Fehmarnbelt Fixed Link: Modal Split Drivers

Promoting an environmentally friendly modal shift for cargo traffic after the opening of the fixed link

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Introduction

The opening of the Fehmarnbelt tunnel will undoubtedly alter the cargo traffic flows not only between the German Baltic Sea coast and Zealand, but also on the Scandinavian-Mediterranean TEN-T core network corridor and other adjacent corridors as a whole. Part of the traffic will be a mere deviation from the existing Great Belt bridge connecting Jutland and Fyn, but it is expected that much of the traffic will be shifted from existing ferry links.

To put it differently: there will be a shift from sea to rail and – yes – from sea to road. This shift, however, will concern nothing but a small fraction of the total transport chains in the case of intra-European long-distance transport. The current ferry distance is only 10 nautical miles, i.e. 18 kilometres.

At the same time, the tunnel may open new opportunities to shift cargo from road to rail on longer distances. While there are no regular rail combined services between Puttgarden and Rödby and the ports' respective hinterland so pre- and post-carriage is exclusively done by truck, the direct rail link provides new opportunities for combined rail services between Denmark/Sweden on the one hand and Germany and the European mainland on the other hand.

The present study will present potential measures that promote such a shift in order to avoid detrimental effects. The measures have been developed through an analysis of the Öresund bridge case and additional desk research. They were developed for the specific case of the Fehmarnbelt fixed link. However, many of them are directly transferable to other fixed links or – more generally – to transport corridors that offer the choice between different modes of transport.

The empirical results of the Öresund case collected for the present study will be used to calibrate the transport model of the upcoming study "Trans-Baltic Transport Structures to 2030". The measures developed in the present study– together with those of the ongoing study "Synergies between the Fehmarnbelt and Short Sea Traffic in the Southwestern Baltic Sea" – will serve as an input for scenario-building in the study "Trans-Baltic Transport Structures to 2030". All three studies will help understanding the impact of different measures on transport flows, which is in turn a very important input for the analysis of economic impacts in the regions.

1. Expected changes to cargo traffic flows

1.1 Lessons from the past: Great Belt and Öresund

The Fehmarnbelt fixed link is not the first fixed link in the south-western Baltic Sea with a sustained impact on cargo traffic flows and the modal split. In 1997, the Great Belt Bridge was opened for rail traffic. Road traffic started a year after. It was the first fixed link between the Danish mainland Jutland and the largest Danish island Zeeland. Just two years later, Zeeland was connected to

Sweden with the Öresund bridge (road and rail). Since the opening of the Öresund bridge, South Sweden is connected to the central and south European mainland by road and rail. For pure land transport (i.e. not using ferries), the Fehmarnbelt fixed link will shorten the route between Hamburg on the one hand and Copenhagen/South Sweden on the other hand by about 160 kilometres. The connections across both straits – the Great Belt (Storebelt) and the Öresund – were previously ensured exclusively by ferries.

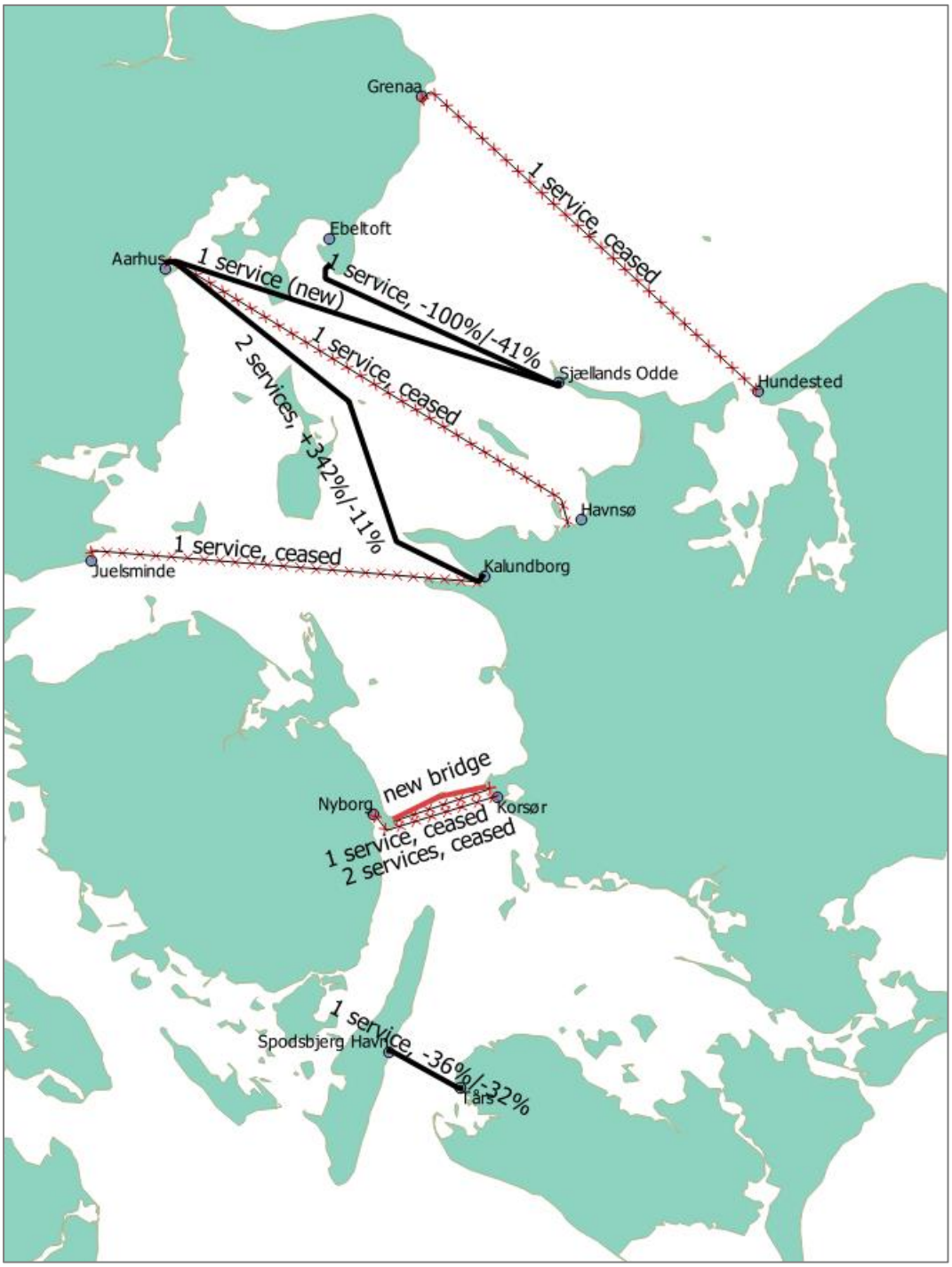
1.1.1 The Great Belt case

In the Great Belt case, three ferry services were connecting Nyborg with Zeeland. All three services stopped operating immediately after the opening of the Great Belt Bridge (see Figure 1). Together, they transported some 360,000 trailers and 10.9 million passengers in 1996.

In the advent of the opening, there were concerns that some fifty kilometres to the South, the ferry route between Spodsbjerg (Langeland) and Tårs (Lolland) could also be closed down. This would have resulted in a considerable increase of distances and travel time for citizens in the region. Therefore, a financial support scheme was developed, deviating part of the revenues from the Great Belt bridge to the ferry operator.[1] Both passenger and trailer volumes have dropped by around one third between 1996 and 2001, but the ferry route is still operating today.

Around the time of the bridge opening (i.e. between 1996 and 2001), there was also a reorganisation of ferry lines connecting Jutland directly with Zeeland (crossing the Samsø Belt). Though the number of services was reduced from four to three, the number of trailers even grew slightly. The number of passengers, by contrast, dropped sharply after the bridge was opened (down 31 % between 1996 and 2001). This may be due to passengers being more sensitive to small changes in travel time than cargo.

[1] see Møller, Lars: Multimodal Mobility in Denmark: A Collaborative Approach to Bridge Building, Policy and Practice; in Tollways: Policy and Practice, May 2006, pp. 77-83



Note: percentage figures indicate change in volume between 1996 and 2001 for trucks and passengers, respectively

Figure 1 - Changes to ferry routes across the Great Belt and neighbouring straits between 1996 and 2001

Source: ISL based on ShipPax Statistics (various issues) and own research

As mentioned before, all ferry links across the Great Belt ceased between 1996 and 1998. The share of seaborne transport hence dropped from 100 % to zero for passengers, trailers, and rail traffic.

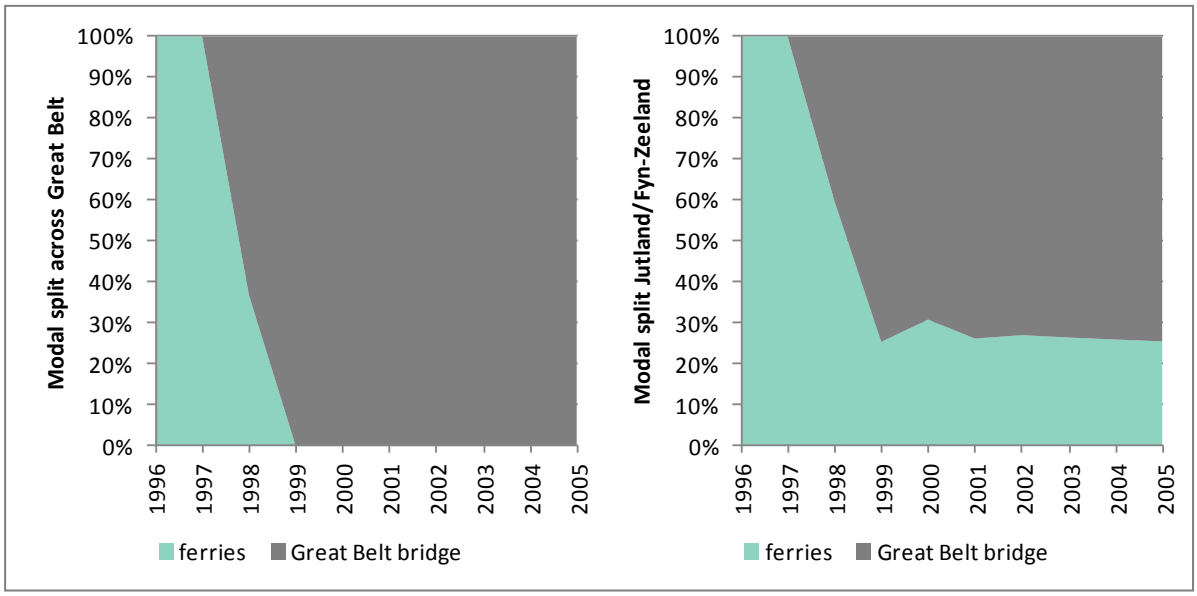


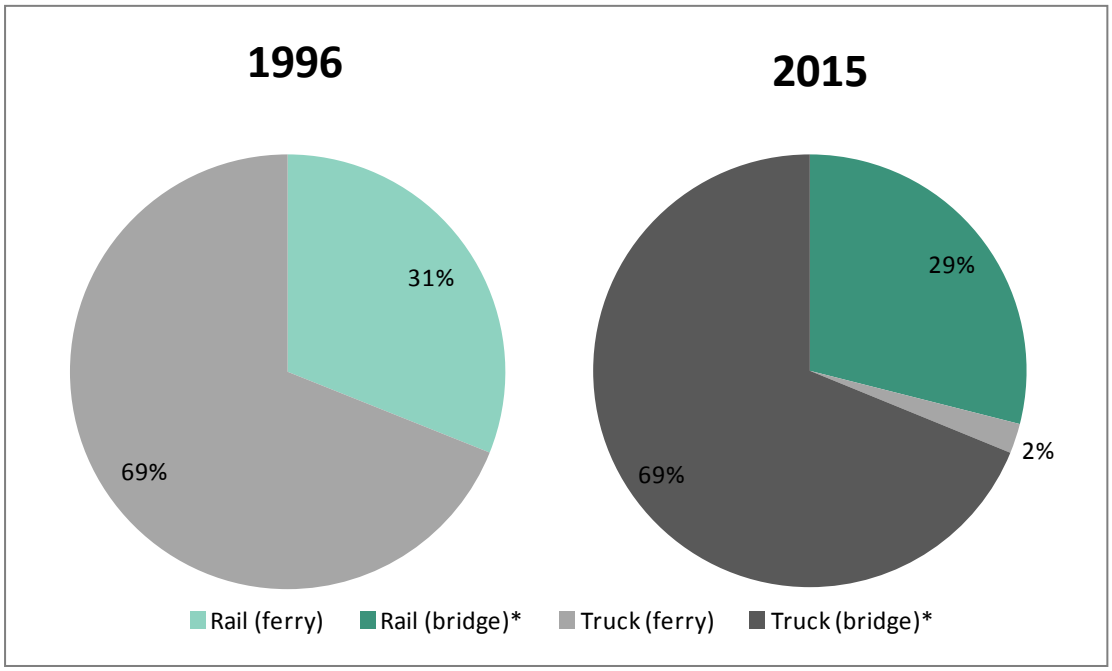
Figure 2 - Modal split for trailer traffic across Great Belt and between Jutland/Fyn and Zeeland 1996-2005

Source: ISL based on ShipPax Statistics (various issues), Sund & Bælt Holding A/S, Eurostat

When including the Samsø Belt and the Langelandsbelt, it can be seen how total traffic evolved between Jutland and the western islands on the one hand and the eastern islands (excluding Bornholm) on the other hand. The shift of truck traffic from the ferries to the bridge was immediate. In 1999, the first full year of operation of the Great Belt Bridge, the share of ferry traffic for cargo transport dropped to around 25 % and remained constant in the following years. This shows that no longer transition period was needed and that an analysis of the dynamics behind the shift has to look at shorter time periods (e.g. the months or weeks around the opening).

For rail traffic across the Great Belt Bridge, no time series was available at the time of writing this report. Therefore, comparison will be made between the year 1996 and the year 2015.[2] In 1996, an estimated 3.8 million tonnes of rail cargo were transported on the Korsör-Nyborg ferry. A total of 4.9 million tonnes were transported by truck or trailer on the three Great Belt ferries, another 3.6 million tonnes by truck or trailer on the Samsø Belt and Langelandsbelt ferries. Overall, the share of truck traffic on the ferries was 69 % and the share of rail traffic on the ferries 31 %.

[2] The enquiry for a time series on rail traffic across the Great Belt Bridge is ongoing.



* estimated by ISL

Figure 3 - Modal split for cargo traffic between Jutland/Fyn and Zeeland/Lolland 1996 and 2015

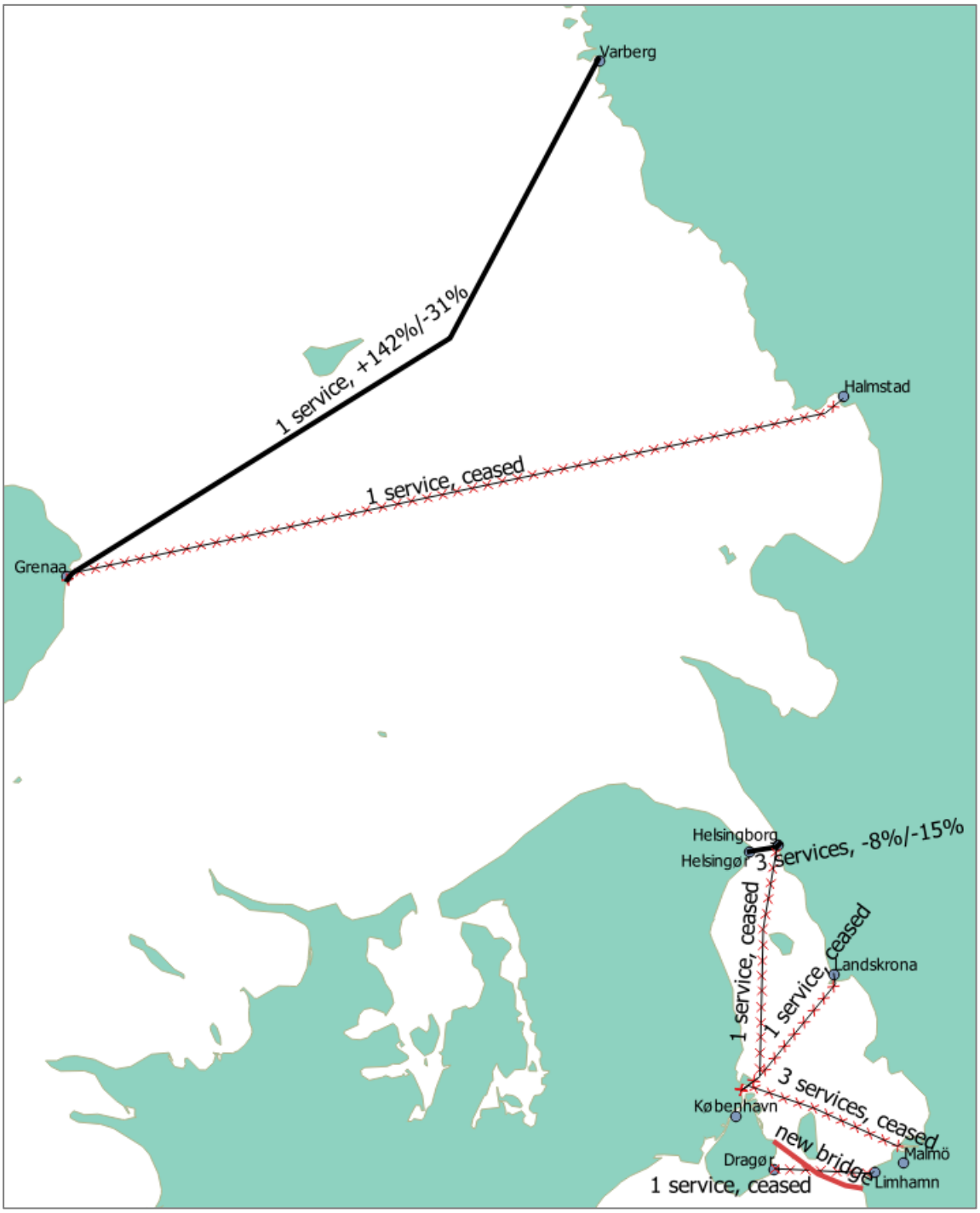
Source: ISL based on ShipPax Statistics (various issues), Sund & Bælt Holding A/S, Eurostat

According to ISL's first estimates,[3] the share of rail traffic (bridge only) was 29 % across the said straits in 2015, slightly down from the 31 % observed in 1996. Truck traffic over the Great Belt Bridge added another 69 % while trucks and trailers on the remaining ferries only contributed 2 %. While the Spodsbjerg-Tårs ferry even increased traffic volumes compared with 2005 (see Figure 1), trailer volumes on the Samsø Belt collapsed after the closure of the Aarhus-Kalundborg ferry service in 2013. Since then, cargo transport on ferries only constitutes a tiny fraction of total cargo transport.

1.1.2 The Öresund case

The Öresund Bridge was opened for rail and road traffic in 2000. Before the opening, there were nine ferry services crossing the Öresund (of which one rail ferry service) and another four services were crossing the Kattegat (see Figure 4).

[3] Subject to revision once actual data become available.



Note: percentage figures indicate change in volume between 1998 and 2003 for trucks and passengers, respectively
Not shown: Frederikshavn-Gothenburg (2 services, 1 ceased, -1%/-40%)

Figure 4 -Changes to ferry routes across the Öresund and neighbouring straits between 1998 and 2003

Source: ISL based on ShipPax Statistics (various issues) and own research

While all six ferry services near the Copenhagen-Malmö fixed link ceased after the bridge's opening, the Helsingör-Helsingborg connection 50 kilometres to the north continued to operate with

three services in 2003.[4] The picture looks quite similar to the Great Belt, where the Spodsbjerg-Tårs ferry connection 50 kilometres to the south continued operations. Another similarity between the two straits is that passenger traffic on the remaining ferries dropped sharply even on ferry routes that were quite far from the fixed link.

The share of trucks using the bridge jumped to 28 % in 2001 when looking at the Öresund only. In the following years, it increased to 45 % (2007). When including the Kattegat, the share of truck traffic across the bridge only had a share of 37 % in the total trailer traffic. Compared with the Great Belt Bridge, the changes were hence more gradual.

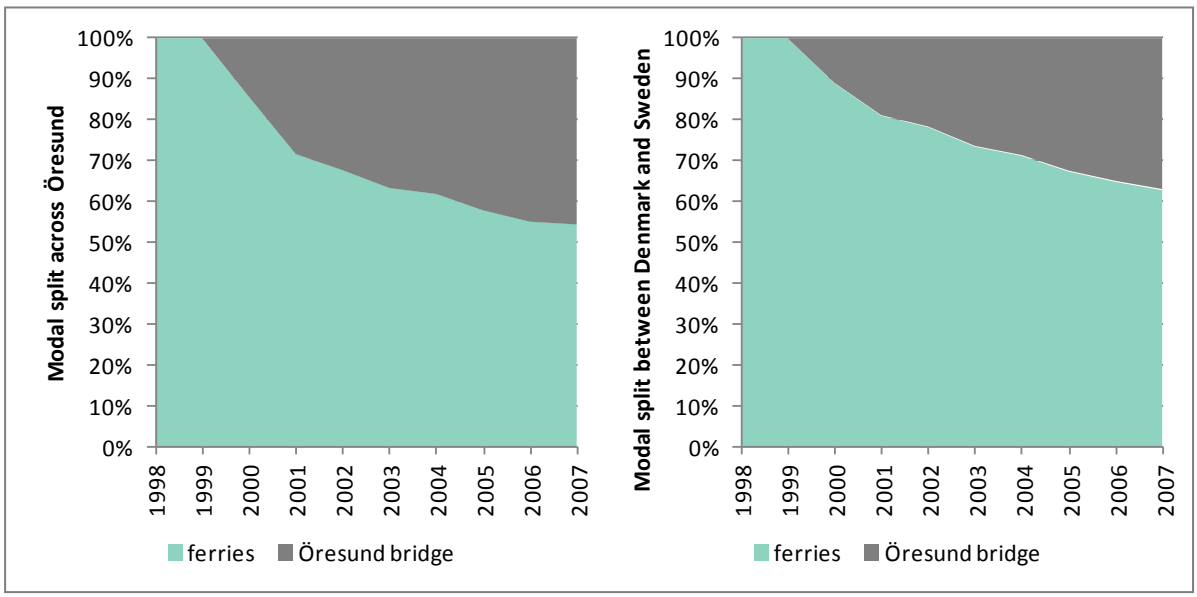
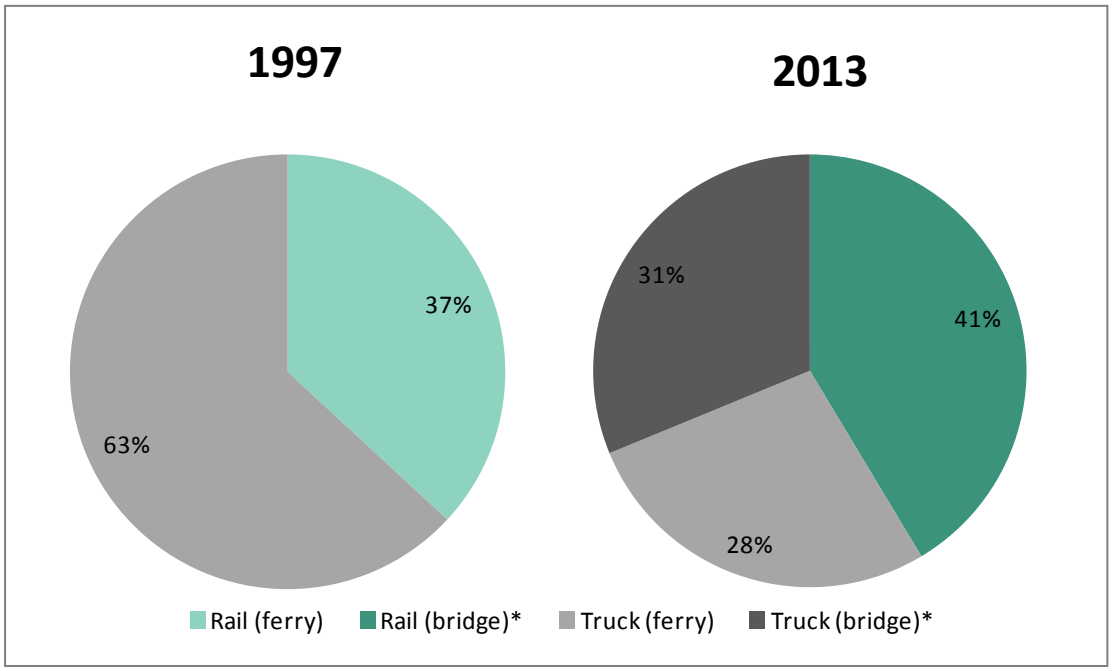


Figure 5 - Modal split for truck traffic across Oresund as well as between Denmark and Sweden 1998-2007

Source: ISL based on ShipPax Statistics (various issues), Øresundsbron Konsortiet, Eurostat

Next to truck traffic, rail traffic also plays an important role for cargo traffic between Denmark and Sweden. In 1996, rail cargo still had a share of 37 % on board of the ferries connecting Denmark and Sweden. The rail ferries stopped operating immediately after the bridge opening. Rail cargo traffic was now using the bridge. In 2013, rail had a share of 41 % of the total traffic between Denmark and Sweden (excluding air cargo and Bornholm traffic) and hence slightly more than before the opening.

[4] The pure passenger service was given up in 2010; the remaining two mixed services continue to function until today.



* estimated by ISL

Figure 6 - Modal split for cargo traffic between Denmark and Sweden 1996 and 2015

Source: ISL based on ShipPax Statistics (various issues), Øresundsbron Konsortiet, Eurostat

Contrary to the Great Belt and its neighbouring straits, the share of cargo traffic on ferries continues to be important (28 %).

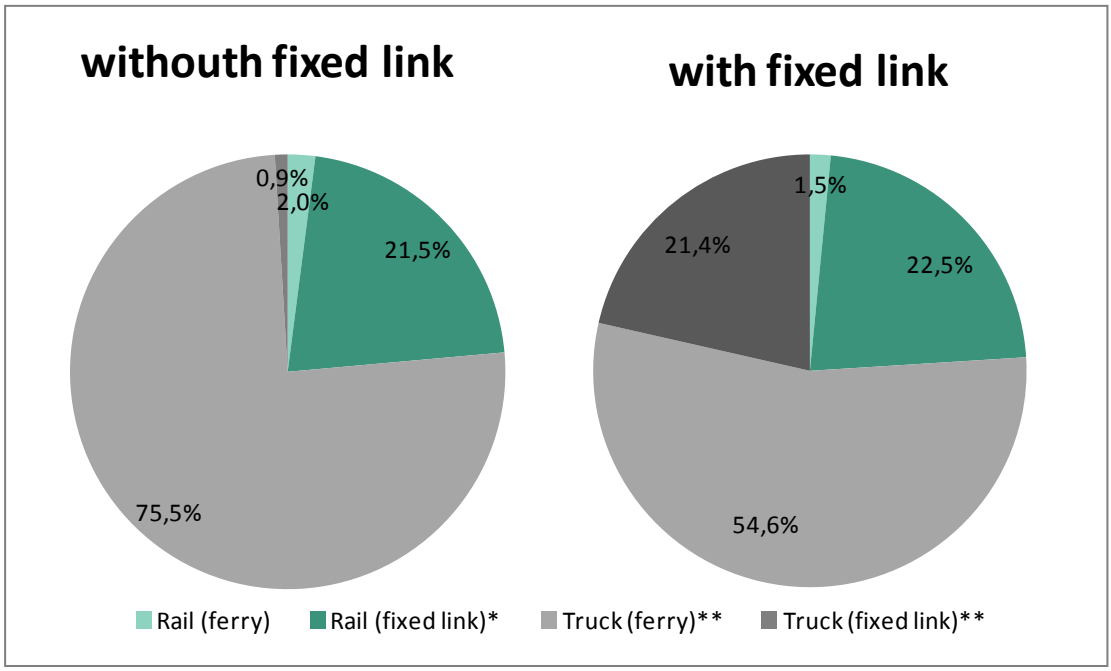
1.2 Expected changes for the Fehmarnbelt

The most recent study on the impact of the Fehmarnbelt fixed link has been conducted by Intraplan and BVU for Femern A/S.[5] Against the background of the straits analysed above, the findings are quite surprising. According to the consortium, only the Puttgarden-Rødby ferry connection will be discontinued, while all other existing links between the German and Polish Baltic Sea Coast and Denmark/Sweden are assumed to persist.

Two scenarios are forecast for 2030: one with the Fehmarnbelt fixed link, the other without. Apart from the Puttgarden-Rødby ferry, the strongest impact is expected for the nearby Rostock-Gedser link. For truck traffic, a minus of roughly 5 % is calculated on this route if the fixed link becomes operational.[6] Overall, the market share of the Fehmarnbelt tunnel is expected to reach roughly 27 % in 2030 – comparable with the share of the Öresund Bridge in 2001, its first year of operation. About 607,000 trucks are estimated to cross the Fehmarnbelt in 2030.

[5] Intraplan/BVU: Verkehrsprognose für eine Feste Fehmarnbeltquerung 2014 – Aktualisierung der FTC-Studie von 2002. München/Freiburg, 2016

[6] Figures in this part are for the case "Basisfall A".



* Great Belt bridge and/or Fehmarnbelt tunnel ** estimated by ISL

Figure 7 - Modal split forecast for cargo traffic between German coast and Sweden 2030 with and without Fehmarnbelt fixed link

Source: ISL based on Intraplan and BVU (2016)

A much more important shift is expected for rail traffic. All existing traffic between Germany and Sweden is supposed to shift from the Great Belt and Öresund to the Fehmarnbelt. This will shorten the rail distance between Hamburg and Copenhagen by about 160 km.[7] This brings a considerable advantage in terms of transport costs, but also in terms of emissions. Some rail traffic is also shifted from the ferries Rostock-Trelleborg and Sassnitz-Trelleborg, which are both supposed to lose around one quarter of their rail cargo.

The Intraplan/BVU forecast of traffic shifts after the construction of the Fehmarn Belt fixed link includes a shift from road to rail, but it is rather small compared to the overall volume (from 23.5 % to 24.0 %; see Figure 7). With or without the fixed link, a little less than a quarter of cargo traffic hence uses rail.

According to the study, by far the most important shift concerning the modal split is a shift from sea to road and hence a change that has negative external effects. This shift concerns 21.4 % of the total cargo volume equal to roughly one third of the ferry traffic.

The most important change regarding ferry routes is the closure of the Puttgarden-Rödby ferry connection assumed in the Intraplan/BVU study. Around 92 % of the tunnel's truck traffic volume is supposed to be shifted from this ferry. The routing of these traffic flows remains largely unchanged, only a small part of the transport (namely the 18 kilometres between Puttgarden and Rödby) are shifted from sea to road.

[7] see https://www.anbindung-fbq.de/en/faq.html

A much more important change is expected for part of the traffic currently using direct ferry connections between Germany and Sweden. Instead of Sweden ferries in Lübeck, Rostock, Kiel or Sassnitz, the direct land route is chosen. For traffic shifted away from the Travemünde-Trelleborg link, for example, this means around 250 km of additional road transport. If, in addition, trucks attracted from other routes drive longer distances in the hinterland in order to use the bridge rather than the closest ferry connection, the additional truck distance increases further.

Taken together – similar to the Great Belt and Öresund cases – the most important change in the modal split after the introduction of the Fehmarnbelt fixed link will be a shift from sea (ferries) to road (tunnel) if no counter-measures are initiated. The shift from road/ferry to rail is very limited according to the Intraplan/BVU forecast, again in line with the experience from the Great Belt and Öresund cases.

2. Modal split drivers and the Fehmarnbelt fixed link

While the construction of new fixed links in the south-western Baltic Sea has considerably altered cargo traffic flows, its immediate impact on the balance between road and rail traffic seems to have been limited. However, rail traffic across the Öresund bridge has been growing above average during the past few years. In 2013, the share of rail for traffic between Denmark and Sweden was 41 % against 37 % in 1997 (before the opening of the bridge). The latest forecast for the Fehmarnbelt fixed link, by contrast, does not predict significant shifts. In this chapter, the factors explaining modal choice will be described briefly (2.1) as a basis to discuss how the share of rail can be increased in the case of the Fehmarnbelt fixed link (2.2).

2.1 Factors influencing modal choice

The literature on mode choice in freight transport focuses on four major variables:[8]

- transport cost
- transit time
- frequency of service
- quality of service (e.g. reliability)

When it comes to weighing these factors, it seems that the focus for cargo transport is on costs.[9] Rather small cost differences can be decisive for the mode choice of a shipper or forwarder. At the aggregate level (i.e. all transports between two regions), the share of each mode hence depends on its comparative cost advantage or disadvantage.

[8] See, e.g., J. Rich et al.: A weighted logit freight mode-choice model, Transportation Research Part E: Logistics and Transportation Review, vol. 45 (6), pp. 1006-19; A. Derakshan and M.Z. Shah, Analysis of Inland Mode Choice Decision for Imported Waterborne Cargo from New York & New Jersey Ports, European Transport, vol. 55, no. 7

[9] In a survey conducted by ISL among selected forwarders in 2011, all of them stated that costs are "very important" while only half of them named one of the other aspects as being "very important".

While in most cases, longer transport times are taken into account if this reduces the cost considerably, transit time is very important for certain cargo types such as (perishable) reefer cargo. Some examples from European container hinterland transport show that even three-digit Euro cost disadvantages per container are taken into account by some shippers in order to gain a few days of transit time.[10] In the literature on mode choice, these aspects have been integrated by adding a cost of transport time per hour with different values for different types of cargo. The variety of cargo types and shippers explains that even for long-distance transport between two regions which are very well connected through rail or barge services with a clear cost advantage, direct truck transport continues to play a role.

Rail, barge and sea transport are less expensive per kilometre than truck transport, but they involve additional costs (e.g. handling of load units). Therefore, the intermodal combinations need minimum distances to make up for the additional costs. Ferry traffic is no exception even though there are no extra handling costs in the case of accompanied ro-ro traffic. The block of fixed costs includes administration, harbour dues and manoeuvres in the ports. For intermodal transport, the service frequency also plays a role. The industry standard is at least one departure per week, but daily departures or even several departures per day make intermodal solutions more attractive and improve their position in the modal split.

Once the minimum distance is reached, the cost advantage of the 'massified' modes of transport increases with distance. However, these distances need to be travelled continuously: additional handling operations (e.g. handling between trains in rail hubs) increase the fixed cost per transport chain and hence also the minimum distance. Therefore, next to reducing the costs of handlings or transport, another way to make intermodal transport more attractive is to reduce the number of necessary handlings. Creating fixed links opens new possibilities in this regard by taking out the two ship-to-shore handlings – be it shunting for rail ferries or handling of trailers between train and ship.

2.2 Fostering the use of rail on the Fehmarnbelt fixed link

The most straightforward way of promoting rail cargo transport on the future fixed link is to make the rail passage costs particularly attractive compared with the truck passages, but also with ferry transport. In the case of the Great Belt link, for example, the revenues from the road link are partly used to cross-finance the rail link in order to avoid a shift from rail to road after stopping the rail ferry service. Therefore, pricing of the link will have a direct impact on the modal split.

If the price makes rail transport an attractive alternative, the aim should not be to limit oneself to 'deviating' trains from the Great Belt and from the rail ferries. Though the distance advantage for rail traffic compared with the Great Belt/Öresund route is maybe the most important environmental benefit of the project, the potential for shifting traffic from road to rail should not be neglected.

The Öresund bridge allowed competitive direct rail transport from central Europe to Sweden for the first time ever. More and more regular cargo trains – particularly trailer transports – were organised in the following years. By decreasing the distance, rail transport becomes again more competitive.

[10] Data from ISL North European Container Traffic Model, October 2016

Today, a trailer transport between Hamburg and Copenhagen, for example, will most likely be transported by truck using the Puttgarden-Rödby link. A train transport via the Great Belt would be possible, but due to more than 100 km additional distance, it is not competitive with truck transport. A trailer transport by rail to Rostock with handling in the port and pickup in Gedser is also possible, but the handling costs and additional distance make this variant unattractive, too. Even a rail service to Puttgarden and then from Rödby to Copenhagen would most probably lose against truck transport because the distances (150 km and 160 km, respectively) are simply too short to make up for the handling costs.

By contrast, once the Fehmarnbelt rail tunnel is open for traffic, the 330 kilometres between Hamburg and Copenhagen could be – depending on the price of the passage and assuming a sufficient volume for a regular rail cargo service – competing with truck traffic. Other connections that are still unthinkable today may become viable. In the end, the market will create these connections as long as passage costs are not prohibitive.

3. Conclusions

When opening the Fehmarnbelt fixed link, policy-makers must be aware of its impact on transport chains. For truck traffic, the major change will be a shift – partly or completely – from the existing ferry link to the tunnel. This means that a small part of the transport chain will be shifted from sea to road and hence lead to detrimental environmental effects. Truck volumes deviated from other routes will even face longer routes than before, adding to the negative environmental impact. It cannot be assumed without further analysis that the considerably shorter rail distances compared with the Great Belt can make up for these adverse effects.

Therefore, the strategy for the future of the Fehmarnbelt fixed link should go beyond a pure reshaping of existing transport chains per mode. Instead, it should be backed by a modal shift strategy targeting an increase of the rail share at the expense of road transport. The most direct way of doing so would be for the Danish government to limit the tariff for rail transport for the future operator of the tunnel. Another, more indirect way would be to set modal shift targets for the future tunnel operator at the example of the port of Rotterdam's Maasvlakte 2 project.

Next to the regulatory aspect, other stakeholders may contribute to the modal shift as well. The responsible national and regional authorities need to assure efficient connections to the rail network and sufficient space for rail/road handling and related logistics activities. The TENtacle project partners will propose specific measures or new regular rail services as a result of the empirical work which can then be discussed with the associated organisations and other stakeholders such as rail operators. The aim of these activities is to stress the opportunities for an environmentally advantageous modal shift after the opening of the fixed link and to help implementing the steps that are necessary to achieve this.