a freight and modal split analysis has been conducted. It sets its focus on types of cargo relevant for intermodal/multimodal cargo transport, such as container traffic as well as trailer traffic. The short sea traffic from/to Hamburg to/from Scandinavia represent a share of around 6 % of total container traffic in the Port of Hamburg. It appears from the examinations made, that intermodal transit rail freight transport through Denmark, covering all direct rail services between Hamburg/northern Germany and Sweden as well as Norway, massively lost shares with regard to modal split within recent years. When looking at road – ferry – road or rail – ferry – rail links between Hamburg and Scandinavia the study sets its focus on the ro-ro/ferry routes via Puttgarden-Rodby and via Lübeck. Whilst on the Puttgarden-Rodby link, no cargo rail services are operating, around 12 % of cargo units (containers, trailers or lorries) shipped via Lübeck came or went via rail services. To inspect the direct intermodal/multimodal Rail link via Denmark the study contains a detailed analysis of rail freight volumes at Øresund fixed link. To get further insights Danish national traffic statistics supplement the data. The study reveales decreasing tendencies for long distance transports of direct road transport via

[1] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

Denmark, though it should be mentioned that in recent years this trend has reversed or at least stagnated since 2014.

The following chart shows an overview on freight volumes and modal split within the Scandria corridor relevant for this study (between Hamburg/northern Germany and Scandinavia) through different modes of transport. It does not function as an in any case comparable and accurate source of data, but a general compilation of different sources of statistical information, giving (or trying to give) a summary. Further detailed findings can be found in the respective chapter.

Figure 1: Mapping of volumes and modal split along the Scandria corridor between Hamburg and Scandinavia: combined container feeder/short sea traffic, ro-ro/ferry volumes, road and intermodal rail volumes



Source: Logistics Initiative Hamburg

Concluding the findings of the freight and modal split analysis, it can be seen that even though significant volumes of freight traffic already uses feeder services, ro-ro or ferry services or intermodal rail services, there is a huge share of road traffic within the corridor, including long distance and cross-border road traffic – thus showing a huge potential for modal shift in the future.

Critical mass analysis

The critical mass analysis of the study aims to determine the plain minimal sufficient amount of freight cargo volume (critical mass volume) per year for an intermodal freight train that is running with a frequency of two departures per week and direction.

To assess the critical mass freight volumes for a feasible and sustainable intermodal connection within the effective area covered by this study, the research team looked into the capacities of intermodal block trains. To simplify matters, today's standard 600 metre trains were used for the assessment. When 740 metre trains are used, capacities would increase accordingly. A distinction had been made between container trains and trailer trains in the capacity calculation.

In general, it can be assumed that an absolute average utilisation rate of 80 % for an intermodal train can be regarded as an absolute minimum value in order to be able to operate it in an economically feasible way in the long term. Usually, however, the capacity utilisation required to ensure economic viability is higher. The critical mass analysis included in this study, is therefore based on a slightly higher capacity utilisation value of 90 %. It has been calculated that the critical mass volumes per year for an intermodal freight train that is running with a frequency of two departures per week and direction are just under 17,000 TEU for container block trains (8,500 per direction) and around 6,500 trailer units for trailer block trains (3,250 per direction). The derivation can be found in the respective chapter.

Transport cost analysis

The transport cost analysis contained in the study covers a general consideration of the cost structure of transportation modes. It was concluded that the reduction of train path prices should be seen as a very important tool to support the competitiveness of rail freight transport.

The general aim of the transport cost analysis included in this study, is to gain a mutual understanding about which transportation mode is the most cost effective option and at which point a critical mass can be reached between both transport modes – direct road transportation or intermodal transportation from Hamburg to Scandinavia. Due to a lack in available and reliable data, the research team collected data from different companies, which offer logistical transport services to Scandinavia. The following summarizes the results. Comparing the costs of the different transportation modes, it can be concluded that no price differences between the intermodal transportation mode and the transportation via road can be found through the study. The only company that made an offer for both of the transport modes to Scandinavia, named the exact same prices for road and intermodal transport, assuming that this is based on a mixed calculation/compensatory pricing between intermodal and road transport.

Even if the cost analysis contains only data from seven companies, the study gives a good overview about the current cost situation of the different available transport modes from Hamburg to Scandinavia. In order to gain more significant results, more companies would need to be included in a case study. Moreover, to get a whole overview about the cost structure, a full overview of the different cost types would be necessary. The study only reveals the total costs but does not split the costs into different components.

Altogether, this shows that there is a lack of transparency about the different transport costs as well as options. In order to make the costs more transparent and to make it easier for the customers to access intermodal transport services. To achieve this, intermodal companies need to have more customer-centred, standardised, digital and real-time processes.

Besides the lack of transparency, it becomes clear that even though it is the proclaimed goal to shift freight from road to rail/intermodal services, there is a clear bottleneck in the supply of suitable transport solutions for the shipping industry.

This can be easily explained by existing boundary conditions, which minimal freight volumes have to meet. Examples include the need for in both directions identified cargo flows (pairing of freight volumes) and a stable intermodal connection with no significant seasonal or short-term fluctuations in volumes. Due to the complexity and the high fixed costs for intermodal companies, it is only possible to offer intermodal block trains if a constant, reliable, plannable and high rather capacity utilisation can be expected.

This in turn contrasts with the approach of our cost analysis, in which ad-hoc requests were made for a stable, but comparatively high volume of goods. It seems logical that intermodal companies should not be able to offer these volumes ad-hoc in free freight train capacities on precisely the specific routes requested. If they could, this would mean that their trains would currently be operated uneconomically and heavily underutilised and would thus not be feasible intermodal service routes.

However, this also shows based on the exemplary case, the difficulty of setting up new and more intermodal or rail services due to a “hen-egg-dilemma”. New services cannot be placed without sufficient, non-volatile cargo volumes in two directions. Cargo volumes that are aimed to be transported on such intermodal/rail services by shippers then cannot be placed onto such serviced because of the lack of service offers.

Analysis of the potentials and constraints for new direct railway freight and multimodal services along the corridor (SWOT analysis)

The study uses a SWOT analysis in order to show strengths and weaknesses of the transport and rail freight system with relevance to modal shift as well as opportunities and risks relating the external view, in particular external influences, trends and developments that affect the rail/intermodal services transport system. The following SWOT scope has been covered by the analysis in terms of key questions.

Figure 2: SWOT analysis scope

Strengths	Weaknesses	Opportunities	Threads
What do intermodal / direct rail services do better than competing modes of transport?	What do intermodal / direct rail services need to improve upon?	What (market) trends could lead to benefits or improving circumstances for indermodal / direct rail services?	What are the advantages competing modes of transport have or will have over intermodal / direct rail services?

Source: Logistics Initiative Hamburg

Following, you can find an excerpt of the conducted SWOT analysis matrix. The entire SWOT analysis can be found in the respective chapter.

Strengths

- Efficient and competitive mode of transport for high volume and long transports
- transport safety
- noise and CO2 reduction

Weaknesses

- Complexity of rail as transport mode
- Transport times
- Missing flexibility and punctuality, interoperability and lack of easy access to intermodal and rail services (information access, transparency, digital services etc.)
- critical mass volumes needed
- high fixed costs
- shortage of suitable rail services in terms of availability for shippers
- Limited rail infrastructure
- Missing redundancies in the transport infrastructure create risks of accessibility

Opportunities

- Huge share of road traffic within the corridor – thus huge potential for modal shift
- Fehmarnbelt fixed link: more transport infrastructure capacities and a better connectivity on main corridor
- Direct rail services will be able to use a direct route that is by 160 kilometres shorter than today and will thus be more competitive.
- Increasing shortage of drivers in the truck sector
- 740-metres trains with potential to increase rail freight capacities by 10-20 percent
- Recent policy decisions resulting in the reduction of rail freight costs

Threads

- The opening of the fixed Fehmarnbelt link will massively change cargo flows also affecting existing intermodal services, e. g. through a modal shift from ferry to road/rail.
- Increasing shortage of locomotive drivers in the railway sector: competitive advantage created by a shortage of truck drivers (see opportunities) is thereby being eliminated.

Development of transnational multimodal transport solutions along the corridor – findings and recommendations

After a detailed evaluation of all the examinations initiated within the study, findings and recommendations were phrased. It is suggested, that all parties involved aim for a continuous development of collaboration on harmonized cross-border corridor approaches on strategic as well as planning level to ensure seamless and efficient transport corridors and services. Furthermore, the creation of a transport policy framework to reduce negative impact on existing ro-ro and ferry services on the corridor through the opening of the Fehmarnbelt fixed link, e. g. through pricing instruments like the toll system applied for the fixed link, would bring enormous benefits to the cause. The transport policy should increase incentives for modal shift. As a positive example, the reduction of track path prices in rail freight traffic decided in Germany in 2019 can be cited here. Such measures have a direct positive effect on the competitiveness of rail as a mode of transport and therefore strengthen it directly. In addition, it should be continued to implement and promote the expansion and maintenance of the railway infrastructure with high priority and with focus on identified existing and/or future bottlenecks shown in this study.

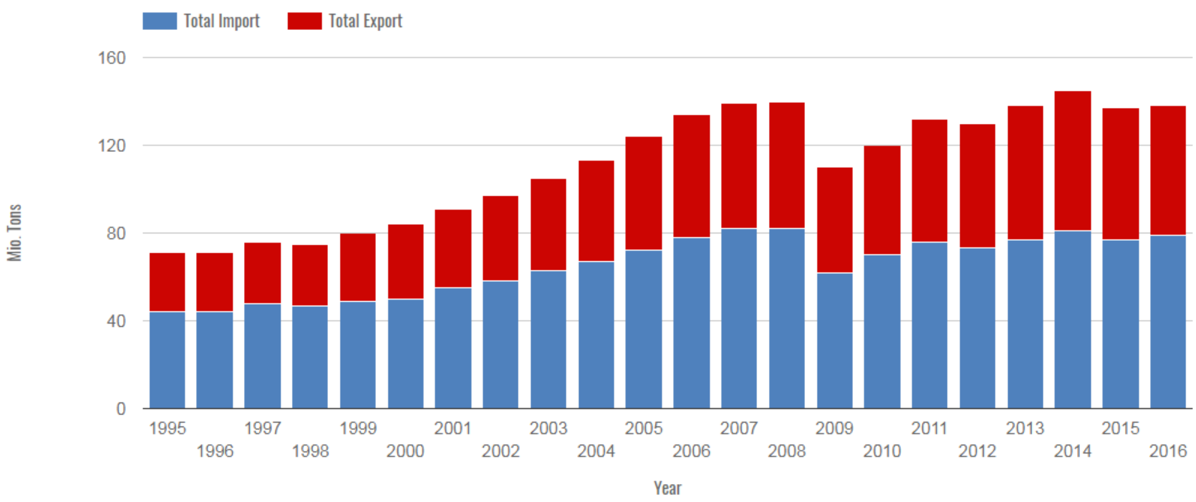
To achieve modal shift, shippers must also create or increase their awareness towards rail as a mode of transport. It is necessary to achieve better networking and information of the shippers, e. g. in order to minimise obstacles to rail transport due to a lack of counter-quantities of cargo. Moreover, it is recommended to fully digitize the rail companies and transport chain, improve capacity, volume and cost visibility, and simplify and digitize booking processes. Online distribution channels that display and dynamise free train capacities, routes and prices should be established. Also the development and use of intelligent wagons with intelligent functions, geofencing, track & trace, etc. is suggested.

The Logistics Initiative Hamburg is targeting these recommendations by the creation of a project cooperation between the Scandria2Act project and a national intermodal project within Germany called "ERFA-KV". Furthermore, the LIHH is continuing its working group rail, organises conferences and regularly informs its network about important developments and interesting facts about rail and intermodal transport. Lastly, the initiative is actively promoting digitisation and digital transformation.

2 Scope and Objectives

The metropolitan region of Hamburg is an important gateway and a major international hub – not only for deep-sea cargo flows but also and especially for incoming and outgoing freight flows to and from Scandinavia. A total of 138.2 million tons of goods were handled in 2016. In container traffic more than 8.9 Mio TEU were moved to and from the port of Hamburg in the same year. Hamburg is under the TOP 20 container ports in global comparison and under the TOP 3 in comparison to European ports (behind Rotterdam and Antwerp).

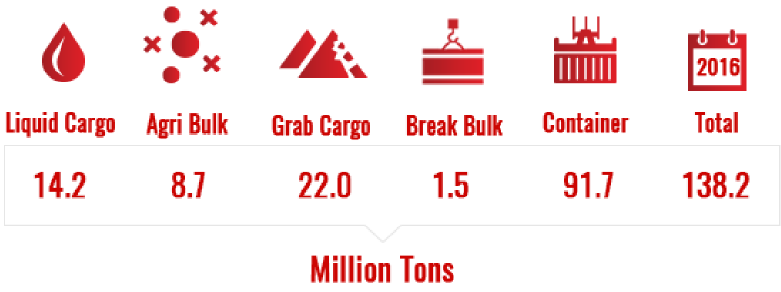
Figure 3: Seaborne Cargo handling in the Port of Hamburg, 1995 – 2016



Source: Hafen Hamburg Marketing e. V.

Even though Hamburg is a multi-purpose port, containerized cargo has by far the highest share (around two thirds) and thus the highest significance concerning cargo volumes, as shown in the following picture.

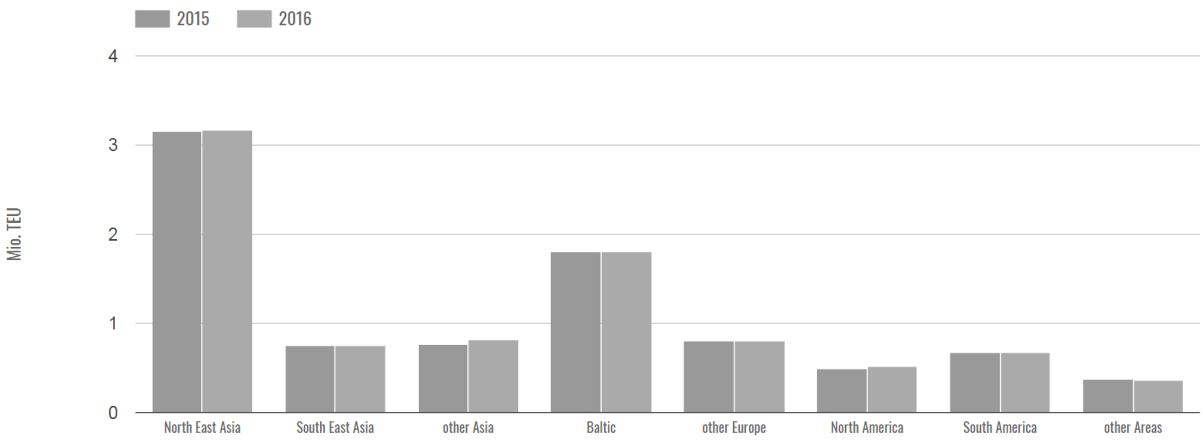
Figure 4: Seaborne Cargo handling in the Port of Hamburg, 1995 – 2016



Source: Hafen Hamburg Marketing e. V.

With 1.8 million TEU in 2015 as well as in 2016, the Baltic Sea Region is the second most important trade region for seagoing container traffic in the Port of Hamburg after North East Asia. This also shows Hamburg’s crucial role as a trade hub for the Scandinavian countries – in this case though, its feeder services. The following chart shows Port of Hamburg’s total container traffic of 2015 and 2016 by trade region.

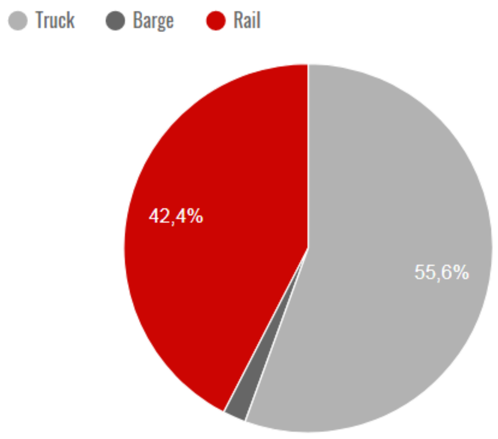
Figure 5: Container Handling by Trade Areas in the Port of Hamburg, 2015 and 2016



Source: Hafen Hamburg Marketing e. V.

Railway transportation plays a crucial role in Hamburg’s hinterland logistics connectivity. Hamburg is the leading rail port in Europe and has a total share of over 40 percent in container hinterland traffic.

Figure 6: Modal Split in Container Traffic in the Port of Hamburg, 2016



Source: Hafen Hamburg Marketing e. V.

In the recent year, rail further increased its share of containers transported from 41.6 percent to 42.3 percent within the Port of Hamburg’s modal split. Linking Hamburg with all hinterland economic centres, more than 200 freight trains reach or leave Europe’s largest rail port every day.

Based on this, this feasibility study aims to show the current situation on goods transport between Hamburg and Scandinavia on the Scan-Med corridor over the different available transport modes, identify and show the role on railway cargo transport on this corridor and – as the key objective - elaborating findings and recommendations how to strengthen this mode of transport in the future in order to achieve modal shift effects from lorry/road transport towards more sustainable rail transport.

In order to achieve this, an **infrastructure and connectivity analysis** is carried out in a first step, showing both the current status of infrastructure between Hamburg and Scandinavia (covering Germany and Denmark on the corridor towards Sweden) as well as major infrastructure plans and projects, especially the fixed Fehmarnbelt link, which, according to the Danish Ministry of Transportation, it is currently planned to be opened in late 2028.[2]

[2] See: https://www.trm.dk/en/topics/the-fixed-link-across-the-fehmarn-belt/the-fixed-link-across-the-fehmarn-belt

This is being followed by a **freight and modal split analysis**, a comparison of transport modes within a **critical mass and transport cost analysis**, an **analysis of potentials and constraints** for new direct railway freight and multimodal services along the Scan-Med corridor as well as a **SWOT analysis.**

Finally, **findings and recommendations** for the development of transnational multimodal transport solutions along the corridor are given based on the above-mentioned analysis.

3 Infrastructure and connectivity analysis

Based on the project output of project activity 3.2-1 (Existing multimodal freight offers in the Scandria®2Act partner regions)[3], there are different alternatives existing on how to transport freight from Hamburg to Scandinavia or vice versa.

They are:

- Direct road transport via Denmark
- Direct intermodal/multimodal Road – Rail link via Denmark
- Intermodal Road/Rail – Ferry – Road/Rail link via the Baltic Sea (ro-ro/ferry services)
- Intermodal/Multimodal Sea – Rail – Road Link via the Baltic Sea (Shortsea Shipping/ feeder services).

They all require appropriate port, rail, road and/or RRT (railroad terminal) infrastructure in order to be used. The status of this infrastructures as well as major infrastructure development plans and projects affecting any of those alternatives mentioned above will be part of this chapter.

[3] See: Uhlin, Lovisa: GoA 3.2 Assessing offers and preconditions for multimodal freight transport in the Scandria®2Act partner regions; Activity 3.2-1 Existing multimodal freight offers in the Scandria®2Act partner regions; Region Örebro county; 03.04.2017

3.1 Infrastructure requirements according to EU/EC

The EU has set specific technical infrastructure parameters for the TEN-T corridors that are required to be met and thus also apply for the Scan-Med Corridor infrastructure covered in this analysis. "Article 4 of the Regulation (EU) No 1315/2013 describes the objectives of the trans-European transport network, which shall strengthen the social, economic and territorial cohesion of the European Union. The aim is to create a single European transport area, which is efficient and sustainable, to increase the benefits for its users and to support inclusive growth. The Member States agreed to the following list of specific objectives, which have to be met by the Scan-Med Corridor by 2030 at the latest." [4]

They are shown in the following table.

[4] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

Figure 7: Objectives – technical infrastructure parameters of Scan-Med Corridor

Mode	Objective
Rail	Full electrification
	Axle load 22.5 t (for all Freight lines on the Core Network only)
	Line speed 100 km/h, minimum (for all Freight lines on the Core Network only)
	740 m freight trains (for all Freight lines on the Core Network only)
	ERMTS fully implemented
	Standard gauge 1435 mm for new lines
Road	Express road or motorway
	Intelligent transport systems (ITS) / toll collection systems comply with Directive 2004/52/EC, Commission Decision No 2009/750/EC and Directive 2010/40/EU [SE]
	Parking areas every 100 km, minimum
	Infrastructure for alternative clean fuels
Airports	Terminal open to all operators
	Infrastructure for air traffic management, SESAR
	Infrastructure for alternative clean fuels
	Main airports (according to Article 41 N° 3 of the Regulation (EU) 1315/2013) connected to (high-speed) rail network
Maritime transport, Ports, MoS	Freight terminal open to all operators
	Connection to rail, road, IWW (where possible)
	Infrastructure for alternative clean fuels
	Facilities for ship generated waste
	VTMIS, SafeSeaNet, e-Maritime services
Rail Road Terminals (RRT)	Sufficient transhipment equipment on freight terminals
	740m train terminal accessibility
	Electrified train terminal accessibility
Multimodal transport	All transport modes connected at freight terminals, passenger stations, airports, maritime ports
	Real time information on freight terminals, maritime ports, cargo airports
	Continuous passenger traffic through equipment and telematic applications in railway stations, coach stations, airports, maritime ports
Environmental targets	Specific target values more detailed than those mentioned in the Regulation (EU) 1315/2013 could be identified for specific sections of the corridor by the Member States concerned in accordance with European legislation.

Source: Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

The status of the infrastructures relevant for this analysis (namely: rail, road, maritime transport ports and selected RRT) in general, in regard to the above mentioned objectives/requirements as well as possible current/expected bottlenecks are being illustrated on the following pages.

3.2 Current infrastructure description and status

Current port infrastructure for feeder services

(Intermodal/Multimodal Sea – Rail – Road Link via the Baltic Sea)

Large vessels operating in inter-continental ('deep sea') traffic will typically only reach ports capable of generating sufficient cargo volumes, while low-volume or off-route ports tend to be engaged in so called feeder traffic services. For this purpose, smaller container ships with capacities adapted to the respective travel area between 300 and 1,800 TEU are typically used.

Important European shipping areas, which are mainly served by feeder vessels, are the North Sea and the Baltic Sea. Hamburg is the most important Northern European transhipment hub for these transports. In addition to distribution traffic, intra-European cargo is also frequently loaded via the Port of Hamburg for these regions – called short sea shipping. Every week there are numerous feeder and short sea connections from Hamburg to Scandinavia and other regions and countries within the North and Baltic Seas. Hamburg thus plays an outstanding role in foreign trade in Germany and neighbouring European countries.

Because of its location at the exit of the Kiel Canal, Hamburg is also referred to as the “westernmost Baltic Sea port”. The Kiel Canal is a key location advantage for the port of Hamburg and the German seaports on the North Sea in competition with the ports further to the west. From Hamburg, for example, the route advantage to Gdańsk in Poland is 437 nautical miles off the 874 nautical miles long route around the northern tip of Denmark (Skagen).

Hamburg’s position as a central hub for maritime cargo flows and its high importance for feeder and short sea services to/from Scandinavia can easily be seen on the following map, indicating all ports with feeder services to and from Hamburg in the Scandinavia region.

Figure 8: Feeder and short sea services from/to Hamburg

Note: Direct feeder/short sea liner services from/to Hamburg are marked in bright red.
Source: Hafen Hamburg Marketing e. V.: Liner Services 17/18

There are five direct services to/from Danish ports (Aalborg, Aarhus, Copenhagen, Fredericia and Kalundborg), 28 to Norwegian ports (of which seven in the Oslo region with relevance to Scandria2Act) and 10 to Swedish ports (Ahus, Gavle, Gothenburg, Halmstad, Helsingborg, Malmo, Norrkoping, Pitea, Sodertalje and Stockholm). Altogether this shows a very good connectivity situation with regard to feeder and short sea services from Hamburg to Scandinavia and vice versa along the Scan-Med corridor.

Regarding to meeting the requirements set by the TEN-T guidelines through EU regulations, the following can be stated for the existing port infrastructure:

Figure 9: TEN-T requirements for infrastructure parameters: Seaports

Objective/ technical parameter	Baseline value (2014)	Status (2016)	Target (2030)
Connection to rail	100 %	100 %	100 %
Connection to inland waterway CEMT class IV	50 %	50 %	100 %
Availability of clean fuels	12 %	20 %	100 %
Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges	100 %	100 %	100 %
Facilities for ship generated waste	100 %	100 %	100 %

Note: Assessment based on whole Scan-Med corridor area
Source: Based on Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

Also this assessment covers the whole Scan-Med corridor and does not distinguish between short sea/feeder port infrastructure and ferry/ro-ro port infrastructure as carried out in this study, it can be stated that most of the quality criteria relevant in regard to modal shift (as is the scope of the Scandria2Act project and this feasibility study) is already achieved by now. Only clean fuel availability and inland waterway connections (both not relevant to this study) are in need of improvement until 2030 according to the "Second Work Plan of the European Coordinator Scan-Med".

Port capacity issues in the relevant ports are also usually related to ship-size related issues in deep-sea cargo traffic due to the increased share of ultra large container vessels (ULCV) et cetera. An example for this is the planned – and due to legal dispute – still pending lower and outer Elbe channel adjustments (river dredging and broadening). For feeder and short-sea traffic, this is not a relevant issue, though.

Altogether it can be stated that port infrastructure for short-sea and feeder traffic is satisfying and suitable for efficient and reliable sea transport.

Current port infrastructure for ro-ro/ferry services
(Intermodal Road/Rail – Ferry – Road/Rail link via the Baltic Sea)

With regard to ro-ro and ferry services linking Hamburg with Scandinavia on the Scan-Med corridor, there are two relevant German ro-ro/ferry ports with connections towards Scandinavia. They are port of Lübeck and port of Puttgarden.

Further ports with relevant services from Northern Germany to Scandinavia are Port of Rostock (not covered within the area of investigation for this study[5]) and Port of Kiel, which is not part of the Scan-Med core network corridor and thus will not be included in this study either.

Port of Lübeck offers direct ro-ro/ferry connections to Swedish ports Malmö (19 departures per week) and Trelleborg (23 departures per week), operated by Finnlines (for Malmö connection) and TT-Lines (for Trelleborg connection). Also, there is a weekly direct ro-ro connection to Husum in northern Sweden operated by SOL Continent Line c/o Manfred Schröder Schiffsmakler.

The most important terminal for ro-ro and ferry connections in Lübeck is the Skandinavienkai in Travemünde. The above mentioned Malmö and Trelleborg links start and end there. Skandinavienkai is the largest terminal of the Port of Lübeck and one of the largest ro-ro and ferry ports in Europe. It provides excellent hinterland connectivity with efficient intermodal transport and links it to a network of reliable and high-frequency scheduled services to partner ports not only in Sweden, but also in Finland and Latvia.

[5] The Scandria2Act project is elaborationg a seperate case study for Rostock within the GoA 3.3 Fostering multimodal shift.

Figure 10: Terminal Skandinavienkai in Lübeck

Source: Lübecker Hafen-Gesellschaft mbH

The intermodal terminal (rail ship and rail road terminal) "Baltic Rail Gate is located directly on the terminal. It is equipped with six rail tracks and two gantry cranes and allows for freight trains up to 600 meters length to be handled.

Figure 11: Intermodal Terminal Baltic Rail Gate at Skandinavienkai

Source: Lübecker Hafen-Gesellschaft mbH

From Baltic Rail Gate at Skandinavienkai intermodal rail services towards Hamburg, West Germany (Duisburg, Herne and Köln), South Germany (Ludwigshafen, Karlsruhe) as well as towards Italy (Verona and Novara) are being offered, all of which are also going via/through Hamburg. Intermodal service providers going to and from Port of Lübeck are: Kombiverkehr, European Cargo Logistics (ECL), HUPAC and TX Logistik.[6]

Also, on the Scandinavian side (Sweden), intermodal services from Malmö and Trelleborg towards Göteborg and Oslo (and from Oslo further distributed towards Bergen, Stavanger, Trondheim and even Narvik) as well as towards Stockholm-Årsta, are being offered as shown in the following map. Thus, a complete intermodal rail – ferry – rail link via Baltic sea is currently already being offered via Lübeck.

[6] See: http://www.lhg.com/index.php?id=233

Figure 12: Intermodal rail – ferry – rail connectivity via Lübeck

Source: European Cargo Logistics GmbH, image section of original map only

Road – ferry – road links via Lübeck or road – ferry –rail and rail – ferry – road links are of course also possible and offered via Lübeck.

The second relevant port on the corridor regarding a ferry connection towards Scandinavia is – as mentioned above – **Puttgarden, linking to Rødbyhavn** in Denmark via a Scandlines ferry service. The ferry link is operating with a high frequency of more than 50 departures per day and with a travel time of 45 minutes one-way.

There are significant freight traffic volumes using this ferry connection (also see chapter 4), all currently running via lorries/road traffic. There are existing freight railway tracks exiting in Puttgarden, which are not being used anymore. Major changes on this transport relation will be evolving through the planned Fehmarnbelt fixed link (see below, chapter 3.4).

Regarding to meeting the requirements set by the TEN-T guidelines through EU regulations, the information on port infrastructure already described above applies for ro-ro and ferry ports on the corridor as well.

Concerning Rail Road Terminal (RRT) infrastructure necessary in order to allow rail based transport to and from the ro-ro/ferry services, the following assessment of parameters applies:

Figure 13: TEN-T requirements for infrastructure parameters: Rail road terminals (RRT)

Objective/ technical parameter	Baseline value (2014)	Status (2016)	Target (2030)
Capability for intermodal (unitised) transhipment	71-100 %	71-100 %	100 %
740 m train terminal accessibility	Data only partly available from publicly available sources	18 %	100 %
Electrified train terminal accessibility	Data only partly available from publicly available sources	32 %	100 %
Availability of at least one freight terminal open to all operators	75-100 %	75-100 %	100 %

Note: Assessment based on whole Scan-Med corridor area
Source: Based on Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

This shows, that especially two infrastructure parameters are in need of improvement according to TEN-T guidelines concerning rail and according to their current status: 740 m train terminal accessibility and electrified train terminal accessibility. This is also true for Baltic Rail Gate terminal in Port of Lübeck, which allows 600 m trains to be loaded and unloaded. Electrification is provided up to the junction of the RRT.

Requirements concerning the relevant railway network in general will be covered below under point "Current railway infrastructure for direct intermodal/multimodal Road – Rail link via Denmark".

Altogether, it can be said that port infrastructure for ro-ro and ferry services from Germany to Scandinavia and vice versa is satisfying and suitable for efficient and reliable intermodal transport via Baltic Sea. When it comes to RRT terminal infrastructure, there are currently only 600 m trains possible to be handled in Lübeck. No intermodal rail – ferry links for freight transport are currently possible or operating in Puttgarden.

Current railway infrastructure for direct intermodal/multimodal Road – Rail link via Denmark

As shown in the project output of project activity 3.2-1 (Existing multimodal freight offers in the Scandria®2Act partner regions)[7], there are direct rail links currently existing and operating between Germany and Scandinavia. Accoring to this output these are:

- Malmö (Sweden) to Köln Eifeltor (Germany), operated by Kombiverkehr and HUPAC
- Malmö (Sweden) to Bad Bentheim (Germany), operated by Kombiverkehr
- Malmö (Sweden) to Herne (Germany) operated by TX Logistik
- Duisburg (Germany) to Göteborg, Katrineholm, Malmö and Helsingborg (Sweden) operated by Samskip Van Dieren Multimodal
- Duisburg (Germany) to Copenhagen (Denmark), Älmhult and Nässjö (Sweden) operated by Samskip Van Dieren Multimodal
- Taulov (Denmark) to Hamburg (Germany), operated by Kombiverkehr.

In addition to this, there are regular intermodal shuttle train services going from Germany (Wanne-Eickel – via Hamburg Maschen and Lübeck) to Sweden (Malmö and Rosersberg) operated by DB Cargo respectively Kombiverkehr. The route from Lübeck to Sweden via Denmark is a so-called "company train link" for Spedition Bode located near Lübeck and runs three times weekly since 2015.[8] Both connections (from Wanne-Eickel via Hamburg as well as from Lübeck) are shown in the following map.

[7] See: Uhlin, Lovisa: GoA 3.2 Assessing offers and preconditions for multimodal freight transport in the Scandria®2Act partner regions; Activity 3.2-1 Existing multimodal freight offers in the Scandria®2Act partner regions; Region Örebro county; 03.04.2017

[8] See https://www.kombiverkehr.de/de/service/kunden/Aktuell/:neues_objekt_2 as well as http://www.dbcargo.com/file/rail-deutschland-de/13058052/VWOP1cPwX0J-wYKy6k7ZgtdKEvY/14025730/data/Broschuere_intermodal.pdf?hl=alter%20schwede

Figure 14: Rail shuttle services operated by DB Cargo/Kombiverkehr between Germany and Sweden via Denmark

Source: http://netzwerk.dbcargo.com/, image section of original map only

The only available route for direct train services from Germany to Scandinavia currently is the rail line from Hamburg via Flensburg and Padborg, Kolding, the Great Belt fixed link, Ringsted and Copenhagen via Øresund fixed link to Malmö (as shown in the DB Cargo map above). All of the above mentioned existing direct rail services use this infrastructure route. This route is double tracked and electrified.

This also applies to the rail infrastructure to and from the above mentioned rail –ferry link via Lübeck. The rail network from Hamburg to Lübeck (Skandinavienkai) is both double tracked and electrified.

This is not true for the rail connection from Lübeck (Bad Schwartau) to Puttgarden, which is currently single tracked and not electrified. The railway network on Danish side from Rødby to Ringsted is also non-electrified.

Regarding to meeting the requirements set by the TEN-T guidelines through EU regulations, the following can be stated for the railway network infrastructure (apply both for direct rail services from Germany to Scandinavia via Denmark as well as rail services connecting to ro-ro/ferry links via the Baltic Sea):

Figure 15: TEN-T requirements for infrastructure parameters: Rail network

Objective/ technical parameter	Baseline value (2014)	Status (2016)	Target (2030)
Electrification	96 %	96 %	100 %
Track gauge 1435 mm	94.5-100 %	94.5-100 %	100 %
ERTMS implementation	6 %	6 %	100 %
Line speed (≥100 km/h)	93 %	93 %	100 %
Axle load (≥22.5 t)	94 %	94 %	100 %
Train length (≥740 m)	66 %	66 %	100 %

Note: Assessment based on whole Scan-Med corridor area
Source: Based on Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

A visualization (map) of the compliance analysis of the Scan-Med railway infrastructure based on Pat Cox: Second Work Plan of the European Coordinator Scan-Med is demonstrated in Annex A.1.

Regarding to electrification, it can be seen above, that requirements are met on almost the entire corridor. The missing few percent are due to the above mentioned non-electrified parts of the rail network between Lübeck and Puttgarden and Rødby and Ringsted. Both will be part of major updates within the framework of the Fehmarnbelt fixed link project (also see chapter 3.4) in the future. In addition, interoperability constraints partly also result from different electrification standards (15 kV 16 2/3 Hz in Sweden and Germany, whereas 25 kV 50 Hz in Denmark on the existing lines used for freight transport)[9].

Concerning track gauge, there are some improvement requirements within the railway network of Finland, but nothing affecting the investigation area of this study. Also not topic of this study is the ERMTS implementation, which needs a lot of improvement until 2030 according to TEN-T requirements.

Axle load parameters are being met in the relevant area of Germany, Denmark and Sweden and thus can be assessed as satisfying. Needed improvements are only relevant to some parts of the Italian railway network on the Scan-Med corridor.

Train length being below standard parameters is an issue with regard to the relevant area covered by this feasibility study in particular in parts of Sweden, where the standard train length is 630 m. For Germany, according to DB Netz a train length up to 740 m is principally possible, due to restrictions in timetabling and operational situations the actually possible train length can be (negatively) influenced, though.[10]

As special situation is given on the railway network from Hamburg (Maschen) to Padborg (German/Danish border region), where, trains with a total length of up to 835 m can be operated since 2012, when in compliance with certain conditions regarding safety and operations.[11] Since 2016, this network has been extended to the Port of Hamburg railway network, too.[12] It is the first railway connection on which trains with a length over 740 m are allowed to operate.

In Denmark, operation of 835 m trains has already been possible since the 1960’s. Most of the trains could not operate on this length though due to them being transit traffic to Germany or Sweden where the given infrastructure requirements do or did not allow such train lengths.[13]

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[9] See Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

[10] See Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

[11] For this, DB Netz AG carried out route upgrading measures amounting to about 10 million euros on the track Padborg – Hamburg-Maschen.

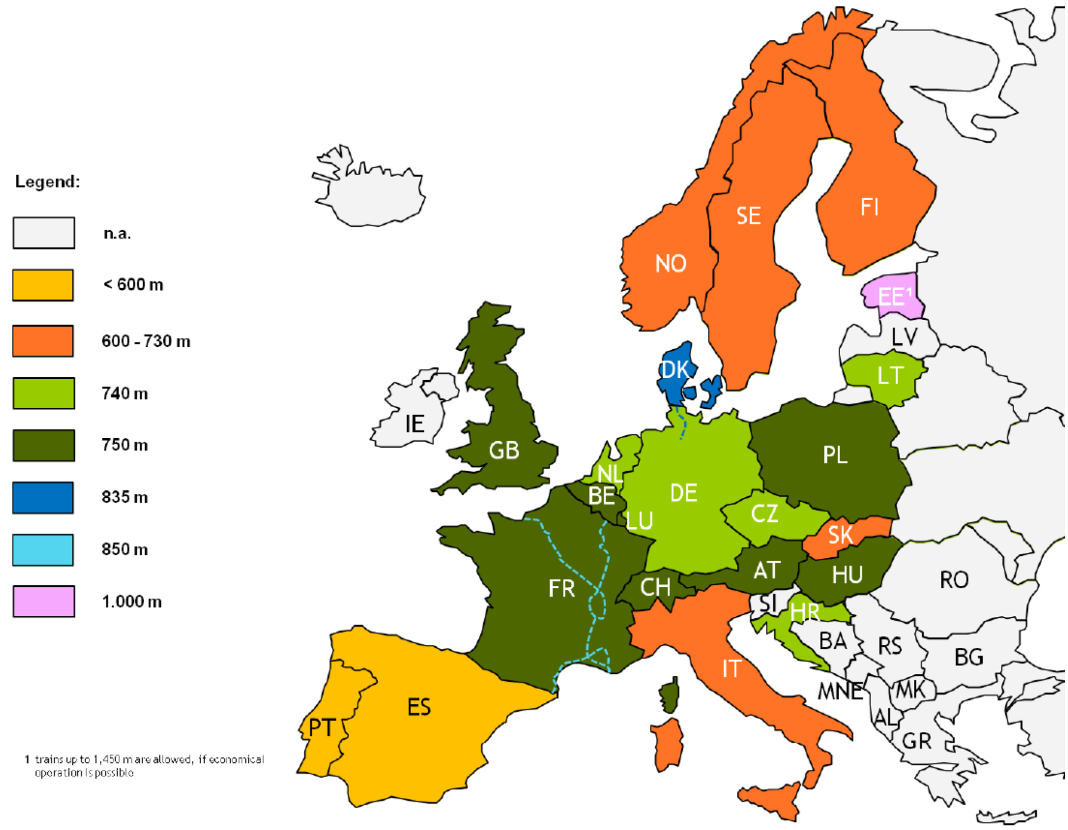
[12] See http://fahrweg.dbnetze.com/fahrweg-de/kunden/betrieb/laengere_gueterzuege.html as well as https://www.forschungsinformationssystem.de/servlet/is/436335/

[13] See CER aisbl: Longer trains Facts & Experiences in Europe, Results of the CER working group on longer and heavier trains; May 2016

A modification between Port of Hamburg and Denmark has thus positively affected rail freight traffic between both countries. During December 2012 and February 2014, 500 freight trains up to 835 meters in length operated on the relation between Padborg and Hamburg-Maschen marshalling yard. According to information from DB Schenker Rail GmbH, train occupancy increased by 22 percent and transport volumes by 25 percent on this relation. According to the company, between December 2012 and February 2014 a total of 200 freight train journeys were thus saved compared to "regular" train length usage.[14]

The following map gives a brief overview over existing standard maximum train lengths per country.

Figure 16: Overview of standard (max.) trains length per country



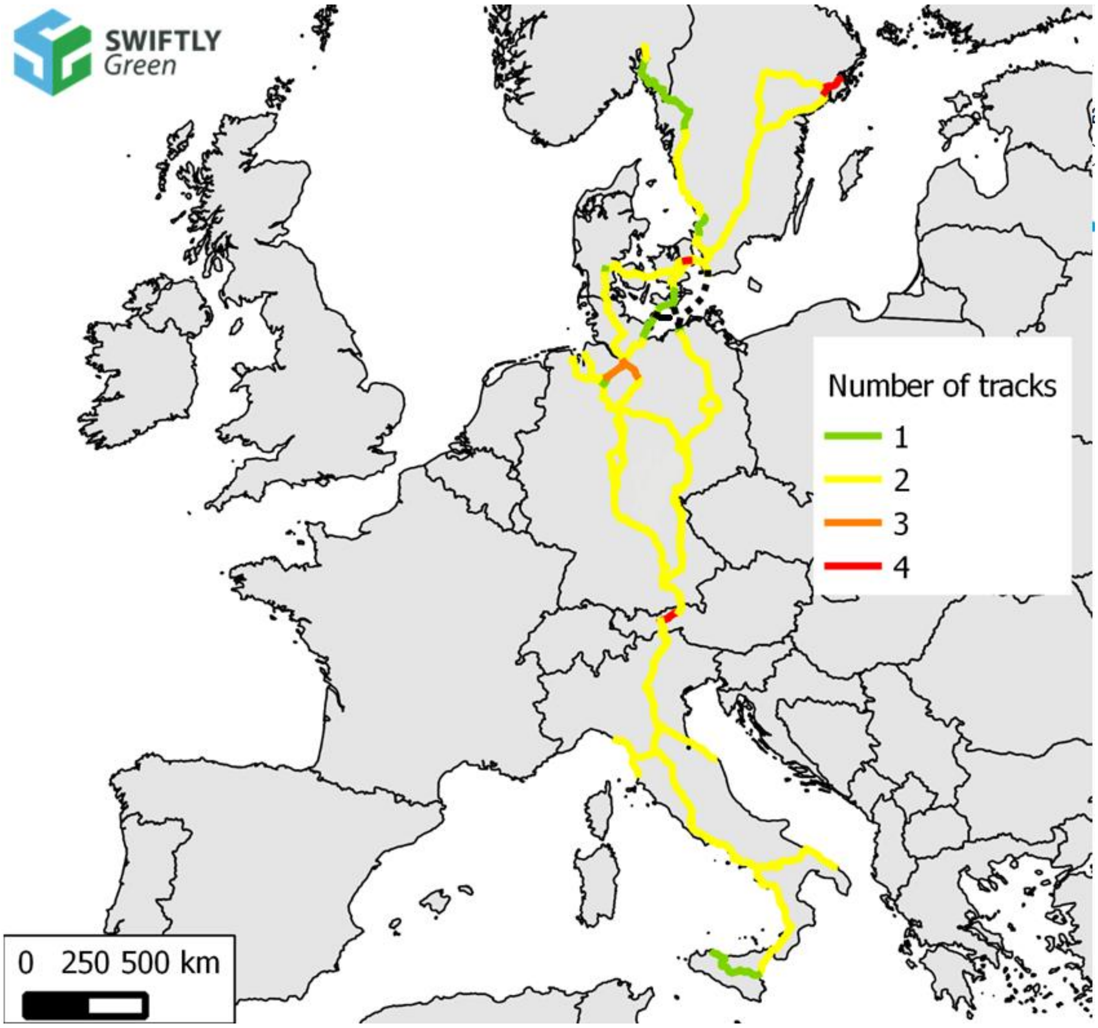
Source: CER aisbl: Longer trains Facts & Experiences in Europe, Results of the CER working group on longer and heavier trains; May 2016

[14] See https://www.forschungsinformationssystem.de/servlet/is/436335/

There are also tendencies of even longer train lengths (1,000 m) on specific routes in the future. See chapter 3.4 for further details.

In addition, the following map gives an overview over the number of tracks available along the Scan-Med corridor, visualizing the single-track part between Lübeck and Puttgarden, as well as in parts of Sweden. The map has been elaborated within the SwiftlyGreen project.[15]

Figure 17: Overview of the railway infrastructure along the analysed corridor: number of tracks



Source: Breitenbach, S., Hafen Hamburg Marketing: Swiftly Green project, Milestone 7 Report: "First Intermediate Results Finalized from Mapping of Current Status and Projects", Final Report, 2015

[15] See www.swiftlygreen.eu

Altogether, one recognizes that both infrastructure and direct rail services are currently already existing and being used on the relation between Germany/Hamburg and Scandinavia. The variety of rail service providers and operators on this relation shows a generally good connectivity. For this, the route via Denmark, Great Belt and Øresund is currently the only accessible route for direct rail links.

Nevertheless, there are existing restraints and constraints regarding modal shift onto this mode of transport. Firstly, the direct rail link via Denmark, Great Belt and Øresund is more than 160 km longer than the most direct connection from Hamburg towards Sweden via Puttgarden and Rødby, which covers only road based lorry freight transport, though. Hence, the longer distance decreases or eliminates economical and logistical advantages of direct freight train services via the above mentioned route. This will change with the opening of the Fehmanrbelt fixed link though, which is currently planned to be opened in 2028. See chapter 3.4 for further details on this matter.

Furthermore, increased train lengths could further improve economic feasibility and benefits of direct rail services already today and apart from the Fehmarnbelt fixed link. This is especially relevant for Sweden, as 835 m long trains are already able to operate between Northern Germany (Hamburg-Maschen and Port of Hamburg) and Denmark today.

Current road infrastructure

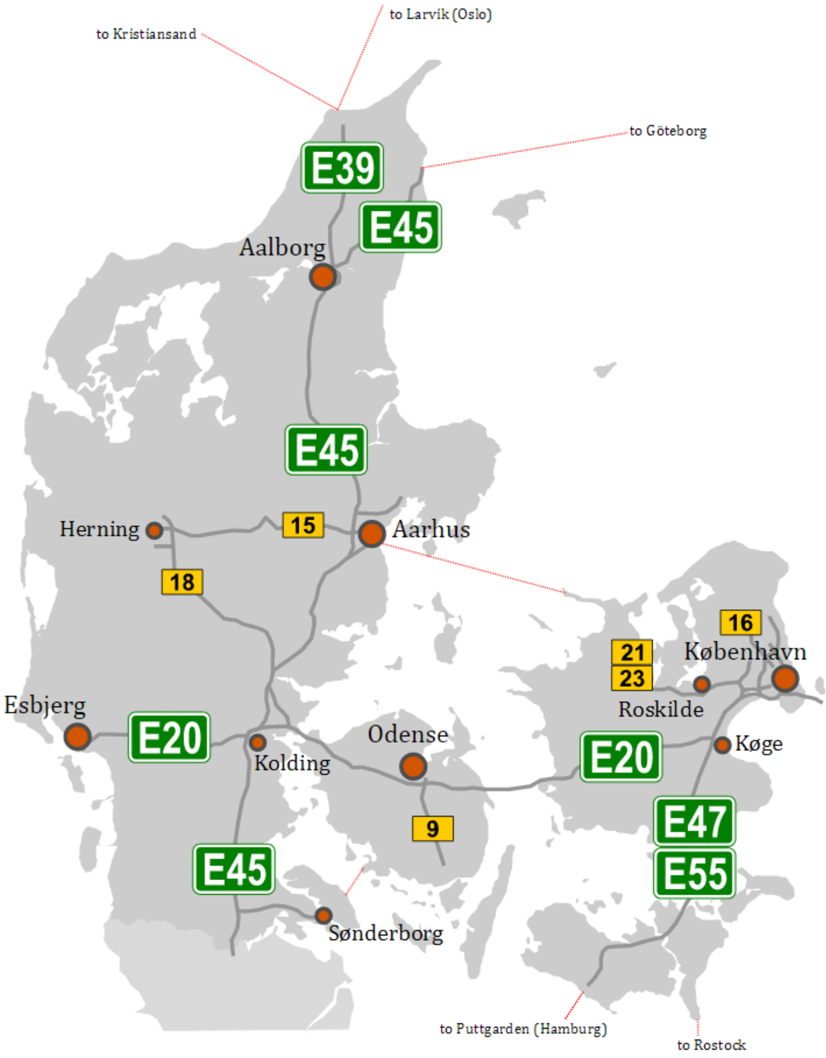
(Direct road transport via Denmark & road ferry road link via Puttgarden & Rødby)

The road infrastructure as well as road infrastructure projects won't be a focus of this feasibility study, as its key objective is to identify feasible ways and recommendations of enhancing modal shift away from road transport towards direct rail links, intermodal rail and ro-ro/ferry transports as well as short sea/feeder transport. Nevertheless, the infrastructure situation as well as planned major road infrastructure updates and extensions will affect the competitive position of all other modes of transport. This is why road infrastructure will briefly be a subject within this chapter as well as the following chapters 3.3 and 3.4.

Just as for direct rail links from Hamburg to Scandinavia, there is currently also just one route option for direct road links for trucks. This route is following motorway E45/A7 in north south direction from Hamburg to Denmark and then continuing in west-east direction from Kolding, via Odense, Great Belt Fixed link on E20 to Copenhagen and crossing Oresund via Oresund Fixed link to Malmö (Sweden).

Alternative options are combined road ferry links, e. g. via Puttgarden – Rødby ferry service (see above) or via E45 to Frederikshavn (Denmark) using the Frederikshavn – Göteborg ferry service to Sweden.

Figure 18: Motorway network of Denmark connecting Germany and Sweden



Source: CC BY-SA 3.0, “Map of the Danish motorways, with labels, cities and ferries” by Michiel1972

Regarding to meeting the requirements set by the TEN-T guidelines through EU regulations, the following can be stated for the road network infrastructure (apply both for direct road link from Germany to Scandinavia via Denmark as well as road links connecting to ro-ro/ferry links via the Baltic Sea):

Figure 19: TEN-T requirements for infrastructure parameters: Road network

Objective/ technical parameter	Baseline value (2014)	Status (2016)	Target (2030)
Express road/ motorway	99 %	99.1 %	100 %
Availability of clean fuels	No. of fueling stations: n. a.	No. of fueling stations: CNG: 2.271* LNG: 7* H2: 3* ECP: 9.318*	A target number of fueling stations at roads cannot be given

Note: Assessment based on whole Scan-Med corridor area
*Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), Hydrogene (H2) fueling stations and electric charging points (ECP) in the Scan-Med Corridor countries. Data for 2016
Source: Based on Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

As can be seen in the above table, the relevant requirement for the TEN-T network on the Scan-Med corridor is express roads or motorways status for all roads on the corridor. “Currently, the minimum road standard of Express Road or Motorway as referred to in Article 17(3) points (a) and (b) of Regulation (EU) No 1315/2013 is covered by all routes with the exception of some sections in Finland, Italy and Malta amounting to about 1 % of the total distance of the corridor”[16] and is thus not relevant for the area of investigation covered by this study.

“There is no formal requirement for a minimum number of lanes. Nevertheless, the number of lanes provides, together with the road standard, a quality measure for the corridor. The number of sections without at least two lanes in each direction in Finland, Sweden and Malta amounts to about 2 % of the total length of the corridor.”[17] Hence, it can be predicated that regarding

[16] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

[17] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

TEN-T requirements set for 2020, road infrastructure formally offers sufficient and efficient quality.

The second requirement (availability of clean fuels) – as shown in the table above – is not relevant to the topic of this study and will therefore not be further investigated or analyzed.

When it comes to road infrastructure on the relation via Puttgarden and Rødby (ferry link), there is no complete motorway or expressway coverage currently existing for the entire route. Whilst Hamburg to Lübeck (motorway E22/A1) is offering a three lane motorway, Lübeck to Heiligenhafen (motorway E47/A1) has two lanes for each direction. From Heiligenhafen to Puttgarden (E47/B207), only 1 lane is available, though. On the Danish side, E47 road offers two lane roads on the whole route from Rødby to Koge, where E47 meets E20 to Copenhagen and Malmö via Øresund. The existing road infrastructure on this route will – same as the rail infrastructure – be subject to major updates through the construction of the Fehmanrbelt fixed link project (see chapter 3.4).

3.3 Bottlenecks and capacity issues

"The comparison of the expected traffic volumes and network loads in the year 2030 facilitates the identification of possible capacity constraints (bottlenecks). The overview for capacity constraints and capacity utilisation provides a valuable indication that, even after the construction of new infrastructure (in particular Fehmarnbelt Fixed Link […see chapter 3.4]), some bottlenecks will remain along the Scan-Med Corridor. These may impede future growth of passenger and freight transport and most notably are"[18] the ones mentioned below with relevance to the area of investigation of this study.

Port infrastructure:

Concerning port infrastructure, as already mentioned above, no major bottlenecks are identified for short sea or feeder respectively ro-ro or ferry services on the corridor. Existing infrastructure is assessed to be suitable and generally meeting requirements of users. Critical bottlenecks rather occur for deep-sea traffic being subject to an increasing share of ultra large vessels (e. g. ULCV) with no relevance to this study's scope.

Rail infrastructure:

The Fredericia-Padborg-Flensburg-Hamburg rail link as part of the Scan-Med corridor is a significant section of the rail network on Jutland corridor as it is the only direct rail link connecting Germany and Scandinavia at the moment. With the commissioning of the Great Belt fixed link in 1997, almost the entire rail freight traffic diverted onto the Jutland railway route so that the utilization limit in terms of traffic capacities of this route is almost reached. However, it is expected that after the Fehmarnbelt Fixed Link has been put into service, transit traffic will largely be relocated to this new direct link, thereby relieving the Jutland route significantly.

[18] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

As assessed in the Second workplan of the European Coordinator Scan-Med, the following current (and future) bottlenecks on the railway network infrastructure between Northern Germany and Sweden (via Denmark) were identified:

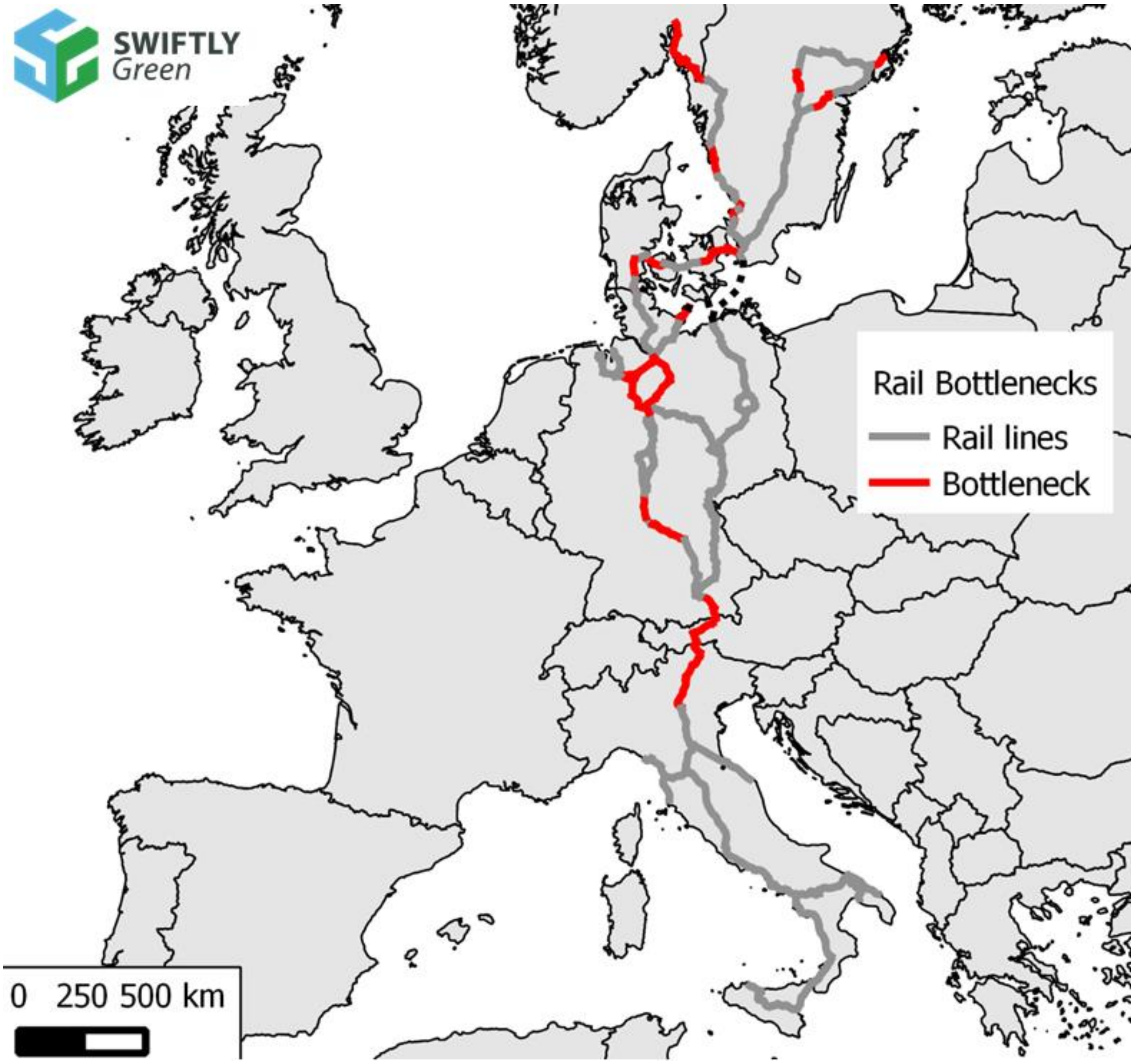
- Sweden: Stockholm and Gothenburg node, Hässleholm – Lund, Trelleborg – Malmö (-Copenhagen)
- Denmark: (Malmö-) Copenhagen region
- Northern Germany: nodes Hamburg and Bremen as well as a section Hamburg – Ahrensburg – (Lübeck).

In addition, it can be stated that several rail construction works in Denmark are currently affecting capacity and reliability on specific routes on the corridor.

The Swiftly Green project[19] has also been assessing infrastructure bottlenecks and came up with similar conclusions as shown on the following map.

[19] See www.swiftlygreen.eu

Figure 20: Overview of bottlenecks on the current rail infrastructure along the analysed corridor



Source: Breitenbach, S., Hafen Hamburg Marketing: Swiftly Green project, Milestone 7 Report: "First Intermediate Results Finalized from Mapping of Current Status and Projects", Final Report, 2015

Bottlenecks in terms of interoperability are existing with regard to train lengths, as 740 m and 835 m trains cannot operate as direct train links from Germany to Sweden and vice versa via Denmark due to existing length constraints in Sweden and in Germany (other than route Hamburg – Padborg, with regard to 835 m trains). See chapter 3.2 for further details on this issue.

This applies for RRT – as already described above. The following table gives a brief overview over maximum train lengths possible in selected RRT in the Scan-Med corridor in Northern Germany, Denmark and Sweden.

Figure 21: RRT infrastructure: tracks and maximum train lengths (selected RRT locations)

Country	Location/City	RRT	No. of rail tracks	Max. train length (per track)
GER	Hamburg	Burchardkai Container Terminal	8	700 m
GER	Hamburg	Altenwerder Container Terminal	9	700 m
GER	Hamburg	DUSS Hamburg-Billwerder	12	720 m
GER	Lübeck	Baltic Rail Gate / Skandinavienkai	6	600 m
GER	Lübeck	Cargo-Terminal Lehmann	4	340 m
DK	Padborg	TX Logistik	2	490 m
DK	Fredericia	Taulov / DB Cargo Denmark	3	700 m
DK	Taastrup	DB Cargo Scandinavia	4	400 m
SWE	Malmö	Malmö kombiterminal	6	750 m
SWE	Helsingborg	Helsingborg kombiterminal	4	650 m
SWE	Nässjö	Nässjö kombiterminal	4	750 m
SWE	Örebro	Örebro Terminal	2	270 m
SWE	Stockholm	Stockholm Årsta kombiterminal	9	700 m

Source: Based on intermodal-terminals.eu database

Road infrastructure:

Even though formal TEN-T infrastructure requirements are met for the relevant road network of the corridor (see chapter 3.2), “there are significant congestion problems on the road network around most large cities during peak-periods. These generally are taken into account in the national and regional plans for each country.”[20] This applies for Hamburg and Copenhagen. “Inter-urban roads generally have less congestion problems. Road infrastructure improvement measures relate not only to physical capacity but also to the smooth flow of traffic, increasing traffic safety or avoiding demographically or environmentally sensitive areas. In some cases, such as the Fehmarnbelt Fixed Link [(also see chapter 3.4)], there will be significant timesaving compared with some ferry alternatives or the longer route through Jutland. Other important measures, not directly related to road infrastructure, such as regulations, technological improvements or improved vehicle capacity unitization are also important.
To address these measures cooperation is necessary between all interested parties, public and private. […] This complexity should be a spur to action to develop appropriate policy tools to deliver desired policy outcomes.”[21]

As assessed in the Second workplan of the European Coordinator Scan-Med, the following current (and future) bottlenecks on the road network infrastructure in Northern Germany, Denmark and Sweden were identified:

- Northern Germany: regions of Hamburg and Hannover
- No major bottlenecks were identified for road network in Denmark and Sweden

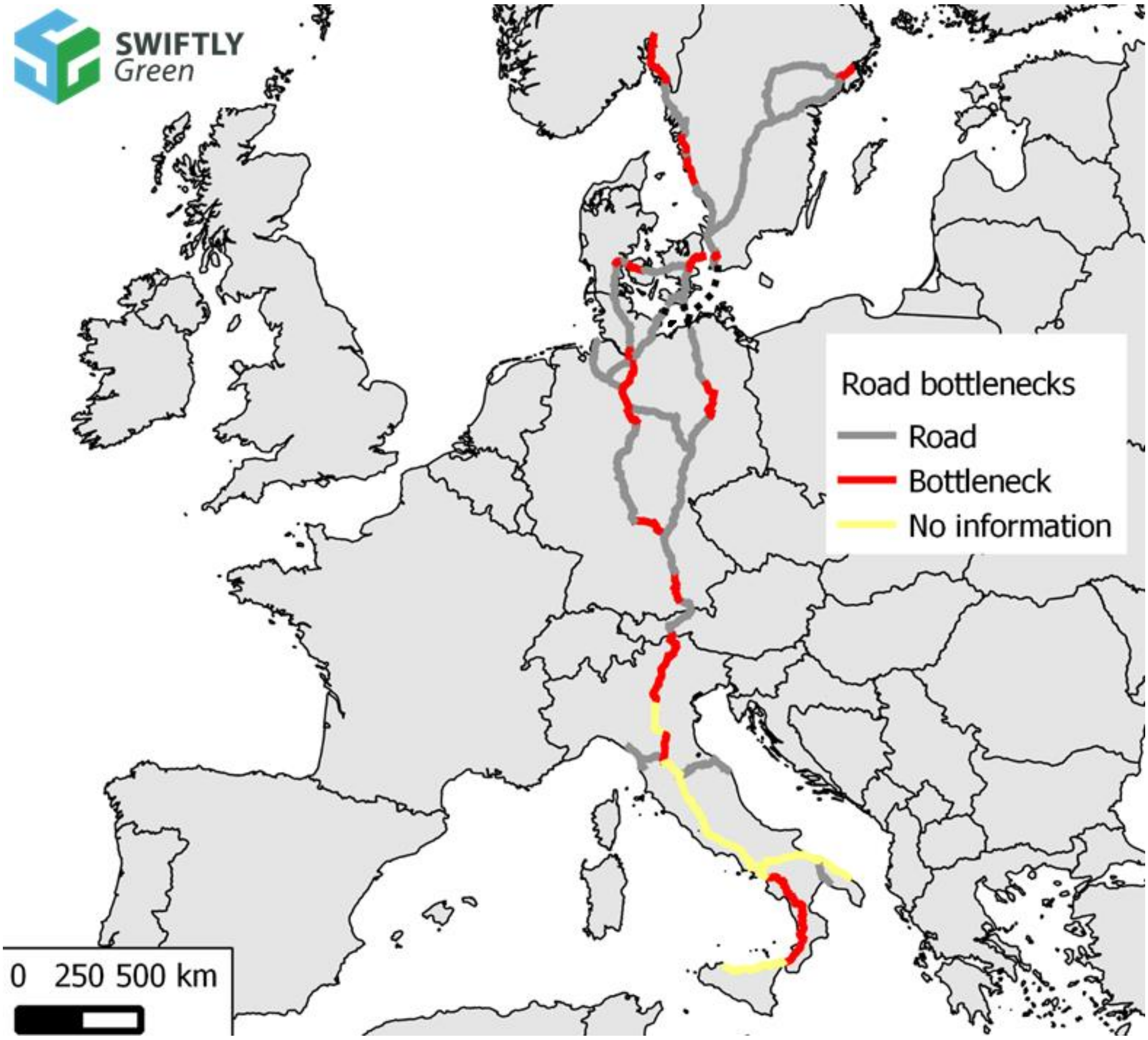
As an aside it can be said that due to extensive and continuing construction works of motorway E45/A7 there is currently a high risk of congestion in the area from Port of Hamburg to junction E45/A7 – A215 (near Bordesholm) on a total length of around 80 km. This includes several constructions works such as widening of the motorway (one extra lane per direction, building of new bridges, renovation of existing bridge constructions as well as building of three noise protection tunnels in the Hamburg area, also see chapter 3.4).

[20] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

[21] Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

The above-mentioned assessment on (future) road infrastructure bottlenecks by the European Coordinator Scan-Med seems to be partly depended on current/planned infrastructure updates, as an assessment made within the scope of the SwiftlyGreen project[22] shows several road infrastructure bottlenecks in their own assessment for Denmark and Sweden.

Figure 22: Overview of bottlenecks on the current road infrastructure along the analysed corridor



Source: Breitenbach, S., Hafen Hamburg Marketing: Swiftly Green project, Milestone 7 Report: "First Intermediate Results Finalized from Mapping of Current Status and Projects", Final Report, 2015

[22] See www.swiftlygreen.eu

The results for E45/A7 in the Hamburg area are consistent with those of the European Coordinator Scan-Med (see above). As the assessment of bottlenecks of European Coordinator Scan-Med are supposed to show bottlenecks in consideration of planned and currently ongoing infrastructure updates, those differences seem to be logic and verifiable.

3.4 Major infrastructure projects and plans

The most important infrastructure project on Scan-Med corridor with regard to the Baltic Sea region is the Fehmarnbelt fixed link on the co-called “Vogelfluglinie”. It will connect Germany (Hamburg, Lübeck, Fehmarn) and Denmark (Copenhagen, Lolland) with a fixed link for both – rail and road on the current route of the Puttgarden – Rødby ferry line. The following map shows the Fehmarnbelt Fixed link project. Besides the fixed link itself, being built as a tunnel between Puttgarden and Rødby, the project includes improved hinterland infrastructure for both – rail and road – between (Hamburg), Lübeck and Puttgarden as well as between Rødby and Ringsted.

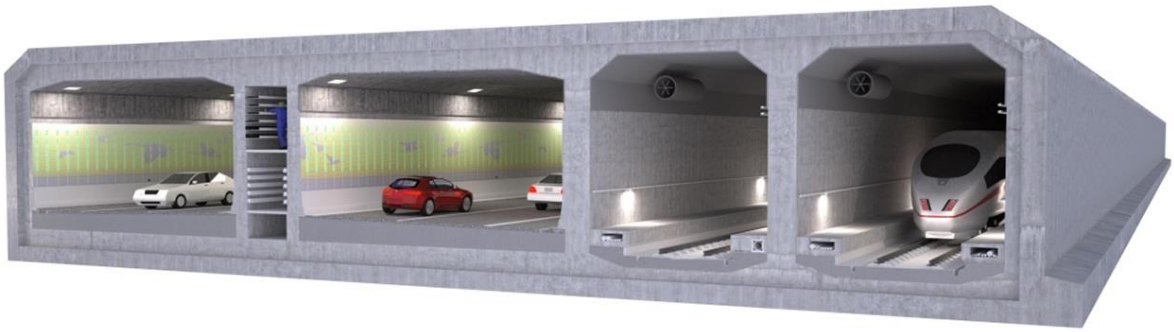
Figure 23: Fehmarnbelt Fixed link map

Source: Lars Friis Cornett, Director Femern A/S Germany, MetroLog Conference Lübeck, 02 November 2017

The Fehmarnbelt fixed link will significantly change traffic flows in the future, as it will offer a second direct rail link route between Hamburg and Scandinavia besides the already existing Jutland route (see chapter 3.2). As the total distance from Germany to Sweden will be around 160 km shorter than via Jutland route, rail services are expected to increase massively and gain competitiveness toward road transport, which is already today using the 160 km shorter route via Puttgarden and Rødby via Scandlines ferry service. On the newly built rail corridor 1,000 m trains are expected to be operated, further increasing rail capacities and competitive position towards direct road links or combined road – ferry links.

The Fehmarnbelt tunnel will be an 18 kilometer long immersed tunnel. It will be the world's longest of its type for both road and rail. It will comprise a four lane motorway and two electrified rail tracks. It will take about 8.5 years to build the Fehmarnbelt tunnel. Opening is currently anticipated for the year 2028. It will take ten minutes to travel from Denmark to Germany by car and seven minutes by train. Motorists (cars and lorries) will be able to drive at 110 km/h in the tunnel. Electric trains will be able to go through at 200 km/h. The planned construction budget for the Fehmarnbelt link is 7.1 billion € [including 1 billion € (15%) accrual/reserves[23]]. The project will be EU funded as it is a TEN-T project and the Fehmarnbelt tunnel will be user-financed. Revenues from the link will repay the loans that financed construction. This is the same model that financed the Storebælt (Great Belt) and Øresund fixed links.[24]

Figure 24: Fehmarnbelt Tunnel model



Source: Femern A/S

Road or rail upgrades regarding the connection from Puttgarden to Lübeck (and Hamburg) as well as Rødby to Ringsted are shown in chapter 3.4.1

[23] Lars Friis Cornett, Director Femern A/S Germany, MetroLog Conference Lübeck, 02 November 2017

[24] See femern.com

Following, selected major infrastructure projects with regard to rail and road infrastructure upgrades on the relevant corridor between Germany and Scandinavia (via Denmark) are briefly shown, including Fehmarnbelt fixed link hinterland infrastructure.

3.4.1 Selected rail infrastructure projects

Denmark

"In recent years there […] [have been enormous efforts and investments towards] upgrading the existing railway infrastructure in Denmark. […] Investments have also been made in the European Rail Traffic Management System (ERTMS), which will harmonize the European signal systems and make Danish railway transport more efficient. […] It was decided to upgrade the single-track section between Vamdrup and Vojens [south of kolding] of 20 km to double tracks. The upgrade was finalized in September 2015 and has thus eliminated the [existing] bottleneck"[25].

"Furthermore, investments will be made in a program focusing on repairing and replacing railways and bridges in order to improve the reliability. In January 2014 the previous Danish government agreed with the parliament on the "Train Fund Denmark". The intention of the Train Fund DK is to modernize the Danish railway system by electrifying the main railways, establishing double tracks and increasing speed limits. However, the current government has proposed a review of the financial fundament of the Train Fund DK in order to clarify the expectations of its financial capacity for future infrastructure projects. As a result, some of the infrastructure projects in the Train Fund DK might be revised. The projects are planned to be finalized in the middle of the 2020s if the agreement is realized under the current conditions."[26]

"Railway improvements through double tracks between Tinglev and Padborg: It is necessary to upgrade to double tracks between Tinglev and Padborg as well as a speed upgrade to

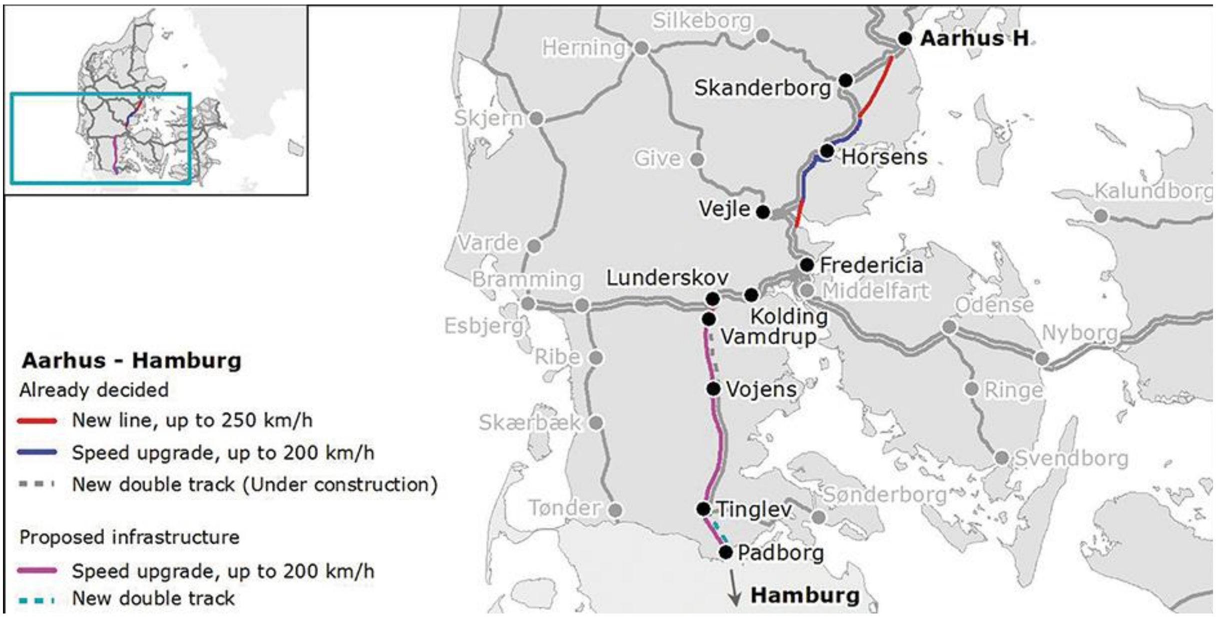
[25] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

[26] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

200 km/h between Lunderskov and Padborg. Most parts of this railway run in straight lines. Therefore, a speed upgrade to 200 km/h is assumed to be feasible on most of the track.

The upgrade to double tracks will increase both capacity and punctuality and will furthermore prevent any accidents on the railway from closing the entire transport route because it will be possible to redirect traffic to the other railway tracks. The double tracks will thus provide a higher degree of supply security for the transport route. […] In addition, the intensified use of intermodal transportation will also experience benefits from the expansion to double tracks because it can be possible to operate with higher frequency without interruptions. […] The upgrade to double tracks between Tinglev and Padborg is estimated to cost around DKK 0.7 billion. The entire project including the upgrade to double tracks and the speed upgrade to 200 km/h is estimated to cost around DKK 1.9 billion.”[27]

Figure 25: Rail infrastructure updates planned between Aarhus and Padborg



Source: The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

[27] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

Ringsted – Fehmarn Banen connecting Copenhagen region to the newly built Fehmarnbelt tunnel: Double tracks planned between Vordingborg and Rødby. In addition, there is a maximum speed upgrade planned to be set at 200 km/h between Ringsted and Rødby.

A new station north of Rødby is planned in order to allow the building of passing tracks for 1000 m long freight trains. Also, a new double tracked bridge will be built across Masnedsund and ERTMS will be implemented.

Concerning current timeline, the following dates apply: Double track, ERTMS and speed upgrade to 200 km/h from Ringsted to Nykøbing will be finished in 2021. Electrification from Ringsted to Nykøbing will be finished latest at 2024. Work on the line on Lolland – Nykøbing to the tunnel is postponed and will be coordinated with the opening date of the tunnel in 2028. Budget for these works is anticipated to be 9.5 billion DKK (as of 2015) including reserves. It is financed by A/S Femern Landanlæg and EU.[28]

[28] See http://www.handelskammer.dk/fileadmin/ahk_daenemark/Marktabteilung/Bauwirtschaft_2016/Banedk_Ringsted-fehmarn_-_Danish_German_Chamber_of_Commerce_June_14th.pdf

Figure 26: Rail infrastructure planned between Ringsted and Rødby

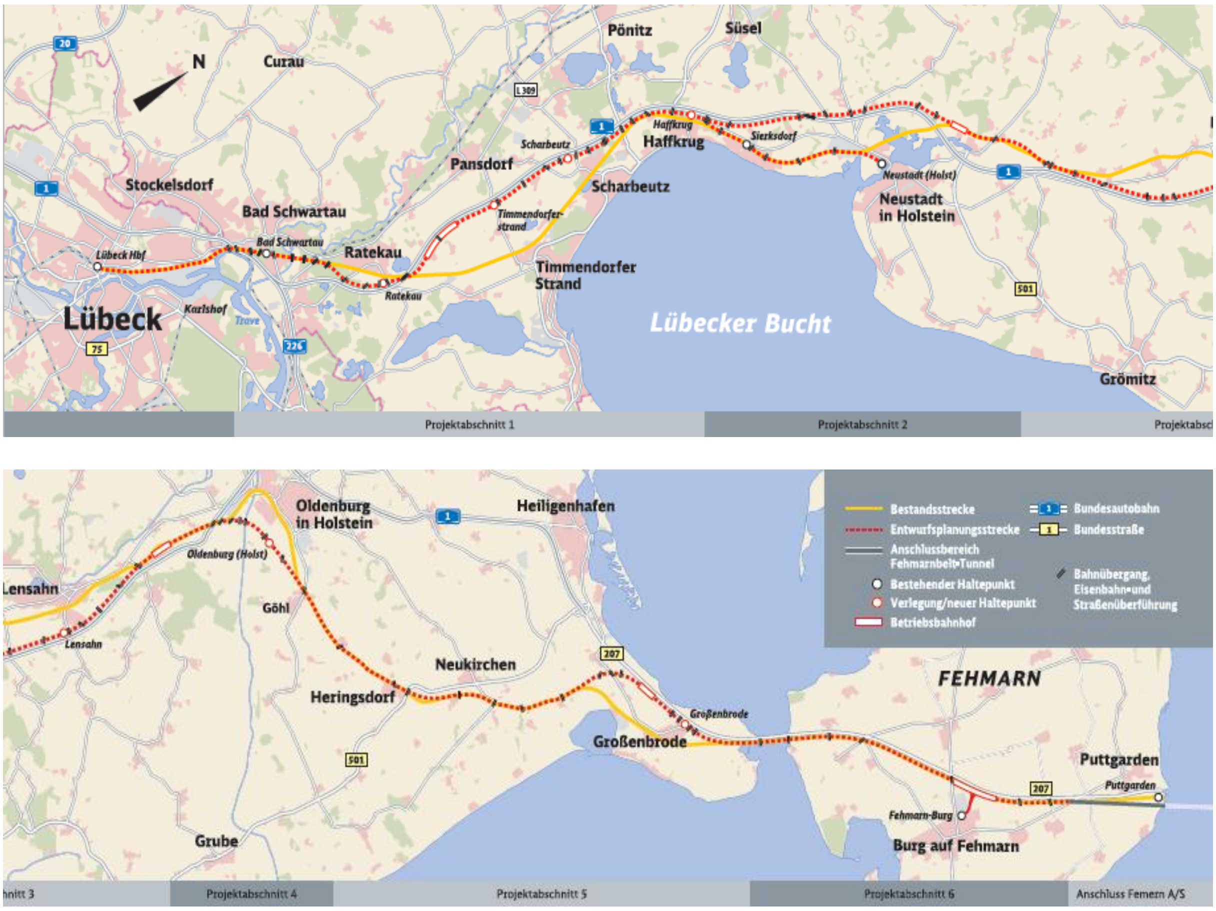
Source: http://www.handelskammer.dk/fileadmin/ahk_daenemark/Marktabteilung/Bauwirtschaft_2016/Banedk_Ringsted-fehmarn_-_Danish_German_Chamber_of_Commerce_June_14th.pdf

Germany

DB Netze is planning a newly built rail infrastructure between Lübeck and Puttgarden in order to create a sufficient rail infrastructure to and from the Fehmarnbelt tunnel. Today, the existing tracks (that will be partly shut down after construction of the new tracks has been finished) are non-electrified single tracks with a maximum velocity of 140 km/h and an average speed of 100 km/h.

Planned infrastructure parameters for the new track are: Section length of 88 km, double track, electrified, planned new maximum velocity of 160 km/h up to 200 km/h. The following map shows the route of the new rail link from Lübeck to Puttgarden (red dots) as well as the old existing rail track (yellow line).

Figure 27: Planned rail link – Lübeck –Puttgarden (part 1 & 2)



Source: Michael Körber, DB Netze: MetroLog Conference Lübeck, 02 November 2017

“In Germany the following expansion projects are planned for the Jutland Corridor:

- Upgrading and modernisation of the railway station in Elmshorn with the construction of a fourth platform line.
- Improvement of the suburban railway connection from Hamburg to Elmshorn including an expansion to three tracks between Elmshorn and Pinneberg.”[29]

[29] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

3.4.2 Selected road infrastructure projects

Denmark

"In the Danish road system the Jutland Corridor is represented mainly by the E45 motorway in Eastern Jutland, which provides a high level of mobility and economic development in the region. However, the growth in traffic causes increasing congestion on parts of E45, which will be one of the key issues for the future infrastructure projects to cope with. Within the last few years, several initiatives have been carried out on E45. In 2013 the most trafficked section at Vejle was expanded and in 2014 the capacity at Kolding was enlarged by inclusion of the emergency lanes. […] In addition, several road projects in the Jutland Corridor are ready to be initiated, when the funding is provided. This is [amongst others] the case for an extension of the motorway between Fredericia and Kolding."[30]

"With regard to the long term development strategies, the Jutland Corridor has been part of a broader planning effort in Denmark, which has identified large scale infrastructure demands in the years after 2020 and major strategic options for further infrastructure investments beyond 2020. […] The strategic analyses have identified two main long-term development strategies for the north- and southbound road capacity in Jutland:

- Further development of the motorway capacity in the E45 corridor
- Different models for establishment of a new motorway corridor in Central Jutland.

The analyses show that the cheapest and most effective way to deal with the growing congestion problems in East Jutland in 2030 will be a gradual expansion of the E45 corridor."[31]

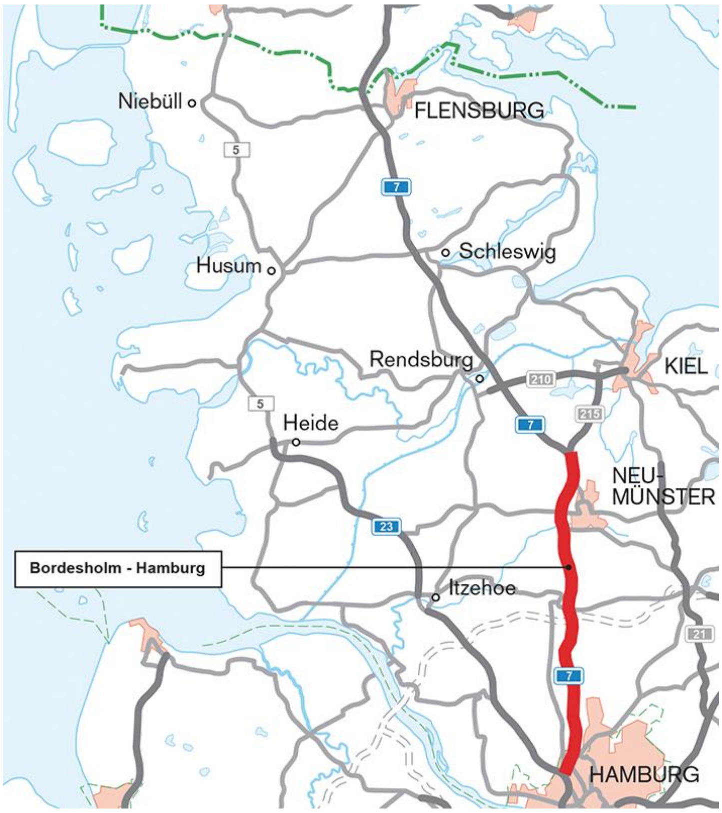
[30] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

[31] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

Germany

“The E45 crosses the border at Frøslev/Ellund and becomes the A7 in Germany. Due to the growing traffic volume, the A7 motorway will be expanded between the interchange at Bordesholm and the Elbtunnel in Hamburg from four to six or eight lanes, respectively. In Schleswig-Holstein the expansion is planned on a section of 65 km.

Figure 28: Motorway E45/A7 sections subject to major upgrades



Source: The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

This expansion project – costing about 372 million € – is included in the “urgent need” category of the BVWP[32] […]. Construction work began in November 2014 and is expected to end in 2018. In addition to that, in Hamburg there are three sections planned for the expansion to six or eight lanes, partly with coverings [noise protection tunnels]. Construction in

[32] “Bundesverkehrswegeplan”: National infrastructure plan of the German government

Hamburg-Schnelsen began in the middle of 2014 and the last section in Hamburg-Othmarschen will be finished in 2025.

To provide relief for the Hamburg Elbtunnel along the A7 motorway, a northwest bypass of Hamburg including a new link across the river Elbe will be realized by the A20 motorway, which will be built in different sections.”[33]

Construction of a bridge to replace Rader Bridge: “Because of the damages to the pier caps discovered in July 2013 and the subsequent closure of the Rader Bridge, extensive tests and calculations were done to assess the load bearing capacity and fatigue resistance of the bridge. The results showed that the remaining useful life of the bridge was 12 years. […] Currently, the Rader Bridge is a bottleneck for several Danish, German and Scandinavian heavy industry manufacturers such as windmill transportations because they cannot cross the bridge due to the weight restrictions. […] Due to current condition of the bridge, a timely replacement, i. e. a new structure across Kiel Canal must be accorded highest priority. […] DEGES was officially commissioned in February 2015 with the planning and execution of construction for the replacement building of the bridge. The aim is that in 2026 a new structure will be established. […] A cost estimate for replacing the bridge without railway is € 220 million.”[34]

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[33] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

[34] The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

Figure 29: New construction of Rader bridge crossing Kiel canal

Source: The Danish-German Transport Commission: Transport infrastructure in the Jutland Corridor, November 2015

In order to provide sufficient road connection from Lübeck to the Fehmarnbelt tunnel, the part that currently isn't covered by a two lane express road (section Heiligenhafen – Puttgarden, B207, also see chapter 3.2) is planned to be upgraded as a two lane road for each direction. The road section due to be updated has a total length of 16.3 km.

The planning approval decision for the section was issued in August 2015. There are currently lawsuits pending on this issue. As soon as the decision becomes legally binding, construction work can begin. It is aimed and necessary to finish road upgrades before the opening of the tunnel in 2028.[35]

Altogether, even though rail infrastructure will massively be upgraded through the newly built Fehmarnbelt fixed link, also new and direct road infrastructure is "coming with it", hence also increasing competitiveness of road transport (e. g. compared to intermodal rail – ro-ro/ferry

[35] See http://www.schleswig-holstein.de/DE/Schwerpunkte/Fehmarnbeltquerung/fehmarnbeltquerung_node.html

links via Lübeck to Sweden). This new risk of modal shift from rail and ro-ro/ferry routes onto road transport emerging with the opening of the Fehmarnbelt fixed link must be addressed and taken into account prior to its opening.

4 Freight and modal split analysis

When it comes to the structured analysis of freight flows and modal split, it is difficult to show a complete and integrated picture on all freight flows, allowing the estimation or calculation of a robust modal split share for the whole corridor concerning cargo transport. This is true due to the facts that for an overall modal split figure

- different modes of transport (road, rail, short-sea as well as intermodal/multimodal combinations of two or more of them)
- different countries (esp. Germany, Denmark and Sweden)
- different cargo-flow routes (trough different ports, via different rail routes, motorways etc.)
- different types of cargo as well as
- different providers of statistical figures (national statistics, local statistics, port statistics, rail statistics etc.)

need to be considered.

The following chapter tries to target this issue by showing different available statistical sources (local or national), illustrating their figures on freight flows (quantity of goods as well as type of good, where applicable) and modal split and aiming to create or derive generally applicable statements on the issue of modal split by reviewing them in a summarizing and comparative way.

The focus will be on types of cargo relevant for intermodal/multimodal cargo transport, such as container traffic as well as trailer traffic. If no other figures are available, total traffic figures will be used.

4.1 Short Sea traffic Hamburg to/from Scandinavia (Short Sea Shipping/ feeder services)

As explained in chapter 2, the Baltic Sea Region is the most important trade region for seagoing container traffic within Europe. 1.8 million TEU were shipped in 2015 as well as in 2016, accounting for more than 20 % of total container traffic to/from Hamburg. When looking in detail, the Scandinavian countries Denmark, Sweden as well as Norway only show a rather low share of freight volumes of those 1.8 million TEU.

Altogether, in 2015 container short sea traffic on the Hamburg-Scandinavia relation (to/from Danish, Swedish or Norwegian ports) amounted to 539,300 TEU, of which 263,800 TEU were export-bound traffic (from Hamburg to Scandinavia) and 275,500 TEU were import-bound traffic (from Scandinavia to Hamburg). 539,300 TEU represent a share of 6.1 % of total container traffic at the Port of Hamburg. The following table shows the figures in detail.

Figure 30: Short Sea container traffic between Hamburg and Scandinavia, as of 2015

From	To	TEU
Hamburg	Denmark	95,000
Hamburg	Sweden	130,000
Hamburg	Norway	37,900
TOTAL		**263,800**
Denmark	Hamburg	88,400
Sweden	Hamburg	140,500
Norway	Hamburg	46,600
TOTAL		**275,500**

Source: Hafen Hamburg Marketing e.V., 2017

Concerning hinterland traffic, as described in chapter 3, around 42 % of total container hinterland traffic from/to the Port of Hamburg was handled through rail services. Statistical information on hinterland traffic related to origin or destination Scandinavia is not available, though.

4.2 Intermodal Road/Rail – Ferry – Road/Rail link via the Baltic Sea (ro-ro/ferry services)

When looking at road – ferry – road or rail – ferry – rail links between Hamburg and Scandinavia, as described earlier, there are several possible routes. With respect to the Scandria corridor and the relevance to this study, they include ro-ro/ferry routes via Puttgarden-Rodby and via Lübeck (Lübeck-Malmö, Lübeck-Trelleborg, Lübeck-Husum). There are also ro-ro/ferry links via Kiel. Kiel is not part of the relevant corridor covered by this study, though and will thus not be analysed in this chapter.

Puttgarden

On the Puttgarden-Rodby link, no cargo rail services are operating, as described in chapter 3.2. This means, all freight traffic to/from the Puttgarden-Rodby ferry link operated by Scandlines is lorry traffic.

In 2017, a total of 472,725 cargo units were transported on this route. This represents a growth of 10.6 % compared to 2016, when 427,419 units were transported via that link[36] – all via lorry and ferry – as no cargo rail services are offered from/to Puttgarden or Rodbyhavn (see chapter 3.2).

Modal split:

- rail: 0 %
- road: 100 %

[36] DVZ: Für Scandlines läuft es; 07.02.2018

Lübeck

At Port of Lübeck, linking e. g. to Swedish ports Malmö and Trelleborg, a total of 716.000 cargo units (containers and trailers) was shipped in 2017 via ro-ro/ferry services from or to terminals of the main terminal operator LHG (Lübecker Hafen-Gesellschaft). In 2016, a total of 678,000 units was shipped. Thus, after several years of decreasing or stagnatic ro-ro/ferry cargo volumes, an increase in turnover of 5.6 % was registered.[37] [38]

At the intermodal rail terminal called Baltic Rail Gate, a total of 88,500 cargo units was loaded and unloaded in 2017. This is a 19 % increase compared to 2016, in which about 74,400 cargo units were handled.

Thus, around 12 % of cargo units (containers, trailers or lorries) shipped via Lübeck came or went via rail services.

Modal split:

- rail: 12 %
- road: 88 %

4.3 Direct intermodal/multimodal Rail link via Denmark

When looking at direct rail links between Hamburg or northern Germany and Scandinavia, for cargo trains going to either Sweden or Norway, with the Jutland route (rail line from Hamburg via Flensburg and Padborg, Kolding, the Great Belt fixed link, Ringsted and Copenhagen via Øresund fixed link to Malmö), there is currently only one possible route in terms of infrastructure, as described in chapter 3.2 [39].

Thus, all direct rail services from Hamburg/northern Germany to Sweden or Norway are using Øresund fixed link and the statistical information published for this crossing gives a first

[37] VerkehrsRundschau: Lübecker Hafen-Gesellschaft wieder mit mehr Umschlag; 15.01.2018

[38] In metric tons the registered surplus in cargo volumes was 4.5% in 2017 compared to 2016.

[39] Also see figure 12

indication, even though also covering cargo rail volumes between Denmark and Sweden, of course.

There are also direct rail services from Hamburg/northern Germany to Denmark, which are also being covered within this chapter.

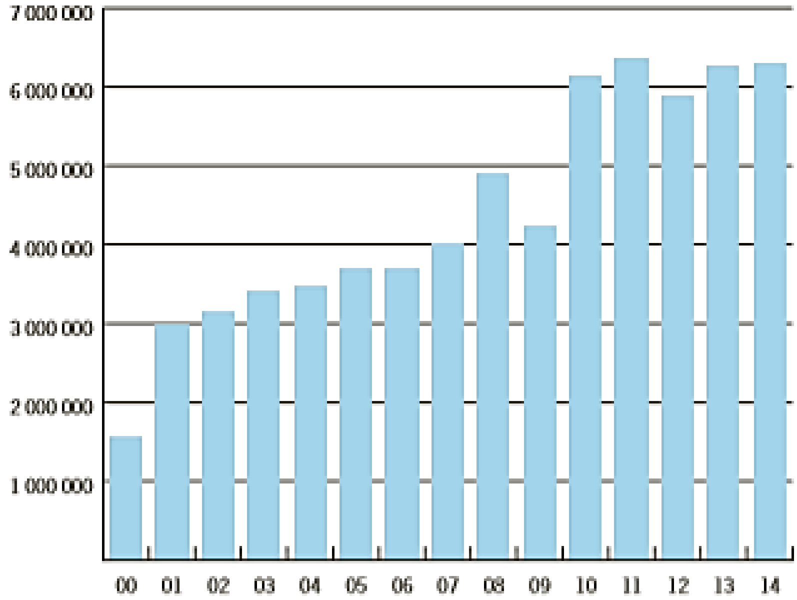
The Øresund Bridge is increasingly used for rail freight links between Sweden and Denmark, including transit volumes only transiting Denmark towards (or coming from) Germany and other European countries. On average, one freight train crosses the bridge about once every hour.

From 2001 to 2009, the total volume of goods transported by rail across the bridge increased by an average of 5 percent per year. Since 2001, total goods volumes have doubled. In 2010, rail freight transport experienced a real boom - 36 percent more trains and 46 percent more goods than in the previous year.

In 2014, around 8,000 freight trains crossed the bridge carrying 6.3 million tonnes of freight, as shown in the following two figures. It is expected that the rail traffic on the Øresund Bridge will increase in the next 20 to 30 years. Therefore, capacity expansions on the connecting lines are required. The expansion of the infrastructure to and from the Øresund Bridge is a prerequisite for more integration in the region.[40]

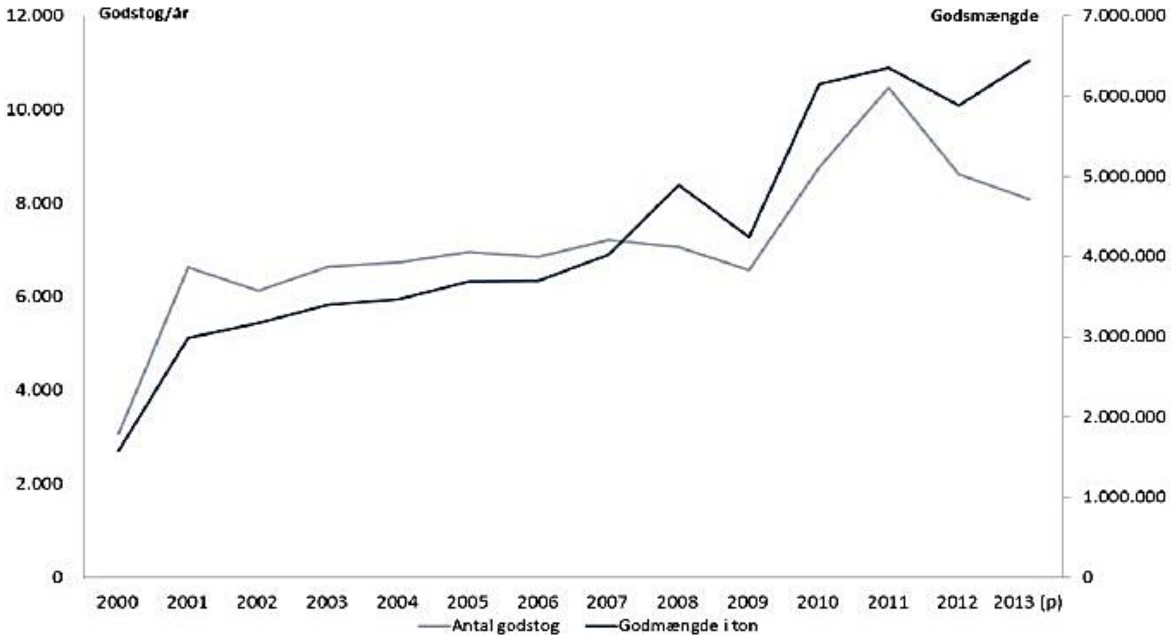
[40] www.oresundsbron.com

Figure 31: Rail freight volumes at Øresund fixed link, 2000 – 2014, in tonnes



Source: www.oresundsbron.com

Figure 32: Rail freight volumes (in tonnes) and number of freight trains at Øresund fixed link, 2000 – 2013



Note: Left axis and light blue line shows number of freight trains per year; right axis and dark blue line shows freight volume in tonnes

Source: Hansen, Sten: New fixed links across the Öresund – what is the point? Trafikdage; 2015; http://www.trafikdage.dk/m/article_view.php?id=261

Further statistical details, including type of cargo, origin or destination of rail service, intermodal rail service or other cargo rail service etc. were not available. Thus, this does not yet show information on the amount or the share of direct rail services from Hamburg/northern Germany to Sweden or Norway.

Further insights can be gained when looking into Danish national traffic statistics from Statistics Denmark[41], though. For rail freight traffic in general, the following statistical information is available with relevance to the investigation area of this study.

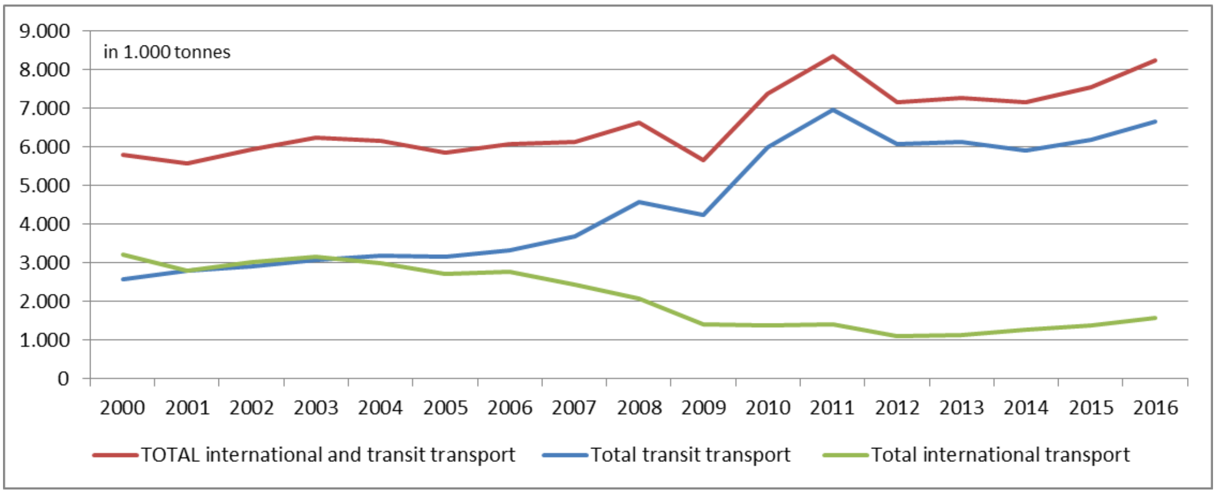
Firstly, as differentiation of transit rail freight traffic and international rail freight traffic is being made with transit traffic meaning cross-border rail freight traffic through Denmark not starting or ending in Denmark (e. g. rail services from Sweden to Germany). International traffic means cross-border rail freight traffic either starting or ending in Denmark (e. g. rail services from Germany to Denmark or vice versa).

Total cross-border rail freight transport

Total cross-border rail freight traffic (both international and transit) have increased from 5.8 million tonnes in 2000 to 8.2 million tonnes in 2016 (+ 42 %). Within this time transit traffic increased significantly (from 2.6 million tonnes in 2000 to 6.7 million tonnes in 2016; + 158 %), whilst international traffic has halved within the same period (from 3.2 million tons in 2000 to 1.6 million tonnes in 2016; - 50 %). See following figure for details.

[41] See statbank.dk

Figure 33: Rail freight volumes international and transit traffic Denmark, 2000 – 2016

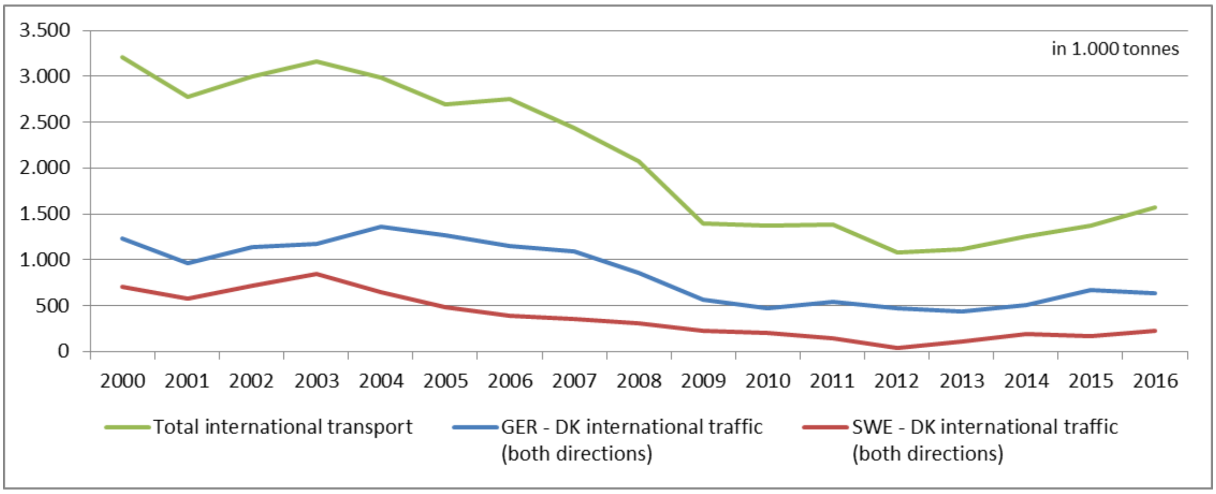


Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

When looking at the international rail freight traffic in closer detail (see following figure), it shows that both – German-Danish cross-border rail freight volumes as well as Swedish-Danish cross-border rail freight volumes have decreased in a comparable way.

It can be assumed that after the opening of Øresund fixed link in 2000 major rail freight volumes from Germany towards Sweden or Norway, which due to the non-existent fixed link had to be organised as subdivided transports (rail/road and ferry) and thus were counting as international instead of transit rail freight traffic within the statistics, were then moved towards direct rail services, therefore counting as transit traffic after 2000.

Figure 34: Rail freight volumes international traffic total and to/from Germany and Sweden, 2000 – 2016



Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Nevertheless, in Figure 33 it can also be seen that total cross-border rail freight volumes did not increase in total since 2011 (8.3 million tonnes in 2011, 8.2 million tonnes in 2016), showing that rail freight volumes decreased when it comes to modal split, compared to road transport volumes (see chapter 4.4).

Intermodal cross-border rail freight transport

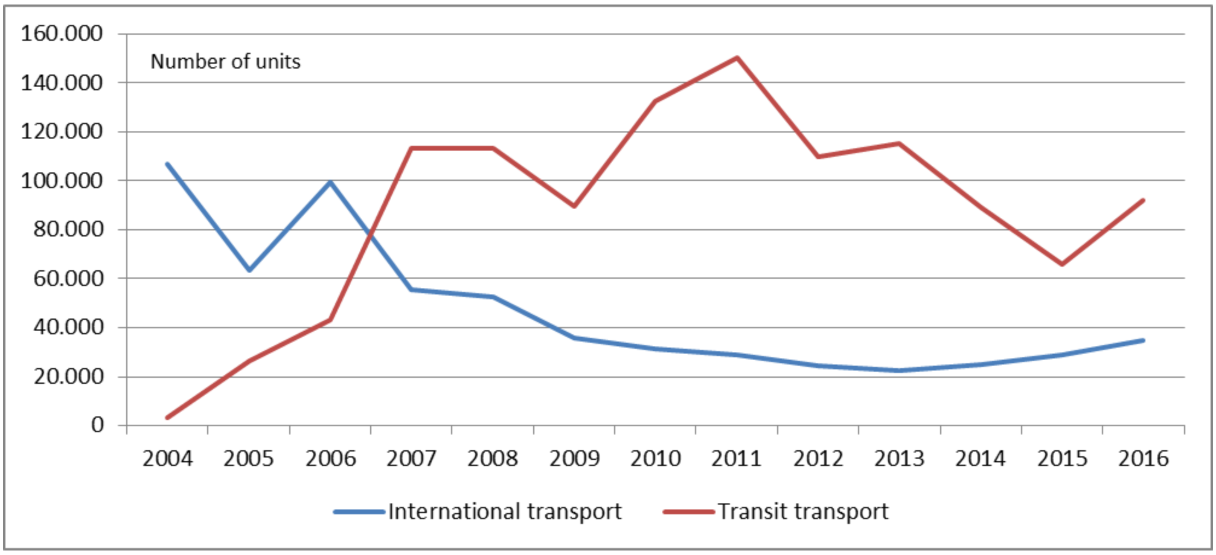
In addition, Statistics Denmark allows insights into cross-border *intermodal* rail freight transport – both international and transit rail freight traffic. The following two graphs show the development of cross-border intermodal rail freight traffic between 2004 and 2016.[42]

[42] The years 2000 – 2003 are not available at Statistics Denmark.

Figure 35: Intermodal rail freight volumes Denmark, international and transit traffic, in 1.000 tonnes, 2004 – 2016

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Figure 36: Intermodal rail freight volumes Denmark, international and transit traffic, in cargo units, 2004 – 2016



Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

As shown for rail freight traffic in total, also for intermodal rail freight traffic it is visible that international traffic volumes (cross-border traffic starting/ending in Denmark) decreased, whilst transit traffic volumes increased, especially until 2011. In 2004 there were only 3,200 cargo units (0.06 million tonnes) of intermodal transit traffic, whilst in 2011 there were 150,200 cargo units (2.4 million tonnes). This can again be explained with regard to the opening of the Öresund fixed link. Prior to that intermodal rail freight traffic basically didn’t play any role on the corridor between Hamburg / northern Germany and Sweden or Norway.

After 2011, intermodal transit cargo volumes decreased, though, and were at a volume of only 91,900 cargo units or 1.3 million tonnes, representing – 39 % in terms of cargo units and even – 47 % in terms of tonnage. Therefore, it can be said that **intermodal transit rail freight transport through Denmark**, covering all direct rail services between Hamburg/northern Germany and Sweden as well as Norway, **massively lost shares with regard to modal split within recent years**.

For further details on intermodal rail freight volumes, see 1A2.

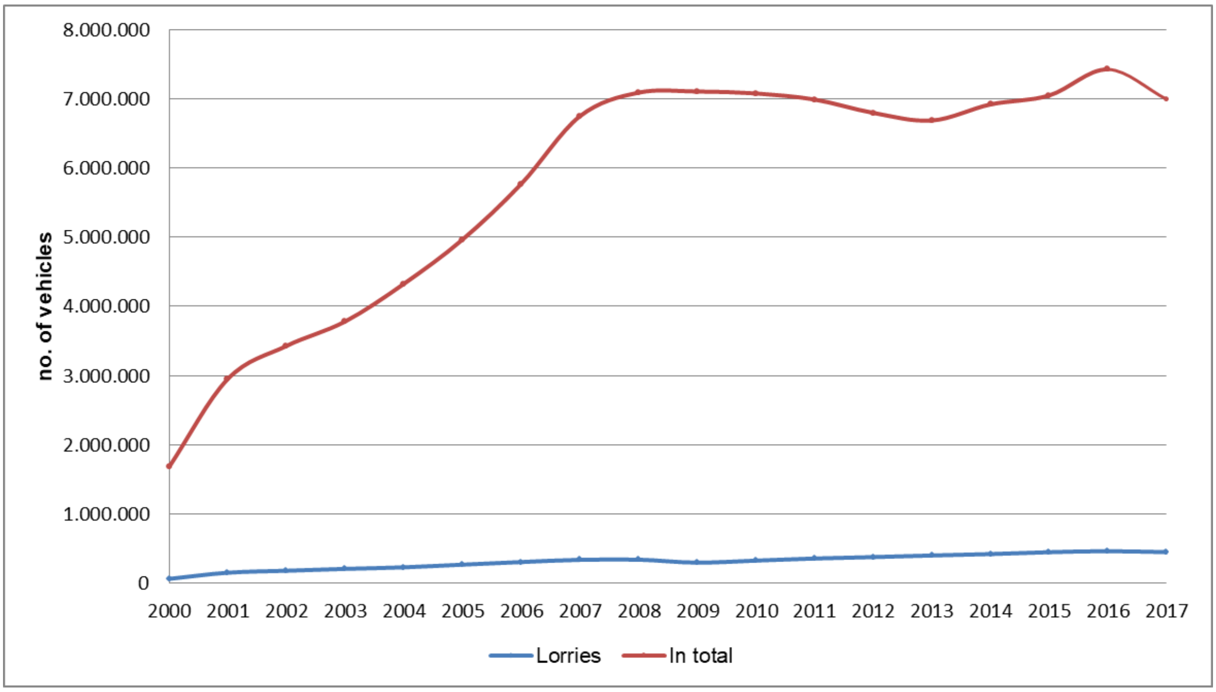
4.4 Direct road transport via Denmark

As for the direct rail links from Hamburg/northern Germany to Sweden or Norway, for direct road transport the Øresund fixed link also is the only possible fixed link existing. Within Northern Germany and Denmark there are of course different route options and border crossings that can be used – all having to route via Øresund fixed link, too, though, when wanting to reach Sweden without using ferry or services.

Thus, as in the case referred to for direct rail services, the statistical information published for Øresund fixed link related cargo road transport gives a good first indication, even though this is also covering cargo volumes between Denmark and Sweden, including rather local border-crossing traffic between Copenhagen and Malmö region, of course.

The following graph shows the development of road traffic volumes for total traffic (all types of vehicles) and for lorries since 2000.

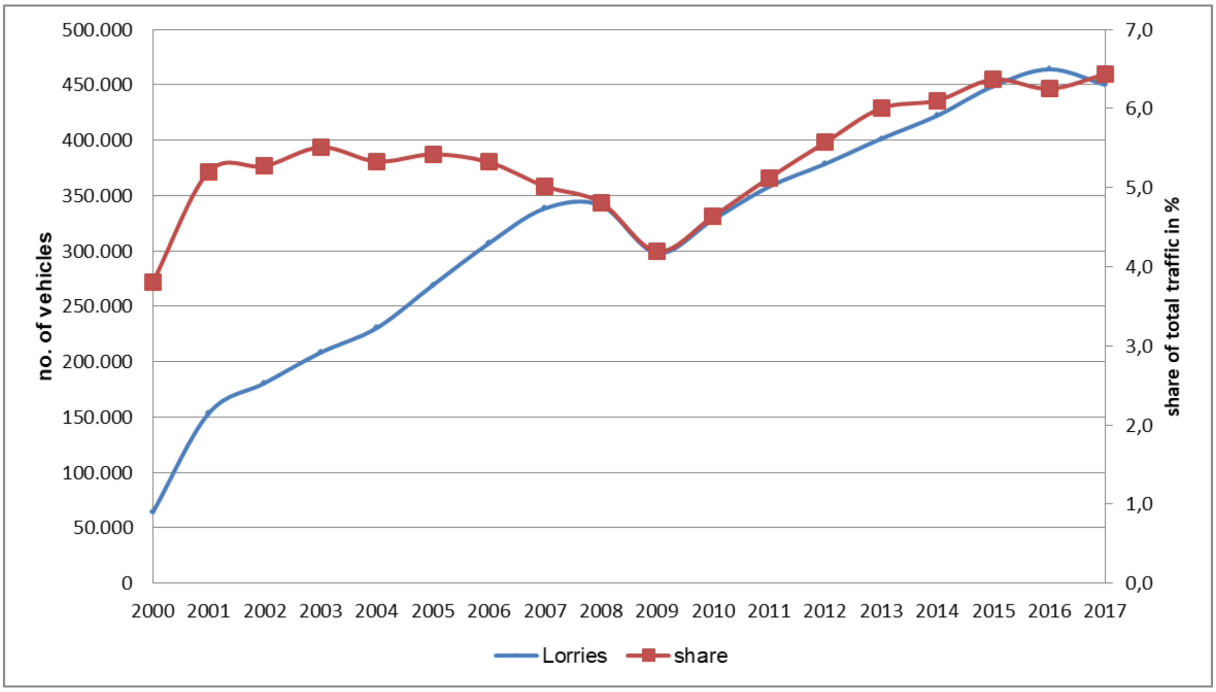
Figure 37: Road traffic in number of vehicles at Øresund fixed link, 2000 – 2017



Note: 2000: 6 months only
Source: Logistics Initiative Hamburg, based on: www.oresundsbron.com

As seen, lorry traffic volumes grow steadily. Its development can be seen clearer when showing it separately in another line chart (see below). In 2017 a total of 450.000 lorries were using Øresund fixed link. This is a share of 6.4 % of total traffic. The share of cargo traffic (lorries) with regard to total traffic also increased during the years. While it was at 3.8 % in 2000, it grew to a level between 5 and 6% in 2001 until 2008 and after a short decrease steadily grew to todays 6.4 % share of total traffic. Details are shown in the figure below.

Figure 38: Lorry traffic in number of vehicles at Øresund fixed link, 2000 – 2017



Note: 2000: 6 months only
Source: Logistics Initiative Hamburg, based on: www.oresundsbron.com

This means that, while intermodal rail freight traffic decreased after 2011 (see chapter 4.3), road traffic (lorries) grew massively from 360,000 vehicles in 2011 to around 450,000 vehicles in 2017, equating to a growth of 26 %.

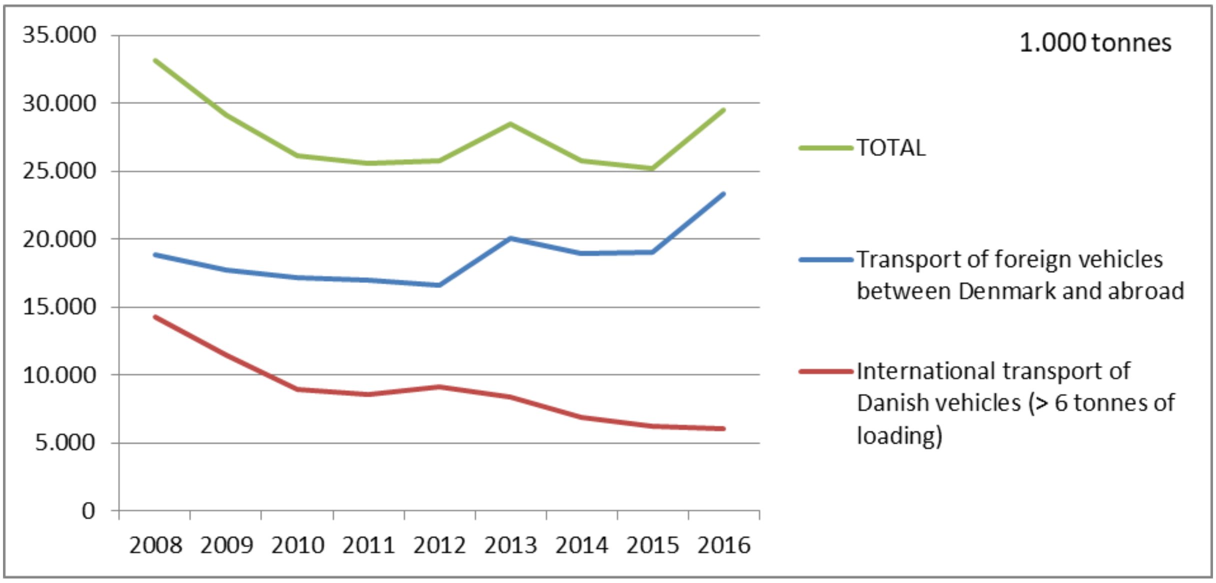
When - as done in the case of rail freight traffic – looking at Danish national statistics, the following situation shows.

Statistics Denmark provides information on international traffic in terms of Danish lorries executing cross-border cargo transports (either to/from Denmark or to/from a different country = transit traffic) and on international traffic in terms of lorries registered in countries outside Denmark that either start or end their journey in Denmark. Due to this – other than for rail freight transport – and overview on total transit traffic volumes by road cannot be given.

Nevertheless, the available road transport information allows some valuable insights, too. As shown in the following chart and table, transport of lorries registered in countries other than

Denmark[43] increased significantly in recent years (+24 % since 2008). This does not cover transit traffic induced by foreign vehicles through Denmark, though, only international traffic starting or ending within Denmark. At the same time, international traffic of Danish vehicles (lorries) decreased significantly (-57 %) – including both transports from/to Denmark or transit traffic executed by Danish vehicles. In total this sums up to a decrease of -11 % since 2008 in terms of lorry traffic for the categories of international traffic, as stated above.

Figure 39: International transport of Danish vehicles and Transport of foreign vehicles between Denmark and abroad, in 1000 tonnes of goods loaded, 2008 – 2016



Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

43 Covers transport by vehicles registered in EU country, Norway, Switzerland or Liechtenstein.

Figure 40: International transport of Danish vehicles and Transport of foreign vehicles between Denmark and abroad, in 1000 tonnes of goods loaded, 2008 – 2016

Weight of goods loaded, 1000 tonnes	2008	2009	2010	2011	2012	2013	2014	2015	2016
Transport of foreign vehicles between Denmark and abroad	18,848	17,688	17,208	17,021	16,583	20,088	18,908	19,009	23,371
International transport of Danish vehicles (> 6 tonnes of loading)	14,294	11,471	8,951	8,592	9,161	8,384	6,895	6,236	6,088
TOTAL	**33,142**	**29,159**	**26,159**	**25,613**	**25,744**	**28,472**	**25,803**	**25,245**	**29,459**

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

It has to be assumed that road transit traffic executed by foreign vehicles has increased significantly, too, within this period. No information on that was available through statistics Denmark.

Other interesting finding occurs when looking onto travelled distances of road transport of goods. This is only available for international transport of Danish vehicles (> 6 tonnes of loading), but it nevertheless shows, that significant amounts of international road transport is transported on long distances that would – in terms of total kilometres qualifiy for modal shift!

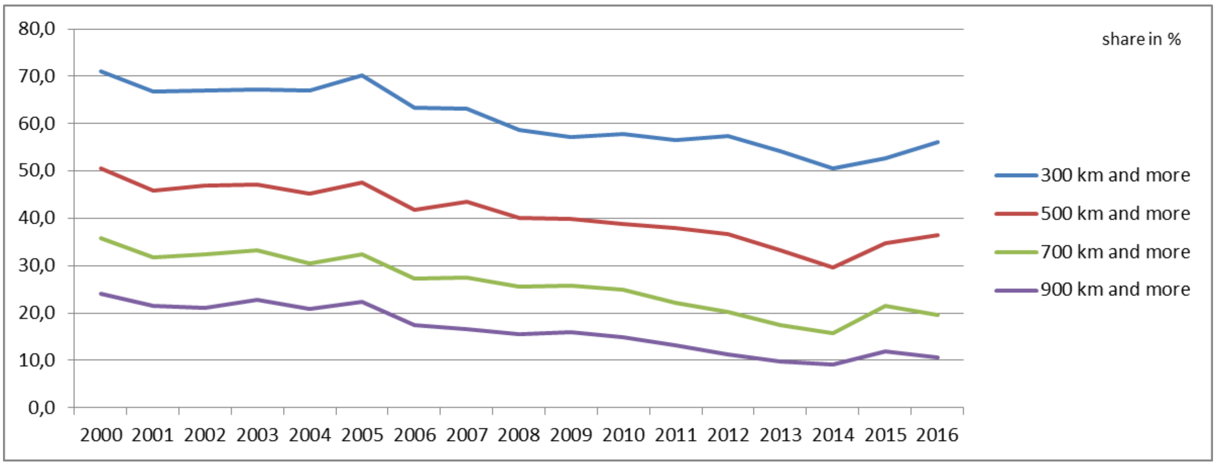
Depending on specific individual cases and circumstances it can be said that in general 300 km mark the minimum distance that makes intermodal transport solutions financially competitive to road transport. When looking on distances for international road transport by Danish vehicles, the following shows:

In 2016, 56 % of international road transports by Danish vehicles had a distance of more than 300 km. 37 % of transports had a distance of more than 500 kilometres, 20 % of transports a distance of more than 700 kilometres and even transports of more than 900 kilometres still had a share of 11 %.

When looking at the development over time, it can be seen that those shares are decreasing (in 2000 more than 70 % of international road transport by Danish vehicles had a distance of 300 kilometres or more), but they are still rather high.

In addition, in recent years (since 2014) shares of long distance road transports have been increasing again – from 51 % of Danish international road transports being 300 kilometres or more to 56 %. The following figure and table show that in detail.

Figure 41: International road transport of Danish vehicles by distance travelled, share in per cent, based on number of journeys, 2000 – 2016



Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Figure 42: International road transport of Danish vehicles by distance travelled, share in per cent, based on number of journeys, 2000 – 2016

share based on no. of journeys	2000	…	2011	2012	2013	2014	2015	2016
300 km and more	71 %	…	57 %	57 %	54 %	51 %	53 %	56 %
500 km and more	51 %	…	38 %	37 %	33 %	30 %	35 %	37 %
700 km and more	36 %	…	22 %	20 %	17 %	16 %	21 %	20 %
900 km and more	24 %	…	13 %	11 %	10 %	9 %	12 %	11 %

Note: Years 2001 – 2010 not shown for reasons of readability; see Annex 1A3 for full table.
Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

For further details, see Annex 1A3.

For foreign road vehicles, this information on travelled distances is not available. It can be assumed that their average travelled distances are even longer than those of Danish vehicles.

Altogether, even though the development of shares of road transport shows decreasing tendencies for long distance transports in the long-term view, in recent years this trend has reversed or at least stagnated since 2014.

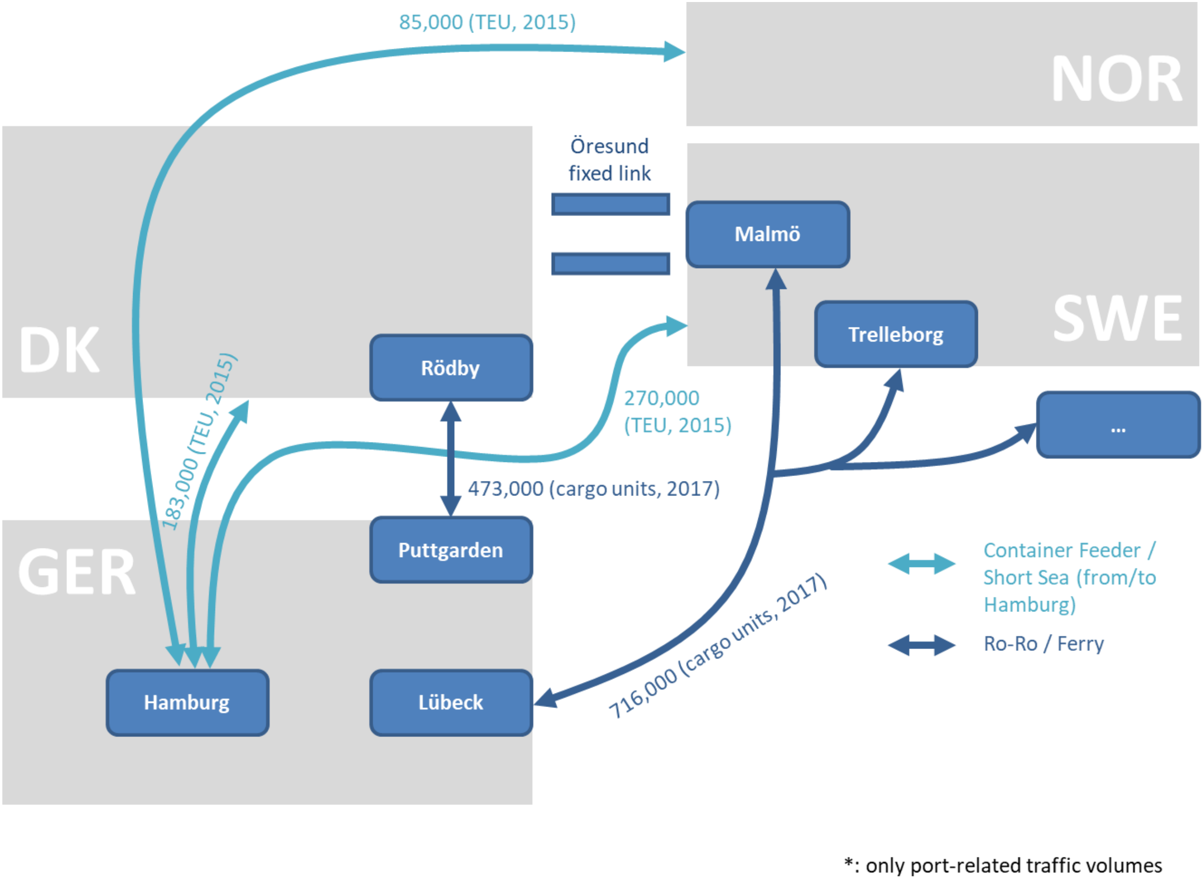
4.5 Summarized mapping of volumes and modal split along the Scandria corridor between Hamburg and Scandinavia

When trying to give an overview on all modes of transport for all the above-mentioned routes on the corridor, it becomes clear that no integrated and/or integral information base is available. Thus, the following summary elaborated in this chapter, does not function as an in any case comparable and accurate source of data, but a general compilation of different sources of statistical information, giving (or trying to give) an overview on freight volumes and modal split within the Scandria corridor relevant for this study (between Hamburg/northern Germany and Scandinavia) through different modes of transport.

As already mentioned and carried out in the previous chapters of this study, the focus is on intermodal/multimodal traffic. Thus, whenever available, intermodal/multimodal cargo volumes (e. g. container transport, ro-ro services and intermodal rail services) were taken into account.

The following figure shows the water bound or seagoing transport volumes (container feeder/short sea volumes as well as ro-ro/ferry services) on the corridor based on the data from chapters 4.1 to 4.4.

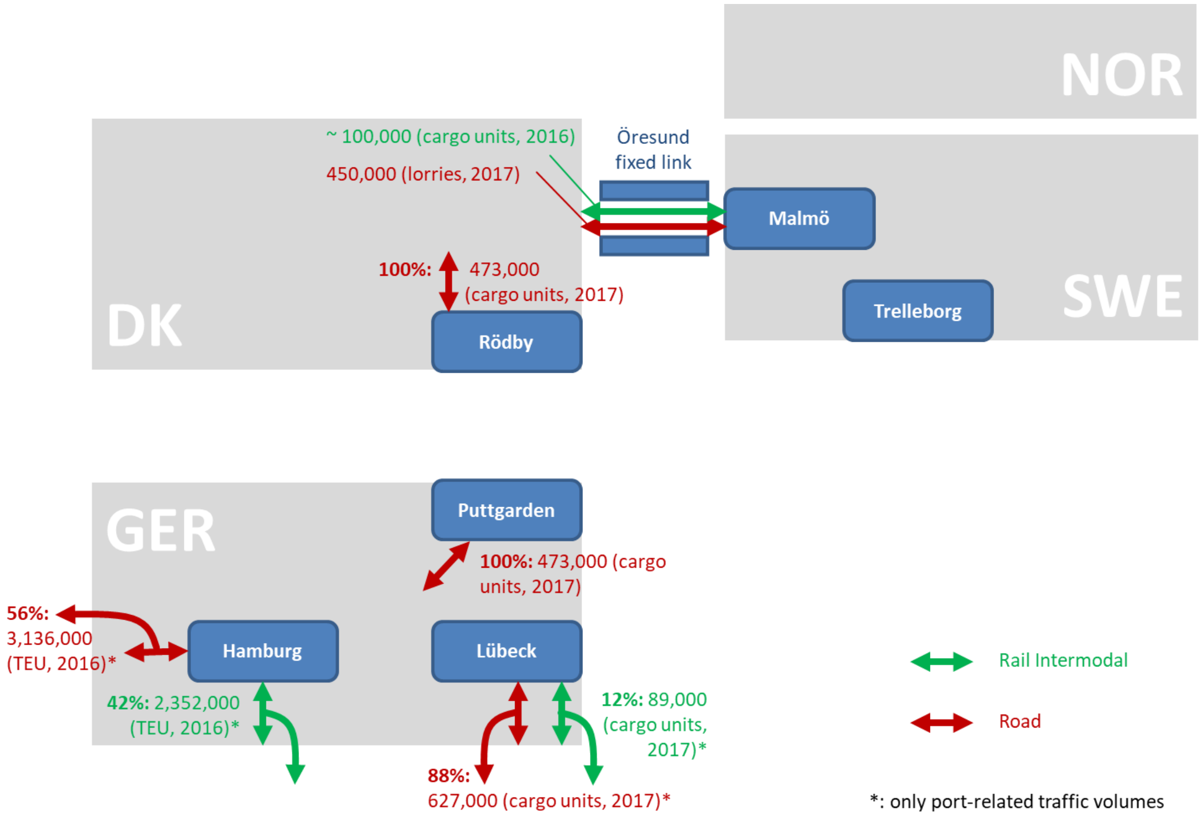
Figure 43: Mapping of volumes and modal split along the Scandria corridor between Hamburg and Scandinavia: container feeder / short sea traffic and ro-ro/ferry volumes



Source: Logistics Initiative Hamburg

When applying the same visualisation on land bound intermodal/multimodal freight volumes (road and intermodal rail) and modal split, the following picture shows, based on the data from chapters 4.1 to 4.4.

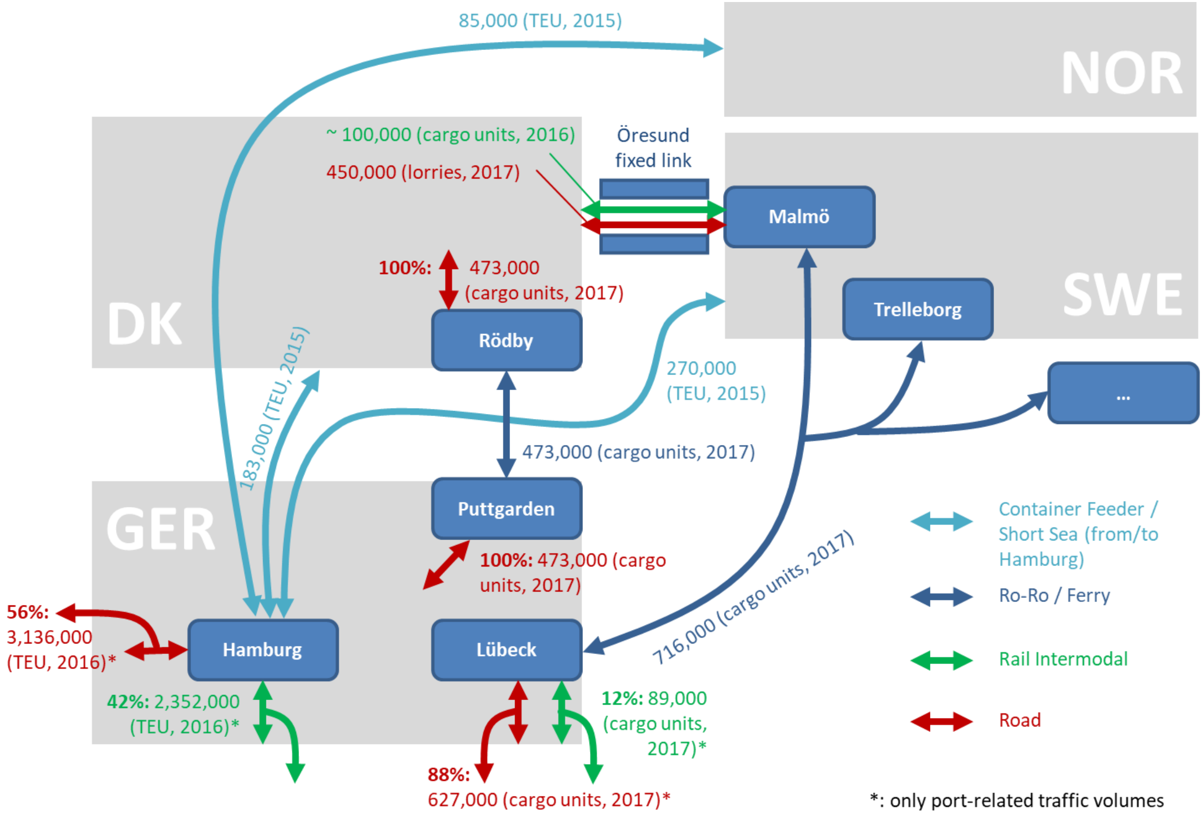
Figure 44: Mapping of volumes and modal split along the Scandria corridor between Hamburg and Scandinavia: road and intermodal rail volumes



Source: Logistics Initiative Hamburg

Finally, combining water bound and land bound traffic from the two previous figures, the following "overall" picture shows.

Figure 45: Mapping of volumes and modal split along the Scandria corridor between Hamburg and Scandinavia: combined container feeder/short sea traffic, ro-ro/ferry volumes, road and intermodal rail volumes



Source: Logistics Initiative Hamburg

It can be seen, that even though significant volumes of freight traffic already uses feeder services, ro-ro or ferry services or intermodal rail services, there is a huge share of road traffic within the corridor – thus showing a huge potential for modal shift in the future.

Many of those road based freight volumes qualify for modal shift through both cargo volumes and distance of transport. Concerning distance of transport, the findings from chapter 4.4 should be highlighted again. They show that 56 % of international road transport of Danish vehicles has a total distance of over 300 kilometres. For Foreign vehicles transporting goods on those relations, the share of long distance transports is assumed even higher.

5 Critical mass analysis

In order to run a train service on market terms, not only the plain minimal sufficient amount of freight cargo (representing the critical mass) needs to be determined. Those minimal freight volumes also have to meet various structural and restrictive boundary conditions, such as:

- Cargo flows in both directions need to be identified (pairing of freight volumes)
- A stable intermodal connection with no significant seasonal or short-term fluctuations in volumes
- A minimum frequency of two more likely three departures per week and per direction
- Similar intermodal cargo units (containers, trailers, etc.) in both directions for which the same freight cars can be used.

Capacities

To assess the critical mass freight volumes for a feasible and sustainable intermodal connection within the effective area covered by this study, the next step would be to look into capacities of intermodal block trains.

To simplify matters, it is supposed that today's standard 600 metre trains will be used for the assessment. When 740 metre trains are used, capacities are increased accordingly.

A distinction must be made between container trains and trailer trains in the capacity calculation.

- Container trains: Average capacity of 80 to 90 TEU per container block train
- Trailer trains: Number of trailers per block train: 30-35 depending on the type of (pocket) wagons and trailers.

Minimal capacity utilisation required

The necessary minimum capacity utilisation of intermodal trains for long-term economic operation depends on the individual case and depends on

- the intermodal connections themselves,
- their frequency,
- the contractual transport tariffs and
- the long-term nature of the connection,
- the stability vs. volatility of the freight volumes,
- etc.

In general, on the basis of the experience and statements made by experts within the framework of the Scandria2Act project and this study, it can be assumed that an absolute average utilisation rate of 80 % for an intermodal train can be regarded as an absolute minimum value in order to be able to operate it in an economically feasible way in the long term. Usually, however, the capacity utilisation required to ensure economic viability is higher. In the following, the **critical mass analysis** is therefore based on a slightly higher **capacity utilisation value of 90 %**.

Determining the values for the critical mass for container block trains

A stable intermodal connection with at least two, but better three departures/week and direction corresponds to a critical mass of the above-mentioned capacity and minimum capacity utilisation:

- **For 2 departures/week and direction:**
  4 departures x 90 TEU x 52 weeks = 18,720 TEU/year capacity
  *at 90 % capacity utilisation = **16,848 TEU/year***
- **For 3 departures/week and direction:**
  6 departures x 90 TEU x 52 weeks = 28,080 TEU/year capacity
  *at 90 % capacity utilisation = **25,272 TEU/year***

The abovementioned structural and restrictive boundary conditions apply.

Determining the values for the critical mass for trailer block trains

A stable intermodal connection with at least two, but better three departures/week and direction corresponds to a critical mass of the above-mentioned capacity and minimum capacity utilisation:

- **For 2 departures/week and direction:**
  4 departures x 35 trailer units x 52 weeks = 7,280 trailer unit/year capacity
  at 90% capacity utilisation = ***6,552 trailer units/year***
- **For 3 departures/week and direction:**
  6 departures x 35 trailer units x 52 weeks = 10,920 trailer units/year capacity
  at 90% capacity utilisation = ***9,828 trailer units/year***

The above-mentioned structural and restrictive boundary conditions apply.

To sum up, this shows, that the critical mass volumes per year for an intermodal freight train that is running with a frequency of two departures per week and direction are just under 17,000 TEU for container block trains (8,500 per direction) and around 6,500 trailer units for trailer block trains (3,250 per direction).

6 Transport cost analysis

6.1 Cost structure of transportation modes

An important factor in the transport mode choice is the price that transport users are being offered. At a certain distance and a certain amount, the use of the intermodal transport mode has clear economic advantage over long-distance road freight transport. From this so-called "break-even point", intermodal transports become more cost-effective than pure road transports.

There is a disagreement about when the “break-even point” occurs. The transport distance is an essential factor when considering freight transport offers, as these in particular affect the system costs of the transportation mode. Sufficient transport distances are particularly relevant for rail with its particularly high fixed costs, as rail freight transport can gain competitive advantages over truck transport mainly through them.

It can be said that in general, at distances of 500 kilometers, economic and ecological advantages compared to pure road freight can be reached. However, in practice, there are numerous examples in which with the intermodal transportation mode, the “break-even point” can be reached already at 300 kilometers, in particular seaport hinterland traffic. Therefore, it is necessary to decide case-by-case about the cost-effectiveness of intermodal or road transportation.

The costs of the transportation modes are mostly based on an agreement between the freight transporter and the customer with freight. At calculating the costs, various factors must be taken into account:

- the amount of goods transported,
- the distance of transportation,
- the type of goods, other goods transported on the same train,
- frequency of transportation and
- whether the train is full on the return trip,
- etc.

Because the costs are highly specific and variable, cost advantages are always to be checked on an individual base for each cases.

The **intermodal transport mode** has the economic advantage that for each section within the intermodal transport chain the most favorable mode of transport can be chosen. Nevertheless, especially through the change of transportation modes and handling, additional costs can occur that must also be compensated in order to achieve a competitive feasibility. This could for example be costs for transshipment, customs, intermediate storage or special services.

Figure 46: Cost structure of the intermodal transport chain

Source: Logistics Initiative Hamburg, *based on:* Posset et al. (2014), Intermodaler Verkehr Europa

´Truck **vehicle costs** can be divided into four main groups:

- Variable or kilometre-dependent costs (e. g. fuel costs)
- Personnel costs (e. g. wages)
- Other, time-dependent (fixed costs) (e. g. insurance)
- Overhead costs (disposition, administration, IT)

While the variable, kilometer-dependent costs depend largely on the intensity of the effort of road transportation, the personnel costs and the fixed costs are largely time-dependent. In addition, there are overhead costs for the scheduling, the personnel management et cetera.

Road transportation profit the most from low variable costs. Diesel and gasoline prices have been determined by a long-term low since a sharp drop in prices at the end of 2012. In the case of diesel, the extraordinarily significant reduction in the tax level to promote the domestic road haulage industry continue to have also an effect.[44]

Train transportation costs in general include:

- rail network infrastructure (fixed costs) (e. g. maintenance and operation of way and structures, such as track and roadway, signals, communication)
- train operations (e. g. fuel or electrical energy, personal, etc.)
- overhead costs (e. g. general administration)

While in long-distance road transport variable costs (e. g. fuel costs) represent the largest cost block, the railways are associated with higher fixed costs. The reason for the extensive amount of fixed costs is that the railroads own their own infrastructure and have to account for the ownership. Most costs for the railway infrastructure network include capital and maintenance costs for track, engineering structures such as bridges and tunnels, train signaling, communications systems, power supply in electrified sections, and terminal infrastructure.

In the case of rail, the costs of infrastructure use are determined by the train path and station charges or the costs of service facilities whose operational "full costs" are passed on to the users. Every year, the DB Netz AG continuously increases the costs of train path utilization with a target value of 2.4 percent. In the 2018 timetable year, EUR 2.98 per kilometer is to be paid for a standard freight train.[45] These annually rising train path charges are a major obstacle to more rail traffic because the high train path costs significantly distort competition between rail and road.

One step towards bringing more freight traffic onto the rail and making the railway freight transport more affordable is the reduction of the train path prices. In June 2018, the Budget Committee of the Bundestag agreed in its settlement meeting that train path prices should be roughly halved and the tracks for long freight trains expanded. To this end, in return, the Deutsche Bahn will receive around 350 million € annually from the federal budget as

[44] Zugkraft für den Verkehrssektor: Wettbewerber-Report Eisenbahn 2017/18, Oktober 2017

[45] Zugkraft für den Verkehrssektor: Wettbewerber-Report Eisenbahn 2017/18, Oktober 2017

compensation for the reduction of the train path prices.[46] The measure is of great economic importance for freight railway undertakings because the implementation of this measure means a noticeable reduction in costs for each operated train.

Furthermore, electrically powered rail transport must also bear the costs induced by the energy policies named as energy transition in Germany, precisely the so-called renewable energies law (EEG) levy, which has been rising sharply since 2014. The Deutsche Bahn is already one of the largest contributors to the EEG-pay system.

Although the EEG levy is limited to 20 % (2016) of the EEG levy calculated for railway companies, this represents a doubling of the value compared with 2014. For rail transport companies, these regulations entail additional costs in the millions. [47]

Price development in freight transport

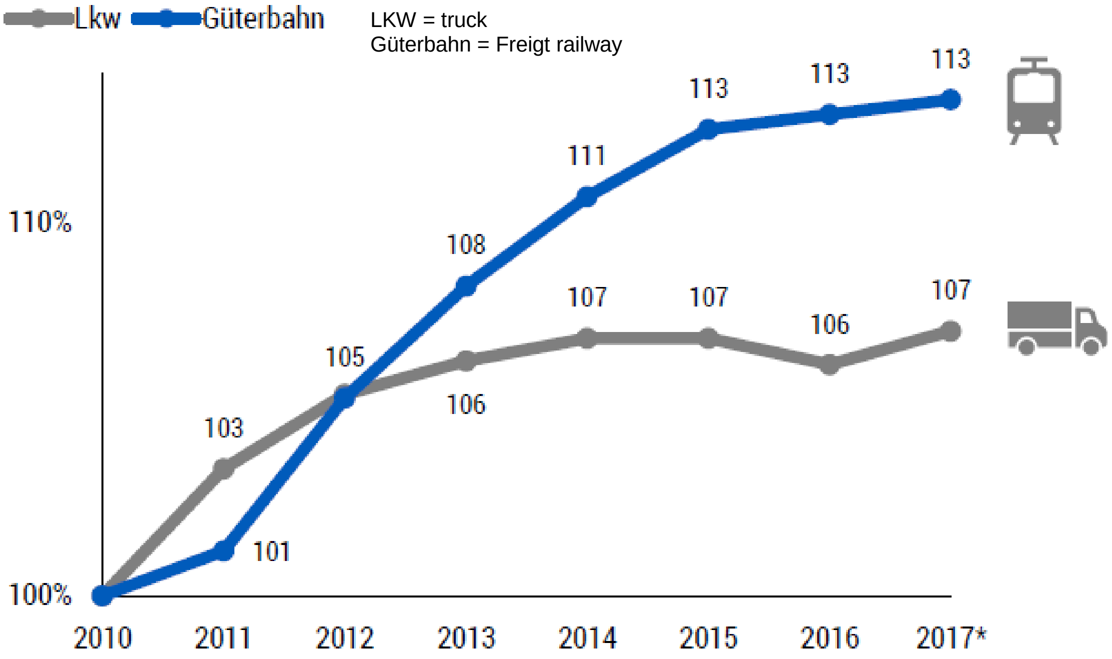
Lower road charges for heavy goods vehicles, increasing track access charges for rail operators, higher taxes on rail traction current and increasing EEG renewable energy levies on goods trains have completely distorted the pricing structure, to the detriment of the railways. In addition, politicians are continuing to subsidize diesel fuel, which has been sinking in price for years.

According to the official producer price index, road freight transport costs are 6 percent lower than pure railway freight transportation (compared to the index price level of 2010). The development of the prices shows that between 2010 and 2017 road transport costs rose by only seven percent while rail freight customers had to cope with price increases of 13 percent in the same period, as shown below.

[46] https://www.eurotransport.de/artikel/bundestag-senkt-trassenpreise-175-millionen-euro-fuer-die-schiene-10217545.html

[47] Ebd.

Figure 47: Price development in freight transport in Germany, truck vs. rail



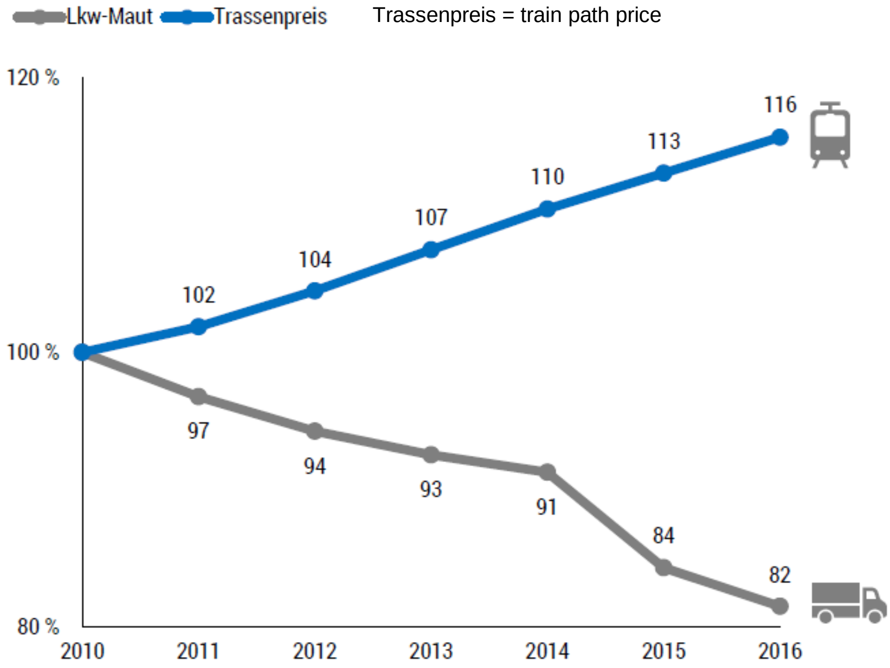
Source: https://www.allianz-pro-schiene.de/presse/pressemitteilungen/preisindex-bahnkunden-von-der-politik-abgehaengt/

While in the case of rail, the costs of infrastructure use are determined by the train path and station charges or the costs of service facilities, which are passed on to the users, the truck bears only a small part of its infrastructure costs itself. Trucks in Germany pay road tolls on motorways and since 01.01.2019 on all federal highways (Bundesstraßen)[48] - and this only from a permissible total weight of 7.5 tons onwards. The data from current market reports show that the truck toll has fallen by 18 percent compared to 2010, while freight trains had to pay an average of 16 percent higher train path charges in the same period. See following figure for details.

[48] https://www.bmvi.de/DE/Themen/Mobilitaet/Strasse/LKW-Maut/lkw-maut.html

Figure 48: Development of infrastructure usage costs in Germany, truck toll vs. train path prices (index prices based on 2010)

LKW-Maut = truck toll
Trassenpreis = train path price



Source: https://www.allianz-pro-schiene.de/presse/pressemitteilungen/preisindex-bahnkunden-von-der-politik-abgehaengt/

This shows that the reduction of train path prices is a very important tool to support the competitiveness of rail freight transport.

In order to make the intermodal transport more attractive regarding cost effectiveness, financial incentives must be provided by the governments to create a shift from road to intermodal transportation, also beyond the now adjusted train path costs.

6.2 Methodolgy of the transport cost analysis

In order to find out more about the actual costs of the different transport modes to Scandinavia, a cost analysis has been conducted. The aim of this analysis is to gain a mutual understanding about which transportation mode is the most cost effective option and at which point a critical mass can be reached between both transport modes – direct road transportation or intermodal transportation from Hamburg to Scandinavia.

During research, the problem occurred that there were no reliable data available for both transportation modes. Many websites offer information about different transport modes and routes but there is no cost transparency regarding actual freight offers and cost structures for the relevant area of research for this study between Hamburg and Scandinavia. Furthermore, there are no standard processes for requesting prices, e. g. automatic fields where distances and prices can be compared. Usually, manual requests need to be send to the different companies in order to receive an offer. Also, there is no widely used or accepted comparison portal available on the internet where different suppliers with different costs are listed.

Because of that lack of transparency, an alternative methodology for the collection of exemplary "real world" information was applied.

A fictional cost request via email has been send out to seven transportation companies. Those seven companies have been chosen deliberately because they operate both on road and intermodal in the area between northern Germany and Scandinavia.

All of the companies are members of the Logistics Initiative Hamburg network and have long-time experiences in container and/or trailer transportation.

The request contained a fictional example about a company that is located in Hamburg and which is asking for three logistical transport services to Scandinavia. Three distances were requested:

- Hamburg to Malmö,
- Hamburg to Örebro and
- Hamburg to Oslo.

Furthermore, the request contained important other factors about the frequency of transportation and the quantity. For the request a stable quantity with a fixed weight was chosen:

The request was specifically chosen with parameters that would allow to be transported through an intermodal transport solution. Also, it was specifically asked for each relation to provide once your best offer both through a combined transport solution (maximum possible intermodal distance) for boxes that are not time-critical, and complete truck/road based transport solution for time-critical deliveries.

Figure 49: Cost/Transport offer request

Original request (in German language)	**English Translation**
Sehr geehrte Damen und Herren, *im Auftrag eines Industriepartners aus unserem Netzwerk möchten wir hiermit einmal Ihr Angebot für eine logistische Transportleistung nach Skandinavien anfragen.* *Es handelt sich um einen Haus-zu-Haus-Transport von 40‘ x 9‘6“-Containern, Auslastung/Ladung ca. 18 t, im Import. Die Leercontainer gehen am Zielort ins Depot.* *Es handelt sich nicht um Gefahrgut.* *Die Verzollung wird vom Auftraggeber abgewickelt.* *Es handelt sich um eine Jahresmenge von ca. 1.000 40‘-Containern mit einer wöchentlichen Frequenz. Das Wochenaufkommen liegt bei 20-30 Containern.* *Die Anfrage beinhaltet drei Relationen:*	*Dear Sir or Madam,* *on behalf of an industrial partner from our network based in Hamburg, we would like to inquire about your offer for a logistical transport service to Scandinavia.* *It is a door-to-door transport of 40 'x 9'6 "containers, capacity / load approx. 18 t, in import. The empty containers go to the destination in the depot.* *It is not dangerous goods.* *The customs clearance is handled by the client.* *It is an annual amount of approximately 1,000 40'-containers with a weekly frequency. The weekly volume is 20-30 containers.* *The request contains three relations:*

D-21129 Hamburg S-21124 Malmö *D-21129 Hamburg S-70363 Örebro* *D-21129 Hamburg N-0668 Oslo* *Der Kunde wird eine der drei Relationen bedienen. Das Mengenvolumen von 1.000 Containern/Jahr gilt also für jede der drei o. g. Relationen.* *Bitte geben Sie uns für jede Relation einmal Ihr günstigstes Angebot im Kombinierten Verkehr (maximal mögliche Distanz Intermodal) für zeitunkritische Boxen sowie komplett Lkw für zeitkritische Lieferungen/Terminware.* *Bitte nutzen Sie die beigefügte Excel-Tabelle für Ihre Preisangaben.* *Wir freuen uns auf Ihre Rückmeldung.* *Mit freundlichen Grüßen* ***Thomas Brauner*** *Projektmanager Innovation und Technologie* *Logistik-Initiative Hamburg* *Wexstraße 7 | D-20355 Hamburg*	*D-21129 Hamburg S-21124 Malmo* *D-21129 Hamburg S-70363 Örebro* *D-21129 Hamburg N-0668 Oslo* *The customer will serve one of the three relations. The quantity volume of 1,000 containers / year thus applies to each of the three relations.”* *Please give us for each relation once your best offer in combined transport (maximum possible intermodal distance) for boxes that are not time-critical, and complete truck for time-critical deliveries/terminables.* *Please use the enclosed Excel table for your price quotations.* *We look forward to your feedback.* *With kind regards* ***Thomas Brauner*** *Projektmanager Innovation and Technology* *Logistics Initiative Hamburg* *Wexstraße 7 | D-20355 Hamburg*

Source: Logistics Initiative Hamburg

A standardized excel sheet has been annexed to the transport offer request in order to receive comparable offers from the companies, as shown below.

Figure 50: Excel table for prices

Preis (netto) je 40'-Container in €					
Volumen: 1.000 40' x 9'6" Container/Jahr					
Relation		Route Lkw (Terminware)		Route maximale Distanz Intermodal (zeitunkritische Ware)	
von	*nach*	*Preis*	*Distanz; via*	*Preis*	*Distanz; Anteil Intermodal; via*
D-21129 Hamburg	S-21124 Malmö				
D-21129 Hamburg	S-70363 Örebro				
D-21129 Hamburg	N-0668 Oslo				

Source: Logistics Initiative Hamburg

6.3 Key Findings of the transport cost analysis

Among the seven companies that were chosen for the survey, only two of the companies submitted a tender. Two of the companies have replied that they do not offer container transports to Scandinavia. The other three companies did not respond to the request. While both of the companies that made an offer operate on road from Hamburg to Scandinavia, only one of the companies made an offer about an intermodal transportation mode to Scandinavia.

In the following, the offers are presented in detail. The requested companies are named with "operator 1 to 7" in order to assure anonymity of the information collected within the following chapter:

- Case 1: Operator 1 – transportation with both transportation modes
- Case 2: Operator 2 – only road transport
- Case 3: Operator 3/4 – no offer of container transports to Scandinavia
- Case 4: Operator 5/6/7 – no answer to request

Case 1 – transportation with both transportation modes

One of the requested companies named as "operator 1" offers both of the transportation modes to Scandinavia. The prices operating on road to Malmö, Örebro and Oslo range from 1.250,00 € to 1.790,00 €. While the operator 1 operate all of the three routes on the road, the operator 1 operates only one of the routes intermodal.

When comparing the offer of the intermodal transportation mode with the direct road transportation, it can be seen that the costs are the same. In both cases the transport costs are at the amount of 1.560,00 €.

While all of the road transports go via Lübeck and Malmö, the intermodal transport goes via Eskilstuna. Eskilstuna Intermodal Terminal is one of Sweden’s leading intermodal terminals with two access points to the national railway network and right next to European route E20.

Figure 51: Transport costs of operator 1

Route	Price road transportation	Distance; via		Price intermodal transportation	Distance; ratio Intermodal; via
HH – Malmö	1.250,00 €	71 km; Lübeck-Malmö		n/s	n/s
HH - Örebro	1.560,00 €	569 km; Lübeck-Malmö		1.560,00 €	728 km; 570 km Intermodal, via Eskilstuna
HH – Oslo	1.790,00 €	629 km; Lübeck-Malmö		n/s	n/s

Source: Logistics Initiative Hamburg

Case 2 – only road transportation

Operator 2 offers the routes only on the road. The company argues that they only operate transportation services to Scandinavia with a 13.6 m tilt or box trailer with max. payload of 24 tons. Via sea, they do not offer the routes due to the small distances to south Scandinavia. That is why they suggest that only a combined transport truck – ferry makes sense.

Figure 52: Transport costs of operator 2

Route	Price road transportation	Distance; via		Price intermodal transportation	Distance; ratio Intermodal; via
HH – Malmö	1.250,00 €	71 km; Lübeck-Malmö		n/s	n/s
HH - Örebro	1.850,00 €	569 km; Lübeck-Malmö		n/s	n/s
HH – Oslo	2.045,00 €	629 km; Lübeck-Malmö		n/s	n/s

Source: Logistics Initiative Hamburg

Case 3 – no offer of container transports to Scandinavia

The *operator 3* does not offer container transports due to its statutes (limited partnership, 50 % DB Cargo as well as 50 % forwarding and logistics companies). They only work exclusively with forwarding agents and logistics companies and do not offer their services to shippers or intermediaries. *Operator 4* also does not offer container transports to Scandinavia. Nevertheless, if the shipper would request it, they can unpack the containers in Lübeck and can make the onward journey Lübeck - Sweden / Norway by a trailer. A price offer was not gives for this option, though.

Case 4 – no answer to the sent request

No answer to the request was given by three of the seven transport companies.

Conclusion

Comparing the costs of the different transportation modes, it can be concluded that no price differences between the intermodal transportation mode and the transportation via road can be found through the study. The only company that made an offer for both of the transport modes to Scandinavia, named the exact same prices for road and intermodal transport, assuming that this is based on a mixed calculation/compensatory pricing between intermodal and road transport.

Even if the cost analysis contains only data from seven companies, the study gives a good overview about the current cost situation of the different available transport modes from Hamburg to Scandinavia. In order to gain more significant results, more companies would need to be included in a case study. Moreover, to get a whole overview about the cost structure, a full overview of the different cost types would be necessary. The study only reveals the total costs but does not split the costs into different components.

Altogether, this shows that there is a lack of transparency about the different transport costs as well as options. In order to make the costs more transparent and to make it easier for the customers to access intermodal transport services. Intermodal companies need to have more customer-centred, standardised, digital and real-time processes in order to achieve this.

Besides the lack of transparency, it becomes clear that even though it is the proclaimed goal to shift freight from road to rail/intermodal services, there is a clear bottleneck in the supply of suitable transport solutions for the shipping industry.

This can be easily explained by the aforementioned boundary conditions from the critical mass analysis. Due to the complexity and the high fixed costs for intermodal companies, it is only possible to offer intermodal block trains if a constant, reliable, plannable and high rather capacity utilisation can be expected.

This in turn contrasts with the approach of our cost analysis, in which ad-hoc requests were made for a stable, but comparatively high volume of goods. It seems logical that intermodal companies should not be able to offer these volumes ad-hoc in free freight train capacities on precisely the specific routes requested. If they could, this would mean that their trains would currently be operated uneconomically and heavily underutilised and would thus not be feasible intermodal service routes.

However, this also shows based on the exemplary case, the difficulty of setting up new and more intermodal or rail services due to a “hen-egg-dilemma”. New services cannot be placed without sufficient, non-volatile cargo volumes in two directions. Cargo volumes that are aimed to be transported on such intermodal/rail services by shippers then cannot be placed onto such serviced because of the lack of service offers.

7 Analysis of the potentials and constraints for new direct railway freight and multimodal services along the corridor (SWOT analysis)

This chapter will address the concluding of an overview of potentials and constraints for new direct railway freight and multimodal services along the corridor between Hamburg and Scandinavia.

This will include both

- all the facts and findings from the previous analyses elaborated within this study (infrastructure and connectivity analysis, freight and modal split analysis, Critical mass analysis and transport cost analysis) as well as
- additional findings that were gathered and learnt during the Scandria2Act project activity, e. g. though knowledge exchange or events with experts as well as through further studies conducted within the Scandria2Act project framework which were not part of the above-mentioned analyses.

Methodology and theoretical approach

The method of a SWOT analysis is used for this in order to show strengths and weaknesses of the transport and rail freight system with relevance to modal shift as well as opportunities and risks relating the external view, in particular external influences, trends and developments that affect the rail/intermodal services transport system.

A SWOT analysis is most commonly used by business entities, but it is also used by nonprofit organizations and, to a lesser degree, individuals for personal assessment. Additionally, it can be used to assess initiatives, products or projects. The framework is based on the works of Albert Humphrey and the Stanford Research Institute and has been adopted by organizations of all types as an aid to making decisions.

A SWOT analysis is often used at the start of or as part of a strategic planning process. The framework is considered a powerful support for decision-making because it enables an entity to uncover opportunities for success that were previously unarticulated or to highlight threats before they become overly burdensome. For example, this exercise can identify a market niche in which a business has a competitive advantage by pinpointing a path that maximizes their strengths while alerting them to threats that can thwart achievement, thus this can be seen as a suitable approach in order to identify recommendations how to create and strengthen direct rail services as well as intermodal services in the Scandria2Act corridor.

The four elements of a SWOT analysis examine the following by applying an internal as well as an external view:

- Strengths: Internal attributes and resources that support a successful outcome.
- Weaknesses: Internal attributes and resources that work against a successful outcome.
- Opportunities: External factors that the entity can capitalize on or use to its advantage.
- Threats: External factors that could jeopardize the entity's success.

A SWOT analysis exists in various template forms, generally in variations of the standard four-quadrant SWOT matrix as shown below.

Figure 53: SWOT analysis scope

Strengths	Weaknesses	Opportunities	Threads
What do intermodal / direct rail services do better than competing modes of transport?	What do intermodal / direct rail services need to improve upon?	What (market) trends could lead to benefits or improving circumstances for indermodal / direct rail services?	What are the advantages competing modes of transport have or will have over intermodal / direct rail services?

Source: Logistics Initiative Hamburg

Following, you can find the SWOT analysis matrix based on the above-mentioned methodology.

Strengths

- Efficient and competitive mode of transport for high volume and long transports as well as cost advantages through mass transport means
- High level of transport safety by rail
- Reducing freight volumes on congested and dilapidated road traffic infrastructures
- Sustainability advantages through noise and CO_2 reduction compared to road freight transport (significantly better CO_2 balance per cargo unit)
- Business benefits (e. g. 44-ton rule, exemptions from driving bans, exemption from vehicle tax, lower toll costs)
- Fixed running times of rail or intermodal services result in truck driver rest periods no longer applying

Weaknesses

- Complexity of rail as a transport mode creates competitive disadvantages compared to road freight transport: Demanding and complex planning requirements (due to bundling of cargo) with at the same time very dynamic events influencing the transport chain, e. g. delays, limited infrastructure availability and a rigid framework of specific authorities (e. g. customs)
- Transport times in intermodal transport is usually longer than in classic road transport.
- Missing flexibility and punctuality due to restrictive boundary conditions that need to be met for rail / intermodal services, which also underline the abovementioned complexity aspect:
    - Transport distances usually need to be longer than 300 km to make intermodal transport feasible
    - Cargo flows in both directions need to be identified (pairing of freight volumes), a lack of a cooperation partner in the recipient region makes the route unfeasible
    - A stable intermodal connection with no significant seasonal or short-term fluctuations in volumes needs to be assured
    - A minimum frequency of two more likely three departures per week and per direction should be available

  - Similar intermodal cargo units (containers, trailers, etc.) in both directions for which the same freight cars can be used are needed
  - Unlike trucks, triangular traffic cannot be organised. This further reduces the flexibility of the system.
- Missing interoperability and lack of easy access to intermodal and rail services, in terms of information access, transparency of the transport/ supply chain, missing digital services and solutions, lack of visibility and controllability on the entire supply chain
- Hurdles due to required minimum volumes in relation to transport quantities (critical mass volumes needed)
- The railway system as a mode of transport is characterised by an expensive use of resources and is therefore subject to high fixed costs.
- “Hen-egg” paradox occurring for rail service offers: As shown in the transport cost analysis, due to the complexity of establishing new rail services and due to the high minimum level of capacity occupation of rail services in operation, there is a shortage of suitable rail services in terms of availability. Although there is an interest in a modal shift, shippers cannot find suitable intermodal or rail offers in many cases.
- Limited rail infrastructure capacity does not allow massive modal shift or volume increase on the relevant mail railway corridors
- Missing redundancies in the transport infrastructure create risks of accessibility, e. g. in case of infrastructure breakdowns, accidents etc. and thus limit the reliability of rail as a mode of transport

Opportunities

- Even though significant volumes of freight traffic already uses feeder services, ro-ro or ferry services or intermodal rail services, there is a huge share of road traffic within the corridor – thus showing a huge potential for modal shift in the future. Many of those road based freight volumes qualify for modal shift through both cargo volumes and distance of transport.
- The opening of the Fehmarnbelt fixed link will massively change cargo flows with an expected shift from Jutland route to Fehmarn Belt/Zealand. More transport

infrastructure capacities as well as cargo volumes and a better connectivity on main corridor are expected.

- Direct rail services will be able to use a direct route that is by 160 kilometres shorter than today and will thus be more competitive. Direct rail services will furthermore then have the same distance as road freight transport on the corridor. As of today road freight transport via Puttgarden-Rodby ferry link have a by 160 kilometres shorter distance on the corridor than rail. Thus, competitive disadvantages of rail will be decreased.
- Increasing shortage of drivers in the truck sector limits availability of road freight capacities and is expected to increase road freight pricing in the future
- 740-metres trains have the potential to increase rail freight capacities by 10-20 percent without the need to increase infrastructure capacities
- Recent policy decisions resulting in the reduction of rail freight costs, especially through the reduction of rail path charges increase competitiveness

Threads

- The opening of the fixed Fehmarnbelt link will massively change cargo flows also affecting existing intermodal services, e. g. through a modal shift from ferry to road/rail. This thread is advised to be taken serious, as it is addressing a complex and thus sensitive transport network of ro-ro/ferry links and rail hinterland services from those ports. If parts of those transport volumes shift to rail or road services on the fixe Fehmarnbelt link in the future, this means that capacities and thus frequencies of both ro-ro ferry services as well as related intermodal frequencies in the port hinterland of the other corridor regions will decrease and therefore will become less competitive, attractive and viable.
- Increasing shortage of locomotive drivers in the railway sector leads to limited availability of rail freight capacities and to growth opportunities. The competitive advantage created by a shortage of truck drivers (see opportunities) is thereby being eliminated.

8 Development of transnational multimodal transport solutions along the corridor – findings and recommendations

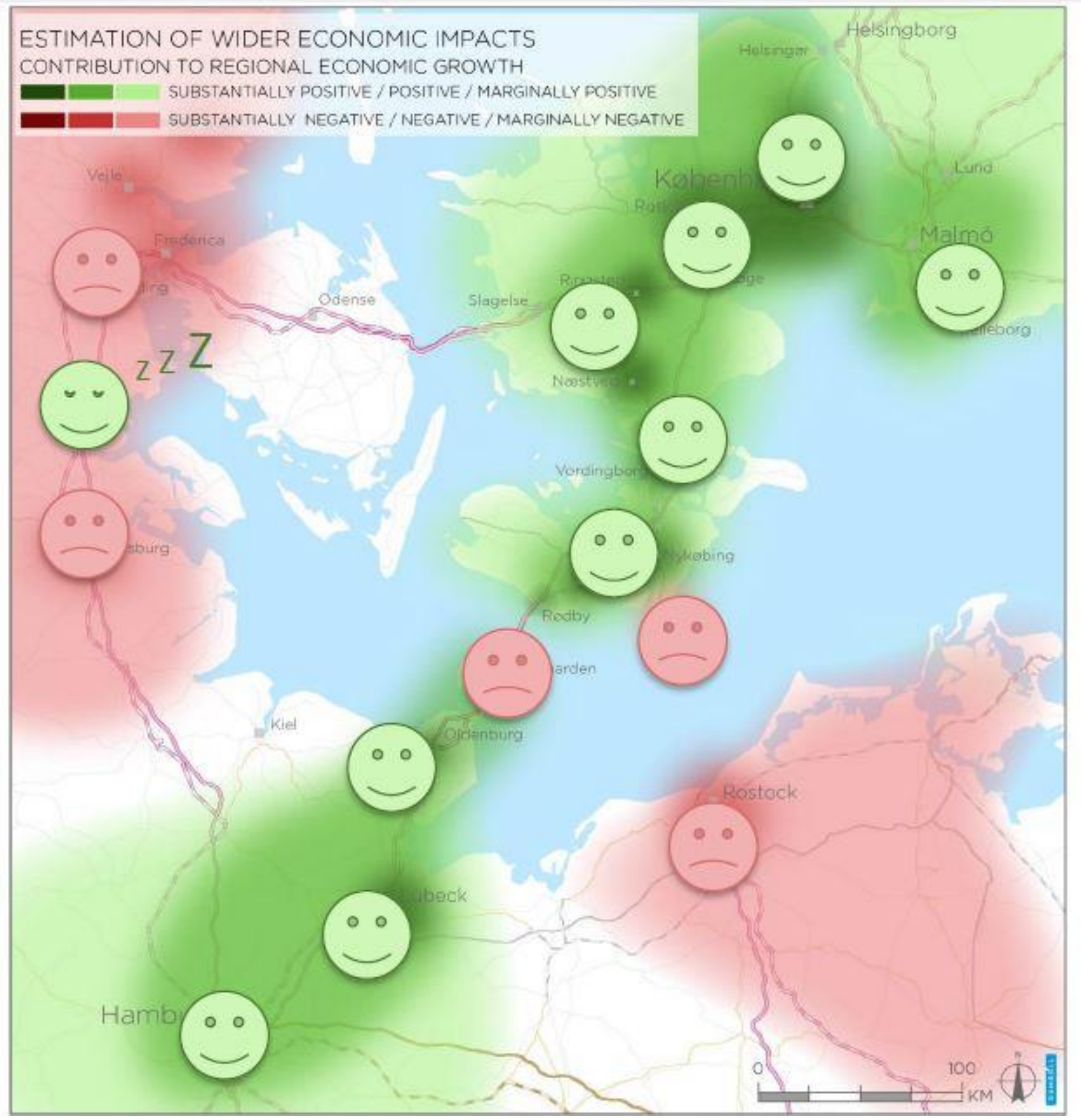
The Scandria2Act project has shown that for a successful sustainable shift from freight transport to environmentally friendly intermodal or rail services, a harmonized corridor approach is necessary and inevitable. This is not only true for spatial or infrastructure planning but also for the setup and development of rail and intermodal services operating on this infrastructure. Only through a common corridor approach streamlined and thus efficient investments, e. g. into Core Network major projects such as the Fehmarnbelt fixed link, in rail tracks to diminish bottlenecks, or into multimodal terminals where needed, are possible. Within the corridors a cooperation of urban nodes, inter-level dialogue on regional challenges associated with transport as well as the essential role of urban nodes in generating the growth within corridors are also important lessons learnt from the Scandria2Act project.

Recommendation: Continuous development of collaboration on harmonized cross-border corridor approaches on strategic as well as planning level to ensure seamless and efficient transport corridors and services.

Even though significant volumes of freight traffic already uses feeder services, ro-ro or ferry services or intermodal rail services, there is a huge share of road traffic within the corridor – thus showing a huge potential for modal shift in the future. Many of those road based freight volumes qualify for modal shift through both cargo volumes and distance of transport.

The opening of the Fehmarnbelt fixed link will massively change cargo flows with an expected shift from Jutland route to Fehmarn Belt/Zealand. More transport infrastructure capacities as well as cargo volumes and a better connectivity on main corridor are expected. Direct rail services will be able to use a direct route that is by 160 kilometres shorter than today and will thus be more competitive. Direct rail services will furthermore then have the same distance as road freight transport on the corridor. As of today road freight transport via Puttgarden-Rodby ferry link have a by 160 kilometres shorter distance on the corridor than rail. Thus, competitive disadvantages of rail will be decreased. The following figure visualises the estimation of wider economic impacts and the contribution to regional economic growth through the opening of the Fehmarnbelt fixed link.

Figure 54: Fehmarnbelt fixed link: Estimation of wider economic impacts



Source: Maatsch S., ISL: Impact of large CNC infrastructure projects on growth and cohesion, Presentation at Scandria2Act, TENTacle and NSBCore Joint Final Conference, Brussels, 6 March 2019

However, this will also be affecting existing intermodal services, e. g. through a modal shift from ferry to road/rail. This thread is advised to be taken serious, as it is addressing a complex and thus sensitive transport network of ro-ro/ferry links and rail hinterland services from those ports. If parts of those transport volumes shift to rail or road services on the fixe Fehmarnbelt link in the future, this means that capacities and thus frequencies of both ro-ro/ferry services as well as related intermodal frequencies in the port hinterland of the other corridor regions will decrease and therefore will become less competitive, attractive and viable.

Thus, in terms of transport policy, it is advised to act in such a way that corridor connecting infrastructures, in this case especially Fehmarnbelt fixed link, do not create an "anti-modal shift" from ferry and ro-ro services including the existing intermodal connections in the hinterland to road freight transport. TEN-T would thus make the EU's transport policy objectives like sustainable transport, road to rail, motorways of the seas absurd.

Recommendation: Create a transport policy framework to reduce negative impact on existing ro-ro and ferry services on the corridor through the opening of the Fehmarnbelt fixed link, e. g. through pricing instruments like the toll system applied for the fixed link.

Recommendation: Furthermore, transport policy should increase incentives for modal shift. As a positive example, the reduction of track path prices in rail freight traffic decided in Germany in 2019 can be cited here. Such measures have a direct positive effect on the competitiveness of rail as a mode of transport and therefore strengthen it directly.

The present study has also shown that numerous bottlenecks still exist, will be created in the future or will become more severe if the infrastructure is not expanded. Strengthening the railway infrastructure through expansion, repair and maintenance is therefore a basic prerequisite for the future viability of the railway and, in particular, for being able to push ahead with a modal shift.

Recommendation: Continue to implement and promote the expansion and maintenance of the railway infrastructure with high priority and with focus on identified existing and/or future bottlenecks shown in this study.

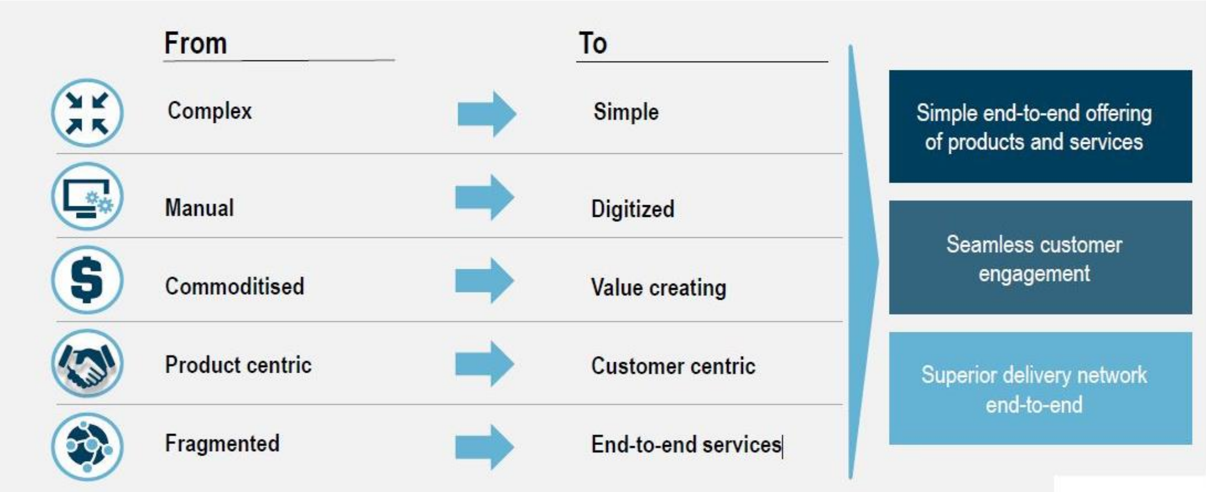
When focussing on rail and intermodal service operation, the Scandria2Act project has shown as one key finding that the rail and intermodal logistics industry as well as logistics in general is being further challenged by a relatively low customer satisfaction and rising expectations in the future, based on trends driven by technology development and continued globalisation. This is being visualised in the following figure.

Figure 55: Technology and globalisation driven trends challenging logistics and rail / intermodal companies

Source: Krenzien, J.-O., Maersk: Transforming the shipping industry. Challenges and Trends; Presentation at the event “2. Bahnkonferenz” organised by Logistics Initiative Hamburg, 18.12.2018, Bremen

Thus, the logistics industry, including rail and intermodal companies will have to change its fundamentals. A collaborative approach will be key in order to succeed with these challenges. See following figure for an overview and below for details and recommendations derived from this.

Figure 56: Necessary fundamental changes in logistics industry, rail and intermodal



Source: Krenzien, J.-O., Maersk: Transforming the shipping industry. Challenges and Trends; Presentation at the event "2. Bahnkonferenz" organised by Logistics Initiative Hamburg, 18.12.2018, Bremen

Shippers are one of the key stakeholders to be addressed in order to further push a modal shift. In the future, they will have to demand more frequent use of rail and intermodal connections from their logistics and transport service providers. In principle, there is sufficient self-interest in this, e. g. reducing the CO2 footprint of one's own process chain and profiting from the economic advantages of rail as a mode of transport. Thus the following is recommended:

Recommendation: To achieve this, shippers must create or increase awareness of rail as a mode of transport. Furthermore, it is necessary to achieve better networking and information of the shippers, e. g. in order to minimise obstacles to rail transport due to a lack of counter-quantities of cargo.

In this context, reference is made to a further study elaborated within the Scandria2Act project framework: The study "Assessing offers and preconditions for multimodal freight transport in the Scandria2Act partner regions: Summary report”[49] addresses the shippers’ needs in relation to multimodal freight transport services.

Not only does the networking and exchange between shippers create potentials. The aim is to significantly improve the networking of the transport chain as a whole and thus also to improve operational cooperation and the efficiency of the transport chain. Shippers must be more closely integrated into the challenges of the supply chain via forwarders and rail operators. In a second step, this also includes establishing a customer-centred view at the railway and intermodal companies. Only this can ultimately and fundamentally improve the customer experience and serve and meet the increasing demands of customers.

Recommendation: Improve the networking of the transport chain as a whole and thus improve operational cooperation and the efficiency of the transport chain.

Recommendation: Implement a customer-centred view into rail and intermodal processes and companies in order to improve customer experience. Create collaborative supply-chain ecosystems instead of “silo” companies and data. This will create customer-centred integrated product offerings and customer satisfaction and will therefore benefit the demand and the quality of rail and intermodal services.

This can only be achieved through a broad and comprehensive digital transformation process, which is expected to be challenging. This also will not be achievable in a short-term perspective, which makes it even more important to raise awareness to this now.

Some railway and intermodal companies in specific parts of the supply chain are already successfully using digitisation approaches. However, these are not yet fully linked to a resilient and comprehensive management logic throughout stakeholders and transport chains but rather most commonly company internal platforms or approaches. Instead of digitizing

[49] See: Technical University of Denmark, Region Örebro County, University of Turku, Copenhagen Business School: Output 3.2, Assessing offers and preconditions for multimodal freight transport in the Scandria®2Act partner regions: Summary report, February 2019 available via https://www.scandria-corridor.eu/index.php/en/scandria-2act/downloads

individual sub-areas, it will be crucial to create comprehensive solutions along the transport chains. For this, you have to change not only the handling of data but also the mind-set of the stakeholders!

Recommendation: Fully digitize the rail companies and transport chain, improve capacity, volume and cost visibility, and simplify and digitize booking processes.

Recommendation: Establish online distribution channels that display and dynamise free train capacities, routes and prices.

Recommendation: Development and use of intelligent wagons with intelligent functions, geofencing, track & trace, etc.

Outlook and specific activities of Logistics Initiative Hamburg targeting these recommendations

The Logistics Initiative Hamburg has created a project cooperation between the Scandria2Act project and a national intermodal project within Germany called “ERFA-KV”. Within this scheme of collaboration, a regional group has been founded with stakeholders including shippers, intermodal companies as well as road transport companies. The aim of this regional group which is meeting on a regular basis is to improve knowledge on intermodal services and thus create suitable solutions and possible foster the implementation of future intermodal services, too.

Furthermore, the Logistics Initiative Hamburg is continuing its working group rail, organises conferences and regularly informs its network about important developments and interesting facts about rail and intermodal transport. The Logistics Initiative Hamburg also advises and consults its network in terms of how to raise funds from national funding programmes or the CEF funding. This contributes significantly to the fact that our network can implement innovation projects.

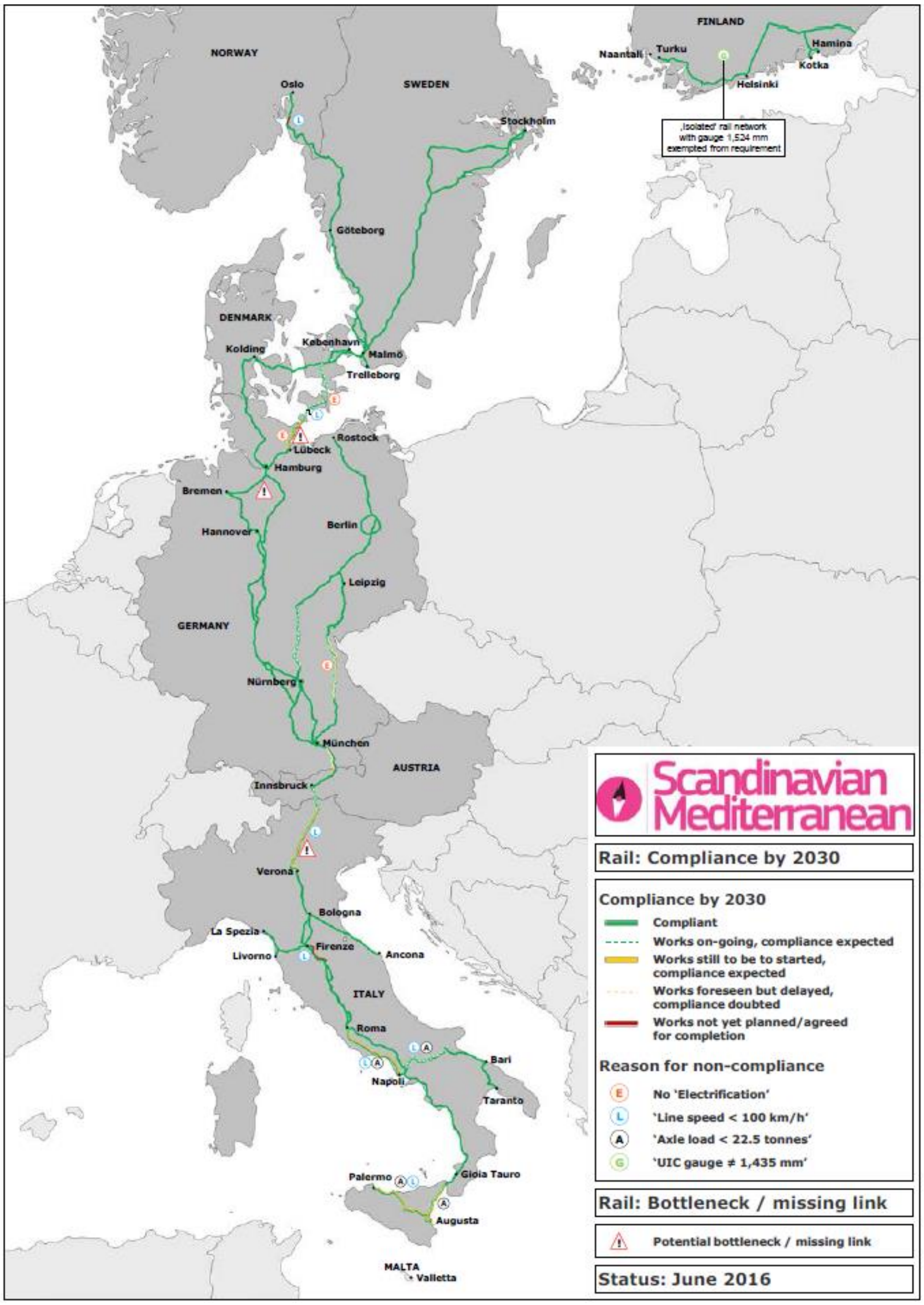
Lastly, the Logistics Initiative Hamburg also actively promotes digitisation and digital transformation by being an active partner in Hamburg's innovation ecosystem. For example, the Logistics Initiative Hamburg is the major shareholder of the Digital Hub Logistics Hamburg[50], which is accessible for every member of our network as an open and independent meeting and project space.

[50] See https://www.digitalhublogistics.hamburg/

Annexes

A1. Infrastructure and connectivity analysis: Railway infrastructure

Figure 57: Results of the compliance analysis of the Scan-Med railway infrastructure



Source: Pat Cox: Second Work Plan of the European Coordinator Scan-Med, October 2016

A2. Freight and modal split analysis: Danish Intermodal cross-border rail freight transport

Figure 58: Intermodal rail freight volumes Denmark, international traffic, 2004 – 2016

Type of intermodal cargo	Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOTAL	No of loaded units	91.851	48.541	86.658	41.479	36.671	26.677	26.577	22.636	19.191	18.674	19.774	23.414	29.921
	No of empty units	15.158	15.000	12.633	13.908	16.061	9.164	4.734	6.054	5.361	3.777	5.273	5.491	4.753
	No of units total	**107.009**	**63.541**	**99.291**	**55.387**	**52.732**	**35.841**	**31.311**	**28.690**	**24.552**	**22.451**	**25.047**	**28.905**	**34.674**
	1000 tonnes	**1.641**	**994**	**1.464**	**876**	**825**	**607**	**595**	**551**	**453**	**454**	**449**	**585**	**637**
Container/swap body	No of loaded units	84.293	44.102	78.258	33.292	26.059	18.160	17.212	13.107	11.833	11.047	11.483	10.560	12.850
	No of empty units	14.093	14.854	12.077	13.412	15.009	8.539	4.353	5.375	4.753	3.556	4.734	4.439	4.286
	No of units total	**98.386**	**58.956**	**90.335**	**46.704**	**41.068**	**26.699**	**21.565**	**18.482**	**16.586**	**14.603**	**16.217**	**14.999**	**17.136**
	1000 tonnes	**1.401**	**860**	**1.213**	**662**	**515**	**362**	**333**	**271**	**237**	**227**	**219**	**235**	**259**
Semi trailer,	No of loaded units	7.558	4.440	8.400	8.187	10.612	8.517	9.365	9.529	7.358	7.627	8.289	12.854	17.071
unaccompanied	No of empty units	1.065	146	556	496	1.052	625	381	679	608	221	539	1.052	467
	No of units total	**8.623**	**4.586**	**8.956**	**8.683**	**11.664**	**9.142**	**9.746**	**10.208**	**7.966**	**7.848**	**8.828**	**13.906**	**17.538**
	1000 tonnes	**240**	**134**	**251**	**214**	**309**	**245**	**262**	**281**	**216**	**228**	**230**	**351**	**378**

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Figure 59: Intermodal rail freight volumes Denmark, transit traffic, 2004 – 2016

Type of intermodal cargo	Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOTAL	No of loaded units	2.524	25.771	42.721	86.003	85.895	66.386	98.917	106.819	81.155	85.590	60.431	38.746	62.226
	No of empty units	629	832	682	27.214	27.559	23.186	33.755	43.360	28.634	29.719	28.764	27.213	29.674
	No of units total	**3.153**	**26.603**	**43.403**	**113.217**	**113.454**	**89.572**	**132.672**	**150.179**	**109.789**	**115.309**	**89.195**	**65.959**	**91.900**
	1000 tonnes	**57**	**410**	**508**	**1.849**	**1.791**	**1.408**	**2.200**	**2.420**	**1.760**	**1.935**	**1.321**	**786**	**1.283**
Container/swap body	No of loaded units	1.921	24.670	42.090	75.345	75.488	57.284	79.289	79.200	62.639	67.183	46.861	30.524	43.078
	No of empty units	622	796	635	26.813	26.943	22.828	33.092	42.494	27.850	28.884	28.171	26.690	28.879
	No of units total	**2.543**	**25.466**	**42.725**	**102.158**	**102.431**	**80.112**	**112.381**	**121.694**	**90.489**	**96.067**	**75.032**	**57.214**	**71.957**
	1000 tonnes	**39**	**384**	**496**	**1.584**	**1.535**	**1.184**	**1.707**	**1.716**	**1.275**	**1.322**	**968**	**578**	**807**
Semi trailer,	No of loaded units	603	1.101	631	10.658	10.407	9.102	19.628	27.619	18.516	18.407	13.557	8.222	19.148
unaccompanied	No of empty units	7	37	47	401	616	358	663	866	784	835	593	523	795
	No of units total	**610**	**1.138**	**678**	**11.059**	**11.023**	**9.460**	**20.291**	**28.485**	**19.300**	**19.242**	**14.150**	**8.745**	**19.943**
	1000 tonnes	**18**	**27**	**13**	**265**	**256**	**224**	**494**	**704**	**485**	**613**	**352**	**208**	**476**

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

A3. Freight and modal split analysis: International road transport of Danish vehicles by distance travelled

Figure 60: International road transport of Danish vehicles by distance travelled, number of journeys, 2000 - 2016

Total journeys, in 1000	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Distance travelled																	
Total	1356	1338	1316	1320	1444	1348	1318	1328	1379	1186	815	735	688	643	595	508	454
< 50 km	47	61	53	60	56	42	57	60	92	93	74	60	46	65	80	51	40
50-99 km	68	99	100	100	111	90	115	98	112	109	83	85	64	61	59	57	46
100-149 km	75	80	83	70	71	64	71	78	92	86	45	52	63	54	60	40	35
150-199 km	64	76	79	69	89	59	62	80	88	74	49	48	37	40	33	32	25
200-249 km	64	63	58	65	68	65	74	77	73	79	43	38	39	34	29	25	26
250-299 km	74	65	61	70	83	87	105	96	113	66	51	37	46	39	34	38	26
300-349 km	87	85	76	82	94	90	119	93	86	64	45	41	53	45	38	32	25
350-399 km	83	82	76	79	104	99	68	70	75	50	37	37	28	31	27	25	20
400-449 km	60	64	59	52	58	61	51	51	48	52	44	29	32	28	36	18	26
450-499 km	48	48	55	51	57	55	44	47	47	40	28	30	30	31	24	16	18
500-599 km	95	87	87	89	102	89	91	99	94	72	56	56	63	55	40	32	38
600-699 km	105	102	104	96	111	114	102	113	108	96	57	60	50	47	42	36	39
700-799 km	91	75	81	77	75	79	81	82	71	69	43	40	42	29	24	28	23
800-899 km	68	62	66	61	65	57	49	63	68	47	40	26	19	20	16	20	18
900-999 km	53	45	38	44	48	56	36	42	48	34	23	19	18	13	12	14	13
1000-1499 km	150	133	131	140	134	132	125	124	115	112	71	58	45	37	26	32	20
1500-1999 km	76	71	70	71	73	74	49	37	36	31	19	16	11	10	11	10	9
> 2000 km	48	39	40	45	46	39	19	18	14	12	8	4	4	3	5	5	6

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Figure 61: International road transport of Danish vehicles by distance travelled, share in per cent, based on number of journeys, 2000 – 2016

share in %, based on no. of journeys	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
300 km and more	71	67	67	67	67	70	63	63	59	57	58	57	57	54	51	53	56
500 km and more	51	46	47	47	45	47	42	44	40	40	39	38	37	33	30	35	37
700 km and more	36	32	32	33	31	32	27	28	26	26	25	22	20	17	16	21	20
900 km and more	24	22	21	23	21	22	17	17	15	16	15	13	11	10	9	12	11

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Figure 62: International road transport of Danish vehicles by distance travelled, weight of goods loaded, 2000 - 2016

Weight of goods loaded, 1000 tonnes	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Distance travelled																	
Total	16897	15257	15235	15725	17047	16616	15368	14290	14294	11471	8951	8592	9161	8384	6895	6236	6088
< 50 km	131	196	121	237	122	84	245	221	288	349	476	387	491	595	395	429	299
50-99 km	306	550	389	542	429	389	603	346	430	639	778	731	573	546	474	580	286
100-149 km	464	370	415	232	326	310	463	519	530	488	404	544	709	532	560	395	388
150-199 km	484	584	639	506	634	371	531	550	781	510	461	501	410	468	366	367	342
200-249 km	603	467	556	544	595	596	674	682	751	672	486	419	467	424	300	251	291
250-299 km	815	649	559	755	828	882	1157	936	1082	587	502	388	591	493	407	497	305
300-349 km	998	891	870	958	1166	1096	1490	883	879	573	456	468	579	628	463	430	359
350-399 km	1095	999	890	954	1237	1221	925	846	842	589	448	545	364	418	423	341	331
400-449 km	824	887	766	650	774	885	627	672	584	571	636	326	448	437	391	193	426
450-499 km	734	703	731	757	792	881	617	612	568	511	371	414	436	485	448	246	277
500-599 km	1402	1231	1292	1312	1599	1253	1275	1389	1139	809	675	831	982	810	653	459	646
600-699 km	1557	1402	1508	1420	1712	1732	1483	1563	1451	1318	749	764	821	765	571	477	659
700-799 km	1343	1052	1175	1117	1098	1223	1204	1107	999	773	511	577	698	447	381	368	388
800-899 km	1010	924	966	885	1000	918	692	865	980	558	432	334	298	324	262	274	327
900-999 km	802	604	556	673	768	857	513	551	689	441	280	218	316	208	199	188	191
1000-1499 km	2303	1946	1926	2188	2021	2017	1753	1715	1543	1460	892	836	724	586	371	494	322
1500-1999 km	1176	1142	1150	1216	1163	1236	775	568	540	457	273	239	185	163	141	154	138
> 2000 km	849	661	727	779	782	668	339	266	220	167	121	70	69	53	91	94	110

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049

Figure 63: International road transport of Danish vehicles by distance travelled, share in per cent, based on weight of goods loaded, 2000 – 2016

share in %, based on weight of cargo	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
300 km and more	83	82	82	82	83	84	76	77	73	72	65	65	65	64	64	60	69
500 km and more	62	59	61	61	60	60	52	56	53	52	44	45	45	40	39	40	46
700 km and more	44	41	43	44	40	42	34	35	35	34	28	26	25	21	21	25	24
900 km and more	30	29	29	31	28	29	22	22	21	22	17	16	14	12	12	15	13

Source: Logistics Initiative Hamburg, based on: http://www.statbank.dk/10049