

Transporting Fresh Produce

A new sea-based transport concept for fresh fish and other commodities linking Scandinavia with Western Europe



INCENTIVE



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Executive summary

This study reports on the possibilities of consolidating fresh fish, (food) and related products. The objective is thereby to increase transport at sea rather than on road.

The sea-based transport concept is a vision but certainly also a way of doing things in line with the needs of the future.

Transporting fish by sea is an obvious solution. During this project, we have learned that the words “volume” and “consolidation” are crucial in relation to sea-based transport solutions. Studying trade statistics has not only fuelled the process, but also underlined the difficulties in moving additional road transported fresh fish to sea transport.

Accepting this fact would have been the easy way to go around things. Nevertheless, during the process we would not have gathered a lot of knowledge and experience. We would also not have been able to present alternatives to our initial ideas.

In essence, based on more facts, greater knowledge, perceptions in the market, discussions with partners and new framework conditions, we have described and analysed the preferred solution- the sea-based concept- and described viable alternatives. This project might give the customers better opportunities within transport by truck instead of what we really wanted: “A sea-based transport concept”.

Moreover, as we demonstrate through the report, this “fact-based” work has opened our minds for other opportunities. In other words: “If I had asked people what they wanted, they would have said faster horses.” - Henry Ford.

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Introduction

LO-PINOD (Logistics Optimisation for Ports Intermodality: Network, Opportunities, Development) challenges traditional practices of freight distribution and offers a more sustainable alternative. Through improvements to short sea routes, multi-modal connectivity between regional ports and their hinterland, and diversified port land use and operational models, LO-PINOD will help deliver social and economic benefits to communities and businesses across the North Sea Region (NSR).

A growing environmental conscience and increasingly crowded roads, raise the importance of discussing appropriate alternatives to road-based transportation.

One of the solutions to lower the impact and congestion on roads throughout Europe might be to shift the mode of transportation from road to sea. This awareness has also reached the EU Commission that has adopted a transport concept for 2050, which intends to reduce the CO₂ emissions from transport by 60%. It estimated that 30% in 2030 and 50% in 2050 of road transport (exceeding 300 km) should move to sea transport.

There is an increasing demand for fresh fish throughout Europe. With a strong fishing sector in Denmark and Norway and thereby large export activities it is appropriate to identify new potentials for how fresh fish is brought to these markets and at the same time move the mode of transportation from road to sea.

Therefore, the objective of this project is to analyse and develop a concept for how fresh fish, mainly from Norway and Denmark, can be consolidated and transported by sea to the market in France, the Netherlands and Belgium.

This project investigates the possibility of establishing a sea-based solution between Norway, Denmark, Netherlands, and Belgium. The selection of transport solutions between these countries are based on a large amount of fish being transferred in between these countries and also on the fact that the ports are all part of the LO-PINOD project.

The general conclusion is that a sea-based solution is cheaper than a truck-based solution. On the other hand, a truck-based solution is (much) faster and much more flexible. This means, that it is only attractive to transport goods by ship if the time restrictions, requirements with respect to consolidation and cost allows it. This basic result motivates a more detailed analysis of whether a specific route can meet the requirements to freight volume and time restrictions.

Outline of the report

To analyse and develop a concept for shifting transportation of fresh fish from road to sea, some analytical steps must be taken:

- A description of the suggested transportation concept should be outlined

- This gives an overview and impression of what the concept should and should not be able to do
- An analysis of potential freight volumes needs to be confirmed.
 - A ship has high requirements for volumes transported if the per unit cost must remain low. Studying existing freight flows, it seems natural to include the flow of fresh fish from Northern to Central Europe.
- The mode of transportation should be investigated
 - Shall fresh fish be transported in Ro/Ro vessels, Lo/Lo vessels or a third type of vessel and what are the environmental consequences of the various modes of transportation?
- The findings regarding environmental- and climatic impact from ships and trucks must be elaborated further.

The transnational approach in the project:

The sailing fish project must also be seen in a transnational approach. The work has involved a number of other partners both within and outside the partner group of the Lo Pinod project. The ports in Drammen and Bodø have helped out with contacts and ideas for the project including a major help in fact - finding regarding especially Norwegian data. The ports have defined logistics patterns including setting up meetings with potential users and opened up meetings for broader presentation of the ideas. Our partners in Harlingen and Oostende have helped out with data and ideas for different sea based solutions. Contacts on the Faroe Islands and Iceland have consolidated the findings from the fact-findings trips to these areas.

Finally the work with the Lo-Pinod partners nurtured ideas to new projects within the development of the port sector and sea - based transport solutions. Among these one can point to green energy projects both with a focus on land - based power solutions. Finally concepts within retrofitting vessels and taking LNG on board shall be mentioned. Both with respect to their positive impact on climate and the environment, but also as new business opportunities.

Lessons learned from the project

In the Lo - Pinod project we have taken several detours, and yet we have not accomplished our final goal: A sea based transport solution.

But if we look at the project in a broader way the results become positive.

During the process, a number of important findings have been gathered.

Among the most important ones we will point out:

- Switching transports from road to sea requires volumes, a real possibility to consolidate goods, balances within the trade, cost competitive solutions and the risk and will among logistic companies to try new transport set ups. All these elements are important.
- In the same instance one has to be aware that the competitive power of truck based solutions have not ceased during the years of the economic crisis. It has developed into new heights, and for the time being it seems unstoppable. So to be able to compete within this regime, one has to be very cost efficient, flexible and smart.
- Transport of fresh products and especially fresh fish requires a very stable and speedy transport including the need for getting to the market at a specific time. This is possible when using a flexible truck based solution, but hard to obtain when using a "timetable", sea - based solution.
- Major changes within the transportation system will not come around when only driven by market forces. They need a helping hand. Therefore ports should work together with a straight focus on how to develop new cooperation's and new transport solutions including road - based solutions. The important issue is to become part of the process, and stay in close connection with the decision makers.

Preliminary results

The results of this report were presented at the B2B meeting in Drammen in March 2013 and at the North Sea Fish meeting in Hanstholm in September 2013. The presentations stressed the fact that flexibility is of great interest when handling fresh products caught, produced, transported, and consumed in small quantities. Sea-based transportation takes, in most instances, longer time and the consolidated volumes are larger compared to the truck-based solution. At this point, networks needs to be established to improve the transportation opportunities for fresh fish and enhanced transportation. It is therefore of high relevance to introduce a stepwise solution to move additional freight from road to sea. The following steps are essential:

- A profound understating of the new role of ports as transport- and consolidation centres for more modalities; ports play an important role in the transport - and value chain.
- An introductory meeting between the sales directors of the ports involved focusing on refining the project and making up a list of potential users and project partners.
- An elaborated concept based on the design presented here using "green trucks" as the means of transportation and a sketch-based design of the concept illustrating route- and timetables.
- Contact the potential users, producers, forwarders and stakeholders with respect to the project and include their comments in the final project description.
- Further investigate the "detour-based" truck concept, and take some basic steps from this to a sea-based concept.
- Starting with a limited (safe) solution and enlarging it when new potentials (new types and larger quantities of goods) are within reach.
- Be realistic; accept that it might take years, but the cooperation and development of the ports and the concept are worth the effort.
- As an integrated part of the setup, the ports must play an important role as first step designers (the final design must be carried out by a logistic company) and develop the facilities in the ports alongside the development of the concept.

In more detail we identified:

- The difference in cost between a road and a sea based solution seems to be rather small. And the difference does not make up for the inconveniences related to the sea based solution compared with the road - based one. Fixed timetables and loading and unloading are among these.
- The road based solution is very flexible with respect to volume, time of pickup and delivery, and possibilities with respect to finding alternatives (new roads, other type of transport equipment etc.) compared with ship, which has to stick to a time table and is limited with respect to volume and sailing route.
- For logistics reasons, fish and seafood might have to wait for long periods on the ship before being transported (time between arriving at the ship and departure). This is in particular a challenge with respect to fish and seafood.
- The ship has to stick to its time - table whereas the truck can go on demand. This might easily lead to trucks missing the ships departure due to delays on the roads etc. This is not only a problem related to congestion in central Europe, but also with bad weather conditions in Norway during winter time.
- Transports by ship of fresh fish will be delivered at one time (theoretically up to around a 1000 tons) compared with an "over the week" deliverance by truck.
- From an overall perspective a ship based transport requires a higher degree of planning compared with a road based transport. This is especially important when dealing with fresh products like fish, seafood and vegetables, which have to respect numerous time restrictions, in order to keep it fresh from producer to consumer.

We therefore point to a stepwise solution for developing sea-based possibilities for transport of fish, seafood and vegetables while recognising the challenges of cost, consolidation, time and regularity in the transport concept.

The next steps should or could be:

Hand over findings from this study to sales directors in ports.

- Fostering closer cooperation and establish a network with the relevant stakeholders such as logistic companies, transport companies and others.
- Raise the awareness of the structure of fish transport from north to south (Norway, Iceland and the Faroe Island) into the EU. The driving mechanism in the transport system is very strong and based on long and well - proven concepts.

Establish closer contact with the other related projects.

- To learn from their findings with respect to a logistics setup.¹
- Create a solid base for introducing more sustainable and green transport concepts within the short sea transport system in northern Europe.

¹ Findings from the Food Ports project have already been taken into consideration

Such cooperation will lead to more ports interested in being partners, with the possibility of having more fish, seafood and other suitable products brought into the transportation system. This might open for a higher frequency and strengthen the competition toward the truck-based solution.

A sea-based transport concept

The concept that will be established and analysed in the following is based on transport of fresh fish from Norway, Denmark and perhaps the Faroe Islands and Iceland to destinations in Central Western Europe. Return loads can be based on fresh/frozen vegetables, other foodstuffs, and consumer products to the Nordic countries.

A sea-based transport concept will open new transport possibilities compared with transport by road. It will be in line with the transport concepts of the future, with focus on reducing the investments in road infrastructure, reducing congestion and hopefully bringing an environmentally friendly solution into our current transport system.

The challenge lies within the shift of today's use of the road-based transport solutions into new transport concepts based on transport by sea. A sea-based transport concept is in many ways different from the well-known and rather simple road-based concept. Ports should be involved and facilitate the services that transport companies need.

These initiatives include:

- Help promote new services to the port focusing on shifting road-based transports to sea whenever viable solutions can be produced
- Help develop new partnerships among companies at the port and between individual ports in other countries.
- Help develop ports into intermodal transport centres, focusing on their ability to handle large volumes of goods, consolidate and become a platform for additional value creation as part of the logistics setup
- How ports can play a major role in the transition of using energy from HFO to MGO or installing scrubbers on board the vessel i.e. helping out in organizing the retrofit scenario
- Finally ports can play a major role in the future focusing on the supply of LNG and other fuels both to the sea-based transports and also to road-based transports, taking the high cost of energy infrastructure into consideration

Trade flows and balances

A sea-based transport network linking the ports of Bodø/Drammen with port of Hanstholm, Port of Esbjerg, Harlingen Seaport and Port of Oostende with ports further down in Europe such as ports in France, Spain, and Portugal was investigated. The following section has an analysis of the current trade flows to identify the routes with the highest potential.

The trade flow is divided into commodity groups and types of transport have been analysed, focusing on the possibilities of transferring goods from road to a sea-based transport solutions. The major criterion for selecting the most appropriate modality is linked to the price, accessibility, speed, and frequency of transport. Commodities with a low value shipped in large quantities are to

a large extent shipped via sea-based solutions. The smaller, more time sensitive and vulnerable shipments are usually transported by road.

In the analysis of trade it is relevant to isolate shipments which currently are transported via road, but from a time and volume perspective can be shifted to a ship-based solution.

Establishing a sea-based transport solution instead of a road-based, poses a number of challenges:

- Larger volumes per shipment – leading to a heavy demand for consolidation. The necessity to include the ports in this concept is vital.
- Balance in trade with respect to the north- and southbound directions as it is necessary to uphold a certain demand and capacity utilization on board the ship or on the trucks in both directions in order to have the necessary revenue from the transports.
- How to develop ports as hubs and consolidation points, connecting the world through sea - and land-based links, should be developed further.
- Finally, northbound trades are important, as these trades possess a higher degree of willingness to pay due to higher volumes and thereby a less favourable market position when focusing on the perspective of the transport buyers.

The sailing fish concept

The potential amount of so-called fresh fish, which is the backbone in the concept, consists with respect to Norway of both wild catch fish and farmed fish. Regarding this concept, moving 100.000 tons of goods from road to sea may result in a reduction of at least 6000 - 7000 lorry units on the road. Fish from aquaculture makes up the largest volume.

An easy solution would be to transfer these products to an existing route. Until now, such a route has not been identified, but in case such a route should be established, the possibilities to use it should surely be investigated further.

Danish fish, on the other hand, is typically caught wild. However, as the Danish fish from Port of Hanstholm will be loaded later than the Norwegian fish, it should be possible to consolidate more fish. There will be a certain time span to work within from when the ship leaves Norway and until it reaches Port of Hanstholm. The seafood company Deutsche See together with Hochschule Bremerhaven have been engaged in setting up a somewhat similar concept linking the southern part of Norway with Bremerhaven based on transports of fresh salmon. In this project a new conservation technique has been tested, unfortunately without a positive result.

The realization of a so-called Motorway of the Sea (MoS) is a part of a possible solution. A MoS could for example be a relatively fast, smaller Ro/Ro vessel calling the ports of Drammen, Hanstholm and Oostende. Solutions could supplement with other sea-based transport solutions.

Focusing on the environmental impact transferring transports from road to sea and rail usually have a positive impact when it comes to emissions especially CO₂. New findings question this statement

as demonstrated in section 5. Focusing on other pollutants the picture might be somewhat blurred, but the impact of NECA and SECA² will in the end help in reducing these pollutants.

A Ro/Ro vessel is the most suitable for this concept. Nevertheless, the decision whether to choose a Lo/Lo or Ro/Ro ship must in the end depend on a total calculation of costs and benefits.

A general issue related to both concepts is how to get hold of an operator, who will be a part of the start-up process and run the service. An example of ship owners' lack of interest in engaging themselves is found in the "Bridge the Bridges"³ project. This project shows in full detail the problems related to the introduction of a new Ro/Ro connection, even with a positive support from Marco Polo funds.

Unfortunately, a large proportion of the routes, which started with support from Marco Polo, shut down when the subsidies ended. For that reason, such a route should start before it is possible to demonstrate a reasonable, commercial basis for running it.

Statistics – perspectives on data collection and general trade flow

The detailed investigation of transport flows and use of modality is based on the Norwegian data⁴, as they are divided into the use of transport modality. This means, that we have taken the modality from the Norwegian trade patterns and transferred them to the Danish data. That is the only way in which we can establish a picture of which modality is being used when looking at transports to and from Denmark as well.

Already today, large quantities of goods are by being transported by ship rather than by road. It is possible to demonstrate that shipping has a major share of the transported volumes. At the same time, it is essential to focus on those commodity groups that have been neglected such as fresh food products. The main reason for this is that the volumes transported by truck are more valuable and are products for which consumers have a higher "willingness to pay/ability to pay" – this is also the case for transport prices.

The analysis of the Norwegian transport and trade data establish a general picture of which types of goods dominates with respect to road transport. These findings will be transferred to Danish data.

² The legislation focuses on a cleaner fuel on board vessels with the purpose of reducing sulphur and NOx emissions. Legislation regarding sulphur (SOx) will be introduced 1st of January 2015.

³ "Bridge the Bridges" is a Marco Polo project, based on a Ro/Ro route linking Frederica (the triangle area in Jutland, Denmark) with Helsingborg in the south westerly part of Sweden. The main idea was to surpass two pay bridges and some of the most crowded road infrastructure in Denmark. Even though the project had positive backup from a large number of customers and received funding from Marco Polo, it was not possible to find an operator.

⁴ The superiority of Norwegian data is based on the fact, that these data are still divided both on country, commodity group and modality, whereas data for EU countries lack the modality division.

It should be emphasized however, that the import and export patterns in Norway and Denmark are not completely alike. As seen by the table below, Denmark's exports are considerably lower than Norway's.

Some groups of goods should be considered independently when transferring the Norwegian shares to the Danish numbers. As an example, one of the most important export sources in Denmark is cereal; it plays a small role for Norwegian export. Cereal is not a time sensitive group of goods it is however, a significant commodity for Denmark – it might therefore be assumed that a larger share than reflected by this method is transported by ship from Denmark than from Norway.

Table 1 presents the total volumes transported between Denmark and Norway on one side and between The Netherlands, Belgium, France, and Spain on the other side.

Table 1

From	To	Quantity of good (tonnes)
Denmark	Belgium	336,306
Belgium	Denmark	828,964
Denmark	The Netherlands	2,469,531
The Netherlands	Denmark	2,071,519
Denmark	France	1,259,796
France	Denmark	905,310
Denmark	Spain	547,158
Spain	Denmark	429,858
Denmark	Portugal	130,999
Portugal	Denmark	294,655
Norway	Belgium	6,917,239
Belgium	Norway	770,335
Norway	The Netherlands	31,910,391*
The Netherlands	Norway	1,763,300
Norway	France	15,133,413*
France	Norway	704,378
Norway	Spain	3,740,827
Spain	Norway	859,384
Norway	Portugal	822,148
Portugal	Norway	114,055

Source: Statistics Denmark, table SITC5R4Y. Statistics Norway, tables 03064 and 03065

* a large part consists of oil and gas

An important driver behind a shift of transport mode is the possibility of greening and improving the transport of a green product (fresh fish). It is more natural to transport fresh fish by sea rather than by road - especially if the sea-based solution has a lower environmental impact than the road-based.

Products can be accompanied with other products that are suitable for a low cost consolidated transport concept. What seems of utmost importance is how the competitiveness of a sea-based solution stacks up against a road-based solution.

Freight volume and truck patterns in Northern Europe

The import and export patterns linking Norway to the European market is different compared to Denmark. Oil and gas are significant export commodities from Norway. Due to the nature of such products, ships have a rather substantial market share. Nevertheless, a number of other products seem to have the potential for shifting the modality. This goes especially for products like fish, vegetables and similar products exported to countries like Spain, France, and the Netherlands.

This section will present the import and export patterns connecting Denmark to Belgium, France and the Netherlands; and Norway to Belgium, the Netherlands, France and Spain.

The major challenge of the sea-based concept relates to volumes, transport time, and cost.

As a result, a modality shift is not likely to take place until it is possible to cope with the challenges of consolidation and the speed of the sea-based solution in contrast to the road-based solution.

Danish trade patterns

Denmark and Belgium

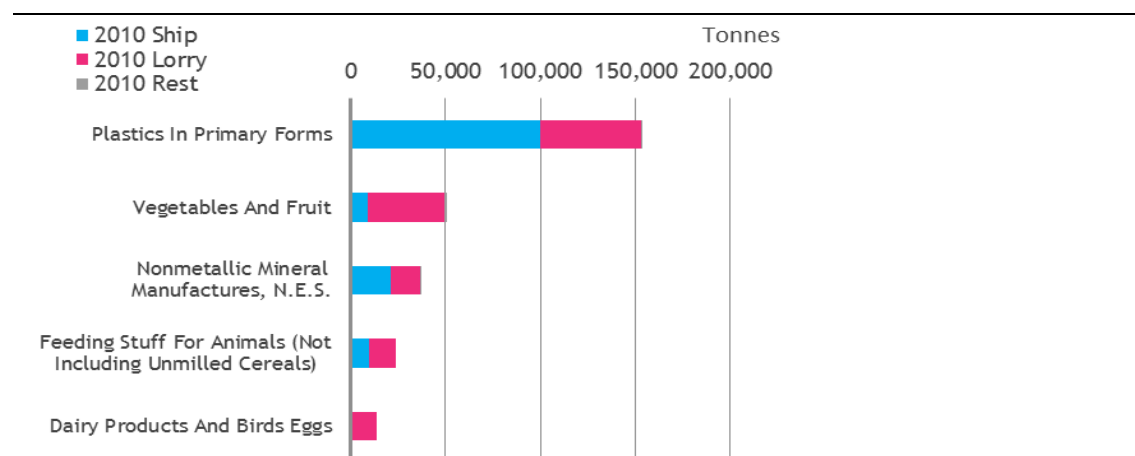
The Danish import from and export of fishery products to Belgium is presented in table 2.

Table 2: Danish import from and export of fishery products to Belgium, volume of cargo in tons		
	2007	2010
Import	1,617	2,017
Export	9,921	8,349

Figure 1 illustrates the five most important Danish import groups from Belgium. These commodities represent products that might have the potential of being shipped rather than being transported via road. The groups are much dispersed, and the total volume is limited.

Denmark's imports from Belgium

Figure 1: The five key Danish import groups from Belgium by lorry, Norwegian shares

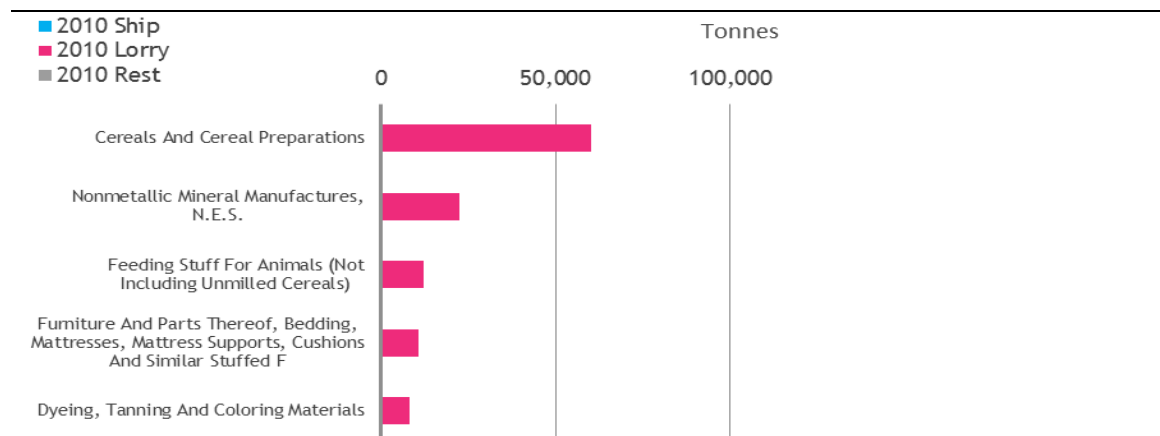


Regarding exports to Belgium, the groups are dispersed and the volumes are somewhat smaller than the import groups. This poses a challenge regarding trade balances. As a rule of thumb, a combination of imbalances and relatively small volumes will normally give preference for truck-based transport, which is more flexible both relating to the size of the shipments and the route. A flexible route includes the possibility of taking a detour and pick up a load for the return trip.

Figure 2 shows Danish lorry exports to Belgium. Cereals are of big importance. In order to be able to match the flexibility of road-based transportation - a shipping route must incorporate as much flexibility as possible.

Denmark's export to Belgium

Figure 2: The five key Danish export groups to Belgium by lorry - Norwegian shares



Again, it should be emphasized that the truck in most instances sets the standard relating for how a specific type of transportation is carried out when it comes to time, price, quality etc.

Denmark and France

In figures 3 and 4 and tables 3 and 4 the trade relations between France and Denmark are presented.

Figure 3: The five key French export groups to Denmark by lorry, Norwegian shares

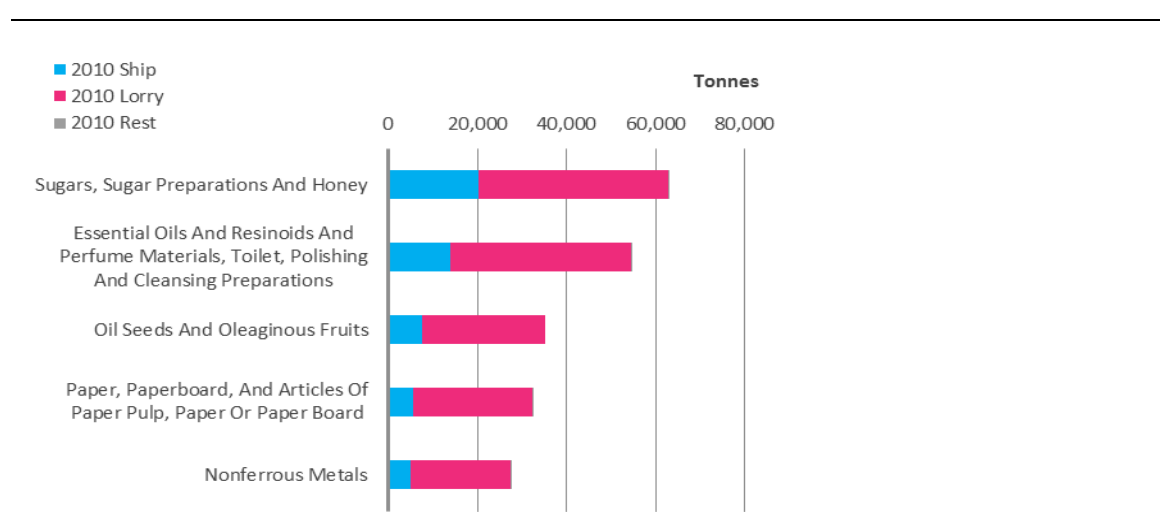


Figure 4: The 5 key Danish export groups to France by lorry - Danish quantities, Norwegian shares

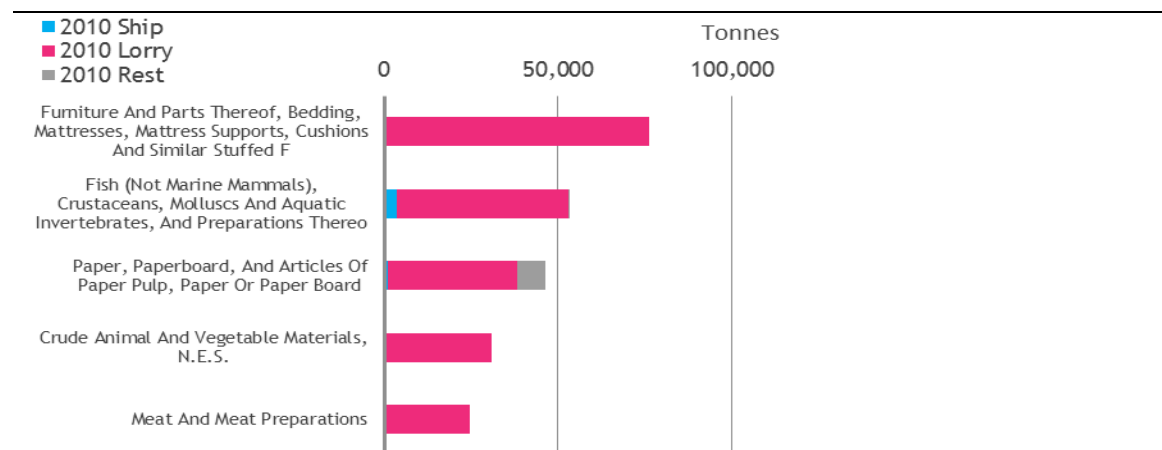


Table 3: Key export groups to Denmark 2010 by lorry – Danish quantities, Norwegian shares

(in tonnes)	Total	Ship	Lorry	Rest
Sugars, sugar preparations and honey	62,857	20,307	42,522	28
Essential oils and resinoids and perfume materials, toilet, polishing and cleansing preparations	54,801	13,991	40,511	299
Oil seeds and oleaginous fruits	35,113	7,563	27,550	0
Paper, paperboard, and articles of paper pulp, paper or paper board	32,323	5,713	26,514	96
Nonferrous metals	27,529	5,088	22,427	14
Plastics In primary forms	31,648	6,778	18,519	6,351
Dairy products and birds eggs	16,570	68	16,495	8
General industrial machinery and equipment, N.E.S., and machine parts, N.E.S.	16,450	1,997	14,285	168
Beverages	38,162	23,906	14,192	65
Iron and steel	56,168	43,674	12,450	44

Table 4: Key Danish export groups to France 2010 by lorry, Norwegian shares

(Tons)	Total	Ship	Lorry	Rest
Furniture and parts thereof, bedding, mattresses, mattress supports, cushions etc.	76,002	453	75,549	0
Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof	52,902	3,658	49,191	54
Paper, paperboard, and articles of paper pulp, paper or paper board	46,467	1,238	36,919	8,310
Crude animal and vegetable materials, N.E.S.	31,014	0	31,014	0
Meat and meat preparations	24,460	335	24,125	0
Non-metallic mineral manufactures, N.E.S.	89,401	70,638	18,763	0
General industrial machinery and equipment, N.E.S., and machine parts, N.E.S.	22,445	5,062	16,565	818
Road vehicles (Including air-cushion vehicles)	16,121	1,779	14,240	103
Feeding stuff for animals (Not including unskimmed cereals)	17,737	3,603	14,134	0
Miscellaneous edible products and preparations	12,867	746	12,121	0

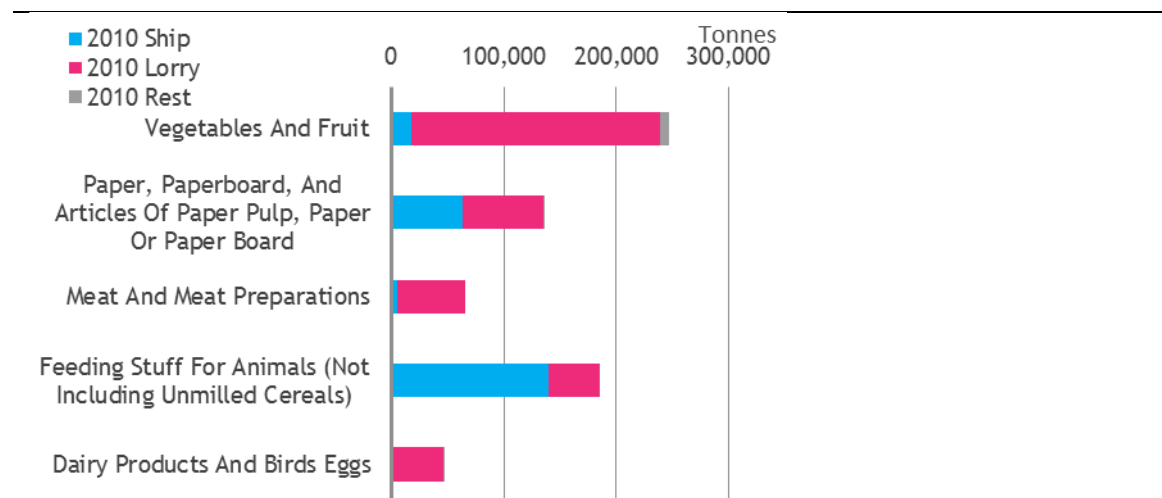
Seafood and fish play an important role in the trade flow from Denmark to France.

Denmark and the Netherlands

In figure 5 the main Dutch export groups are presented. The total quantity transported by lorry from Netherlands to Denmark is approximately 575,000 tons.

Netherlands' export to Denmark

Figure 5: The five key Dutch export groups to Denmark by lorry, Norwegian shares



Regarding the Netherlands exports a different picture appears. Vegetables and fruit make up a large share of the exports and much of it is transported by lorry. Vegetables and fruit are difficult to transfer from road to sea because of the limited quantity and the time factor.

Table 5: Key import groups from Netherlands 2010 by lorry – Danish quantities, Norwegian shares

(in tonnes)	Total	Ship	Lorry	Rest
Vegetables and fruit	246,519	17,548	221,965	7,00
Paper, paperboard, and articles of paper pulp, paper or paper board	136,568	63,447	71,896	1,225
Meat and meat preparations	65,197	5,433	59,764	0
Feeding stuff for animals (Not including unskimmed cereals)	185,648	139,851	45,797	0
Dairy products and birds eggs	46,641	1,561	45,017	62
Plastics in primary forms	141,740	116,218	24,735	787
Plastics in nonprimary forms	28,100	6,996	21,078	27
Miscellaneous manufactured articles, N.E.S.	44,292	23,602	20,349	341
Cork and wood manufactures other than furniture	26,827	7,129	19,570	127
Iron and steel	128,936	108,639	18,875	1,42

The Netherlands' imports from Denmark

The tables and graphic illustrations in figure 6 and table 6 show the Dutch imports. It is indicated that a substantial amount of products goes by truck.

Figure 6: The five key Danish export groups to Netherland 2010 by lorry, Norwegian shares

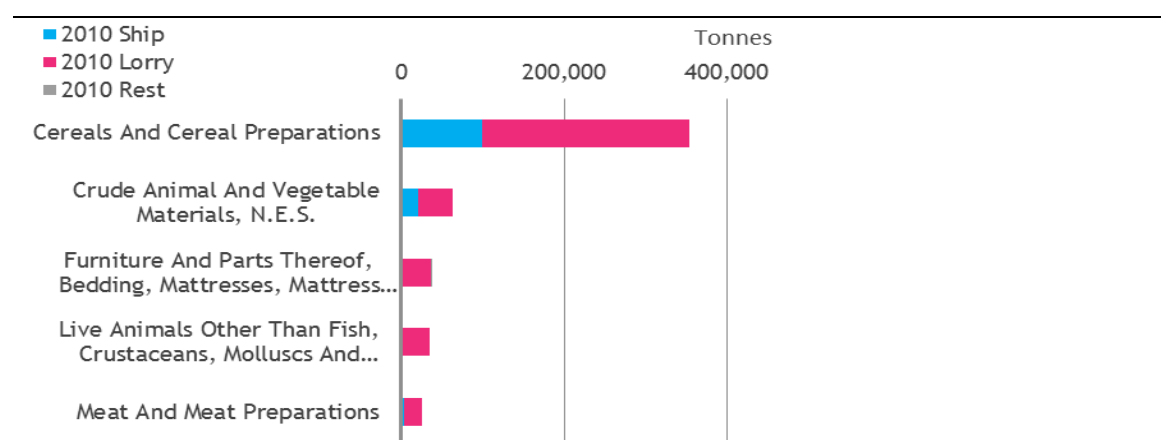


Table 6: Key export groups to the Netherlands 2010 by lorry – Danish quantities, Norwegian shares

(in tonnes)	Total	Ship	Lorry	Rest
Cereals and cereal preparations	354,454	98,662	255,791	0
Crude animal and vegetable materials, N.E.S.	62,303	19,790	42,512	0
Furniture and parts thereof, bedding, mattresses, mattress supports, cushions etc.	36,170	551	35,554	65
Live animals other than fish, crustaceans, molluscs and aquatic invertebrates of division	33,852	0	33,852	0
Meat and meat preparations	24,673	3,084	21,589	0
Vegetables and fruit	22,598	1,441	21,157	0
Plastics in nonprimary forms	19,505	834	18,625	46
Paper, paperboard, and articles of paper pulp, paper or paper board	33,032	14,149	17,830	1,054
Fish (Not marine mammals), crustaceans, molluscs and other aquatic invertebrates.	35,463	18,470	16,992	2

According to Statistics Denmark a total of approximately. 450,000 tons was transported from Denmark to the Netherlands by lorry in 2010⁵.

The tables and figures describing the Dutch/Danish trade pattern indicate a potential for a modality shift from road to sea. Several hundred thousand tons of products that are suitable for sea transport are transported via road.

⁵ Source: www.statistikbanken.dk, table UVG1 and IVG2

Norwegian trade patterns

The trade pattern in the Norwegian case is rather different from the Danish patterns. A relatively large amount of fish and related products are transported by ship. This indicates a possibility of moving the products from road to sea also in a Danish context.

Norwegian foreign trade shows a large surplus in exports, which with an economic volume of 792 billion Norwegian kroner exceeds the imports by more than 325 billion Norwegian kroner.

In monetary terms, the largest exported commodities are oil and gas, consumer products, and products for the production sector. In addition, the export of fish constitutes a large volume with a total value of more than 52 billion Norwegian kroner. Fresh salmon is the largest species within this category with a value up to 23 billion Norwegian kroner. Besides that, the export of steel and other metals seems to be of major importance with a value of more than 60 billion kroner.

With respect to imports, products for the production sector constitute more than 34 % of the total value. Investment goods such as trucks and other transport equipment made up 21 % and passenger cars 6 %. Consumer products constitute a total value of 22 % and products for the building industry (10 %).

The Norwegian trade statistics indicate exports dominated by oil, gas, and fish, and imports represented by consumer goods, investment goods, and transportation equipment.

In the following, focus will be on the products which seem suitable for a sea-based solution with respect to geography, volume, and time.

Norway and Belgium

Figures 7 and 8 illustrate the Norwegian imports from Belgium in 2010 transported by ship and lorry.

Figure 7: Norwegian imports from Belgium 2010 – 10 largest product groups – ship and lorry

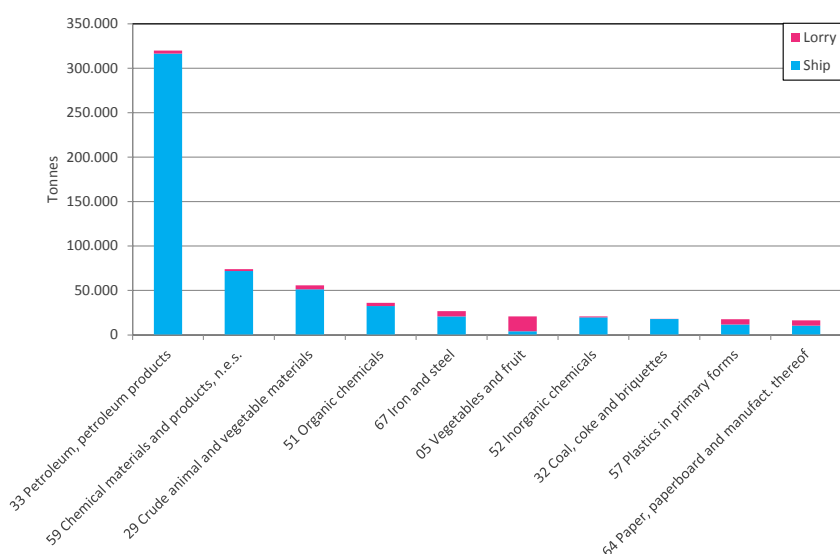
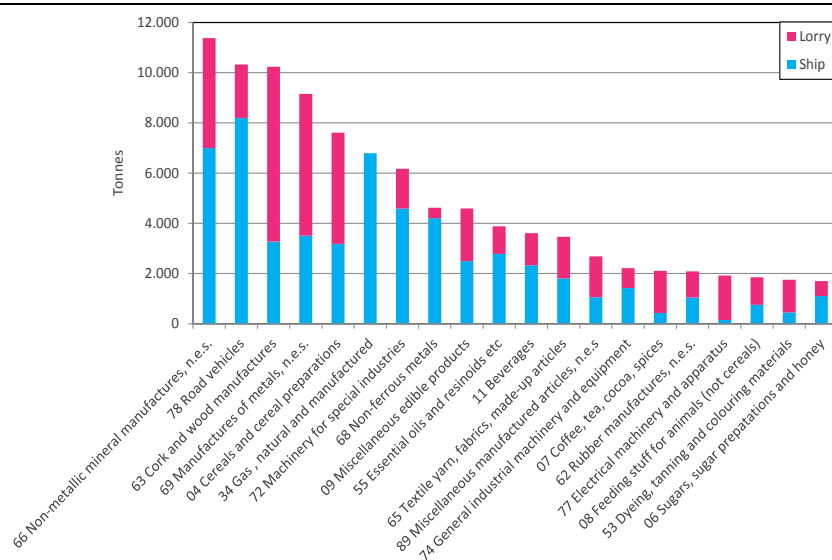


Figure 8: Norwegian imports from Belgium 2010 – 11-30 largest product groups – ship and lorry



Figures 7 and 8 show that most of the goods between Norway and Belgium are transported by ship. Belgium is of high interest as a transit country on the south bound route because of the constitution of high relevant products and large volumes. This could make the volumes for establishing a north going route. Figure 9 and 10 show the Norwegian exports to Belgium divided into different commodity groups.

Figure 9: Norwegian exports to Belgium 2010 – 10 largest groups – ship and lorry

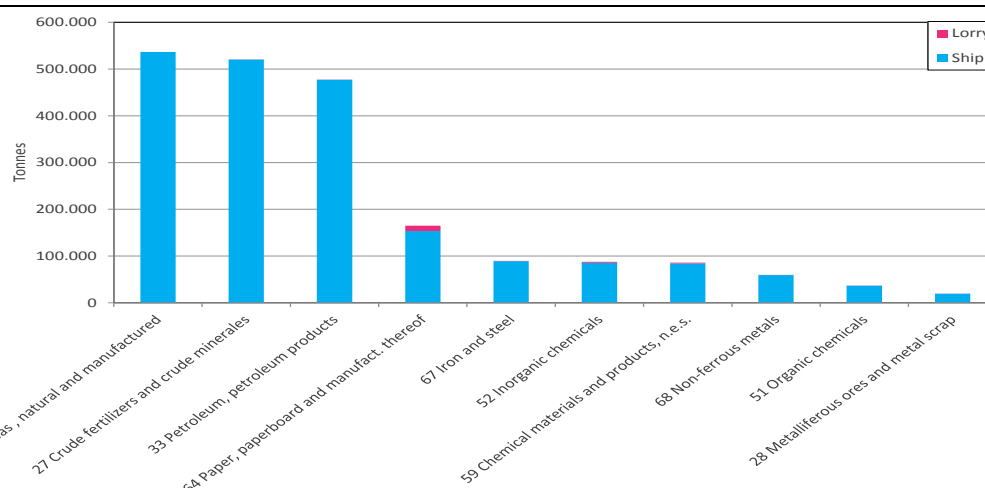
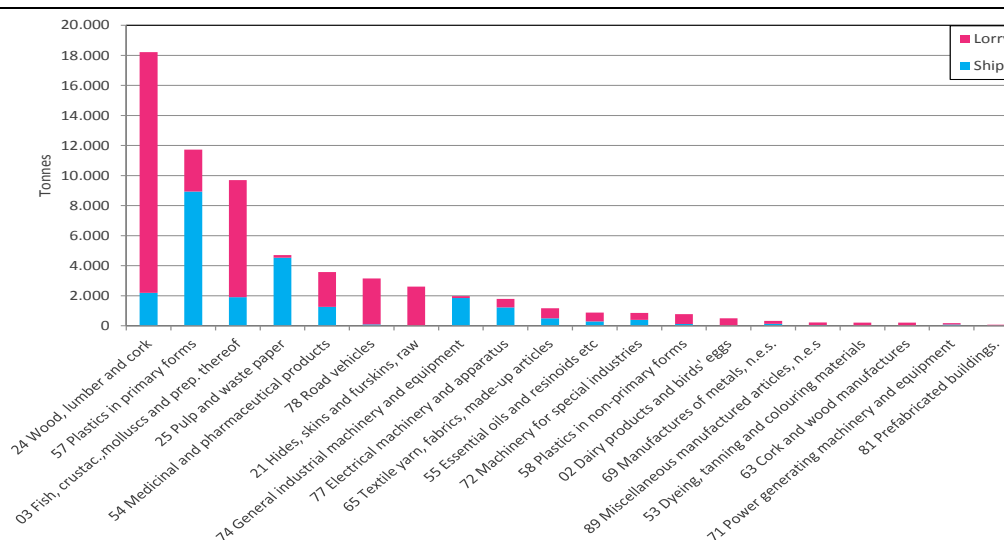


Figure 10: Norwegian exports to Belgium 2010 – 11-30 largest product groups – ship and lorry



Norway and the Netherlands

Figures 11 and 12 illustrate the Norwegian imports from the Netherlands divided in the 10 most traded product groups and the 11 – 30 largest groups respectively.

Figure 11: Norwegian imports from the Netherlands 2010 – 10 largest product groups – ship and lorry

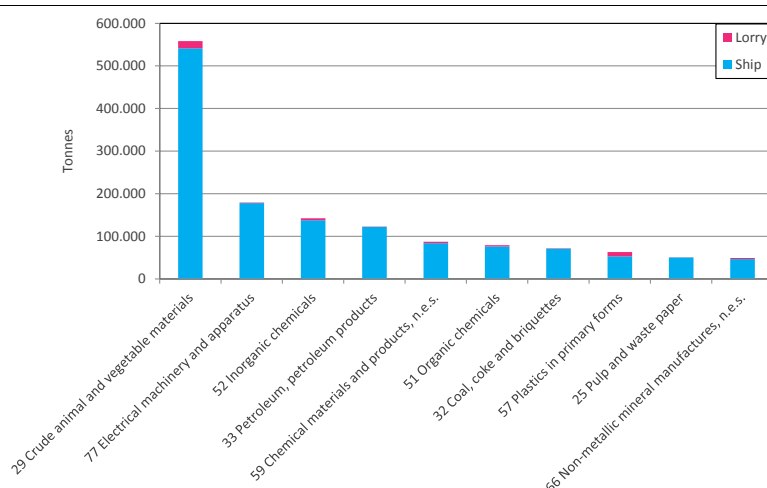
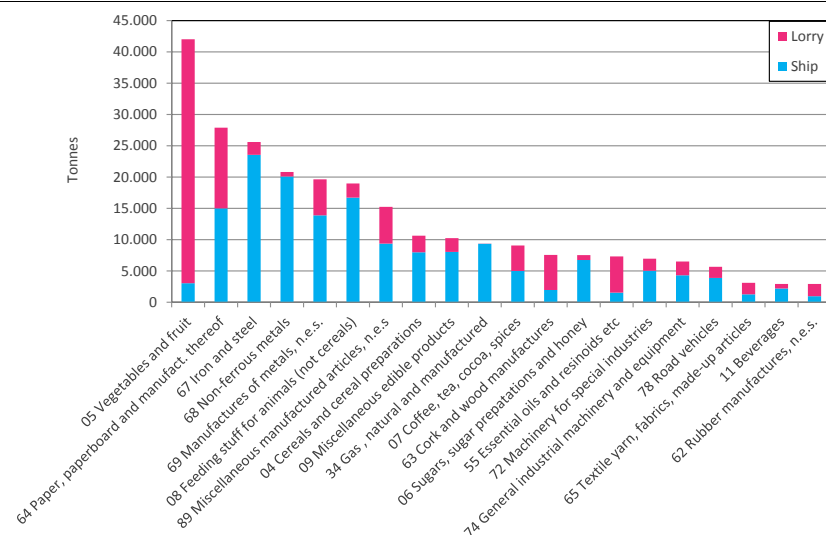


Figure 12: Norwegian imports from the Netherlands 2010 – 11-30 largest product groups – ship and lorry



Regarding the Netherlands' north going transports of e.g. vegetables, it could be of interest to investigate if this could be transported by sea rather than by road. This would include an analysis of transit time and whether the fruits and vegetables would sustain the increased transport time.

Figures 13 and 14 illustrates the Norwegian export to the Netherlands divided in the 10 most traded product groups and the 11 – 30 largest, respectively.

Figure 13: Norwegian exports to the Netherlands 2010 – 10 largest product groups – ship and lorry

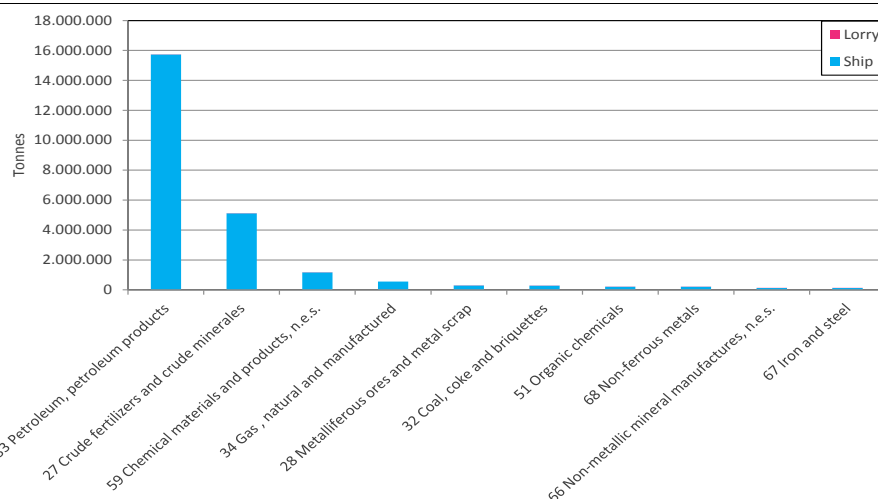
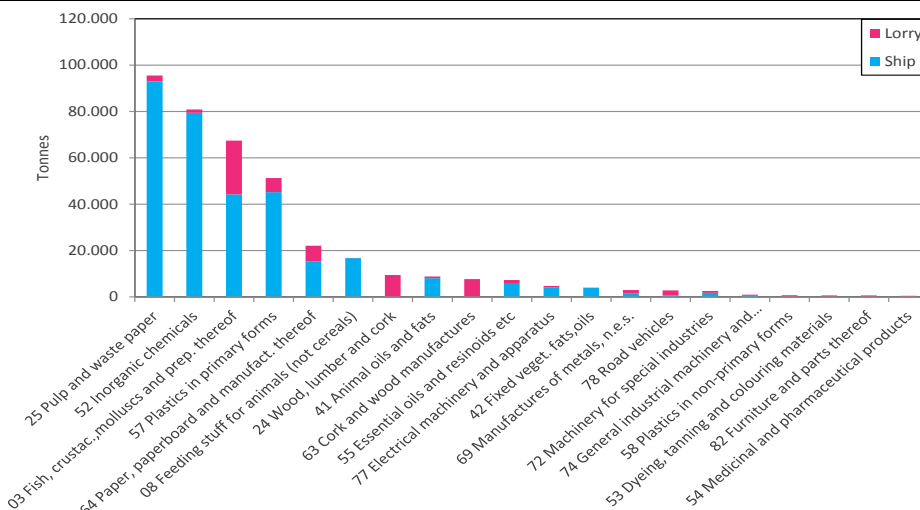


Figure 14: Norwegian exports to the Netherlands 2010 – 11-30 largest product groups – ship and lorry



To sum up, the trade flow of the five most important commodity groups between Norway and the Netherlands are illustrated in figures 15 and 16.

Figure 15: The five most important lorry export groups from Netherlands to Norway

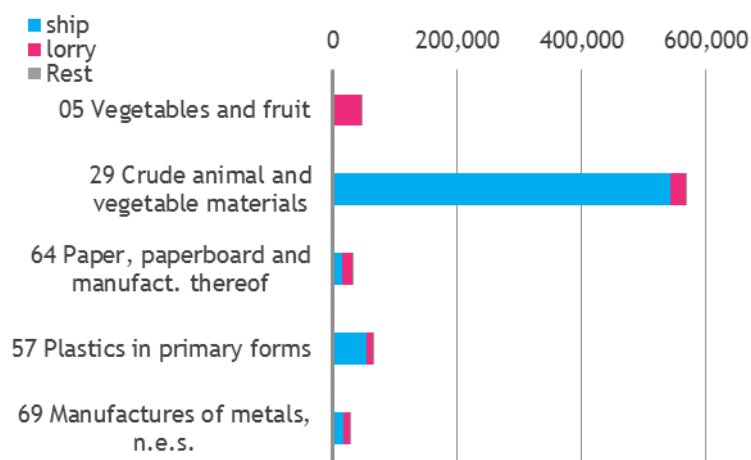
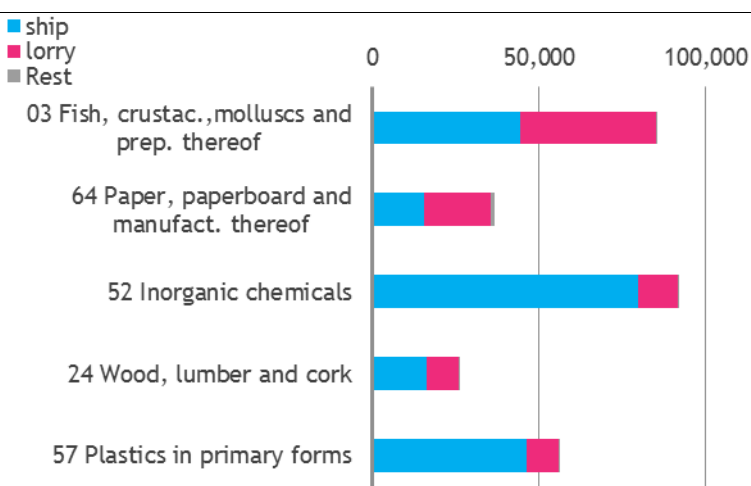


Figure 16: The five most important lorry export groups from Norway to Netherlands



A big part of fish and seafood from Norway is transported by lorry. This could create a big potential for moving fish from road to sea.

Norway and France

The trade flow between Norway and France is illustrated in figures 17 and 18.

Figure 17: Norwegian imports from France 2010 – 11-30 largest product groups – ship and lorry

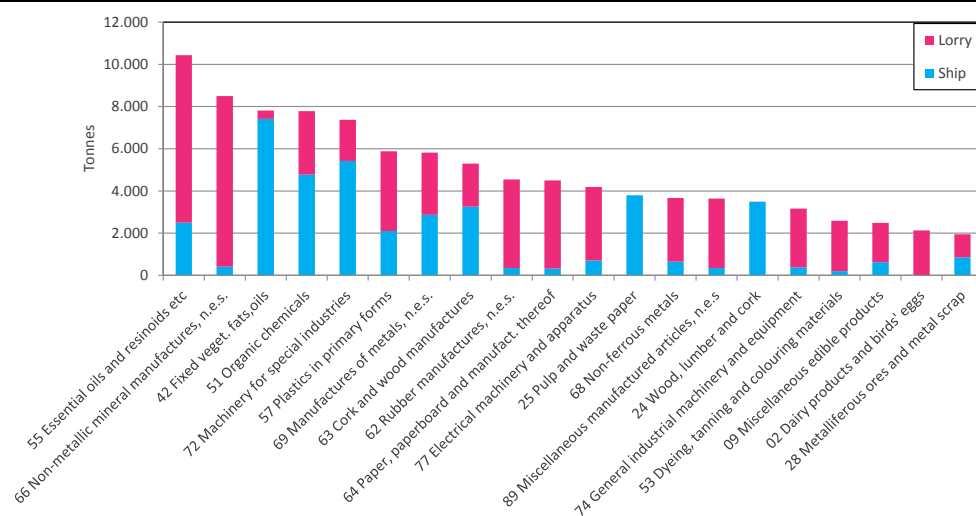


Figure 18: Norwegian exports to France 2010 – 2-10 largest product groups – ship and lorry

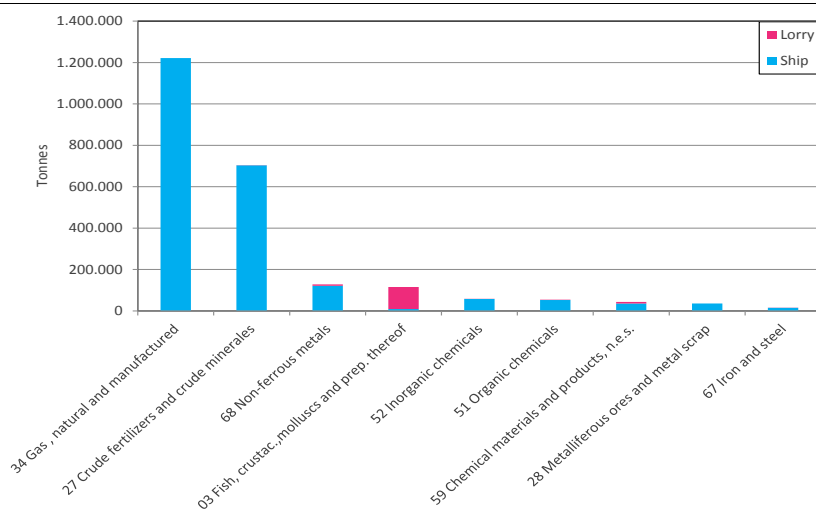
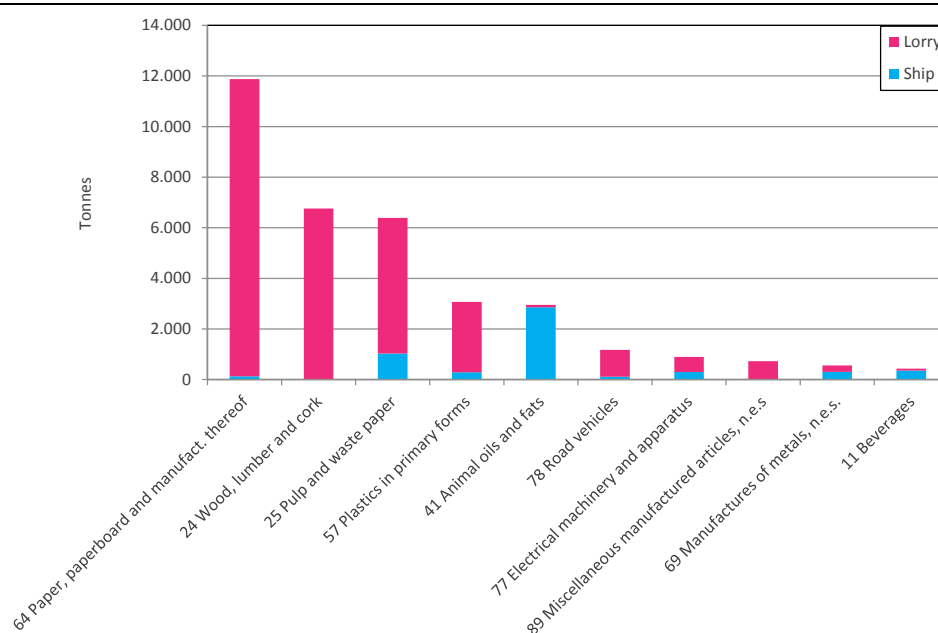


Figure 19: Norwegian exports to France 2010 – 11-20 largest product groups – ship and lorry



As shown in the figures, there is a large volume of especially fresh fish (around 100,000 tons) going from Norway to France by road today. Shifting 50 % of these volumes from road to ship could alone make up for the southbound transports.

Whether or not this is a feasible possibility is discussed in more detail in section 5.1.

Norway and Spain

Figures 20 to 23 in the following section illustrate the trade flow between Norway and Spain.

Figure 20: Norwegian imports from Spain 2010 – 1-10 largest product groups – ship and lorry

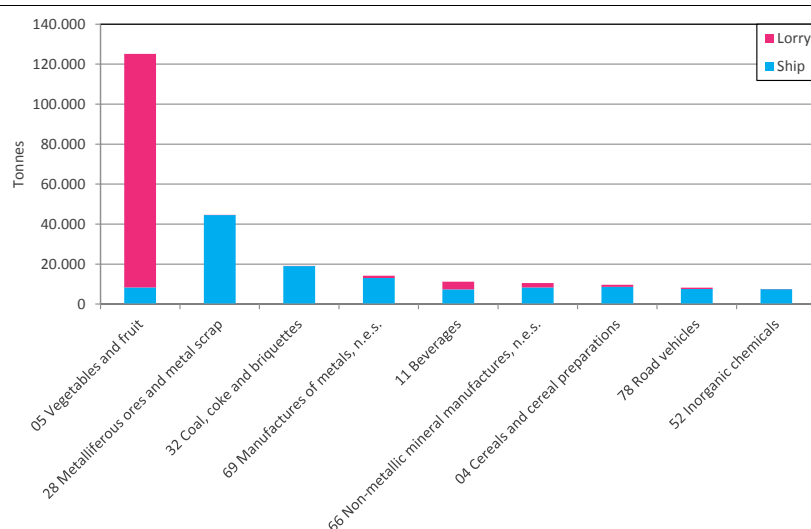
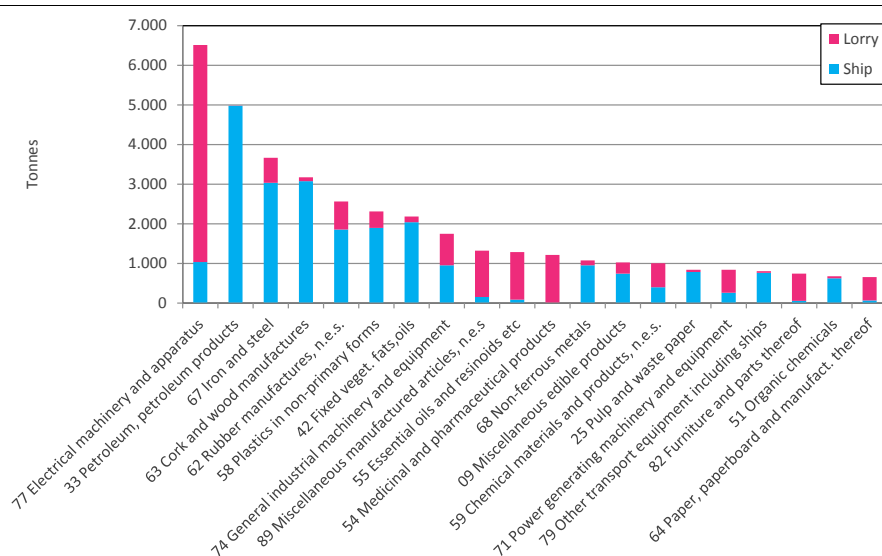


Figure 21: Norwegian imports from Spain 2010 – 11-30 largest product groups – ship and lorry



Norway exports gas, natural and manufactured (1.000.000 tonnes) to Spain – all transported by ship.

Figure 22: Norwegian exports to Spain 2010 – 2-10 largest product groups – ship and lorry

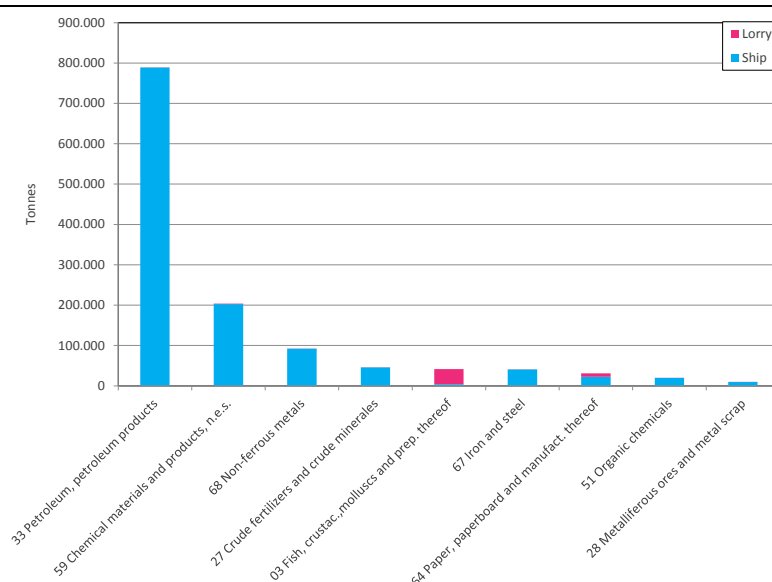
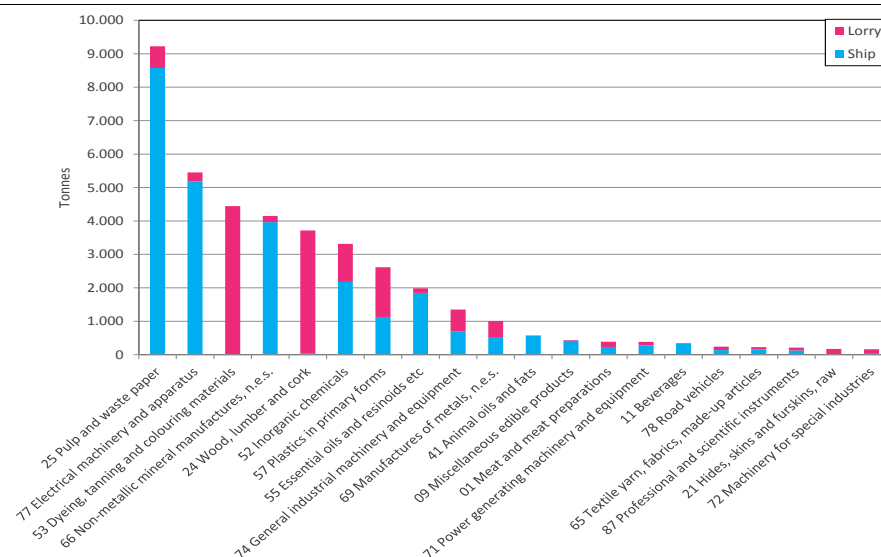


Figure 23: Norwegian exports to Spain 2010 – 11-30 largest product groups – ship and lorry



The figures show that there are large volumes of products carried by truck (around 100,000 tons of vegetables) going from Spain to Norway. The possibility of shifting especially the fresh fruit from

truck to sea will mostly depend on the demand for transit time for these special product items. These demands have not been analysed in this report – but in many ways fresh fruit and vegetables have the same needs as fish and seafood regarding transport quality and time.

Summarising

The trade flow from Norway and Denmark to the Netherlands, Belgium, France and Spain are now illustrated and commented on. Excluding oil and gas, which constitute a large share of the trade, the land-based lorry transportation dominates many of trade flows illustrated here.

The figures do indicate some potential in increasing the transportation by sea rather than by road. A large amount of fruits and vegetables are transported via road from the southern countries to Denmark and Norway. It might be within this segment that the largest potential of establishing a 'fresh food route' exists. This could be made up of transports of fresh fish in the southbound direction and fresh fruits and fresh and frozen vegetables in the northbound direction.

Fish, fruits and vegetables have high requirements with respect to a careful, flexible and fast transport system. Trucks can lift this challenge. The question is whether a sea based solution, including consolidation of large volumes on a vessel, can match such requirements.

In the next section more details on landings of fresh fish are given. In sections 5.6 and 5.7 the challenging and critical issues when comparing on one hand the extreme flexibility of the truck based solution (with respect to time, volume and geography) with the less flexible and high volume demanding sea based solution on the other are evaluated in more detail.

Fish landings in Denmark and Norway

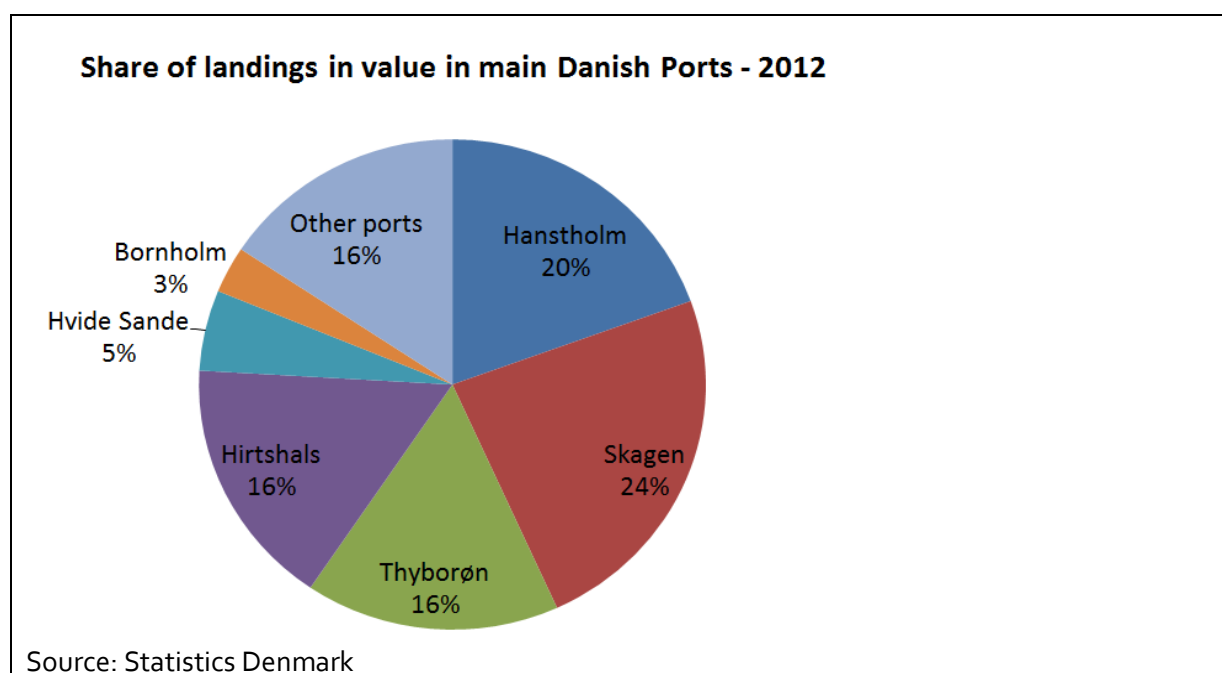
To illustrate the potential of fish exports, the following section provides an overview of the landings of fish in Denmark and Norway.

Denmark – emphasis on Port of Hantsholm

The main part of the Danish fishery is located on the west coast where is easy accessible from the North Sea. This also implies that it is along the Danish west coast the main fishery ports are located.

Figure 24 presents the distribution of landing values in the main fishery ports in Denmark. From this chart it appears that the four ports Hantsholm, Skagen, Thyborøn and Hirtshals together makes up 76% of the total value of fish landed in Denmark.

Figure 24: Landings of fish



The Fisheries in Denmark have during the later years experienced a decrease in landed fish. This is to some extent compensated for by an increase in price which implies that the total value has decreased a little. Table 7 shows the landings in Danish ports in value, weight and price pr. kg for 2011 and 2012.

Table 7: Landings in Danish ports in value, tonnes and prices in 2011 and 2012

	2011			2012		
	Value (1000 DKK)	Tonnes	DKK/kg	Value (1000 DKK)	Tonnes	DKK/kg
Other fish	1.016.863	144.37	7,04	1.145.822	188.302	6,09
Fresh water fish	3.662	157	23,32	4.182	186	22,48
Flatfish	437.024	28.502	15,33	419.55	29.605	14,17
Industrial fish	891.205	521.204	1,71	520.905	252.702	2,06
Crustaceans	558.412	50.427	11,07	552.46	52.34	10,56
Cod fish	590.95	45.002	13,13	550.964	44.12	12,49
Total	3.498.115	789.662	4.43	3.193.882	567.255	5,63

Port of Hanstholm is one of most important fishery ports in Denmark. Almost all Danish landings of saithe (Pollock) are landed in Hanstholm.

Table 8 below shows the landings of the same main fish categories in Hanstholm. The table illustrates the share of the total national value and quantity. It also shows that approximately 20 % of the value landed in Denmark goes through the Port of Hanstholm.

Table 8: Landings of fish in Port of Hanstholm, in value, tonnes and prices in 2011 and 2012 and an indication of the % share of national landings in value and tonnes

	2011			2012		
	Value (1000 DKK)	Tonnes	DKK/kg	Value (1000 DKK)	Tonnes	DKK/kg
Other fish	36.438	1.16	31,41	31.585	1.019	31,00
Fresh water fish	40	2	20,00	6	0	-
Flatfish	77.95	6.167	12,64	64.411	4.836	13,32
Industrial fish	183.686	104.126	1,76	80.407	39.434	2,04
Crap/shellfish	49.911	750	66,55	37.349	666	56,08
Cod fish	366.1	28.57	12,81	332.71	25.81	12,89
Total	714.126	140.775	5,07	546.468	71.765	7,61
Share of national (%)	20,4	17,8		17,1	12,7	

Source: Ministry of Food, Agriculture and Fisheries

From table 8 it appears that approximately 20% of the value landed in Denmark goes through the Port of Hanstholm.

Table 9: Share of landings on selected fish groups in value (1000 DKK) 2012

	Hanstholm	Denmark	% of national landings
Other fish	31.585	1.145.822	2,76
Fresh water fish	6	4.182	0,14
Flatfish	64.411	419.55	15,35
Industrial fish	80.407	520.905	15,44
Crustaceans	37.349	552.46	6,76
Cod fish	332.71	550.964	60,39
Total	546.468	3.193.882	17,11

Table 9 shows the percentage share of national landings in 2012 in terms of value. It appears that approximately 60 % of cod-fish in Denmark is landed in Hanstholm.

Table 10 shows the Danish import and export in 2010 and 2011 in value (1000 DKK), quantity and value/kg appear.

Table 10: Total imports to and exports from Denmark of fish in 2010 and 2011

	2010			2011		
	Value (1.000 DKK)	Quantity (tonnes)	DKK/kg	Quantity (tonnes)	Quantity (tonnes)	DKK/kg
Import	12,730,509	1,310,450	9.71	1,232,727	1,232,727	11.17
Export	18,617,032	1,007,280	1.48	960,782	960,782	20.59

Source: Ministry of Food, Agriculture and Fisheries

Table 10 shows that Denmark is a hub for fish import and export and re-export to EU. It is clear that Port of Hanstholm and the fish-processing companies located in the surrounding of the port play a crucial role for fish exports to Europe.

Norway

A detailed investigation of the trade flow and mode of transportation from Norway to continental Europe has been carried out in the major Norwegian study, "Fisketransporter fra Norge til kontinentet" (Transportation of fish from Norway to the continent)⁶.

This study presents a detailed investigation of the catch and transportation of fresh fish. The setup is based on a train concept where return cargoes were not a focal point.. In regards to this Norwegian study it is of high relevance to have a detailed description of the amount of fresh fish and how they were transported to the European market.

The following section takes point of departure in this study and statistics from national Norwegian sources.

⁶ Mathiesen, Nerdahl et. al: "Fisketransporter fra Norge til kontinentet" Transportutviklin, hhb, Report nr272009

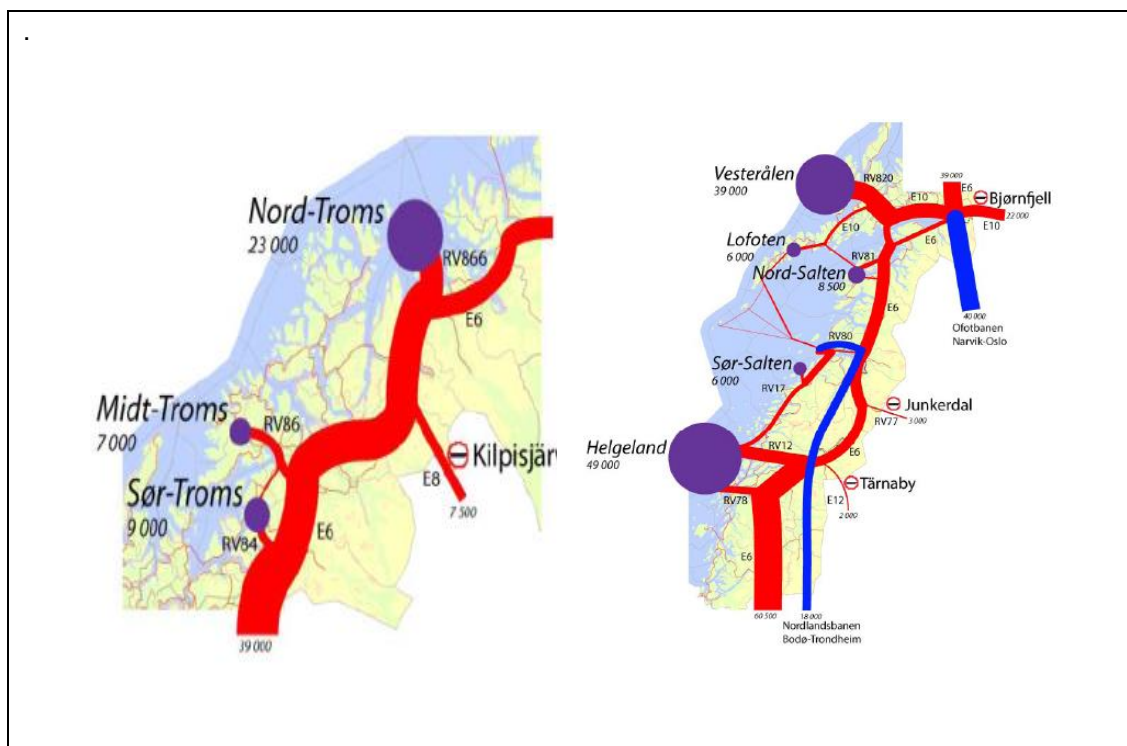
Table 11 describes the catch and mode of transportation of fresh fish exported from Norway.

Table 11: Exports of fish from Norway by modality				
County	Shipments	Road transport	Car/trailer on ferry	Flight
Finnmark	1,089	97%	2%	1%
Troms	3,195	90%	2%	8%
Nordland	9,105	75%	2%	23%
Nord-Trøndelag	6,721	70%	2%	28%
Sør-Trøndelag	14,872	56%	2%	42%
Møre og Romsdal	11,647	54%	1%	45%
Sogn og Fjordane	4,122	45%	4%	51%
Hordaland	15,068	67%	11%	22%
Rogaland	10,277	41%	38%	21%
All	76,123	63%	8%	29%

The table above highlights the previous findings and shows that a large part of goods are transported on road rather than by truck or a truck/ferry combination.

Figure 25 illustrates the amount of fresh trout and salmon that is transported and consolidated through the Troms region and the Nordland region of Norway towards continental Europe.

Figure 25: Transport of fresh trout and salmon from the Troms and Nordland regions to continental Europe



These illustrations indicate a large amount of fish consolidation, but only very little, if any, transportation at sea.

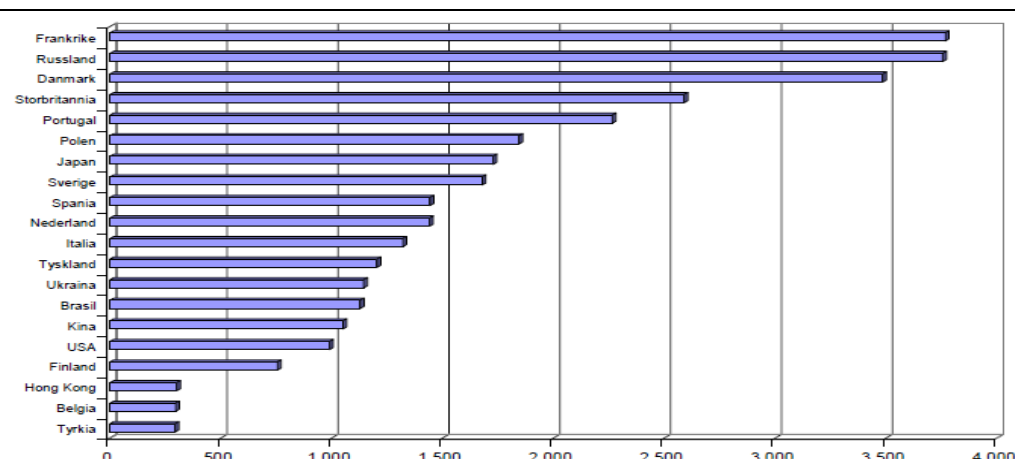
Table 12 below illustrates in a clear way on the one hand the large amount of fresh salmon being transported from Norway and down to the continent, and on the other the large number of destination in Europe. This last issue is a major problem when looking into a sea - based concept. This will be displayed in detail later on in the report.

Table 12: The 10 most important transshipment locations for fresh Norwegian salmon in 2007				
First location of delivery	Country	Net weight (tons)	Value (1000 NOK)	Number of connections
Boulogne sur Mer	France	27859	729683	4205
Padborg	Denmark	22929	589704	2636
Grimsby	UK	18589	504317	1253
Hirtshals	Denmark	15174	392371	962
Madrid	Spain	6925	182608	1653
Rungis	France	6462	170738	1132
Göteborg	Sweden	5153	136913	2189
Milano	Italy	3922	108006	1082
Stockholm	Sweden	2954	78041	1466
Zeebrugge	Belgium	2087	57931	1113
Sum		112,055	2,950,311	17,691

Source: SIB - Norwegian Centre for Innovation and Economics

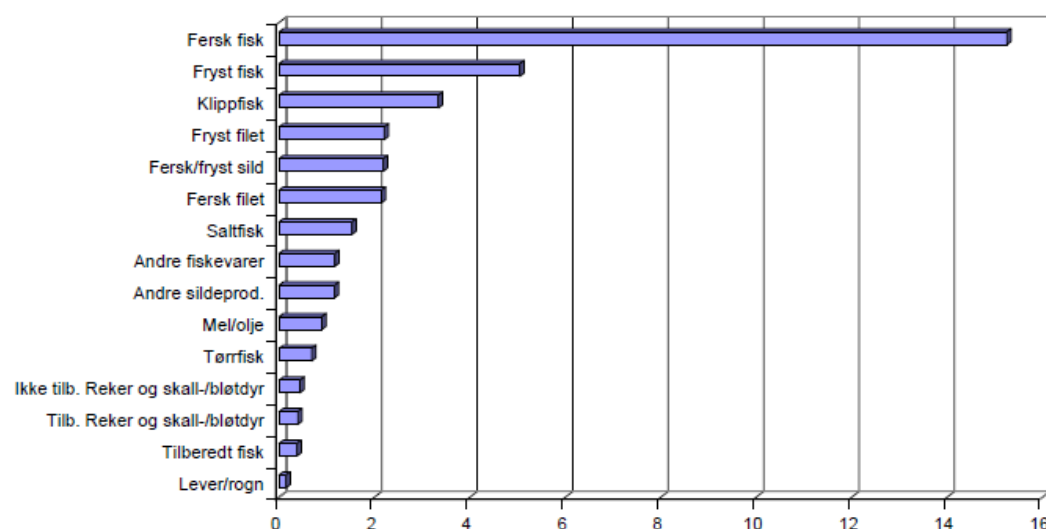
The figure below illustrates the most important export markets for fish from Norway. France and Russia supplemented by Denmark are the most important marketss.

Figure: 26: The 20 largest export markets for Norwegian fish in 2007, measured in value in mil. NOK



Source: SIB - Norwegian Centre for Innovation and Economics and the Norwegian Export Council for Fish

Figure 27: Export values for various product groups. 2007 (Billion NKR.)



Source: SIB - Norwegian Centre for Innovation and Economics and the Norwegian Export Council for Fish

The figure above illustrates that the export of fresh fish (fersk fisk) is far the most valuable compared to frozen fish (frosset fisk) and salted fish (klippfisk).

In sum, this illustrates the importance of fresh fish from Norway to the markets in Europe with respect to both volume and value. When we link these figures with the transport figures in the earlier sections of the report, it displays rather clearly a potential volume for a sea-based transport.

The essential findings demonstrate that alone through Svinesund (southeastern part of Norway close to Drammen), more than 220,000 tons of trout and salmon were in 2007 handled by truck designated for the continent. In all, more than 300,000 tons were handled for the continent. Fish from Norway should be supplemented with more than 50,000 tons per year of fresh fish from Denmark (Hanstholm and other ports), and in the future additional fish from the Faroe Islands and Iceland consolidated in Hanstholm.

More details on these issues including both the challenges of shifting transports from road to sea and the necessity of consolidation versus keeping things fresh are given in a later section.

A Ro/Ro or Lo/Lo sea-based transport

A basic sea-based concept based on a route linking Drammen (NO), Hanstholm (DK) and Oostende (BE). From Oostende, fish is distributed by truck to the market. Goods from central Europe to the Nordic countries consolidate in Oostende as well. Drammen links to Bodø by truck⁷ or later on by rail e.g. the Artic Rail Express line, which can be extended from Oslo to Drammen. This seems to be more of an organizational issue than a technical one.⁸

From Drammen and onwards the transport will be sea-based - either on a Ro/Ro or a Lo/Lo ship. The exact type of ship and the size cannot be determined until details of the exact concept are known. This description will focus on the pros and cons of the different concepts. If possible, the ship should be able to do two round trips per week, but this will depend on speed (which should probably not exceed 18 knots) and handling time in ports. In this report we have calculated with one round trip per week.

A major challenge compared with the road-based solution is the lack of flexibility and the need for large consolidated volumes, which is a prerequisite for a ship-based concept. In addition, the less flexible solution with respect to the range of companies and tailor-made concepts, which is an inherent part of a sea-based concept, is taken into consideration when comparing a sea-based concept with a road-based. Therefore, both a number of organizational/ technical issues as well as the economic issues, are of importance.

Nonetheless, time is on the side of the sea-based concept, as the ongoing development puts more and more stress on the road network. The very low cost of road transports will perhaps fade away within the following years. This will happen if both the salary for truck drivers increases and the congestion and infrastructure charging on the European network increase too. Conversely, the effects of the upcoming SECA regulations from January 2015 on sea-based transports will surely hamper the competitive powers of the sea-based concept.⁹

For a new transport solution, the following elements should be in place:

- Sufficient freight volumes to feed a sea-based concept
- Ports in place with respect to handling procedures, good hinterland connections and facilities in port to “install value” to the handled products
- An efficient sea-based concept with the right mix of speed, tonnage size, tonnage type and cost structure

⁷ Most fresh fish are today transported by truck

⁸ Port of Drammen is going to develop its intermodal terminal in the coming years. Part of the planning of this has been carried out as part of the LO-PINOD project.

⁹ SECA was not a real issue when we started out our work with the sea-based concept in 2011. Due to its importance, a section in the report has now been devoted to this issue.

- A door - to - door transport concept which is “+ competitive” compared to an all road concept
- A concept that reduces the negative impact on the road infrastructure, environment, energy consumption, and at the same time opens up positive possibilities for establishing new and better concepts.

A more complicated matter relates to the type and size of tonnage, that should be used in the future concept. Normally a Ro/Ro concept would be the obvious choice, but taking the special features related to the transport of fresh fish and vegetables into consideration, a concept-based on Lo/Lo transports might be more promising, more cost efficient and have a better environmental profile.

Finally, it should be remembered that standard ISO containers are not compatible with Euro-pallets, which is why it is necessary to use pallet wide (PW) containers, which are slightly more demanding compared to standard containers. On the other hand the use of pallet wide containers is becoming a well-known technique used widely, and this secures a smooth transfer between sea and road. Thereby it enhances the competitive power of the concept. Focus could be on the use of especially containers either on a Lo/Lo or a Ro/Ro ship.

Regarding the tonnage type, Lo/Lo ships and especially Ro/Ro ships come in a number of sizes, so in most instances it will be possible to find suitable tonnage and charter for the route. As a rule of thumb the cost per unit analysis will decline as the size of the ship goes up. This reflects the market as well, as the average size of the ships increases¹⁰. Still there is a market for small/smaller ships. The decision whether to choose a Lo/Lo or Ro/Ro ship must in the end depend on a total calculation of cost and benefits.

¹⁰ The Mærsk triple E class is a good example on this. But even for smaller Ro/Ro and Lo/Lo vessels, there seems to be a clear tendency towards these.

The SWOT analysis is presented in the table below. It indicates the basic elements in such an analysis.

Table 13: Ro/Ro or Lo/Lo

Ro/Ro:

<p>S (strengths):</p> <ul style="list-style-type: none"> • Flexible with respect to load type • Flexible handling of goods in ports • Relatively fast • Can handle both accompanied and unaccompanied units • Few specific requirements with respect to installations in ports 	<p>W (weaknesses):</p> <ul style="list-style-type: none"> • Rather high lease premium • Relatively few minor vessels on the market • High regulations • High fuel costs and poor environmental performance
<p>O (opportunities):</p> <ul style="list-style-type: none"> • Rather flexible with respect to types of goods: Trailers, containers (on MAFI) and project loads (like cassettes, wind mill wings and self-propelled units) • Can call most at most ports due to limited demands with respect to handling equipment and port facilities • Trailers can be handled on/off with a simple/cheap tractor • Transport of goods can eventually be supplemented with transport of passengers 	<p>T (threats)</p> <ul style="list-style-type: none"> • High costs through e.g. high fuel consumption and environmental threats¹¹ • Less flexible handling procedures on especially older ships (elevator and no possibility to "drive through" the ship) • The demand for a larger crew can be expensive

In the case where a Ro/Ro solution seems to be the obvious choice, but cost and especially the environmental issues restrict such a solution, a combination of the Ro/Ro and Lo /Lo, technique is needed. Such a concept is based on putting the so-called pallet wide 45 feet containers in a double stack (two) on a mafi-trailer, rolling these units on and off the Ro/Ro ship. Such a concept will lead to a higher utilization of the ship and thereby reduce per unit cost and emissions.

¹¹ This is very important regarding to the upcoming SECA regulations.

Lo/Lo:

<p>S (strengths)</p> <ul style="list-style-type: none"> • Possible to have high capacity on a rather small ship • Well suited for handling containerized goods • Lower fuel and lease costs (compared to Ro/Ro) • Easier access to leasable tonnage 	<p>W (weaknesses)</p> <ul style="list-style-type: none"> • More complicated handling of container units compared to Ro/Ro units. Strong wind might hamper the smooth handling of containers • Necessary investments in cranes and other equipment. if not self-handler (not very likely) • Somewhat more time consuming operation in ports • Loading units restricted to containers
<p>O (opportunities)</p> <ul style="list-style-type: none"> • More cost efficient (at least on board the ship) • A broad range of load units suitable for different types of cargo, including refrigerated goods (reefer goods) both in frozen and refrigerated form • Matches the transport on rail very well 	<p>T (threats)</p> <ul style="list-style-type: none"> • Lack of handling facilities (cranes, etc.) in a number of ports • Pre - and post - haulage could be more costly • Only PW containers are compatible with the use of pallets • The payloads of transports carried out with containers are generally lower compared to trailers

The concept is still not widespread, even though it has been used with success for years on the Cobelfret route linking Esbjerg to Zeebrugge. In order to handle the double stacked containers, one will need a number of reach stackers in each port.

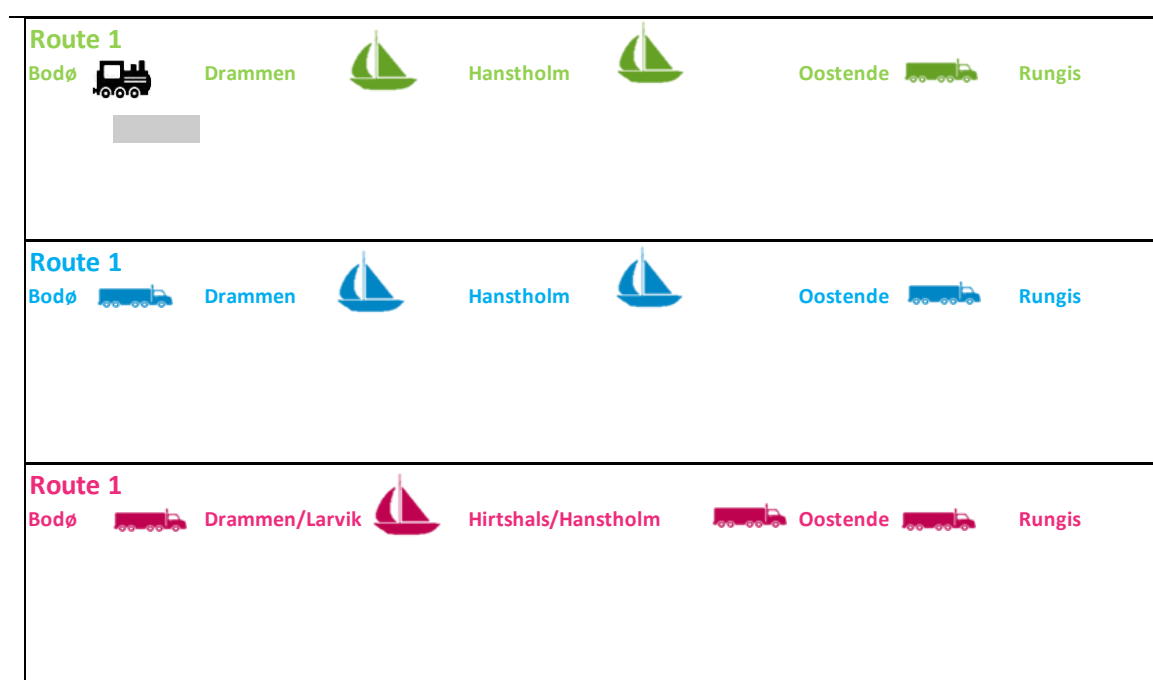
Finally, one should be aware that using a container instead of a semi-trailer would also reduce the total payload, especially on the part of the journey carried out by truck between port and customer.

Transport routes

As discussed earlier, a possible sea-based transport route would need to be flexible to compete with a lorry-based solution. Looking at the import and export data described above, it would make sense that the destinations of a route would be a combination of ports from the LO-PINOD project and perhaps a port in southern Europe. However, the final decision on this must be based on calculations not yet known. This would also include assumptions and calculations on freight volumes, total travel times, and costs.

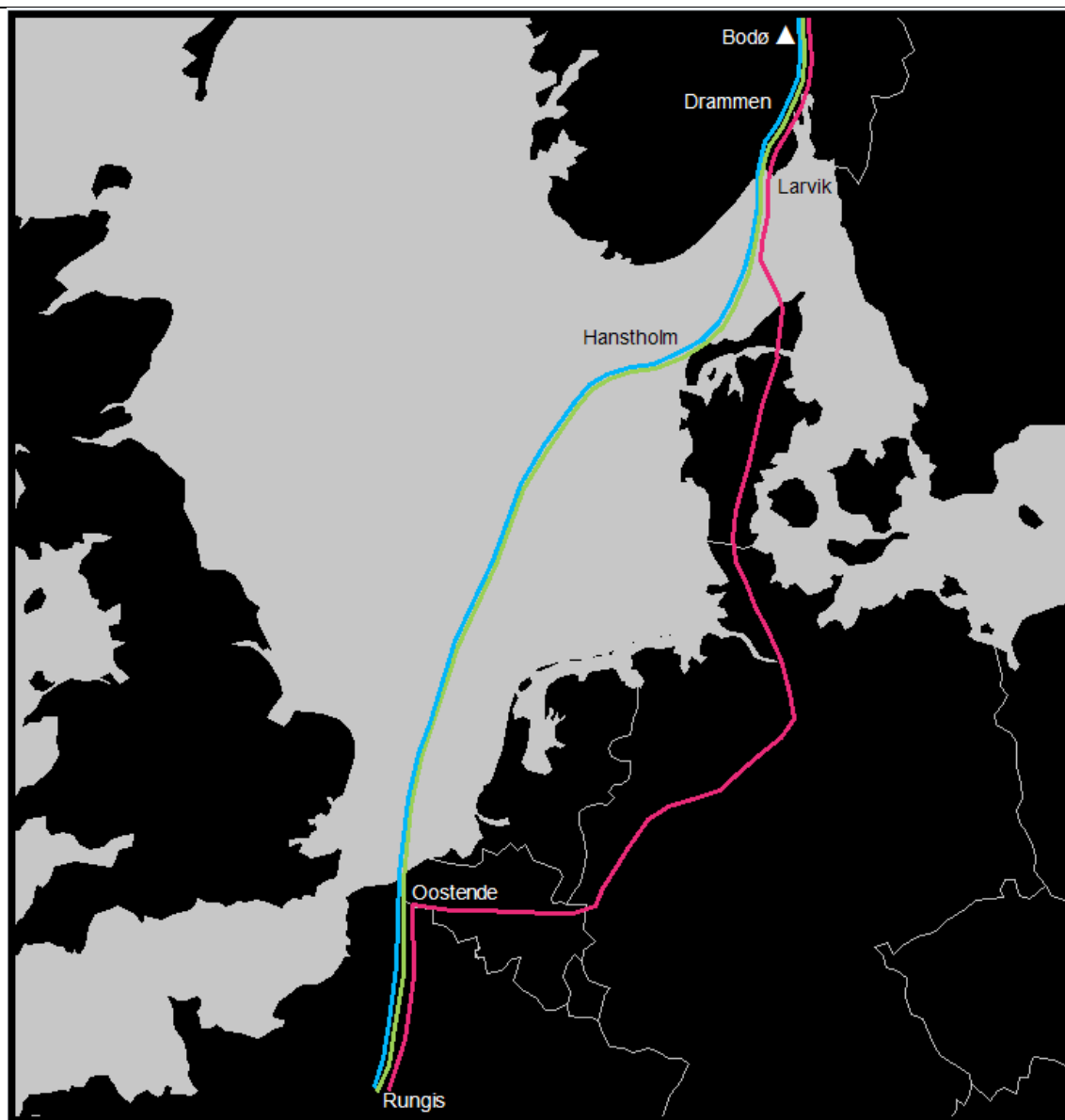
The two figures below represent two routes with different combinations of destinations. Each route then has three different combinations of means - of- transport. Even though the destinations in the two routes vary, the blue line represents a sea-based solution, while the red lines represent a land-based route or a combined sea and land-based solution. The red and blue combinations have been added so it is possible to compare a sea-based solution with other alternatives on key competitive factors such as time and costs.

Figure 28: Overview of routes



The routes presented are examples and other combinations are possible.

Figure 29: Route 1



The figure above represents the route from Bodø/Drammen, via Hanstholm/Hirtshals and Oostende, and down to Rungis in France¹². For each combination of route 1, time and costs have been calculated and are presented in the two figures below. For the train solution no specific time and cost calculation have been carried out. We therefore assume time and cost to be at same level as for a truck.

¹² More details on the fish market in Rungis is given in section 5.7

These calculations are based on the following assumptions:

- A sea-based solution including a Ro/Ro solution, with one ship able to contain volume equivalent to 55 trucks and an average speed of 18.5 knots
- A land-based solution including 55 trucks and an average speed depending on assumptions concerning the driver(s).
-

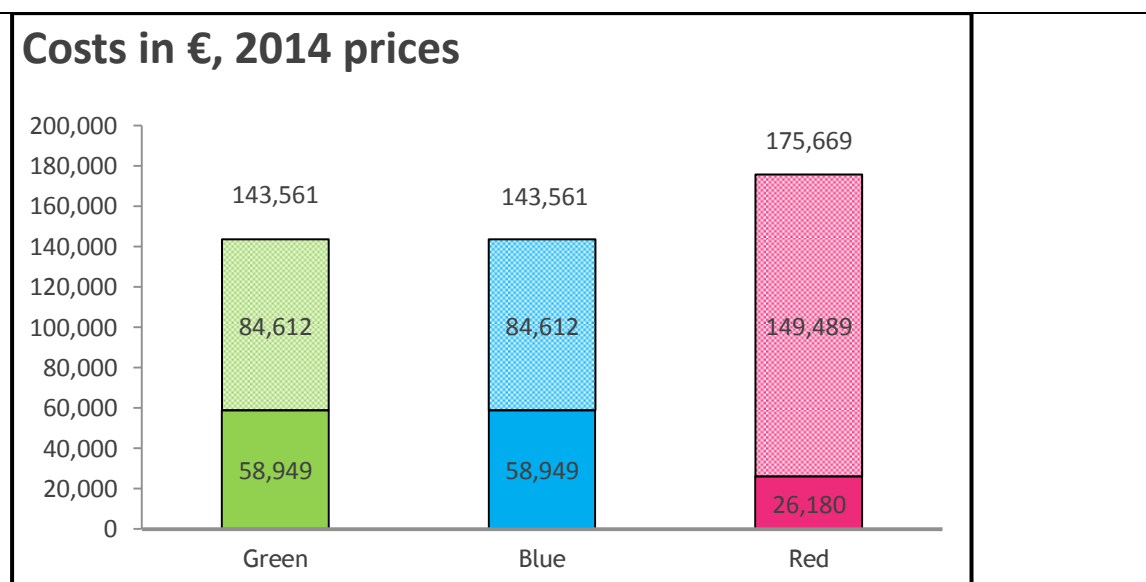
The comparison and the calculations are based on the assumption, that approximately. 100,000 tons of goods (both directions together) should be shifted from road to sea. A Ro/Ro vessel with a capacity of approximately 800 lane metres and a weekly round trip would be able to handle such a transport assignment.

Estimations of time and cost for transports by sea and road

In order to calculate differences and similarities between transport solutions based on sea or road, a number of calculations have been made on time consumption and transport costs for the different setups. More information about the specific calculation can be obtained from the authors.

At this point, the basic differences regarding cost and time for the sea-based (Ro/Ro) and land-based (40 - tons truck) are displayed in the figures below.

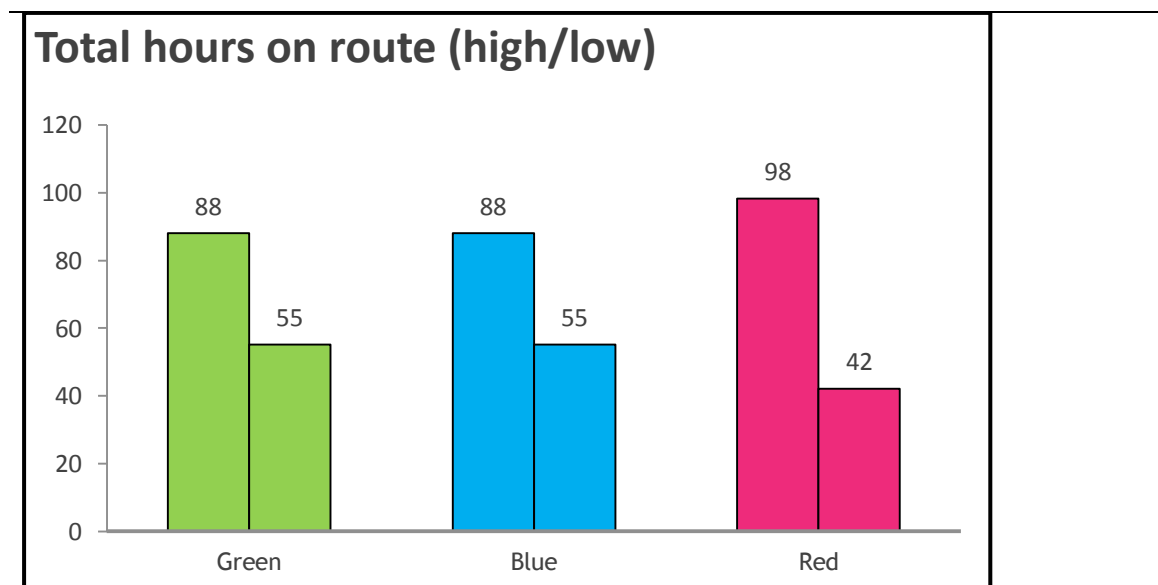
Figure: 30: Bodø – Rungis, costs in €, 2014 prices (55 semitrailers)



The top shaded part of each column represents costs associated with lorries while the bottom plain colored part represents costs from transporting the freight by ship.

Note that when calculating costs for the land based truck routes, a German LKW - Maut of 0.155 € per truck per kilometer has been imposed.

Figure: 31: Bodø – Rungis, time (hours)



The left column represents the time used when calculating with an average speed of 30 km/h for lorries. We base this assumption on the fact that lorries with one driver are able to drive 700 km per day. The right column represents time used when calculating with an average speed of 72 km/h for lorries. We calculate on the assumption that if the lorries change driver frequently, one driver can drive 80 km/h in 4.5 hours before resting for half an hour. Moreover, when the daily driving time has been used, a new driver will take over the truck. Please note that we have only calculated the direct transport time. Additional time for handling, waiting, delays etc. shall be added. Probably in the range of approximately 5- 10 hours for the sea - based solution and 2-5 hours for the road based one.

In the cost calculation, the effects of SECA starting in 2015 have not been included. We stipulate that the ship will use low sulphur oil (MGO) on all relevant sections of the route after January 1, 2015.¹³

The illustrations show that a sea-based solution cannot compete with trucks with more than one driver when it comes to speed, but they can still compete on cost. However, the cost gap is narrowing in. This is because operating a truck still becomes cheaper and cheaper. This is mostly due to the fact that both the cost of the trucks as well as the cost of drivers steadily decline, whereas the cost of the sea - based transport is rising. With the afore mentioned introduction of SECA in 2015, cost of sea based transports will most likely be raised with 10- 15%.

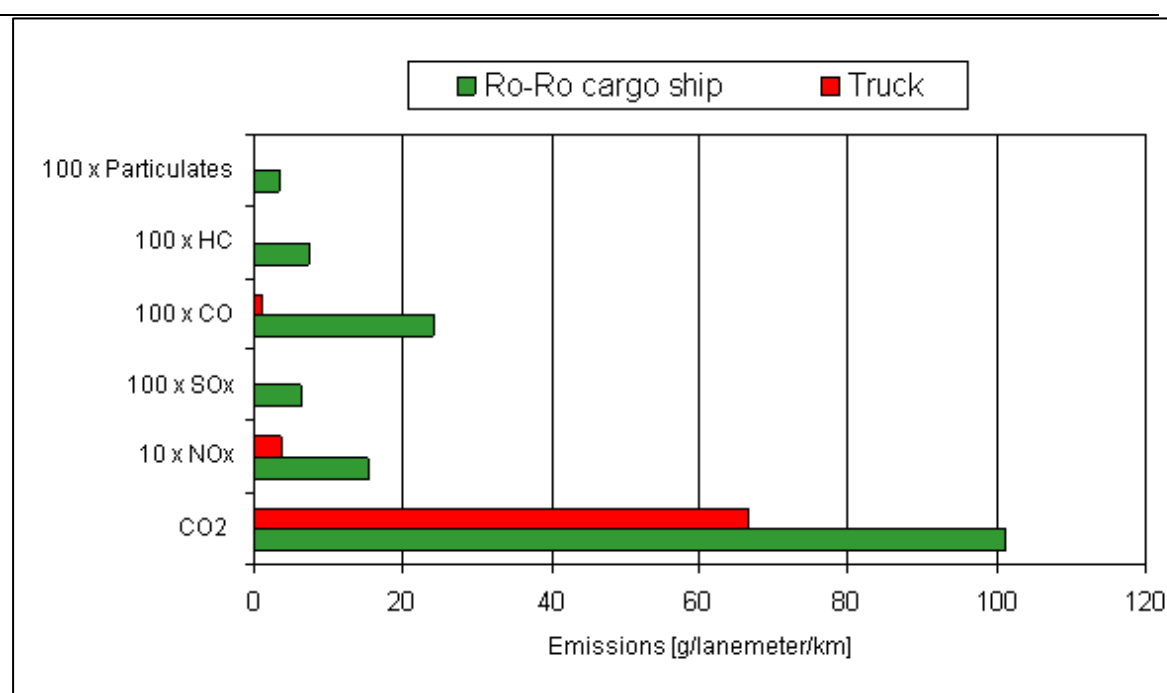
¹³ As an alternative to MGO, a scrubber could be installed on the vessel. Such an installation will cost approximately 2-4 million euros depending on size and type of ship. Compared to the prize of MGO, it will most likely have a payback time of 2- 3 years. Calculations are based on various studies and EU- Ten - T applications.

Environmental issues

Although, if the sea-based transport can hardly compete with trucks on cost and time, it can compete on environmental factors and other external cost like congestion, accidents and the like. Unfortunately, as the illustrations below show, this is hardly the fact either. New calculations carried out by Hans Otto Kristensen from the Danish Ship-owners Association clearly demonstrate, this.

The illustration below shows the challenges when using a Ro/Ro vessel compared with a modern truck (Euro 5) looking at things from an environmental/climate perspective.

Figure 32: Effects on climate emissions



What can be seen from the illustration is that the Ro/Ro cargo ship exceeds the truck on all parameters. A replacement of heavy fuel with MGO or the installation of a scrubber will certainly reduce some emissions, but will have no positive effect on the fuel consumption and thereby on the climate. So from a climatic perspective, a Ro/Ro vessel will therefore not be able to compete with a truck at least on parallel routes.

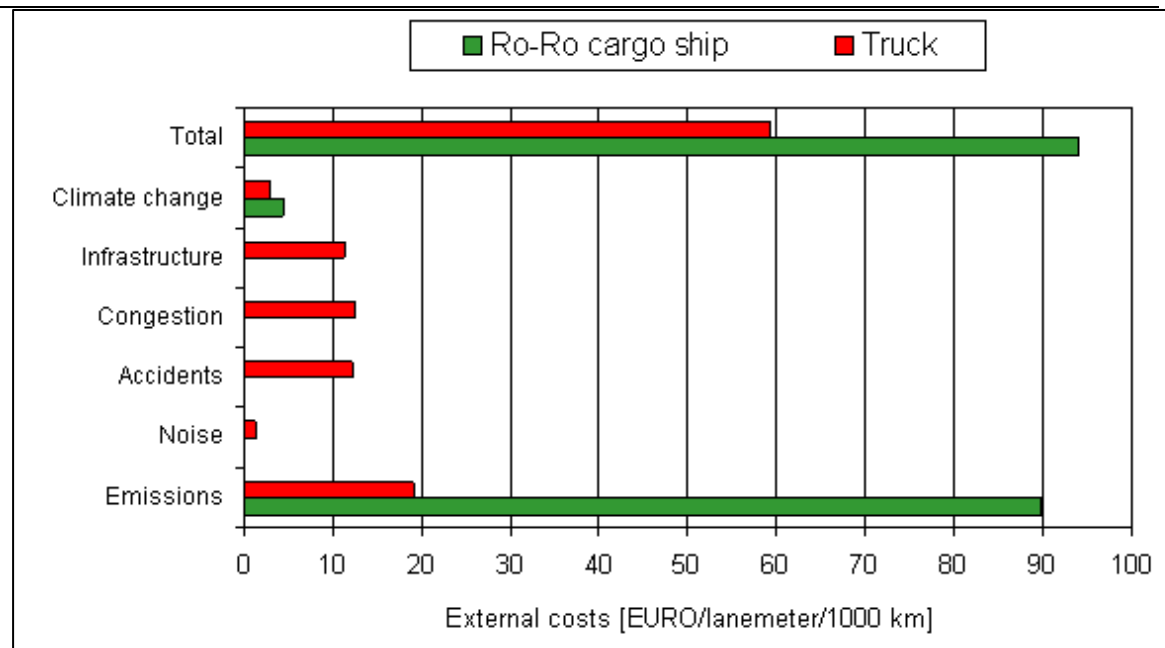
In the future the energy consumption for Ro/Ro vessels will undoubtedly be reduced.¹⁴ But new engines and other fuel saving devices cannot change the basic fact that Ro/Ro vessels due to the

¹⁴ The Danish naval architect company Knud. E. Hansen have managed to develop a new con/ro design for a ship to the Bahri company (Saudi Arabia), which will have a 45% lower energy consumption compared with its predecessor. See: www.knudehansen.com

design of the ship and the characteristics of the load (semi-trailers), have a less fortunate utilization of the ships' capacity compared with Lo/Lo or bulk vessels.

Emissions and effects on climate do not make up the whole picture when comparing Ro/Ro transport with transports by road. Other external factors are of importance as well, which are depicted in the illustration below.

Figure 33: Total external effects comparing a Ro/Ro vessel with lorries



In particular, figure 33 shows the effects of taking transport of the road have major positive effects when looking at infrastructure, congestion, accidents and noise. In the illustration above, the average values from Denmark are displayed. Moving into mainland Europe, the named effects will be larger, meaning that shifting transports off the road make even more sense. This is likely the explanation of the fact, that when using the Marco Polo environmental calculator, Ro/Ro vessels perform better from a total external cost perspective than trucks.

More transports of fish/new routes

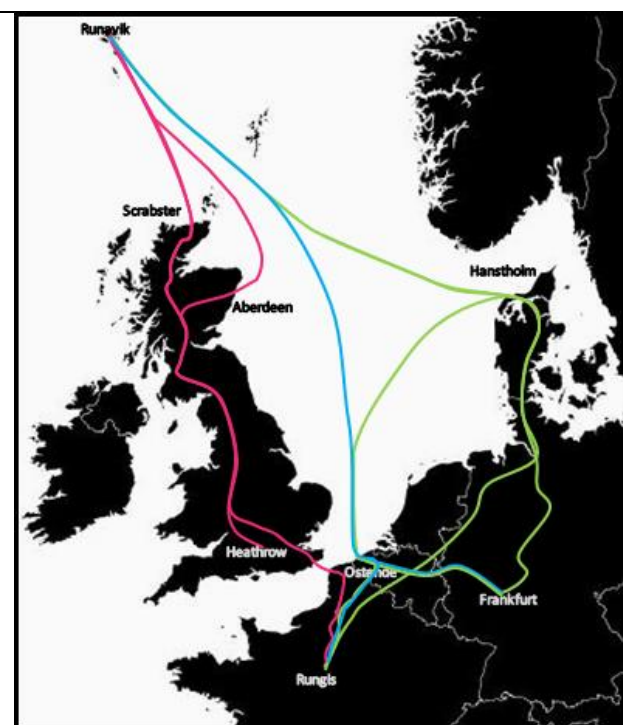
Besides Norway, also the Faroe Islands is a great supplier of fish. The fishing industry of the Faroe Islands needs a connection to Europe and a fast route to a big airport that connects Europe with the rest of the world, especially USA. Currently this need is met by sailing the fish to Scrabster (UK) and then transport by truck to Heathrow Airport or further down in Europe.

The plans for the expansion of the port of Hanstholm, makes it more attractive as a destination. An alternative route could then be sailing the fish to Hanstholm and then consolidate them with the

quantities from Denmark and Norway. From Hantsholm it would seem obvious to use Frankfurt as an airport instead of Heathrow.

Below we have displayed some calculations regarding the change in time and costs for this option. These calculations are similar to the calculations presented above, but the main point is to compare the presented routes with each other and expand the sea - leg of the transport.

Figure 34: Possible routes from the Faroe Islands



The results displayed below follow the same assumptions as previously stated, although one further assumption has been imposed:

- Half of the trucks go to the nearest airport (Heathrow or Frankfurt), and the other half go to the market of Rungis, France.

Figure 35: Overview of routes

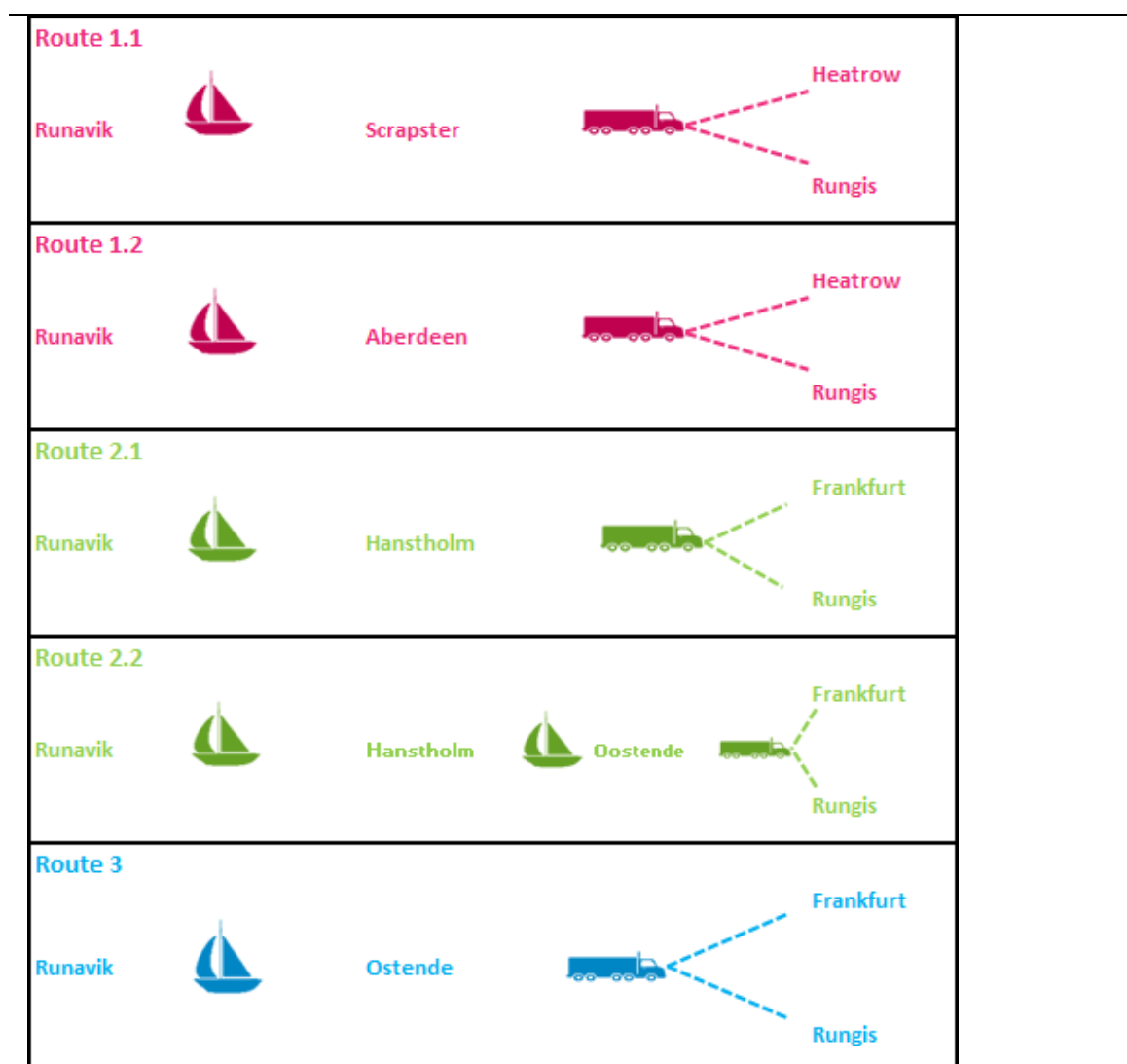
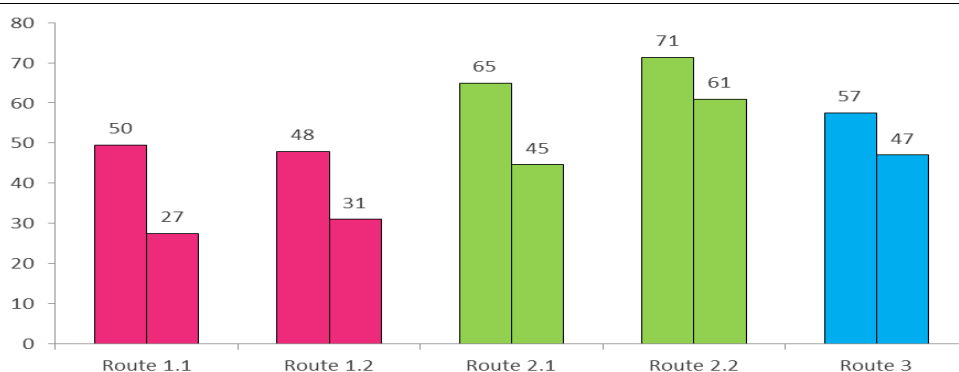


Figure 36 illustrates the different routes and the amount of hours taken to go between Runavik and the airport.

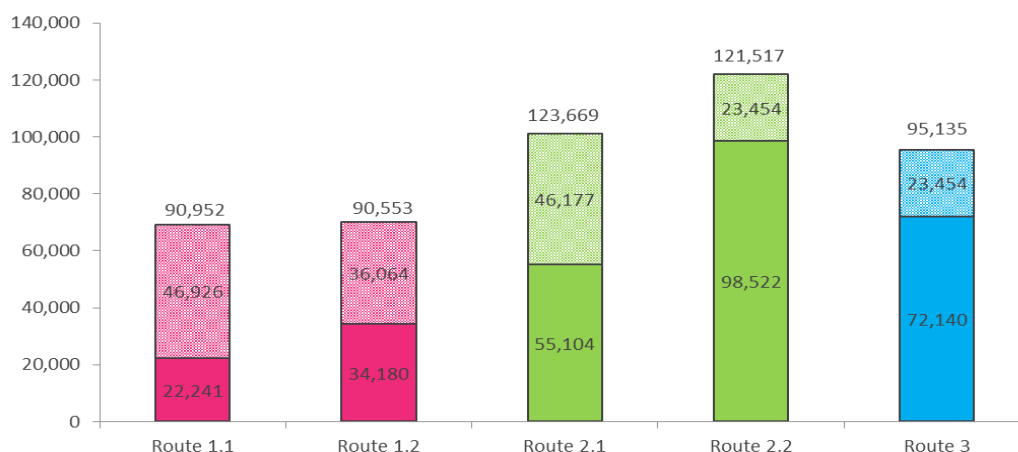
Figure 36: Hours from Runavik to airport (Heathrow or Frankfurt)



The left column represents the time used when calculating with an average speed of 30 km/h for lorries. This is based on the assumption that lorries with one driver are able to drive 700 km per day. The right column represents time used based on average speed of 72 km/h for lorries and the assumption that the lorries change driver frequently, and hereby one driver drives 80 km/h in 4.5 hours before resting for half an hour.

It seems clear from these calculations, that only the sea - based route going directly from Runavik via Oostende to Frankfurt is able to compete with a lorry route going to Heathrow with respect to time. This conclusion becomes even clearer when taking the cost element into consideration.

Figure 37: Costs from Runavik to airport (Heathrow or Frankfurt)



The top shaded part of each column represents costs associated with lorries while the bottom plain coloured part represents costs from transporting the freight by ship. Note that, when calculating costs for the routes through UK, a freight rate of € 249 has been imposed on each truck crossing the Euro Tunnel

Including the Netherlands in the concept

Another possibility might be to include a Dutch port like Harlingen in the network, since both Norway and Denmark each year have an extensive trade with the Netherlands. This is emphasized in table 14 below.

Table 14		
From	To	Quantity of transport (tonnes)
Denmark	Belgium	336,306
Denmark	The Netherlands	2,469,531
Belgium	Denmark	828,964
The Netherlands	Denmark	2,071,519
Norway	Belgium	6,917,239
Norway	The Netherlands	31,910,391
Belgium	Norway	770,335
The Netherlands	Norway	1,763,300

Source: Statistics Denmark, table SITC5R4Y. Statistics Norway, tables 03064 and 03065

Denmark has an export to the Netherlands of approximately 250,000 tons of cereal and related products¹⁵, while Norway has an export of approximately 85,000 tons of fish. The fact that the trade with the Netherlands in general is more extensive than with that of Belgium supports Harlingen as a destination. The ship could call the port of Esbjerg instead of Hanstholm on the way back to Drammen. The reason is that Esbjerg is better connected to the rest of Denmark when it comes to the distribution of consumer goods.

On the other hand, on its way down to the continent the ship must call at the port of Hanstholm, because the port can provide a greater quantity of fish to be exported. This would be fish caught in Denmark or the Faroe Islands.

Still, the issues related to lack of competitiveness with respect to time and the logistics of consolidation seem to be of major importance. What about the total volumes of goods? These issues are discussed in the next section

The Rungis Seafood Market and consolidation

The fish market in Rungis in France is the largest wholesale food market in the world. Regarding seafood products, the market of Rungis sells about 170,000 tonnes each year, which is equivalent to about 12.5 % of the French consumption of seafood.¹⁶ Linking our routes with this market is therefore of the outmost importance.

Overall, the preliminary conclusion is that trucks are faster, but a ship-based solution to Oostende might be cheaper. But it is only cheaper if one can consolidate enough volumes on-board the ship. So the question is if this is possible?

Gathering all these considerations in one route yields the route displayed at figure 38 below, where the ship sails from Drammen via Hanstholm to Oostende (blue route) and back to Drammen via

¹⁵ As mentioned earlier, we cannot determine from Danish Statistics if these quantities are being transported by road.

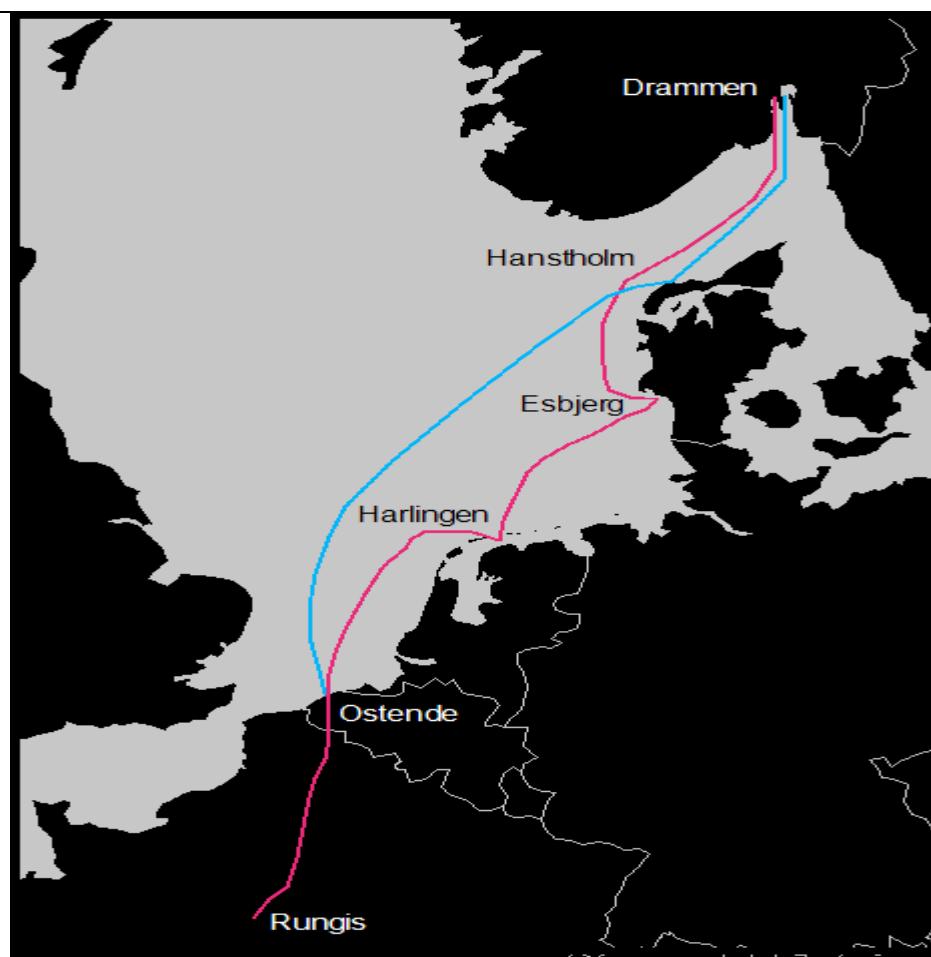
¹⁶ www.rungismarket.com

Harlingen and Esbjerg (pink route). From Oostende and onwards to Rungis, the transports will be carried out by truck.

Then it is necessary to decide whether the potential quantity to be transferred from road to sea is big enough to support such a route. If one ship containing approximately 55 trucks sails this route once a week, 52 weeks a year, it will be able to transport more or less 100,000 tons per year in both directions together.

In these calculations, it is assumed that the ship is fully loaded both ways. Therefore, it is necessary to locate at least 100,000 tons of goods, currently transported by truck, which are suitable to transfer by ship. In the suggested route, the ship calls at ports in both Norway and Denmark before going south, so imports and exports from both countries are included.

Figure 38: The best possible sea - based route



When combining the Norwegian and Danish numbers it looks plausible to transfer approx. 100,000 tons of goods to a sea-based concept. 100,000 tons equal approximately 20% of the total imports to

Norway and Denmark transported by truck, while 100,000 tons equal approximately 10% of the total exports from Norway and Denmark transported by truck. Furthermore, it has not been taken into consideration that the ship could contain traded goods between Denmark or Norway and European countries further south.

If one combines the suggested sea-route with a lorry-based route from Oostende to e.g. Vigo (ES) the time duration would be approximately four days and thus possible.

Table 15: 100,000 tons as a share of the imports and exports. 5 groups

	Imports	Exports
NO	128,071	321,440
DK	419,484	684,732
Sum	547,555	1,006,172
Share	18.26%	9.94%

Before making any final conclusions, it is important to remember that the route has to compete with the alternative, which is a lorry-based route. The suggested sea route is not as flexible as a land-based alternative. Firstly, the route is too long for a ship to sail twice a week, thus the solution is not time flexible. Secondly, the solution does not offer a door - to - door solution, which further complicates things. It has not been possible to determine whether the origin and destination are located conveniently relative to a port, which might result in a solution being geographically inflexible.

Finally, the assumption that the Norwegian lorry shares can be directly transferred may not be fully correct. The assumption that Denmark and Norway hold the same import and export patterns should be questioned. Secondly, the two countries do not share the same size of population, and the geographical base is very different since Denmark has a much more continental connection to the rest of Europe. Thirdly, the export groups that Denmark and Norway find important are not identical. As an example, fish as an export group is extremely important to Norway, while cereal is more important to Denmark.

Nevertheless, with these precautions taken into consideration, the figures indicate a possibility of having enough volumes for a sea-based concept.¹⁷

Consolidation and flexibility

The final and perhaps most essential issue related to the possible modality shift from road to sea are related to consolidation and flexibility. Even though we have demonstrated enough volumes of fresh fish and other products to start a sea-based transport concept, a number of obstacles still have to be removed.

¹⁷ These conclusions are supported by Norwegian data displayed in the "Fisketransporter fra Norge til Kontinentet" study, Bodø 2009.

At first, the fresh fish must be consolidated in a transport centre (port) in order to fill the volume of the ship. In Norway this should be Drammen, but at present a number of transport centres are being used, meaning that the total volume is divided into these.

The use of more centres is natural when it comes to truck-based transport. These are designed to handle smaller volumes per unit in a flexible manner. The opposite is the case when we look at the sea-based concept, where a prerequisite for implementing this concept is the consolidation of volumes. And even though we have illustrated the large volumes of fresh fish passing the Norwegian/Swedish border nearby Drammen by truck (see section 4.2), the essential challenge will be to consolidate enough volumes to make up a sea - based transport.

From a Danish perspective, the situation is exactly the same or perhaps even worse. A realistic approach on the volumes handled in Hanstholm that are ready for the sea-based concept is around 10,000 tons, which on a weekly basis sum up to 200 tons. The basic assumption is that 200 tons is not enough to generate a call from a vessel to the port, when comparing the income from the cargo with the additional cost of calling at the port. Consequently, this volume has to be raised.

In previous sections, we have described the possibilities of introducing fish from the Faroe Islands and Iceland into the concept. This is surely one possibility. Another possibility would be to have fish landed in two or three other North-western ports in Denmark moved into this transport system. The basic idea is not to move the landings from these ports (e.g., Thyborøn, Hirtshals and Skagen), but to change the transport concept from a road-based, individual setup to a common sea-based concept with Port of Hanstholm as the transport centre and consolidation point.

Such a consolidation might be possible. But again, the need for consolidation on one side paired with the quest for freshness on the other points in opposite directions. Moreover, as illustrated earlier in table 12 in section 4.2, fresh fish are being dispersed into a number of locations on the continent, making it difficult to consolidate enough volumes in a speedy way. This is a basic prerequisite for running a ship based solution with fresh produce.

On the return trip, consumer goods like frozen vegetables and similar products could fill the capacity on the ship. Frozen vegetables are a major product group in this geographic relation. As these products are not very time sensitive, transport by ship should be an obvious solution. It must be taken into consideration that the Cobelfret route, linking Zeebrugge with Esbjerg, is already in the market, but to the best of our knowledge, they do not handle fresh or frozen products.

These findings and results have been presented at the B2B meeting in Drammen in March 2013 and at the North Sea Fish meeting in Hanstholm in September 2013. The reactions from a range of transport companies, forwarders and fish producing companies at these meetings were positive and showed a real interest in the concept, but at the same time reservations with respect to in particular consolidation, flexibility and freshness. Finally the project has been presented to Blue Water Shipping, a company with vast experience in setting up new routes and developing new transport solutions. They were also interested in the concept, but pointed to the facts related to time and consolidation. The fact-finding trips to Iceland, Norway and Faroes Island all - in - all showed a

potential for a more optimized transport solution regarding fish and seafood. The outstanding task is to create volume and new technology for preserving and storing.

The same reactions have been experienced by the Food Ports Project working along the same lines. As mentioned previously, the seafood company Deutsche See has tested a new conservation technique making it possible to keep the fish fresh for a longer period, in order to cope with the challenges of consolidation and sea - based transports.¹⁸ Unfortunately this technique has not proven to achieve the expected results, leaving the challenge of consolidation and freshness unsolved.

The nearby future

At this point we have demonstrated that the cost of using sea-based transport is lower than a road-based solution.

However, the time consumption is somewhat higher when using a sea-based transport system and the environmental gains can surely be disputed. Finally, the need for consolidation versus freshness of the product is a major challenge as well. This is in particular the case when wild, caught fish has to be consolidated with other types of fish and seafood products.

The challenge is fundamental; still fresh must reach the consumer.

An early opening of a sea-based concept is therefore not to be foreseen.

Nevertheless, at the same time, the EU Commission pledges for more transport on sea and rail, and points out problems related to increasing congestion and environmental problems. It goes very well in hand with the bulletins for problems in the coming years related to major problems on crucial parts of the road network in Germany due to major restoration work. All these elements are surely in favour of moving transports from road to sea.

Still the logistics impediments of such a shift must be overcome. In addition, the upcoming rise in cost due to the introduction of the SECA regulations in 2015 must be included as well.

¹⁸ Presentations at the Food Ports final conference 20.02.2014

Environmental requirements

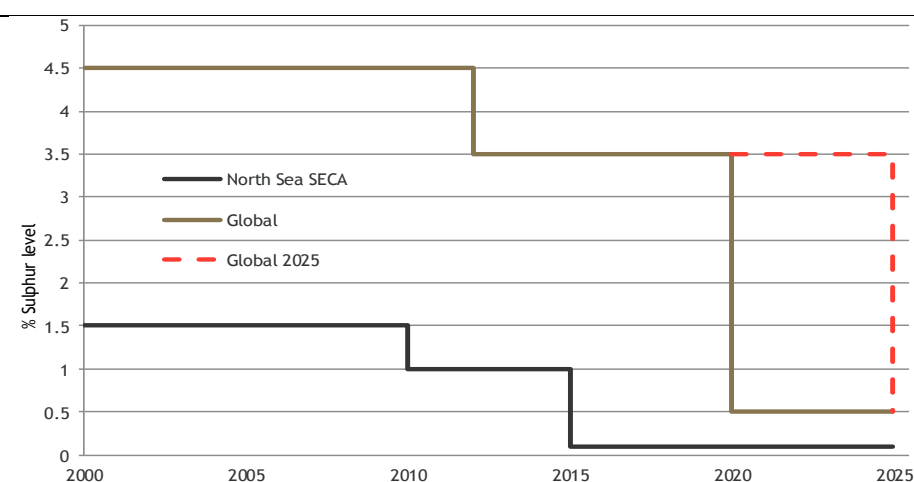
The introduction of SECA¹⁹ in the North Sea Area in 2015 will raise the fuel costs for vessels. The major elements in SECA will be:

In 2008, the International Maritime Organization (IMO) adopted their revised MARPOL Appendix VI, which outlines stricter regulations of air pollutant emissions from ships. Amongst others, the requirement applies to emissions of sulphur and nitrogen oxides.

In 2010, the North Sea countries decided to initiate a process that entails studies of environmental and economic implications of a nitrogen oxide emission control area (NECA) to comply with the TIER III standards.

The SECA requirements are set in the MARPOL Annex VI regulation, which lowers the permitted level of sulphur in fuels from 1% in 2010 to 0.1% in 2015 within the SECA.

Figure 39: North Sea SECA and global sulphur requirements



Source: (Green Ship, 2012).

Note: Whether the global limit is lowered in 2020 or 2025 depends on the outcome of a review of fuel oil availability. It is to be completed in 2018, however 2020 is the reference date (Lloyd's Register, 2012).

In the figure above, the development in requirements for SECA is illustrated. As can be seen from the figure, 2015 will be a turning point with respect to the amount of sulphur in the oil. The need to reduce the sulphur level to 0.1% will require either a very clean oil (1st suggestion), or a shift to another type of fuel (LNG, as an alternative). A third possibility is retrofitting the vessel with some kind of exhaust cleaning device, which takes out the sulphur related elements from the exhaust.

¹⁹ SECA= Sulphur Emission Control Area

The most relevant technique is installing a scrubber device on board the vessel. The scrubber will clean the exhaust through a chemical process using certain chemicals combined with seawater. Installing a scrubber device opens up the possibility for continued use of oil with a high sulphur level, and still obtain the positive effects related to low sulphur oil with respect to environmental damage.

Nevertheless installing a scrubber requires space on the vessel, and cost for installation and operating has to be included. A scrubber is most likely the most cost- efficient solution (depending on the future market prices for low sulphur oil). The requirements related to the vessel and the ongoing maintenance and cost may, however, prevent a large number of vessels from installing the device.

For vessels operating on shorter distances on a strict timetable, LNG might be a solution, but only for new build ships. It must be taken into consideration, that the deployment of LNG into the shipping environment will require the development of a LNG infrastructure into and in the ports. This might be a major benefit for the ports with respect to attracting new vessels and thereby new routes.

These gains must be compared to the cost of establishing the LNG infrastructure in the ports, which at present is very costly and with few secure users. A possibility for some ports might be a wider use of these installations for other transport modalities. Among the most promising and relevant possibilities, one could point out public busses in local and regional traffic and, in a somewhat longer perspective, also vans and freight vehicles for heavy transports of goods.

A system of this character might contribute to viable economic solutions related to the LNG systems, and may help bring more activities in the ports. The port's function as a multi - modal transport centre can be enhanced by such developments. If it is possible to combine the handlings of goods with a fuel filling function, it would be a good combination of handling goods and (clean) fuel filling in the same place.

The geographic boundaries related to NECA

As shown in the illustration below, the upcoming SECA area covers the whole of the North Sea area. With respect to LO-PINOD, only the port of Bodø is located outside the area. In various studies it has been discussed if environmental restrictions would result in a shift of port (to ports outside the restriction area) or to other modalities, most likely road. Alternative ports are located so that extra sailing and additional road transports makes such an option less interesting.

It is difficult to identify alternative ports in the near proximity of the SECA area. This is mostly due to the geographic dimension. From an economic point of view, the picture is more blurred. This is caused by the additional costs for sailing a few miles within the SECA area as the cost of installing dual fuel systems etc. are high. For vessels with a possibility of bypassing SECA waters, avoiding installing this equipment will surely be a very interesting option. Especially older vessels with a short remaining, operational period will fall within this category. For most other vessels, changes in the competitive situation will more or less be the same, wherefore they will try to adapt themselves to the new situation.

Figure 40: The North Sea



Source: (Incentive, 2012a)

For vessels which access the SECA waters on a regular basis, finding the most promising or cost efficient solution is surely the way ahead.

Change of modality

Not all ship types are prone to modal shifts. We identify the types of ships potentially prone to modal or port shifts:

- Ro/Ro cargo
- Ro/Ro passenger (Ro/Pax)
- Container (Lo/Lo)

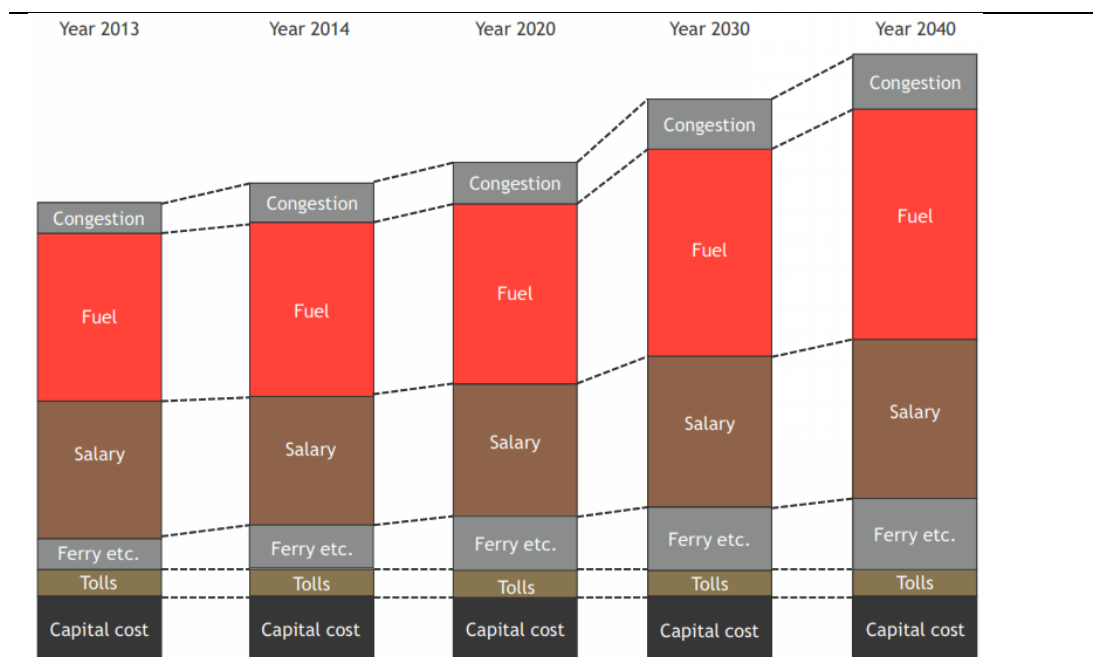
The core criterion for a ship type to be prone to modal shift is quite simple: A plausible land-based transport alternative must exist. This is not the case for a large share of the North Sea shipping. The short list is the result of an elimination process and the report by (UK Chamber of Shipping, 2013).

- Modal shifts are in general not expected for long-distance transport and transport of goods with a low value. For example, bulk products such as grain will not be affected by SECA and NECA. On the other hand, highly valued fragile goods might also be less sensitive to SECA and NECA, as they are sensitive to unloading, and transport by only one mode (truck) might already be preferred prior to SECA and NECA (Rich, Kveiborg, & Overgård, 2011).
- Transports of fresh fish partly falls within this segment both with respect to value and their sensitivity to loading/unloading.
- Most trucks operating in European countries operate with a total weight limit of 40 tons (54/60 tons in Denmark and up to 60 tonnes in Sweden and Finland), making weight restrictions an important restraining factor. With an isolated focus on the transport of fish, this is not an issue.

- It is possible to identify other routes of the same nature as well. An example is the Oslo - Kiel route operated by Color Line. With a transit time of 20 hours the route is somewhat more time consuming than a truck (with more than one driver). Also the punctuality with respect to sticking to the timetable is often better compared with road.

Cost of land based transport

Figure 41: Costs of land-based transport (for illustration purposes only)



The figure above, even though designed for illustration purposes only, indicates the rising level of costs for road transport is related to congestion, fuels and salaries in the future. It can be argued as well, that the level of tolls also will increase, as more countries will impose kilometre-based road charges instead of the Euro vignette fixed price system. This toll system is still in force in a number of countries including Sweden, Denmark, Holland, Belgium and Luxembourg.

We expect this system will be displaced by a GPS-based system with tolls based on truck type and distance. Based on the experiences with these kinds of systems, and especially with the toll levels, this is supposed to be of much higher cost compared with the present level. A future level of around 20 eurocent/kilometre should be expected, which is a drastic increment, compared to the present cost per day. This raise will of course influence the total cost level of road transport compared to a sea-based solution. At sea, no tolls of such character will be introduced.

On a more elaborate scale, the costs related to the sea transports due to SECA and later on to NECA will to some, or to its full, extent be set off by the new road tolls if they are being introduced as we have described here.²⁰

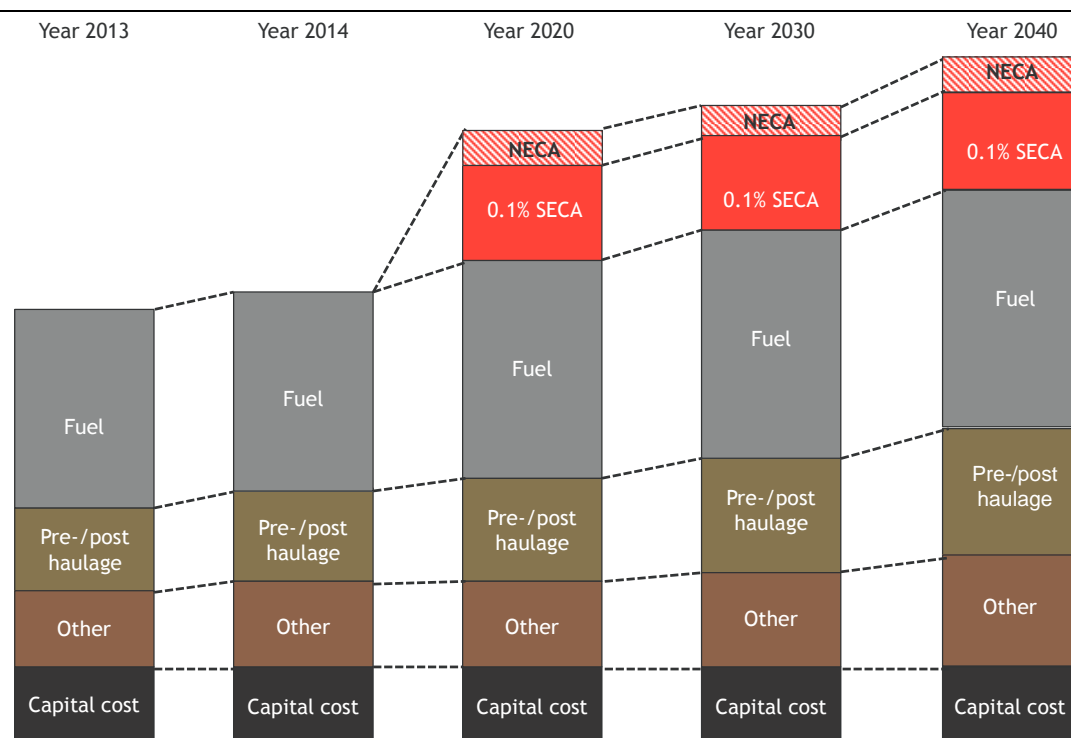
The growth of fuel costs is a consequence of a general rise in this cost component paired with a possible rise in demand for low sulphur oil due to a competition from sea-based transports operating within the SECA waters. Even though SECA is surely a sea-based system, it might have some cost effects on the road-based transports as well. As fuel costs are responsible for more than 1/3 of the cost of each truck kilometre, this will surely have a cost effect on road transports as well. In the table below, the most dominant features with respect to changes in road cost in the coming years have been described.

Table 16: Cost of land-based transport per truck/trailer combination, 2014-2040					
Cost variable	Differentiation	2014	2020	2030	2040
Distance dependent, euro/km					
Fuel, highway (high- speed)	Motorways (high speed)	0.42	0.46	0.58	0.74
	Urban areas (low speed)	0.63	0.70	0.88	1.11
Tolls		0.04	0.04	0.04	0.04
Capital costs		0.11	0.11	0.11	0.11
Time dependent, euro/hour					
Salary	Foreign driver	8.04	10.14	14.94	22.02
	Domestic driver	15.36	16.92	19.87	23.34
Capital costs		18.64	18.64	18.64	18.64

²⁰ The effects and the level of NECA are much lower and more uncertain than SECA. In most instances, a SCR unit is relatively easy to install, and the regulation will only affect new vessels.

Cost of sea-based transports

Figure 42: Costs of sea-based transport (for illustration purposes only)



The figure illustrates the cost division and possible development within the individual elements of the sea-based transports. Along with road transports, the cost of fuel constitutes a heavy burden on the sea-based transports. Any additional cost is of importance, and remedies to set off the new costs are of great importance.

A possibility is to introduce larger vessels with more capacity. The consumption of fuel will rise, but will only increase slightly compared to a smaller vessel. On top of this, it might be possible to improve the present capacity utilization on board the vessel. Finally, the overall energy consumption can be reduced by reducing the speed (if possible in a competitive market) or retrofit the vessel design in a way which reduces the consumption.²¹

In the future, these possibilities will be in force when addressing the topic. Nevertheless, the competitive situation for sea versus road transports in combination with the quest for short transit times is still a major challenge. Once more, the necessity for consolidating goods upon the vessel will always be a challenge when addressing this issue.

²¹ Possible adaptations of the vessel itself or adaptations of the energy consuming equipment on board the vessel

Therefore, an active role of the ports working within the field of attracting goods to the sea - borne routes by acting as a consolidation centres is a prerequisite when introducing these new concepts.

In the table below a cost calculation including the upcoming effects of SECA and NECA is shown. It must be taken into consideration that the real effects of SECA and NECA are not yet known.

Table 17: Total cost in euros of sea-based transport of one trailer with a Ro/Ro vessel sailing 1,000 km				
Cost variable	2014	2020	2030	2040
Project scenario				
Fuel	402	490	594	720
Capital cost and other fixed costs	167	167	167	167
Other costs	369	407	478	561
Total cost excluding SECA and NECA	938	1,064	1,239	1,448
Alternative scenario				
SECA	0	148	179	217
NECA	0	13	13	13
Cost of SECA & NECA	0	160	192	230
Total cost excluding SECA and NECA	938*	1,222	1,428	1,676

Note: We have assessed the costs based on the assumption that the global sulphur cap will be introduced in 2020.* These cost include pre/post haulage and basic port fees.

As can be seen from the table, the cost of operating a ship in European waters are expected to raise substantially, which is a major challenge with respect to have more transports by sea in the future. It does make the introduction of sea-based transports even more complicated. Therefore, new ways of switching transports from road to sea must be introduced, and more parties must take action on this. Possible ways are sketched out in the following section.

Port: Dynamic centre for consolidation and value adding

Ports, and in particular a number of their companies within the technical/shipbuilding/retrofit sector, can play a more important role now and in the future. Adapting vessels for less energy consumption and afterwards retrofitting them with anti-pollution devices would surely be an obvious task for companies in the ports. This would be suitable for companies already engaged in building and adapting vessels and the equipment onboard. This topic is part of the ongoing work of Port of Hanstholm in the refreshed LO-PINOD project.

Even though the initial focus should be on the vessels, techniques, and equipment developed as part of this project it may spread to other sectors - even sectors with no direct linkage to the sea and the ports.

A good example is the former shipyard in Elsinore in Denmark. When the yard closed down in 1983, an initial section of the yard continued to live on in the port. Initially producing turbo equipment for large diesel engines, they changed the product line to energy-focused solutions for wastewater aeration processes. By using their initial skills and knowledge, they simply changed focus from one sector to another.

Focusing on technical equipment related to energy consumption, preservation and production might be of great interest. By combining skills and well-known techniques from one sector, it should be possible to develop new systems in new sectors.

For existing companies with a will and drive to rethink their business, their location in a port opens up new possibilities.

Change of mind-set

In order to develop the ports, it is necessary to focus on transport schemes but also on the possible development of other skills and "institutions" in the ports.

Ports have long focused on sea-based transports. This must be supplemented with more focus on the whole transport/value chain. Besides this, it may bring chances to look into other kind of businesses.

As mentioned earlier, ports should engage themselves in working with or building dry ports in their hinterland. This could bring around changes within the transport chain and location of activities.

Ports might also see themselves much more in a role of playing a bigger supportive role in helping start- up of new businesses in the port areas. This means working more closely together with a broad range of companies located in or nearby the ports. Such cooperation might bring around new types of services and entrepreneurship in the ports.²²

²² The work of the maritime centre MARCOD in Northern Denmark is a good example of how new services can develop in the port areas. The centre has helped companies in a number of ports to develop multiple ship-based services, including retrofitting ships to comply with future environmental standards.

Nevertheless, to do this, it is necessary to change the mindset and perception of the port's role.

To sum up, the essence of this is to change the mind-sets of the operators and other actors in the ports to change what the ports should engage themselves in - both when it comes to transport and when it comes to other activities.

The regional port

Can regional port build up the needed competencies and new skills? The findings in this study show that the regional ports have new potentials to fulfil this task. The connection to the hinterland and the knowledge of usable competencies is more accessible here compared with the bigger ports. At the same time, it is essential to have these smaller ports work together in order to develop networks and competencies, as is done in the LO-PINOD project.

The close relationship between the smaller regional ports becomes even more important when focusing on more fierce competition between smaller and bigger ports, and the future EU concept on ports in the core and comprehensive network. If smaller ports do not cooperate, they will find it hard to compete with the bigger ports in the near future.

The plans for the new port in Hanstholm focus on the following topics:

- The new port will be able to generate more fish for larger vessels to call. Furthermore, the facilities in the port will be improved, so that both fresh and frozen fish will be handled in a better and more efficient way. The newly installed automatic box sorting equipment is part of this improvement.
- Beside the LO-PINOD ports, a closer cooperation with other ports can be realized in the future.
- The port should play a more important role as transport centre. Not only on its own but also in cooperation with land-based units. Ports have access to a number of skills and facilities, which they can spread into land-based transport centres. Thereby, more competencies can be developed and a closer relation between sea-based and land-based modalities can be obtained. Also, different kinds of logistics – and storage facilities located either in the port or in the dry port area - can supplement each other.
- New financial instruments will be used when financing the port development. Among these, the establishment of a number of wind turbines as part of the breakwater can be mentioned.
- The docking facilities must develop with focus on being able to service Norwegian vessels. Carrying out service and eventually inspection of these vessels are an excellent opportunity for the dock. Whenever possible this shall be extended to include services in the field of retrofitting the vessels. Such services, with a clear focus on reduction of energy consumption and emissions, are an active answer to the consequences of SECA, as discussed earlier in the report.

A toolbox invented by the Danish Ship owners organisation²³ can help assess which interventions shall be carried out for the individual vessel, in order to reduce energy consumption and emissions. The toolbox can be used for all types of vessels and thus by both large and small docks in the ports.

²³ See www.shipowners.dk

The essence of these ideas and findings related to the ports are:

- Regional ports can cooperate in attracting more business and goods
- Regional ports can develop their competencies and business areas
- Regional ports can develop strong positions, as they know the local business environment. In order to make local strongholds, they must develop their competencies in cooperation with other ports and business partners²⁴
- Regional ports can play an active role in relation to transport centres in the hinterland. Regional ports can foster new transport- and logistic schemes
- Regional ports can be part of road-based transport solutions as a supplement and/or substitute for sea-based solutions
- Regional ports shall see themselves as active players in developing the transport concepts of tomorrow. This is done by linking up with present and potential agents within the transport- and logistics sector. Ports must therefore go through a development from mere ports to hubs or transport centres. From simple loading or unloading of goods to places where value adding is an integral part of the process.²⁵
- Ports need to take actions versus the transport companies, the shippers and other agents in order to present new ideas and improved solutions for transport and logistics, whenever possible based on transports by sea.

If such changes are possible, it must be discussed among the LO-PINOD partners and later among the Norwegian and Danish ports involved.

A sea-based transport concept – a stepwise solution.

As described earlier, the possibility of introducing a sea-based transport concept as an alternative to the present “single road” concept is too much to change at once. A solution could be to introduce a stepwise approach leading from the present solution via a consolidated road concept to a sea-based concept.

The idea of changing modality in several stages should be based on a number of considerations. These considerations entail both technical issues as well as issues of a more psychological nature, related to how difficult such a modality shift is from the perspective of the operators and other parties involved in the transport setup.

²⁴ Transport i det kompetente og innovative Danmark p. 9

²⁵ A good example to this is the Peel Ports group. They strive to develop from ports to hubs, from loading to logistics and from today's methodology into tomorrow's vision. By developing new skills and integrating even rival ports into a cooperative society, they have demonstrated one possible way of developing ports into consolidating logistic hubs. Thereby new lines of business can be opened, with a broader range of logistic activities.

In the making of a transformation, the following elements should be included:

- A worked through description of the present and especially the future transport setup regarding the design, the present and the future structure of the complete transport chain
- The psychological aspects related to the shift of modality. Such a shift will lead to the abolition of a concept based on a great number of transport companies in favour of a concept based on only one or perhaps a few potential shipping companies.
- The volumes involved and the possibilities regarding balancing the trades and achieving a high degree of utilization of the transport equipment involved.
- The actual descriptions of the concept with respect to timetable, cost, environmental gains, etc.
- Possible partners (owners of commodities or forwarding/shipping companies) which can engage themselves in the project
- Partnerships between ports engaged in the project with respect to a common promotion of the project as well as common projects with respect to an initial funding (possibly the EU) of the project in the start-up period. Funding by Marco Polo would be obvious, but it is questionable whether it will be applicable with respect to timing and geography.
- With all these aspects taken into consideration, the idea of setting up an intermediate solution based on a consolidated truck concept might look even more promising and realistic.

Finally, relating to the launch of such a project, the possibility of funding, especially for the start up phase, should be well considered. Most likely none of the ports involved would be able raise such a funding. Issues related to the necessary freight volume must be solved as well.

Introducing a partnership between numerous of ports will open up more ports as described in the project, including the possibility of including more freight into the system.

Future trends

Although a Ro/Ro solution is often preferred when it comes to transport in European waters, new possibilities within the Lo/Lo concept can be seen. In most instances Lo/Lo is the solution for long distance transports, but a slowly growing trend towards intra - EU transports with Lo/Lo ships can be found.

A number of reasons can be given to this. An important one is surely related to cost, where Lo/Lo ships due to much higher capacity utilization and a lower speed, can perform a voyage somewhat cheaper than a Ro/Ro carrier.

In the course of more and more factories moving back to Europe from the Far East (textile, clothing etc.), the possibilities and advantages related to the use of containers and Lo/Lo vessels instead of trailers and Ro/Ro vessels, might become a very interesting alternative in the future.

A general issue, related to both concepts, is how to get hold of an operator who will start up and run the service. Experiences concerning ship-owner interest in engaging themselves in new routes, even

of a rather traditional nature. An example is related to the "Bridge the Bridges"²⁶ project. This project shows in full detail the problems related to the introduction of a new Ro/Ro connection even with a positive support from Marco Polo funds.

Marco Polo²⁷ funding might also be a possibility when a connection will move a lot of ton - km from road to sea. Related to this, the concept is exceptionally interesting, as we are focusing on transports on a north/south axis in Europe, thereby removing vehicle kilometres from some of the most stressed road sections in Europe. A successful instalment of such a route will, moreover, demonstrate that not only projects in the Baltic Sea and in the Mediterranean area are worth funding.

Prior to this the idea of having more volumes of goods including fresh produce, through the ports is essential. This is what persons and companies related with the ports should strive for in the future.

²⁶ "Bridge the Bridges" is a Marco Polo project, based on a Ro/Ro route linking Frederica (the triangle area in Jutland, Denmark) with Helsingborg in the south westerly part of Sweden. The main idea was to surpass two toll bridges and some of the most crowded road infrastructure in Denmark. Even though the project had positive back up from a large number of customers and received funding from Marco Polo, it was not possible to find an operator.

²⁷ At the present, the future for the Marco Polo concept is not fully clear. Therefore, this possibility has not been investigated further.

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Appendix: An example of time calculation

One can imagine a weekly routine, since the fish has to be fresh when arriving in Rungis. For the fish to be considered fresh, it requires a maximum transportation time of approximately 3-4 days from first port to market. The table below gives a cautious estimation of travel time from Bodø to Rungis. The market in Rungis is open for business Tuesday – Saturday from 02:00 – 07:00 or until sold out. Therefore, it makes sense to deliver the fish around 23:00 on, for example, a Wednesday. As seen from the table below, it is possible to transport the fish and meet the required maximum travel time.

Table 18			
Port	Truck-Ro/Ro solution	Time	
Bodø	Truck: 20 hours - 2 drivers	Monday:	04.45
Drammen	Distance: 1.247 km.	Tuesday:	00.00
Drammen	Ro/Ro ferry:	Tuesday:	02.00
Hanstholm	Distance: 166 mile	Tuesday:	14.00
Hanstholm	Ro/Ro ferry:	Tuesday:	16.00
Oostende	Distance: 420 mile	Wednesday:	16.00
Oostende	Truck: 5 hours - 2 drivers	Wednesday:	18.00
Paris Rungis - fish market	Distance: 330 km.	Wednesday:	23.00
			67 hours

If the ship sails weekly, this limits which destinations can be incorporated. The difference in time consumption in this example versus the one in the report text (67 versus 55 hours) is mostly due to the inclusion of handling and waiting time in this calculation.

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