Fehmarn Belt Forecast 2002

Final Report

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1 PREFACE

The *Bundesministerium für Verkehr, Bau- und Wohnungswesen* (Berlin) and *Trafikministeriet* (Copenhagen) have asked the Fehmarnbelt Traffic Consortium (FTC) for an update of the traffic demand forecast for a Fehmarn Belt fixed link and for a test of different scenarios for the year 2015.

The work has be done by the four FTC partners:

BVU – Beratergruppe für Verkehr und Umwelt GmbH, Freiburg (BVU)
Carl Bro as, Glostrup (CB) – leading partner
Institut für Seeverkehrswirtschaft und Logistik, Bremen (ISL) and
Intraplan Consult GmbH, München (ITP).

The fifth FTC partner, the former *Hague Consulting Group (HCG)*, now merged into RAND Europe, Leiden, has not be involved in this project as HCG contributed to the forecast model construction and calibration but not in the forecasting work.

Sund & Belt Partner Ltd. served as sub-consultant to the FTC.

The working period was from July 2002 to March 2003.

This report documents the work and its results.

Chapter 2 contains an executive summary of the report.

In chapter 3 the background of the present study is put forward.

Chapters 4 to 7 describe the forecast preparation and results with a review of all forecasts for 2015 in chapter 7. In chapter 8 the trend forecasts for 2025 are presented.

In chapters 9 and 10 the possible competition from a parallel ferry line (chapter 9) and from the Great Belt fixed link (chapter 10) is evaluated.

Detailed results of the forecasts and supplemental evaluations are documented in the Appendices.

In this report, the German/Danish rule of using ‘,’ (comma) as the decimal character in numbers and a ‘.’ (point) to separate thousands has been applied.

Copenhagen, March 2003

2 EXECUTIVE SUMMARY

2.1 Introduction

2.1.1 Study Objectives

This report summarises the results of the traffic demand forecasts for the Fehmarn Belt fixed link that were performed in 2002. The forecasts are an update of the traffic forecasts that were documented by the FTC in a report to the national transport ministries in Germany and Denmark in 1999[1].

In the 1999 report, which documents the transport survey and modelling that was done by the FTC during 1995-99, forecasts are presented of traffic demand across the Fehmarn Belt and the relevant ferry connections across the Baltic Sea for a number of technical alternatives of a Fehmarn Belt link including a reference case with continuing ferry service. The forecasts were summarised by the Danish Ministry of Transport in a report covering various preliminary studies about a fixed link[2].

One of the fixed link alternatives that was investigated in the previous forecasts is a fixed link between the shore lines of Lolland and Fehmarn consisting of a double-track railway and a 4-lane motorway (2+4). This forecast will in the following be referred to as '1999 forecast'. Its forecast horizon was 2010.

In 2001-02 an Enquiry of Commercial Interest (ECI) regarding a Fehmarn Belt fixed link was held. The enquiry revealed that there is a clear, positive interest with private investors to participate in the design, finance, construction and operation of a fixed link. Some concern was mentioned about the general development of the traffic market and, more specifically, the effect of a parallel ferry operation close to a fixed link and the competition from the Great Belt. In addition, the possible competition from other existing ferries across the Baltic Sea was mentioned as a risk factor.

As a next step, the two Ministers of Transport decided to perform further tests of the traffic demand on a fixed link including an evaluation of the questions raised during the ECI.

At the same time, it was decided to extend the forecast horizon to the year 2015, which is the target year of the presently on-going *Bundesverkehrswegeplanung* (*BVWP*) and to bring the forecast-relevant structure data in line with the *BVWP* framework.

The present report describes these tests and the resulting traffic demand.

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[1] *Fehmarnbelt Traffic Demand Study – Final Report January 1999*. By the FTC – Fehmarnbelt Traffic Consortium for *Bundesministerium für Verkehr, Bonn,* and *Trafikministeriet, Copenhagen*.

[2] *Femer Bælt-forbindelsen, forundersøgelser – Resumérapport. Trafikministeriet*, March 1999 (printed both in Danish and in German)

2.1.2 Trends in Traffic across the Baltic Sea

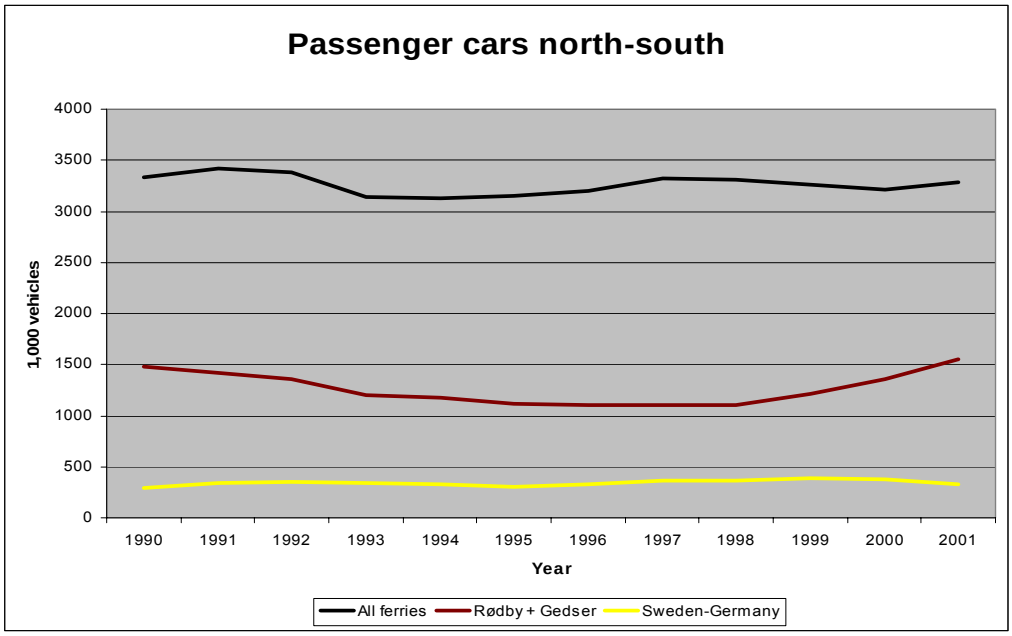

Figure 2.1: Number of passenger cars/year crossing the Baltic Sea north-south

The fall of the Iron Curtain gave rise to rather optimistic expectations about the development of trade and passenger interaction with the former communist countries – expectations that had to be revised after a while. The 1999 forecast of traffic and trade across the Baltic Sea was partially influenced by the more optimistic outlook for Eastern Europe. Not until the late 1990'ies, the interactions accelerated leading to a strong increase in trade relations with this part of Europe whilst the freight flow with Western Europe continued its steady growth throughout the 10 years' period.

The total number of passenger cars across the Baltic Sea has remained approximately constant during the period shown on figure 2.1 (1990 –2001) but the proportion using the ferries calling at Rødby/Puttgarden and Gedser/Rostock has varied considerably.

The Rødby/Puttgarden and Gedser/Rostock ferries have regained their share from the beginning of the period after it had dropped by over 25 percent. This decrease is mainly due to the decline of traffic to and from the Central and Eastern European Countries when the over-optimistic expectations after the fall of the Iron Curtain were not met in the early 90'ies. In addition, Sweden experienced an economic recession during these years. The increase in Rødby-Puttgarden traffic during recent years is due to the increased frequency on the Rødby-Puttgarden line, to the opening of the Øresund fixed link and to the improved economic situation in Sweden.

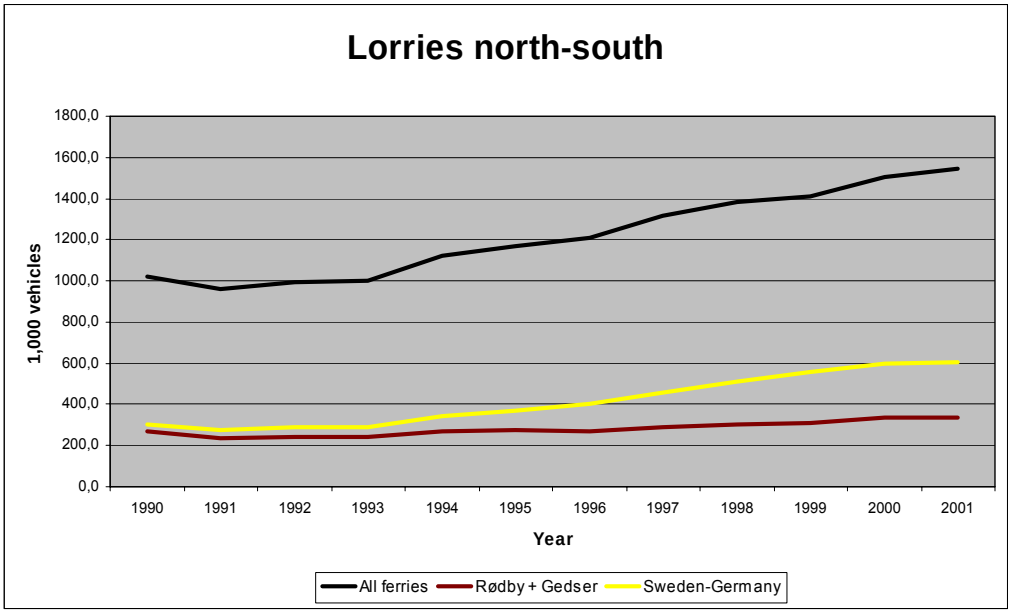

Figure 2.2: Number of lorries/year crossing the Baltic Sea north-south

The lorry traffic across the Baltic Sea has increased by almost 50 percent during the 11 years from 1990 – 2001 (see figure 2.2).

It is most remarkable that the lorry traffic between southern Sweden and Germany has doubled during the period while the ferries calling on Rødby and Gedser only had an increase by 25 percent. The Sweden-Germany ferries increased their market share from 30 to almost 40 percent; most of the other ferry corridors lost market shares including the Rødby and Gedser ferries that had a share of 26 percent in 1990 and 22 percent in 2001.

The bus traffic across the Baltic Sea has declined throughout the period considered, the total in 2001 being about 70 percent of the peak figure in 1992.
Until 1996 the Rødby-Puttgarden ferries carried about two thirds of the freight trains across the Baltic Sea. After opening of the Great Belt fixed link in 1997, this traffic was rerouted via the fixed link, and the only railway traffic remaining on the Fehmarn Belt ferries are the passenger trains between Copenhagen and Hamburg during daytime.

2.1.3 Need for Updated Forecasts

The 1999 traffic forecast is based on traffic data mainly from 1992-1997. Since 1997 a number of changes have occurred that are in more or less conflict with the forecast input data used earlier. Some of these changes are mentioned below:

- The socio-economic forecasts of population, employment, GDP and car ownership that are available now differ from the ones used in the previous forecasts. This is especially relevant for Central and Eastern Europe for which region the former assumptions had been fairly speculative.

- The present plans for the road and railway networks in the hinterland of the Fehmarn Belt have been altered in various respects: this applies most considerably to the expectations about the extent of the high-speed railway network. E.g. the Transrapid between Hamburg and Berlin, which had been assumed previously, is no longer relevant. The railway connection between Copenhagen and Hamburg, which previously had been given a cruising speed of 200 km/h, is now set at a maximum speed of 160 km/h.

- A number of ferry links across the Baltic Sea have been closed including most of the fast ferry connections that were included in the previous forecasts, and some of the previously assumed departure frequencies are no longer realistic. A few new ferry connections have been opened since 1997. Also, the fare levels have changed.

- Opening of both the Great Belt and the Øresund fixed links caused changes in the general traffic patterns.

- The toll structure on the Øresund fixed link has been changed recently.

- The air traffic conditions have changed considerably during the last years.

- User costs for both road and railway need to be revised in the forecast assumptions as significant changes are envisioned.

The Enquiry of Commercial Interest has raised questions about market traffic risk, the effects of ferry competition and of the possible competition from the Great Belt link.

2.2 Forecast Preparation and Model Runs

2.2.1 Forecast Model

The 2002 forecasts were prepared using the forecast models developed by the FTC in the period 1995-1999 after two adjustments: (1) The base data used in the current *Bundesverkehrswegeplanung* (*BVWP*) were adopted, and (2) the models were recalibrated with 2001 traffic statistics for the Baltic Sea screen line.

The forecast models consider all traffic between Scandinavia (Finland, Norway and Sweden) and the eastern part of Denmark (east of the Great Belt) on the one hand and the European continent on the other hand. The dividing line consists of the Skagerrak, Kattegat and the Baltic Sea south and east of Denmark. Traffic between Jylland and Germany via the land border is not considered. When we in the report refer to 'Denmark/Scandinavia' we mean Denmark east of the Great Belt and the three Scandinavian countries mentioned.

Separate models are used for person and freight traffic although they have many commonalities. The forecast procedure consists of the following steps:

- Formulation of input variables,
- Calculation of general traffic growth,
- Calculation of the share of the different transport modes,
- Calculation of the load on the different links of the network including ferry lines and the fixed link.

The input variables regarding the networks (roads, railways, bus lines, ferry connections, airlines) include data about user costs, schedules, and travel times. The structure data used include GDP, population and car ownership.

The modes considered for person traffic are: rail, bus, car, air and walk-on at the ferries. For freight the modes forecasted are rail, road and combined. Air freight is not included in the model as it will not be affected by the existence of a fixed Fehmarn Belt link.

2.2.2 Forecast Assumptions

Figure 2.3: Ferry Lines

The following assumptions for all 2015 forecasts were chosen as common assumptions:

- A fixed link between Rødby and Puttgarden consisting of a double-track railway and a four-lane motorway,
- The ferry lines and schedules of Summer 2002 for all ferries between Denmark/Scandinavia and the continent – except for Rødby-Puttgarden,
- The planned infrastructure in the hinterland for road and rail traffic in Germany: *BVWP* assumptions, in Denmark/Scandinavia: the major planned and committed projects,
- The assumed bus and air traffic supply,
- The latest national socio-economic forecasts (GDP, population, car ownership).

The toll levels for a Fehmarn Belt fixed link were set at the present (2002) Rødby-Puttgarden ferry fare (list price) for cars (€ 46) and lorries (€ 259) in fixed prices excluding VAT. Many truck operators receive considerable discounts. Some of these discounts have been communicated (confidentially) to FTC and these discounts have been applied in the calculations.

For the future transport policy, some changes are expected that will affect traffic demand like raising petrol taxes, further deregulation of railways, decrease of border resistance in the extended European Union.

As far as user transport costs are concerned, two sets of assumptions were defined:

- **Base Case A,** which is mainly oriented towards the *Bundesverkehrswegeplanung (BVWP)* Integration scenario, and
- **Base Case B,** which basically is an extrapolation of the 1999 forecast assumptions with some revisions to reflect changes that have occurred since the forecast was made, so the most significant changes in user transport costs have been incorporated.

In Base Case A the *BVWP* assumption of higher running speeds and reduced loading/unloading and transfer times for rail freight is included.

Table 2.1 presents an overview of these user costs assumptions.

	Base Case A	Base Case B
Road traffic		
Car user costs	+15 %	-10 %
Lorry user costs	-4 %	-6 %
Bus user costs	No change	No change
Rail traffic		
Rail pass. user costs	-30 % private long-dist.	No change
Rail freight user costs	-18 %	No change
Pass. train speed	max. 160 km/h	max. 160 km/h
Freight train operation	highly effective loading /unloading, short transfer times	No change
Air traffic		
Air passenger costs	Average +9 % 25 % lower for low-cost routes	Average no change 25 % lower for low-cost routes

Table 2.1: Key variables for user costs and traffic operations for Base Case A and Base Case B

2.2.3 Forecast Runs for 2015

Forecasts were run for the two Base Cases A and B and four scenarios with varying combinations of fare levels and service of the ferry connections across the Baltic Sea. In all six forecast runs a fixed link is assumed across the Fehmarn Belt having a double-track railway and a four-lane motorway.

Base Case A that was defined in close reference to the *BVWP* transport policy and user costs assumptions was applied throughout the scenarios.

In total, six different forecast runs for 2015 represent the following planning assumptions:

- **Base Case A***:* in principle the *Integration Scenario* under the *Bundesverkehrswegeplanung* with ferry supply 2002

- **Base Case B***:* in principle the assumptions used for the 1999 forecasts of traffic demand on the Fehmarn Belt link with ferry supply 2002

  In order to test the sensitivity of the calculated traffic demand on the fixed link forecasts have been run for different scenarios. The four scenarios represent variations in the ferry service across the Baltic Sea – either increased or reduced ferry supply and fare levels varying by ±25 percent (see table 2.2). The fares for crossing the fixed link across Øresund and the ferries between Helsingør and Helsingborg have been changed in the opposite direction as these crossings also serve as complements to a fixed link across Fehmarn Belt.

- **Scenario 1***:* Base Case A assumptions with increased ferry supply for competing ferries

- **Scenario 2***:* Base Case A assumptions with increased ferry supply and reduced fares for competing ferries

- **Scenario 3***:* Base Case A assumptions with reduced ferry supply and raised fares for competing ferries

- **Scenario 4:** Base Case A assumptions with increased ferry supply and reduced fares for competing ferries (like Scenario 2) and a parallel ferry service between Rødby and Puttgarden.

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Fehmarn Bælt fixed link tolls	as ferry fares in 2002	as ferry fares in 2002	as ferry fares in 2002	as ferry fares in 2002
Ferry services	increased ferry services	increased ferry services	reduced ferry services	increased ferry services + ferry Rødby-Puttgarden
Ferry fares	as in 2002	-25 %	+25 %	-25 %
Øresund tolls and ferry fares[3]	as in 2002	+25 %	-25 %	+25 %

Table 2.2: Basic definition of scenarios
'Ferry services' regards the ferry connections across the Baltic Sea east of the Fehmarn Belt

[3] Ferries between Helsingør and Helsingborg

2.3 Main Results

2.3.1 Passenger Traffic

Table 2.3 shows the distribution of the total passenger flows between Denmark /Scandinavia and the continent by mode for the base year 2001, the 99 forecast with horizon 2010,the two Base Case forecasts and the four scenarios for 2015.

Passenger Traffic pass./day	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	Scenario 2	Scenario 3	Scenario 4
Rail passengers	2.340	2.929	4.211	3.899	4.186	4.178	4.244	4.178
Car passengers	23.282	29.074	32.992	34.047	33.058	33.156	32.833	33.184
Bus passengers	7.504	9.282	8.145	8.049	8.145	8.140	8.151	8.148
Air passengers	27.137	38.096	46.090	47.564	46.090	46.063	46.118	46.063
Walk-on passengers	5.285	8.452	5.068	5.068	5.266	5.408	4.734	5.877
Total passengers	65.548	87.833	96.507	98.627	96.745	96.945	96.079	97.449

Table 2.3: Total traffic between Denmark/Scandinavia and the continent, by mode

In 2001, about 24 million person journeys were made between Denmark/Scandinavia and the continent, corresponding to more than 65.000 journeys on an average day. Of these, a little more than 40 percent were made by air, while the remainder had to use one or two ferry connections. One third of the total took their car, 11 percent took the bus, 4 percent the train, and 8 percent went on foot aboard the ferries (these are called walk-on passengers).

In 2015 the number of person journeys between Denmark/Scandinavia and the continent has risen to a total of 96,1 – 98,6 million person journeys/day, depending on the Base Case /Scenario.

In 2015, air traffic will have an even greater share than in 2001 because more low-cost airlines are expected to operate. The private car will retain its part of the total transport while the bus will loose market shares. With the Fixed Fehmarn Belt link most of the present walk-on passengers (today mostly day trips with shopping purpose) will use other travel modes. The railway is expected to pick up more passengers although its share of the market remains small.

There are only small differences in the results for the other forecast scenarios for 2015 if one looks at the total number of trips between Denmark/Scandinavia and the continent but the traffic using the Fehmarn Belt fixed link will vary considerably depending upon the scenario assumptions about service level and fares for the competing ferries (see table 2.3).

Passenger Traffic pass./day	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	Scenario 2	Scenario 3	Scenario 4
Rail passengers	964	5.027	4.101	3.797	4.077	4.068	4.134	4.068
Car passengers	11.118	15.868	18.077	18.655	17.345	16.710	19.403	16.737
Bus passengers	3.419	5.630	4.542	4.488	4.496	4.490	4.595	4.501
Walk-on passengers	1.967	1.863	0	0	0	0	0	471
Total passengers	17.468	28.389	26.721	26.940	25.918	25.268	28.132	25.778

Table 2.4: Person traffic across the Fehmarn Belt, passengers per average day

Table 2.4 and figure 2.4 show the number of persons crossing the Fehmarn Belt on an average day in 2001 and in the different forecasts.

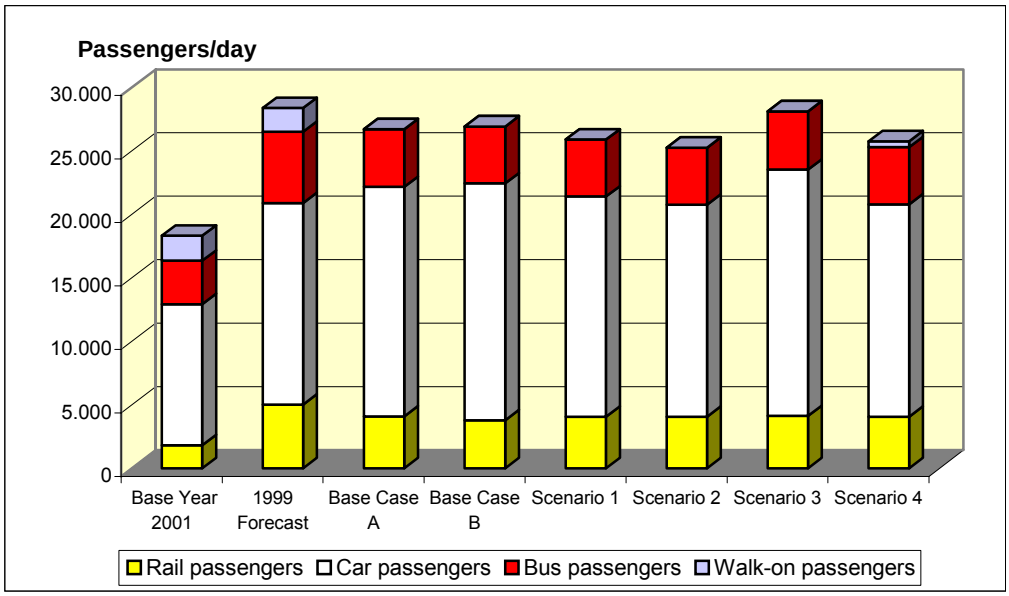

Figure 2.4: Person traffic across the Fehmarn Belt

About 25.000 passengers will cross the Fehmarn Belt in 2015, which is approximately the same amount as in the 1999 forecast for 2010 because the air traffic takes a greater share in 2015 of the total passenger traffic between Scandinavia and the continent.

The increase of passengers from 2001 to 2015 ranges from 38 – 53%, depending on Base Case / Scenario.

Scenario 3 results in the largest amount of Fehmarn Belt traffic because this scenario assumes the lowest service level and highest fares for the competing ferries among the scenarios tested. In this scenario, both train and car passengers have a relatively high share. Walk-on passengers play a certain role today without a fixed link; the parallel ferry in Scenario 4 will only attract a relatively small number of foot passengers.

2.3.2 Freight Traffic across the Fehmarn Belt

The total freight flows between Denmark/Scandinavia and the continent are shown in table 2.5.

Freight traffic t/day	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	Scenario 2	Scenario 3	Scenario 4
Road freight	63.107	76.732	85.795	96.934	85.959	86.403	85.304	85.795
Rail conventional	15.285	31.899	34.485	23.773	34.334	33.910	34.959	34.485
Rail combined	2.737	8.299	5.537	5.110	5.523	5.504	5.553	5.537
Total t/day	81.129	116.929	125.816	125.816	125.816	125.816	125.816	125.816

Table 2.5: Total freight transport by road and rail between Denmark/Scandinavia and the continent

The total amount of freight by lorry and railway is expected to increase from 30 million to almost 46 mill. tons/year in 2015 or by 55 percent. The share of the different modes varies only marginally between the different scenarios with the exception of Base Case B that does not have the effective rail system and has a more liberal road transport policy as Base Case A and scenarios 1-4.

Looking at the Fehmarn Belt traffic, greater variations are evident between the scenarios and the base cases with Scenario 3 having the largest volumes both for road and rail freight (see table 2.6).

Freight traffic t/day	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	Scenario 2	Scenario 3	Scenario 4
Road freight	12.148	15.214	17.605	19.742	16.630	14.499	20.088	14.712
Rail freight	0	29.515	29.707	21.871	28.526	27.575	32.784	27.570
Total t/day	12.148	44.729	47.312	41.614	45.156	42.074	52.871	42.282

Table 2.6: Freight transport across the Fehmarn Belt, tons per average day

The increase from 2001 to 2015 ranges from 29.466 t/day to 40.723 t/day, or an increase between 2½ and more than 4 times the transport in 2001

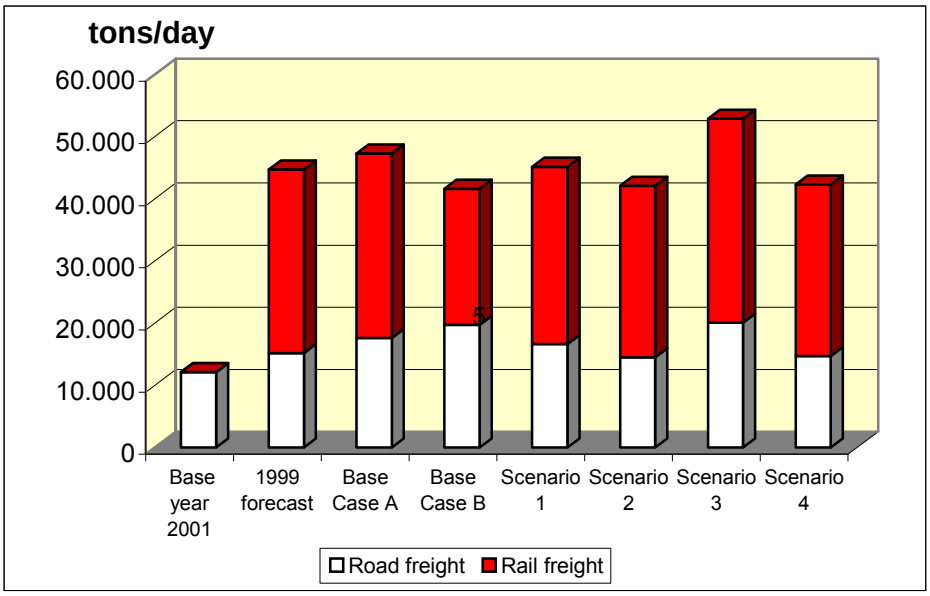

Figure 2.5: Freight transport across the Fehmarn Belt

The freight volumes across the Fehmarn Belt vary considerably throughout the forecasts depending upon the traffic supply and cost variations for the Baltic Sea crossings. The greatest volume is calculated for Scenario 3 that includes the most favourable conditions for the fixed link relative to the competing connections, and applies to both road and rail transport (see figure 2.5).

In 2001 no rail freight is transported via Fehmarn Belt.

2.3.3 Total traffic across the Fehmarn Belt

The total road traffic consisting of cars, buses and lorries over the fixed link varies between 8.000 and 9.450 vehicles/day in the four scenarios and the base cases.

Total road vehicles/day across the Fehmarn Belt	**Base year 2001**	**1999 Forecast 2010**	**Base Case A 2015**	**Base Case B 2015**	**Scenario Forecasts 2015**				
					Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**thereof ferry**
Passenger cars	3.718	6.214	7.496	7.786	7.197	6.953	8.027	6.967	559
Buses	88	162	129	129	129	129	132	129	3
Lorries	751	1.318	1.132	1.238	1.068	932	1.290	945	121
Total road vehicles/day – ADT (Average daily traffic)	4.556	7.693	8.756	9.153	8.395	8.014	9.449	8.041	682

Table 2.7: Total number of road vehicles across the Fehmarn Belt, vehicles/day

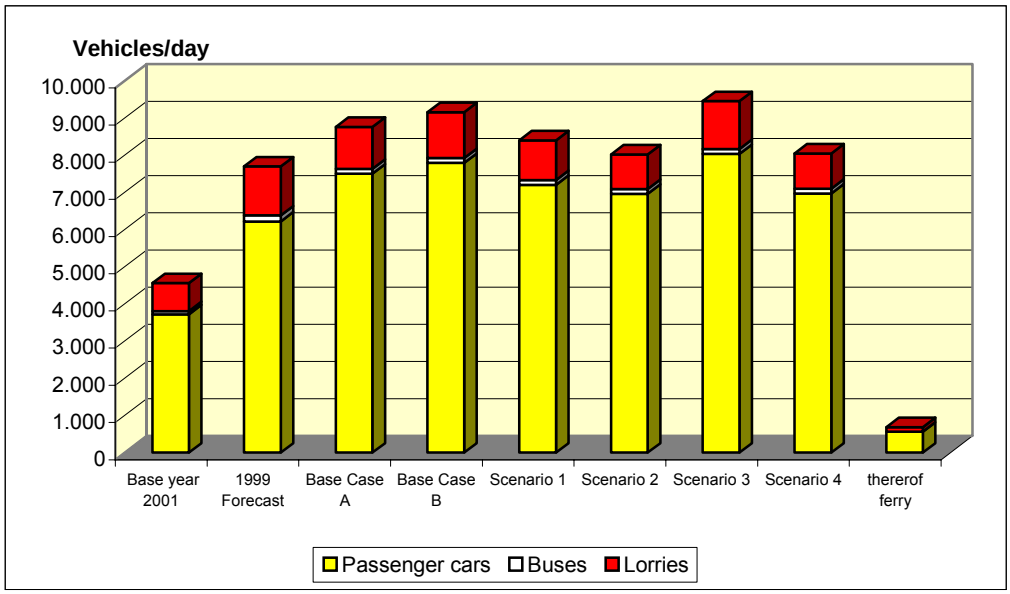

Figure 2.6: Number of road vehicles across the Fehmarn Belt

The 1999 forecast gave 7.700 vehicles/day in 2010 with a lower share of cars and a higher share of lorries (due to the smaller lorry load factor in the old forecast).

The percentage of cars and lorries remains approximately the same through the scenarios. (see table 2.7 and figure 2.6)

Table 2.8 and figure 2.7 show the number of trains across the Fehmarn Belt. Here it must be noted that the number of freight trains is model output as it is calculated according to the amount of freight forecasted while, on the other hand, the number of passenger trains is input to the passenger model and is a result of the assumed passenger train schedule, which is constant for all 2015 forecasts. Therefore, the number of passenger train wagons is not calculated by the model.

The parallel ferry in Scenario 4 does not take railway traffic.

Total rail traffic across the Fehmarn Belt	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	Scenario 2	Scenario 3	Scenario 4	thereof ferry
Freight trains/day	0	45	56	43	54	52	61	52	0
Passenger trains/day	9	38	40	40	40	40	40	40	0
Total trains/day	9	83	96	83	94	93	101	93	0

Table 2.8: Number of trains across the Fehmarn Belt, trains per average day, both directions together

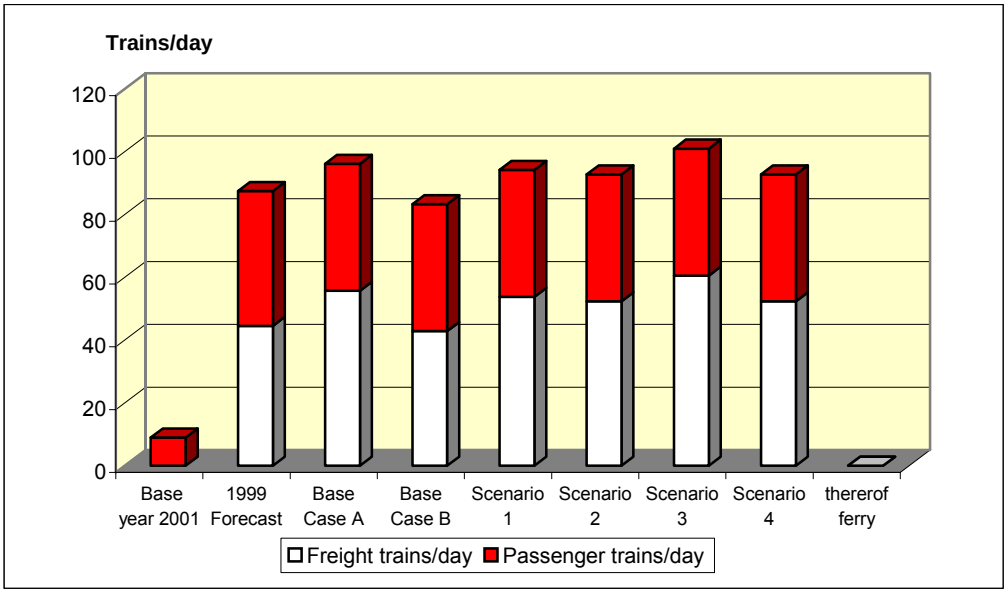

Figure 2.7: Number of trains across the Fehmarn Belt

In accordance with the calculated rail freight, the number of freight trains is largest in Scenario 3. The 101 trains per day in both directions together would correspond to a little more than two trains per hour in each direction on the average. But the number will not be evenly distributed throughout the week and the 24-hour day as most of the freight trains run on weekdays and most of the passenger trains will run between 6:00 and 22:00 hours.

2.3.4 Conclusions

The general conclusion of the new forecasts is that there are no dramatic changes in the Fehmarn Belt demand figures as compared to the 1999 forecast. On the other hand, the present forecasts provide more firm conclusions about the competition between the fixed link and the existing ferry lines in the Baltic Sea.

Main figures

Road traffic over the Fehmarn Belt link is forecasted at about twice the present volume carried by the Rødby-Puttgarden ferries, and for rail passengers about four times the present volume is forecasted.

Base Case A vs. Base Case B

Fehmarn Belt traffic/day	Base Case A 2015	Base Case B 2015
Pass. cars	7.496	7.786
Lorries	1.132	1.238
Freight trains	56	43

Table 2.9:Traffic across the Fehmarn Belt

The main difference between the Base Case A and B assumptions are in road user costs and rail freight efficiency. Accordingly, both private car and lorry traffic is greater in Base Case B whereas Base Case A generates more freight trains. (see table 2.9)

Scenarios 2015
The four scenarios all apply the Base Case A user costs and rail policy assumptions; they differ in the assumptions for the Baltic Sea ferries.

Fehmarn Belt traffic Units/day	Base Case A ferries as in 2002	Scenario 1 ferries more efficient	Scenario 2 ferries more efficient and cheaper	Scenario 3 ferries less efficient and more expensive	Scenario 4 ferries more efficient and cheaper; parallel ferry	Scenario 4 only traffic on the parallel ferry
Pass. cars	7.496	7.197	6.953	8.027	6.967*	559
Lorries	1.132	1.068	932	1.290	945*	121
Freight trains	56	54	52	61	52	0

** Total traffic across the Fehmarn Belt = fixed link + ferry*
Table 2.10: Traffic across the Fehmarn Belt. Scenarios 2015

With the 2002 schedules for the competing ferry lines across the Baltic Sea (Base Case A), the fixed link would attract about 7.500 cars and 1.100 lorries per day. With the more competitive ferry schedules in Scenario 1, the number of cars would be 300 less and the number of lorries would be reduced by 60 per day. If the competing ferries would reduce their fares (Scenario 2 assumption: - 25 %) the number of cars would drop further by 150 and the number of lorries by 140 per day.

Scenario 3 assumes that the competing ferries are less efficient (lower frequency and longer travel times) and more expensive than in Base Case A. The Fehmarn Belt link demand would be at its maximum among the scenarios tested: 8.000 cars, 1.300 lorries and 61 freight trains per average day would be the result.

A parallel ferry between Rødby and Puttgarden would – with the same assumptions as in Scenario 2 – add a little extra traffic to the Fehmarn Belt total, as compared to Scenario 2, but the ferry would take 560 cars and 120 lorries of that total. (It has not been analysed if a ferry operation with the calculated traffic load could operate on a reasonable financial base).

The number of freight trains necessary to move the forecasted rail freight volumes across the fixed link shows similar variations as the number of lorries.

Likely Range of Demand

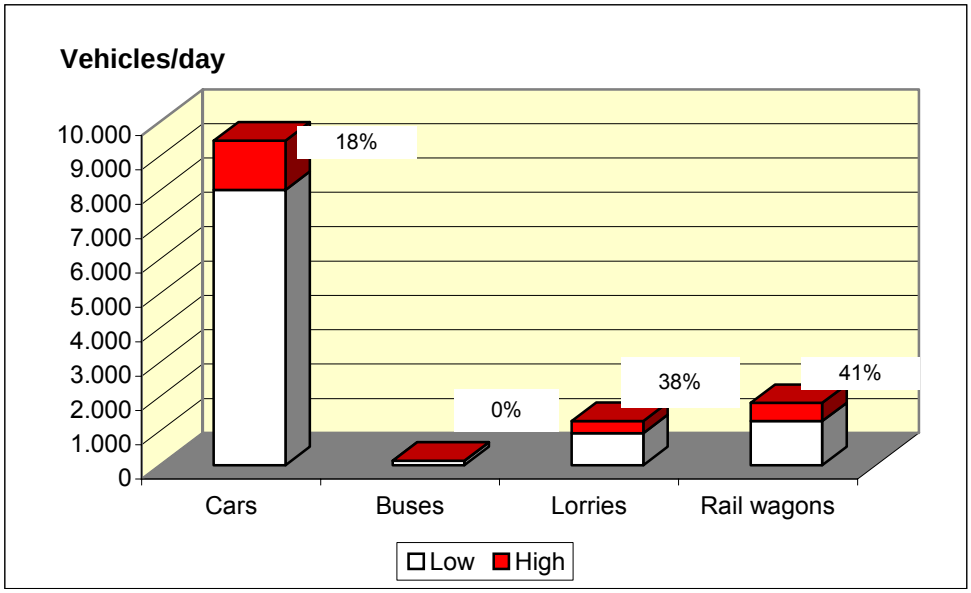

Figure 2.8: Range of traffic demand according to the 2015 forecasts

Figure 2.8 shows the likely range of traffic demand for cars, buses, lorries and freight wagons across the Fehmarn Belt according to the 2015 forecasts (high and low values). The % numbers in the figure show the percentages between the low forecasts (Scenario 2) and the high forecasts (Scenario 3).

The variation in car traffic is relatively smaller than the variation in lorries and freight rail wagons. This relationship can be expressed by the elasticity of traffic demand.

Elasticity of Demand

The elasticity can be defined as the percent change in calculated traffic volumes due to a percent change in the variable that has influence on the size of the volume. If the elasticity is defined in terms of a competing variable (in this case the competing ferries) the relationship is called cross-elasticity.

	Cross-supply elasticity	Cross-price elasticity for reduced fares	Cross-price elasticity for increased fares
Passenger cars	-0,16	0,14	0,28
Lorries	-0,22	0,51	0,56
Rail passengers	-0,02	0,01	0,03
Freight wagons	-0,20	0,11	0,35

Table 2.11: Elasticities of demand

An elasticity of 0,14 or 14 % means that a 10 percent fare reduction on the competing ferries would result in a loss of passenger cars over the Fehmarn Belt link of 1,4 percent. The cross-supply elasticities are negative because a higher level of ferry supply for the competing ferries results in less traffic across the Fehmarn Belt.

The variation of bus traffic between the forecasts is very small, and the elasticities are very close to null (not shown).

For road traffic, the cross-price elasticities for reduced fares on the competing ferries are of the same size as the cross-supply elasticities (in absolute numbers), but much lesser than for increased fares on the ferries. Lorry traffic has greater elasticities than car traffic, especially when considering ferry fares. This can be explained with the fact that lorry trips on the average are much longer than car trips and that, therefore, more alternatives are relevant for lorry drivers. As lorry drivers have better knowledge of the relevant routes they are in a better position to choose the optimum route than car drivers are.

Rail traffic elasticities are in absolute numbers generally smaller than road traffic elasticities because the supply of different routes in the railway system is limited. (See table 2.11)

Comparison with 1999 Forecast

The number of private cars across the Fehmarn Belt is greater in the 2015 forecast than in the 1999 forecast, both in the base cases and the four scenarios. This is mainly due to greater GDP in the involved countries and higher car ownership.

For bus traffic, today's outlook is less optimistic than it was in the late 1990'ies.

Fehmarn Belt traffic/day	1999 Forecast 2010	Base Case A 2015	Base Case B 2015
Pass. Cars	6.214	7.496	7.197
Buses	162	129	129
Lorries	1.318	1.132	1.238
Rail passengers	5.027	4.101	3.797
Freight wagons	1.422	1.671	1.285

Table 2.12: Base Case A and Base Case B compared with 1999 forecast.

The new forecast for the number of lorries, both in general and for the Fehmarn Belt, is reduced in relation to the 1999 forecast because the average load factor has been raised in the light of the recent trends, partly because of more reliable statistics.

The number of rail passengers across the Fehmarn Belt is lower than in the 1999 forecast because the former assumption of high-speed rail service between major centres in Northern Europe is no longer realistic. On the other hand, more effective freight railway operations, as assumed in Base Case A and the scenarios, result in larger rail freight volumes than in the 1999 forecast.

Considering the total traffic demand expressed in road vehicles and trains, no significant changes are evident in the forecast figures for the Fehmarn Belt.

2.4 Discussion of the Results

2.4.1 Important Factors Governing the Forecasted Traffic Demand

On the background of the forecast results in relation to the various assumptions and other input variables the following considerations about the most important factors that control the traffic demand on a fixed Fehmarn Belt link should be noted.

The general growth in welfare and GDP plays an important role for the travel and transport activity, both in person trips and in trade and freight transport.

A variable that depends highly on general welfare is the private motorisation, which obviously is growing steadily in our region.

The on-going European integration will give rise to more intense interaction within the growing European Union, which has implications on both passenger and freight traffic.

Other factors that might have a limiting effect on unrestricted growth are the limited amount of natural resources, mainly oil, the growing concern for the environment and the capacity of traffic facilities, which obviously not can be extended above certain limits.

This has led to some revised transport policy decisions in Germany and other European countries like the *Ökosteuer* and the *Lkw-Maut*. These new or increased contributions to the road user costs have been included in the forecast assumptions, together with the expected reactions by especially the trucking industry in the form of re-organisation towards higher efficiency and productivity.

Another means to relieve the roads from excess freight traffic has been incorporated into the *Bundesverkehrswegeplanung* that is the base for the 2015 scenarios: a significant enhancement of the railway freight operations by speeding up running times, loading and unloading and transfer between road and rail modes. This assumption has the effect that the share of rail freight between Denmark/Scandinavia and the continent, according to the Base Case A forecasts, will increase from 22 percent today to 32 percent in 2015.

For passenger traffic between Denmark/Scandinavia and the continent, the development of the airline market plays an important role. A further increase in the supply of low-cost airlines, as is assumed in the forecasts, will take a larger share of the passenger traffic in the relevant relations, leaving a smaller part of the total travel market to the surface modes car, bus and train. Bus traffic will further loose market shares in the city-to-city relations as air transport becomes cheaper.

The remainder of the person travel is made by car and rail with the private car being able to outweigh the train by a factor 8.

Looking at the variables that have been investigated specifically in the present forecasts for 2015, it is evident that the fare of the competing ferries are the most important factors for car and lorry traffic across the fixed link. The competing ferries are the ferry connections across the Baltic Sea east of the Fehmarn Belt, i.e. the Gedser-Rostock line and the ferries between Sweden and Germany. The influence of the service level of these lines is important, too, but not as much as the fares.

Bus and rail passengers are much less depending upon the competing ferry services and fares whereas the rail freight on the Fehmarn Belt is influenced to some extent.

2.4.2 Market share for a Fixed Link

The following three figures illustrate the share of the Fehmarn Belt traffic, of the competing ferries – i.e. other ferries between Denmark and Germany and all ferries between Sweden and Germany - and all other ferries considered.

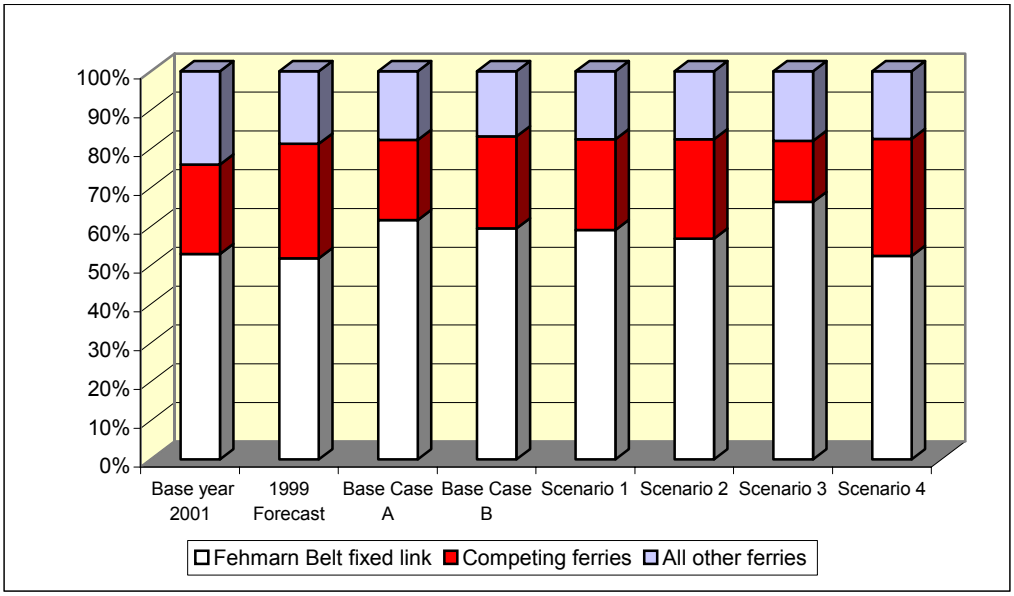

Figure 2.9: Distribution of passenger cars

Figure 2.9 shows the distribution of passenger cars between Denmark/Scandinavia and the continent. Today, the Fehmarn Belt has approximately 50 percent of the car traffic, and this share may increase in the 2015 forecasts depending upon the competing ferries.

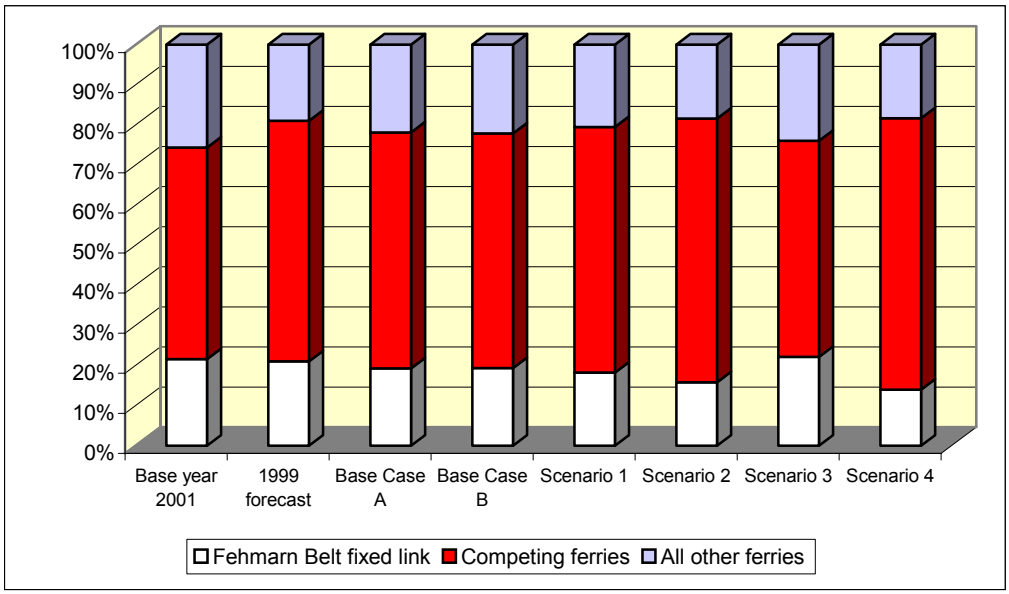

Figure 2.10: Distribution of lorry traffic

Figure 2.10 shows the distribution of the lorry traffic that is highly dominated by the competing ferries whereas the other ferries (Skagerrak, Kattegat and Poland ferries) have a little higher share than in car traffic.

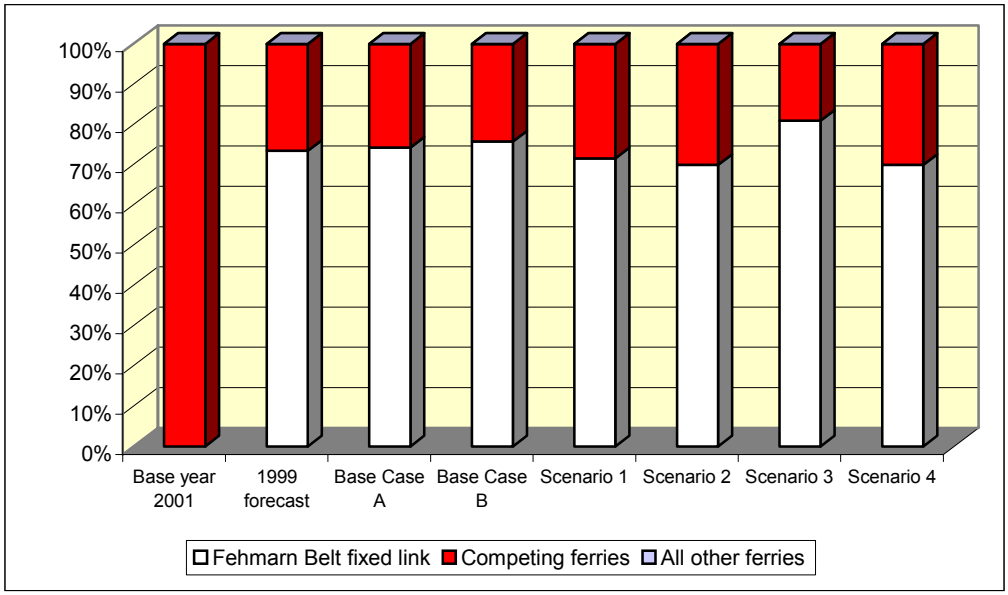

Figure 2.11: Distribution of railway freight

Figure 2.11 illustrates the distribution of railway freight. There are only two groups: the Fehmarn Belt and the Sweden-Germany ferries. The latter ones carry about 30 percent of the traffic, less in Scenario 3 and almost 40 percent in Scenarios 2 and 4 in 2015. In 2001, no rail freight crosses the Fehmarn Belt. On the passenger side, the Fehmarn Belt dominates the railway market. In 2015 96-97 percent of the railway passengers are forecasted to cross the Fehmarn Belt (not shown).

2.5 Trend Forecast 2025

2.5.1 Forecast Method

Two trend forecasts for the year 2025 have been carried out for each of the Base Cases A and B. The forecasts are carried out as a low and a high forecast for each Base Case.

The low forecasts are based upon the principle that the mode-specific traffic increase on the fixed link in the years 2015-2025 is equal to the increase per year from 2001 to 2015. The high forecasts are based upon the assumption that the mode-specific increase in the years 2015-2025 is at least twice as high as in the low forecasts, implying that the fixed link across Fehmarn Belt gives rise to a high degree of integration leading to a stronger increase per year than prior to the establishment of the fixed link.

2.5.2 Results and Conclusions

		Base Case A			Base Case B		
Traffic/day	**2001**	**2015**	**2025 low**	**2025 high**	**2015**	**2025 low**	**2025 high**
Pass. Cars	3.718	7.496	8.053	9.055	7.786	8.486	9.694
Buses	88	129	140	153	129	140	153
Lorries	751	1.132	1.323	1.571	1.238	1.498	1.836
Total road vehicles	4.556	8.756	9.516	10.779	9.153	10.124	11.683
Rail passengers	964	4.101	4.261	4.500	3.797	3.848	3.924
Rail freight wagons	740	1.671	2.252	2.877	1.285	1.611	1.959

Table 2.13: Trend projections for traffic based upon Base Case A and Base Case B

The figures 2.12 and 2.13 illustrate the result of the trend projections to 2025 for road traffic based upon Base Case A and B, respectively, each with the low and high trend. More detailed results are summarised in table 2.13.

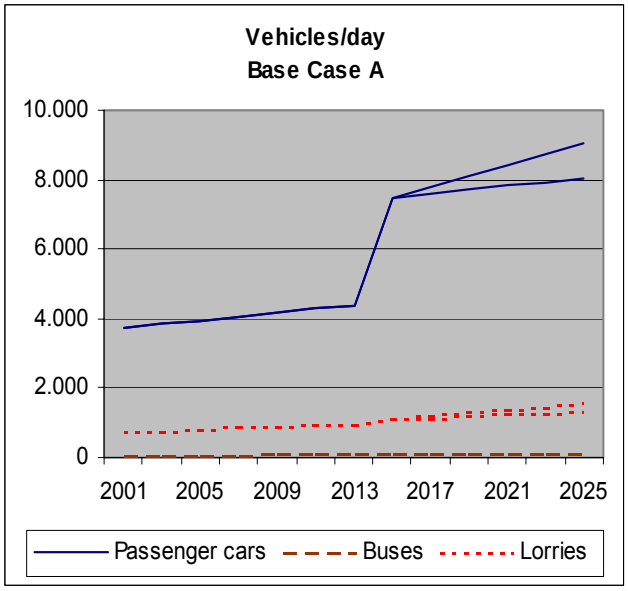

Figure 2.12: Base Case A

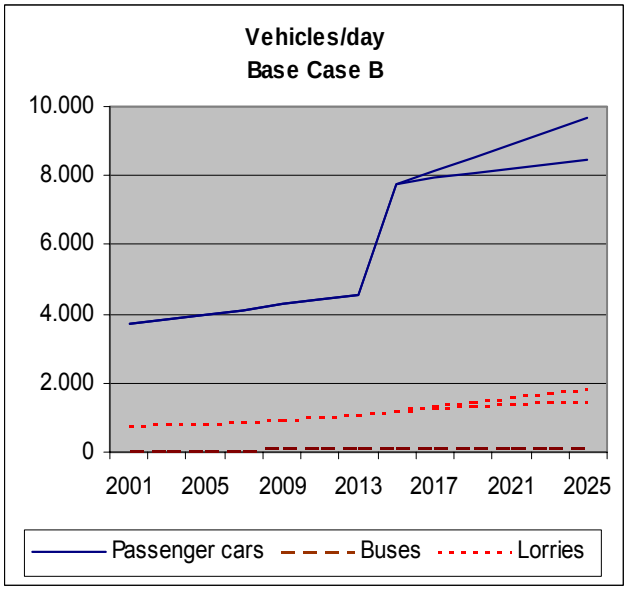

Figure 2.13: Base Case B

2.6 Further Investigations

As part of this study, the possible operation of a parallel ferry line between Rødby and Puttgarden and the possible competition from the Great Belt link was evaluated based upon existing experiences and investigations.

Parallel ferry
In Scenario 4, a ferry line operating parallel to the fixed Fehmarn Belt link between Rødby and Puttgarden has been tested. 12 daily departures in each direction were assumed. According to the forecast model, the ferry line would attract about 560 cars, 120 lorries, 3 buses and 470 walk-on passengers on an average day in 2015. In comparison, in 2001 the Rødby-Puttgarden ferry line carried 3.700 cars, 750 lorries, 90 buses and 2.000 walk-on passengers per day.

It has not been evaluated in this context if a ferry operation would be financially feasible with the above traffic figures in 2015. But, with the experience from the Great Belt and Øresund fixed links, it seems unlikely that this could be the case.

On the Great Belt, a private car ferry operating directly parallel to the fixed link seized its operation the day the fixed link opened in 1998.

In the Øresund example, a car ferry operating across the Øresund just south of the fixed link was closed down seven months before the fixed link opened. High-speed passenger ferries between the city centres of Copenhagen and Malmö seized to operate 16 months after the fixed link opened. These ferries had been very popular with commuters and shoppers during many years but most of the previous customers transferred to the train connection between Copenhagen and Malmö via the fixed link.

Ferries between Helsingør and Helsingborg (50 km north of the Øresund link) still operate with a high level of service.

Competition from the Great Belt Link
According to the conclusion in Chapter 10, the competition relationship between the Great Belt link and a fixed link across the Fehmarn Belt is rather modest.

In a recent survey performed by Sund & Belt Ltd., it was found that only 3 percent of the present Great Belt traffic has either destination or origin in Germany; 97 percent is national Danish traffic. Hence, only the 3 percent could consider to use the Fehmarn Belt link in the future.

This result confirms previous FTC forecasts, which showed that only 1,9 % of car traffic and 0,8 % of lorries on the Great Belt link would be attracted by the Fehmarn Belt link in 2010.

The above shows, that at Fehmarn Belt link will only be an attractive alternative for a small share of the existing traffic across the Great Belt.

On the other hand, the Great Belt link might be an attractive alternative for some of the travellers that could use a Fehmarn Belt link. This will depend entirely on the difference in the toll levels at the two fixed links. The transport route via Rødby-Puttgarden is approximately 150 km shorter, than the route via the Great Belt. The current cost of travelling via this route including the cost associated with travelling a longer distance is 60-80 Euro, which is substantially higher than the ferry fare at Rødby-Puttgarden of 46 Euro. Unless, there are significant changes in relationship between the tolls at these crossings, the Great Belt link, will not be a significant competitor to a Fehmarn Belt link.

3 BACKGROUND OF THE STUDY

This study of new tests of the traffic demand on a fixed Fehmarn Belt link is a supplement to previous investigations and evaluations carried out by the two national ministries of transport.

The study has basically three purposes:

- Extension of the forecast horizon until 2015 by utilising the results of the ongoing *Bundesverkehrswegeplanung* and with a projection to 2025
- Include the past years' experience from changes in traffic patterns, ferry supply, socio-economic conditions, opening of the fixed links across the Øresund and Great Belt and the recent development in the infrastructure development and plans in the hinterland of the Fehmarn Belt.
- Test the sensitivity of the traffic demand on a fixed link towards the competing ferry supply.

In addition, the competing role of the Great Belt fixed link has been evaluated.

3.1 Status of the Investigations about a fixed link across the Fehmarn Belt

The two national ministries of transport performed preliminary investigations about a fixed link across the Fehmarn Belt in the years 1995-1999.

In the course of these investigations a traffic demand study was carried out including comprehensive surveys of the traffic and transport across the Baltic Sea between Denmark/Scandinavia and the continent. Forecast models were developed for both person and freight traffic by all modes and forecasts for the year 2010 were prepared for different technical solutions of a fixed link between Rødby and Puttgarden. This work was performed by the FTC.

In addition to the traffic demand investigations, the two ministries evaluated the technical, environmental, economic and financial viability as well as the regional consequences of a fixed link.

With these results, an Enquiry of Commercial Interest (ECI) regarding a Fehmarn Belt fixed link was held. The enquiry revealed that there is a clear, positive interest with private investors to participate in the design, finance, construction and operation of a fixed link. Among the commercial risks were mentioned the likelihood of a parallel ferry operation to open close to a fixed link and the competition from the Great Belt fixed link. In addition, the possible competition from other existing ferries across the Baltic Sea was mentioned as a risk factor.

As a next step, the two Ministers of Transport decided to perform further tests of the traffic demand including an evaluation of the questions raised during the ECI.

3.2 The 1999 Forecasts

The traffic demand forecasts published in 1999[4] covered four different technical alternatives for a Fehmarn Belt crossing in the year 2010.

The four alternatives were tested based on the same set of socio-economic and growth assumptions in the study area and the fixed assumptions about all ferry lines across the screenline:

1. A reference forecast, which for the Fehmarn Belt crossing assumes status quo, i.e. ferry service as in 1997. For the road and railway systems in the hinterland, the committed improvements have been reflected in this forecast. This includes a number of railway improvements in Scandinavia and Germany that had been determined at the time.
2. A combined fixed link across the Fehmarn Belt with a 2-track railway and a 4-lane motorway across the Belt (2+4). The adjoining sections of the rail and motorway networks are extended accordingly. For the railway, high-speed service was assumed between Copenhagen and Hamburg allowing a travel time for passenger trains of 2 hours and 30 minutes.
3. A rail fixed link across the Fehmarn Belt with shuttle trains for road vehicles (2+0). The assumed railway improvements are the same as in the 2+4 case while road vehicles would have to use specially equipped shuttle trains similar to the ones used in the Eurotunnel. They operate on a 20 minute schedule.
4. A combined fixed link across the Fehmarn Belt with a single-track railway and a 2-lane highway (1+2). The purpose of this scenario test was to reveal the sensitivity of the forecast model towards a reduced transport supply. It was defined technically by adding 10 minutes extra travel time for road traffic and 30 minutes extra time for railway traffic between Copenhagen and Hamburg.

In all fixed link alternatives, a local means of transport (e.g. a passenger ferry) was assumed operating between Rødby and Puttgarden to serve the considerable number of local shopping and excursion travellers that used to walk on board the ferries. Many of these were attracted by the possibility of duty-free shopping.

The 1+2 scenario did - contrary to the 2+4 scenario - not assume motorway standard for the fixed link and certain connecting road sections. This was reflected in the assumption that the average road travel time between Copenhagen and Hamburg was fixed at 10 minutes above the time in the 2+4 scenario. As traffic problems must be expected in peak periods with the reduced alternative this extra time would have substantial variations.

Passenger traffic
The next table summarises the total passenger flows between Scandinavia and the Continent by mode for the different Fehmarn Belt scenarios.

[4] *Fehmarnbelt Traffic Demand Study, Final Report, January 1999*. By: FTC – Fehmarnbelt Traffic Consortium - for *Bundesministerium für Verkehr*, Bonn, and *Trafikministeriet, Copenhagen*

Traffic between Denmark/Scandinavia and the Continent					
Passenger Traffic	**Base year**	**Reference case**	**Fixed Link Forecasts 2010**		
1.000 pass./year	**1996**	**2010**	**2+4**	**2+0**	**1+2**
Rail passengers	899	1.069	1.874	2.277	1.619
Car passengers	7.326	10.612	12.002	10.862	11.798
Bus passengers	2.945	3.388	3.619	3.369	3.590
Air passengers	7.504	13.905	12.905	13.054	13.116
Walk-on passengers	3.508	3.085	2.755	2.856	2.769
Total passengers	**22.182**	**32.059**	**33.155**	**32.418**	**32.892**
Traffic across the Fehmarn Belt					
Passenger Traffic	**Base year**	**Reference case**	**Fixed Link Forecasts 2010**		
1.000 pass./year	**1996**	**2010**	**2+4**	**2+0**	**1+2**
Rail passengers	717	633	1.835	2.234	1.576
Car passengers	3.195	3.765	5.792	4.220	5.590
Bus passengers	1.435	1.642	2.055	1.677	2.030
Walk-on passengers	1.751	1.369	680*	680*	680*
Total passengers	**7.098**	**7.409**	**9.682**	**8.131**	**9.196**

Table 3.1: 1999 forecast: Total passenger flows, 1996 and 2010 alternatives
* Using the passenger ferry Rødby-Puttgarden

The table shows that the total number of passenger trips varied somewhat between the alternatives.

The share of the different modes revealed considerable variations between the alternatives. Rail had the highest share in the 2+0 alternative. The car mode had its maximum in the 2+4 scenario, followed by the 1+2 alternative, both of them assuming a fixed road link. The number of walk-on passengers was smallest in the same two alternatives because the road connection attracts part of the walk-on passengers in the alternatives having no road link.

Freight traffic
The following table summarises the total freight flows between Denmark /Scandinavia and the continent (upper part) and across the Fehmarn Belt (lower part) by mode for the different Fehmarn Belt alternatives in the 1999 forecasts.

Freight Traffic	**Base year**	**Reference case**	**Fixed Link Forecasts 2010**		
1.000t/year	**1994**	**2010**	**2+4**	**2+0**	**1+2**
Total Traffic between Denmark/Scandinavia and the Continent:					
Road	16.276	28.155	28.007	27.987	28.024
Rail conventional	6.568	11.509	11.643	11.661	11.629
Rail combined	1.700	3.015	3.029	3.031	3.027
Total	**24.544**	**42.679**	**42.679**	**42.679**	**31.063**
Traffic across the Fehmarn Belt					
Road freight	3.241	5.042	5.553	5.313	5.525
Rail freight	3.845	9.886*	10.773	10.787	10.725
Total	**7.086**	**5.042**	**16.326**	**16.100**	**16.250**

Table 3.2: 1999 forecast: Total freight flows and freight across the Fehmarn Belt, 1994 and 2010 alternatives
*These transports are routed via the Great Belt

The total amount of freight was constant and there were only very small changes in the modal split between road and rail. The rail share of the freight was largest for the fixed link alternative with a shuttle train (2+0).

Freight traffic across the Fehmarn Belt showed somewhat greater variations through the fixed link alternatives, especially road freight that had its maximum value in the 2+4 alternative.

Total road traffic
The total road traffic consisting of cars, buses and lorries across the Fehmarn Belt is summarised in the next table.

Total road vehicles across the Fehmarn Belt 1.000 veh./year	**Base year** **1994**	**Reference case** **2010**	**Fixed Link Forecasts 2010** **2+4**	**2+0**	**1+2**
Passenger cars	994	1.319	2.268	1.526	2.171
Buses	39	47	59	48	58
Lorries	272	427	481	461	479
1.000 vehicles/year	**1.305**	**1.793**	**2.808**	**2.035**	**2.708**
Average daily traffic, vehicles/day	**3.575**	**4.912**	**7.693**	**5.575**	**7.419**

Table 3.3: 1999 forecast: Total number of road vehicles across the Fehmarn Belt, base year and alternatives 2010

The forecasted number of road vehicles varied significantly throughout the alternatives, mostly due to the variations in passenger car traffic. The number of buses and lorries had the same tendency but the variations are smaller, both relatively and in absolute numbers. The highest total demand occurred for the two alternatives that include a fixed road link.

3.3 Trends in Traffic across the Baltic Sea

The fall of the Iron Curtain gave rise to rather optimistic expectations about the development of trade and passenger interaction with the former communist countries – expectations that had to be revised after a while. The 1999 forecast of traffic and trade across the Baltic Sea was partially influenced by the more optimistic outlook for Eastern Europe. First in the late 1990'ies, the interactions accelerated leading to a strong increase in trade relations with this part of Europe whilst the freight flow with Western Europe continued its steady growth throughout the 10 years' period.

On the passenger side, the development of traffic to and from Central and Eastern Europe played a minor role as compared to the changes due to the deregulation of air traffic and the effects of the abolition of duty-free shopping between EU countries.

These developments are summarised in short in the following as their implications are accounted for in the new forecasts.

3.3.1 Freight Transport Trends

- The German foreign trade with the Transformation Countries bordering the Baltic Sea has increased by 314 percent between 1992 and 2000;
- After the decline of Baltic Sea transport due to the transformation processes in the beginning of the nineties, sea transport recovered in 1994 and lead to an increase of port handling volumes in the Baltic Sea by more than 100 Mill. t until 2000, i.e. from 442 Mill. t in 1994 to 566 Mill. t in 2000 or 3,9 % p.a.;
- Trade among the Transformation Countries and the traditional Free Market Economies consists westbound primarily of raw materials and partly processed goods and eastbound of manufactured consumer and investment goods;
- However, trade with manufactured goods has grown faster that trade with raw materials and bulk goods;
- Container transport has dominated the external Baltic Sea trade while ro-ro and ferry transport has gained a dominant position for intra Baltic Sea trade.

3.3.2 Passenger Transport Trends

Low-price airlines have increased their market shares for passenger transport to the disadvantage of ferry and rail transport.

After abolition of duty-free for intra-EU transport services in 1999, the amount of passenger transport has declined for most routes, e.g. on the routes Sassnitz-Trelleborg, Travemünde-Trelleborg, and Kiel-Göteborg – but not Rødby-Puttgarden – while passenger numbers on ferry services between EU and non-EU Member States have grown, e.g. for the Kiel-Oslo route or services between Sweden and Poland.

3.3.3 Ferry Traffic

The following four charts illustrate the trend in the annual number of vehicles carried by the ferries operating in the Baltic Sea excluding ferries across the Øresund (to avoid double-counting). The figures refer to 45 ferry lines in total, some of them only operating during part of the 11-year period covered.

The total number of passenger cars across the Baltic Sea has remained approximately constant during the period but the proportion using the ferries calling at Rødby and Gedser has varied considerably. Table 3.4 shows the relative distribution of car traffic in the beginning, in the middle and at the end of the 11-year period.

The Rødby and Gedser ferries have regained their share from the beginning of the period after it had dropped by over 10 percent points (it was down at 34 percent in 1997). This decrease is mainly due to the decline of traffic to and from the Central and Eastern European Countries when the over-optimistic

expectations after the fall of the Iron Curtain did not fulfil in the early 90'ies. In addition, Sweden experienced an economic recession during these years. The increase in Rødby-Puttgarden traffic during recent years is due to the increased frequency on the Rødby-Puttgarden line and to the opening of the Øresund fixed link, which has re-directed a number of passenger car journeys between Scandinavia and the continent via eastern Denmark.

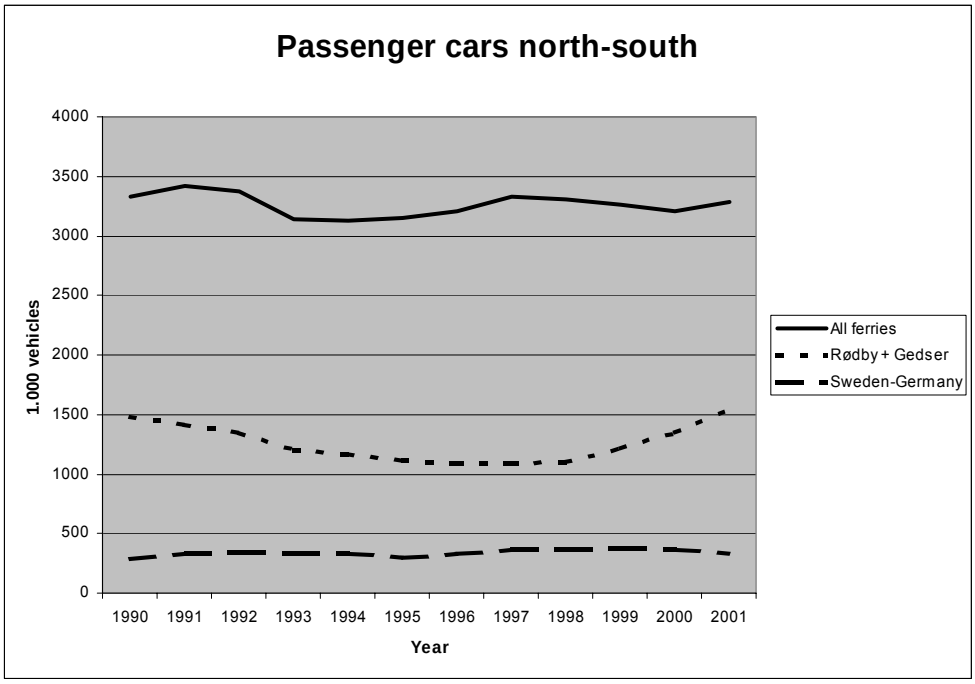

Figure 3.1: Number of passenger cars crossing the Baltic Sea north-south[5]

Year	1990	1995	2001
	Percent		
Denmark-Norway	12,3%	14,2%	15,6%
Denmark-Sweden (Kattegat)	17,9%	21,8%	13,3%
Denmark-Germany	52,3%	44,6%	50,0%
thereof Rødby + Gedser	*44,4%*	*35,6%*	*47,2%*
Denmark-Poland	0,3%	0,3%	0,4%
Germany-Norway	1,4%	1,8%	2,5%
Germany-Sweden (Kattegat)	3,1%	3,6%	2,8%
Germany-Sweden (Baltic)	8,7%	9,6%	10,1%
Germany-Finland	0,9%	1,1%	2,0%
Sweden-Poland	3,1%	3,1%	3,3%
All ferries	100,0%	100,0%	100,0%
	1.000 cars		
All ferries, absolute	3.333,2	3.146,4	3.288,7

Table 3.4: Relative distribution between ferry groups for passenger cars

[5] The sources of this and the following graphs and tables are *Danmarks Statistik* and *ShipPax*

Other major traffic flows are carried by the ferries between Denmark and Norway that have increased their share, and the Denmark-Sweden ferries in the Kattegat dominated by the Frederikshavn-Göteborg lines that had their peak in the mid-90'ies and have lost a major amount of traffic lately. This could be due to the stop of duty-free sales on board. The ferries between Germany and southern Sweden used to have between 9 and 12 percent of the total car traffic.

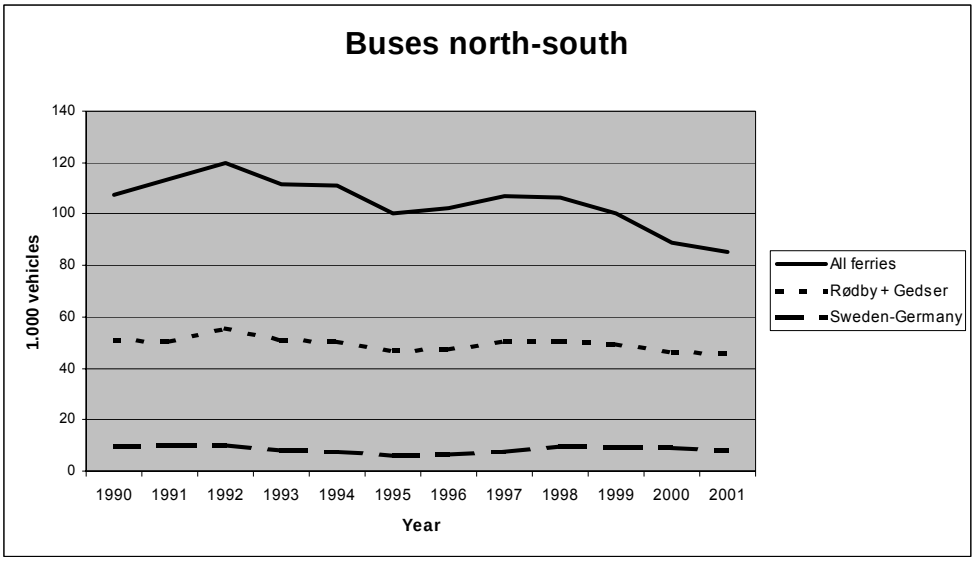

Figure 3.2: Number of buses crossing the Baltic Sea north-south

The bus traffic across the Baltic Sea has declined throughout the period considered, the total in 2001 being about 70 percent of the peak figure in 1992. The Rødby and Gedser ferries had a minor decline as well but their share of the total has increased to 56 percent of the total. The Sweden-Germany ferries carry 10 percent.

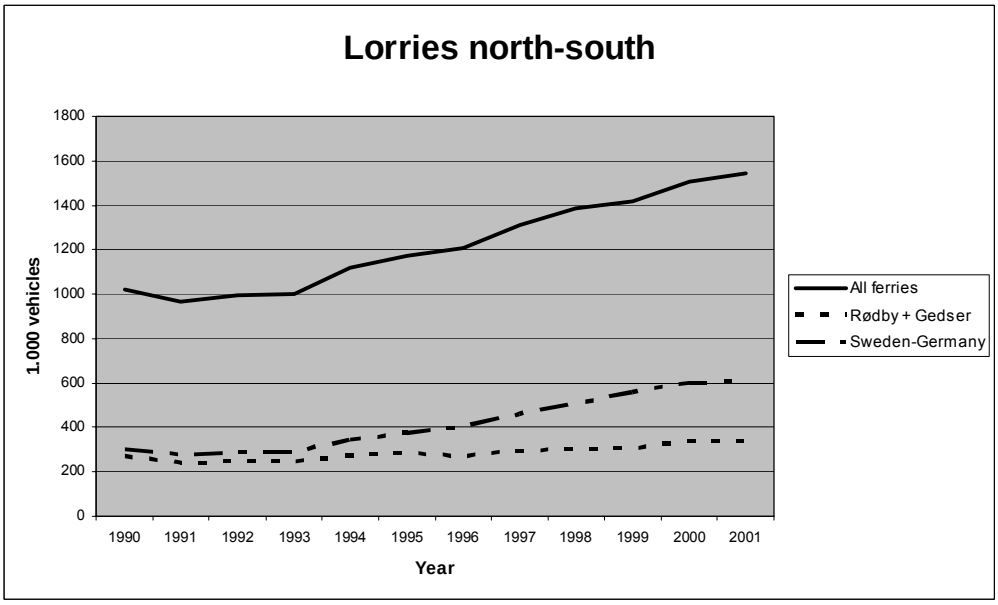

Figure 3.3: Number of lorries crossing the Baltic Sea north-south

The lorry traffic across the Baltic Sea has increased by almost 50 percent during the 11 years. All types of lorries and trailers reported in the statistical records are included.

Year	1990	1995	2001
	Percent		
Denmark-Norway	11,4%	10,2%	7,5%
Denmark-Sweden (Kattegat)	16,1%	14,2%	11,7%
Denmark-Germany	26,7%	24,7%	22,3%
thereof Rødby + Gedser	*26,2%*	*23,7%*	*21,7%*
Denmark-Poland	0,5%	0,7%	0,2%
Germany-Norway	2,6%	3,3%	2,6%
Germany-Sweden (Kattegat)	7,9%	9,7%	6,3%
Germany-Sweden (Baltic)	29,4%	31,5%	39,1%
Germany-Finland	0,2%	0,2%	2,5%
Sweden-Poland	5,1%	5,4%	7,7%
All ferries	100,0%	100,0%	100,0%
	1.000 lorries		
All ferries, absolute	1.022,0	1.172,0	1.541,8

Table 3.5: Relative distribution between ferry groups for lorries

It is most remarkable that the lorry traffic between southern Sweden and Germany has doubled during the period while the ferries calling on Rødby and Gedser only had an increase by 25 percent. The Sweden-Germany ferries increased their market share from 30 to almost 40 percent; most of the other ferry corridors lost market shares including the Rødby and Gedser ferries that had a share of 22 percent in 2001.

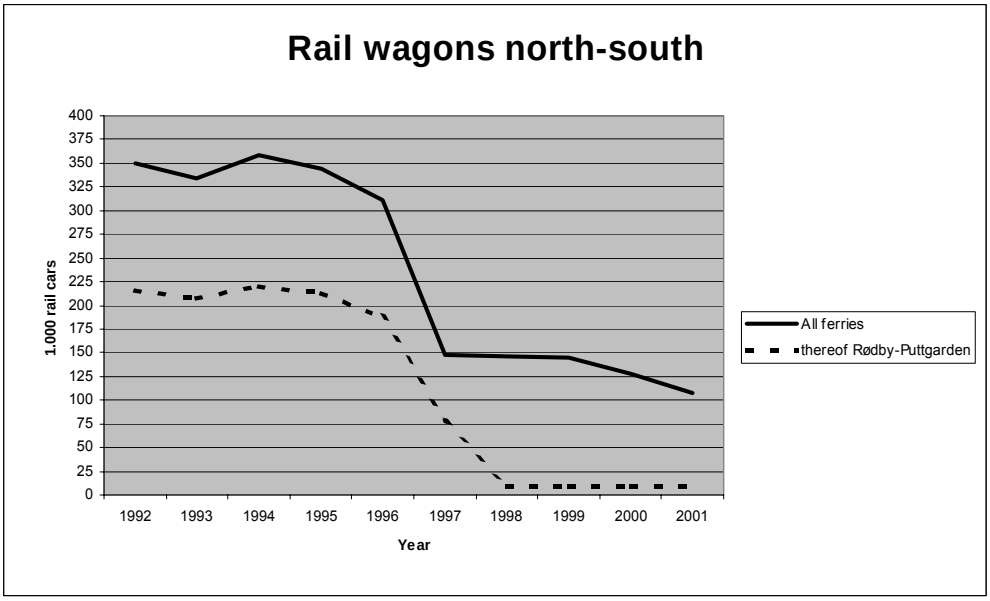

Figure 3.4: Number of rail wagons crossing the Baltic Sea north-south. The statistics are incomplete before 1992

Rail traffic has declined during the 1990'ies, particularly on the Sassnitz-Trelleborg route since 1995, Puttgarden-Rødby since 1997 (when the Great Belt link opened and all Rødby-Puttgarden freight was redirected via the Great Belt) and on Rostock-Trelleborg since 2000.

The Rødby-Puttgarden crossing handled freight wagons until 1997. From this year on, both freight trains and passenger night trains between Copenhagen and the south were routed via the Great Belt. As a consequence, the number of rail wagons between Puttgarden and Rødby was reduced from some 200.000 to just above 9.000 annually.

3.4 Need for Updated Forecasts

The 1999 forecast assumptions were defined in 1997 and represent basically the 1997 status in structure data and transport networks including the 1997 ferry supply across the Baltic Sea. The underlying traffic surveys were performed in the period 1996-98, and the survey sample data were expanded to the base year 1996 for person travel and 1994 for freight movements.

The source of the socio-economic data forecast for the continental part of the study area was the *Strukturdatenprognose 2015* by Prognos as published in 1995, which was used in the *Bundesverkehrswegeplanung 1992*. For Denmark and Scandinavia available forecasts for population and GDP with the base year 1996 were used.

For the road and railway systems in the hinterland the existing and committed networks according to official 1997 plans were applied. The ferry and ro/ro links across the Baltic Sea represent the 1997 supply including a number of fast ferry links that were in operation or had been programmed by the ferry operators.

Since 1997 a number of changes have occurred that are in more or less conflict with the forecast input data used earlier. Some of these changes are mentioned below:

- The socio-economic forecasts for population, employment, GDP and car ownership that are available now differ from the ones used in the previous forecasts. This is especially relevant for Central and Eastern Europe for which region the former assumptions had been fairly speculative.
- The present plans for the road and railway networks in the hinterland of the Fehmarn Belt have been altered in various respects: this applies most considerably to the expectations about the extent of the high-speed railway network. E.g. the *Transrapid* between Hamburg and Berlin, which had been assumed previously, is no longer relevant. The railway connection between Copenhagen and Hamburg, which previously had been given a cruising speed of 200 km/h, is now set at a maximum speed of 160 km/h.

- A number of ferry links across the Baltic Sea have been closed including most of the fast ferry connections that were included in the previous forecasts, and some of the previously assumed departure frequencies are no longer realistic. A few new ferry connections have been opened since 1997. Also, the fare levels have changed.
- The toll structure on the Øresund fixed link has been changed recently.
- The air traffic conditions have changed considerably during the last year.
- User costs for both road and railway need to be revised in the forecast assumptions as considerable increases are expected to be implemented in some countries.

These and other relevant factors have been reflected in the new traffic demand forecasts.

4 FORECAST PREPARATION

4.1 Forecast Method

4.1.1 The Forecast Models

The 2002 forecasts were prepared using the forecast models developed by the FTC in the period 1995-1999 after two adjustments: (1) The base data used in the current *Bundesverkehrswegeplanung* (*BVWP*) were adopted, and (2) the models were recalibrated with 2001 traffic statistics for the Baltic Sea screenline.

Separate models are used for person and freight traffic although they have many commonalities. The forecast procedure consists of the following steps:

- Formulation of input variables,
- Calculation of general traffic growth,
- Calculation of the share of the different transport modes,
- Calculation of the load on the different links of the network including ferry lines and fixed link.

The input variables regarding the networks (roads, railways, bus lines, ferry connections, airlines) include data about user costs, schedules, and travel times. The structure data used include GDP, population and car ownership.

The modes considered for person traffic are: rail, bus, car, air and walk-on at the ferries. For freight the modes forecasted are rail, road and combined. Air freight is not included in the model, as it is assumed that this will not be affected by the existence of a fixed Fehmarn Belt link.

4.1.2 Model calibration for 2001

Person Traffic
Based on the ferry statistics summarised in section 3.3.3, air traffic statistics between Scandinavian and German airports[6] and on railway statistics[7] the O/D matrices have been updated from 1996 to 2001 (see chapter 5 below). Using updated network data for road, rail, air and ferry services, the model could be re-calibrated in the following steps:

(1) Adjustment of the modal split at the overall Baltic Sea screenline level due to the shares of car, rail, bus and air traffic
(2) Iterative calibration of the assignment model and the O/D-matrix for car and passenger traffic on the different ferry lines.

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[6] Statistisches Bundesamt, Wiesbaden, Fachserie 6, Reihe 8

[7] *Intraplan Consult GmbH* und *TLC* : *Regionale Struktur des Personenverkehrs in der Bundesrepublik Deutschland im Jahr 1997*, on behalf of the *Bundesministerium für Verkehr, Bau- und Wohnungswesen* and *Deutsche Bahn AG*
Intraplan Consult GmbH, INRETS, IMTrans : *Passenger Traffic Study 2010/2020*, on behalf of the *UIC (International Union of European Railway Companies)*

Freight Traffic
For the calibration of the freight transport model the same procedure was used as for person traffic:

(1) Update of the O/D matrices from 1994 to 2001 based on ferry statistics and available road and railway statistics.
(2) Update of the network data for road and rail.
(3) Iterative calibration of the assignment model to match traffic on the different ferry lines.

In addition, the parameters of the vehicle and train model were adjusted using the latest information and trends based upon the road and railway statistics and information applied in the current *Bundesverkehrswegeplanung*.

For road freight, two main statistical sources are available to calibrate the vehicle model: The statistics of German freight vehicles (*Verkehrsleistungsstatistik deutscher Fahrzeuge*) and the Baltic Sea ferry statistics. The freight vehicle statistics reveal that the average loading weights in international road transport have increased from 1994 to 2001 but are still lower than according to the ferry statistics. One reason for this is that the traffic across the Baltic Sea is mainly long-distance, which calls for higher loading weights than other international traffic. Because the ferry statistics appear to be more reliable for the transport across the Baltic Sea it has been used in the new model calibration.

For rail freight, it was assumed in the 1999 forecast that the average net weight per freight train would be 650 tons. Comparing this figure with the BVWP assumptions and having the recent trend towards lower net weights in mind it seems too high. Therefore, a lower net weight per train has been assumed in the new forecasts.

4.1.3 Reference to *BVWP* forecast

One main reason for the update of the Fehmarn Belt Study is the German *BVWP*-process, which is under way. Reference has to be made to main inputs for the basic *BVWP* forecasts[8] including the socio-economic data and networks and to the demand forecasts themselves because international traffic and transport flows were regarded as very important and were analysed thoroughly. Naturally with regard to the ferry lines and user costs for ferries the *BVWP* forecasts were less detailed than required for this study. However, the hinterland network in Germany could be derived fully from the *BVWP*.

[8] BVU Beratergruppe Verkehr + Umwelt GmbH, ifo Institut für Wirtschaftsforschung, Intraplan Consult GmbH, Planco Consulting GmbH, Verkehrsprognose 2015 für die Bundesverkehrswegeplanung (FE-Nr. 96.578/1999), on behalf of the German Bundesministerium für Verkehr, Bau- und Wohnungswesen, München/Freiburg/Essen 2001

4.2 Common Assumptions 2015

4.2.1 Basic Ferry Supply 2015

The basic assumption is that – except for Rødby-Puttgarden – all ferry connections across the Baltic Sea operating today are in operation in 2015 as defined both in number of departures per day, crossing times and fares.

DFDS Seaways has opened a new service Copenhagen-Trelleborg-Gdansk in October 2002. This is included in the basic 2015 assumptions.

The key figures are shown in table 4.1. Table 4.2 allows a comparison between the ferry supply for the 1999 forecast for 2010 and the new forecast for 2015. In table 4.3 a summary by ferry corridor of the departures and travel times is presented.

For the base cases it is assumed that the ferry supply in 2015 will correspond to the supply in 2002 – except for the Rødby-Puttgarden ferry, which is expected to discontinue services when the fixed link opens.

The ferry connections offering railway transport are marked as such. It may be noted that the possibility of a railway ferry service between Gedser and Rostock, which has been mentioned recently, has not been included in the forecasts.

The ferry supply in the 1999 forecast for 2010 was based upon ferry schedules and fares for Summer 1997 and those planned changes by 2010 that were communicated by the ferry operators in an enquiry held by the two Ministries. These changes consisted mainly of the deployment of fast ferries between Rostock and Trelleborg and between Sassnitz and Trelleborg.

It must be noted that, according to the European VAT rules, passenger fares in public transport including ferries are free of VAT but that passenger cars using toll bridges have to pay VAT as part of the bridge toll.

In the forecast the total toll rates including VAT to be paid by users of the fixed Fehmarn Belt link are assumed to be equal to the present ferry fares in fixed prices. A passenger car is assumed to pay € 46 and a lorry € 259 for a one-way trip. (price level 2002)

	Frequency departures /day	Travel time minutes	Pass. Fare[9] €	Freight fare[10] €	Railway R
Denmark-Norway					
Frederikshavn-Oslo	1	540	210	446	
Frederikshavn-Larvik/Moss	2	300	210	551	
Hirtshals-Oslo	1	750	210	551	
Hirtshals-Kristianssand	3-4	170-240	210	541	
Hanstholm-Egersund/Bergen	1	990	355	940	
Copenhagen-Oslo	1	960	631	no info	
Germany-Norway					
Kiel-Oslo	1	1.140	422	878	
Denmark-Sweden					
Frederikshavn-Göteborg	5	210	111	380	
Frederiksh. - Göteborg FF	2	120	128	n.a.	
Grenå-Varberg	3	270	111	396	
Helsingør-Helsingborg HH	36	20	29	99	
Helsingør-Helsingborg Scand	55	20	31	116	
Rønne-Ystad	2	150	120	270	
Rønne-Ystad FF	3	80	85	n.a.	
Øresundsbron	bridge	11	17-30	92	R
Germany-Denmark					
Rødby-Puttgarden Ferry	48	52	46	259	(pass.)R
Gedser-Rostock	9	120-145	82	259	
Rønne-Sassnitz	0,7	210	151	348	
Rønne-Mukran	1	210	151	348	
Havneby-List	6	55	43	161	
Germany-Sweden					
Kiel-Göteborg	1	840	418	540	
Travemünde-Malmö	2	540	100	375	
Travemünde-Göteborg	1	900	n.a.	499	
Travemünde-Trelleborg TT	2	450	189	n.a.	
Travemünde-Trelleborg Scand	2	480	n.a.	562	
Rostock-Trelleborg TT	3	360	189	n.a.	
Rostock-Trelleborg TT FF	4	180	189	n.a.	
Rostock-Trelleborg Scand	3	360	115	464	(freight) R
Sassnitz-Trelleborg	5	225	88	348	R
Germany-Finland					
Lübeck-Helsinki	0,25	1.980	1.177	1.250	
Rostock-Hanko	0,86	1.320	421	1.142	
Rostock-Helsinki	0,43	1.500	340	n.a.	
Poland					
Copenhagen-Swinoujscie	0,7	540	128	480	
Copenhagen-Trelleborg-Gdansk	0,5	1.080	142	n.a	
Rønne-Swinoujscie	0,14	360	177	480	
Swinoujscie-Ystad	2	390-480	227	604	(freight) R
Gdynia-Karlskrona	1	630	278	n.a.	

Table 4.1: Key information for ferries, Summer 2002.
FF= fast ferry, HH = HH Line, TT= TT Line, Scand = Scandlines, n.a. = transport not available, no info = no information available

[9] One-way fare for a passenger car and 4 persons incl. cabin where applicable, 2002 prices
[10] One-way fare excl. VAT for a trailer/semi-trailer incl. handling charge where applicable, 2002 prices

Ferry lines in forecasts	Frequency departures /day		Travel time minutes		Pass. fare €[11]		Freight fare €[3]	
Forecast made in:	**1999**	**2002**	**1999**	**2002**	**1999**	**2002**	**1999**	**2002**
Denmark-Norway								
Skagen-Larvik FF	3	0	170	-	118	-	n.a.	-
Frederikshavn-Oslo	1	1	600-720	540	149	210	1.018	446
Frederikshavn-Larvik/Moss	1	2	375-780	300	262	210	no info	551
Hirtshals-Oslo	1	1	510-750	750	149	210	632	551
Hirtshals-Kristianssand	2	3-4	270-360	170-240	149	210	587	541
Hirtshals-Kristianssand FF	3	0	145	-	101	-	n.a.	-
Hanstholm-Egersund/B.	1	1	(435)[12]	990	(316)[4]	355	no info	940
Copenhagen-Oslo	1	1	960	960	454	631	803	no info
Germany-Norway								
Kiel-Oslo	1	1	1.140	1.140	no info	422	874	878
Denmark-Sweden								
Frederikshavn-Göteborg	3	5	180	210	76	111	520	380
Frederiksh. - Göteborg FF	6	2	105-120	120	81	128	n.a.	n.a.
Grenå-Varberg	2-3	3	240-330	270	84	111	553	396
Helsingør-Helsingborg HH	0	36	-	20	-	29	-	99
Helsingør-Helsingborg	45	55	20	20	27	31	136	116
Rønne-Ystad	2	2	150	150	72	120	31	270
Rønne-Ystad FF	0	3	-	80	-	85	-	n.a.
Øresundsbron	bridge	bridge	11	11	39	17-30	219	92
Germany-Denmark								
Rødby-Puttgarden Bridge	bridge	bridge	12	12	64	46	244	259
Gedser-Rostock	4	9	105[13]	120-145	66	82	328	259
Rønne-Sassnitz	1	0,7	210	210	230	151	335	348
Rønne-Mukran	0	1	-	210	-	151	-	348
Havneby-List	12	6	55	55	37	43	no info	161
Germany-Sweden								
Kiel-Göteborg	1	1	840	840	no info	418	612	540
Travemünde-Malmö	2	2	480	540	134	100	596	375
Travemünde-Göteborg	1	1	840	900	159	n.a.	no info	499
Travemünde-Trelleborg TT	4	2	430	450	124	189	596	n.a.
Travemünde-Trelleborg	0	2	-	480	-	n.a.	-	562
Rostock-Trelleborg TT	0	3	-	360	-	189	-	n.a.
Rostock-Trelleborg TT FF	7	4	165	180	108	189	913	n.a.
Rostock-Trelleborg Scand	0	3	-	360	-	115	-	464
Sassnitz-Trelleborg	2	5	225	225	81	88	320	348
Sassnitz-Trelleborg FF	7	0	120	-	87	-	320	-
Germany-Finland								
Lübeck-Helsinki	0.5	0,25	1.380-1.680	1.980	no info	1.177	1.481	1.250
Rostock-Hanko	0	0,86	-	1.320	-	421	-	1.142
Rostock-Helsinki	0	0,43	-	1.500	-	340	-	n.a.
Poland								
Copenhagen-Swinoujscie	1	0,7	540-600	540	130	128	385	480
Rønne-Swinoujscie	0	0,14	-	360	-	177	-	480
Swinoujscie-Ystad	0	2	-	390-480	-	227	-	604
Malmö-Swinoujscie	2,5	0	240-600	-	131-140	-	385	
Gdynia-Karlskrona	0	1	-	630	-	278	-	n.a.

Table 4.2: Comparison of ferry supply in the 1999 forecast for 2010 (2+4) with the 2002 forecast base case for 2015. Same abbreviations as table 4.1

[11] in 2002 prices; Pass. fare = car plus passengers, Freight fare = trailer/semi-trailer
[12] only to Egersund
[13] to Warnemünde

	Frequency departures /day		Travel time minutes	
Forecast made in:	**1999**	**2002**	**1999**	**2002**
	sum		average	
Denmark-Norway	13,0	9,5	364	480
Germany-Norway	1,0	1,0	1.140	1.140
Denmark-Sweden	58,5	106,0	53	42
Germany-Denmark	17,0	16,7	76	112
Germany-Sweden	24,0	23,0	284	378
Germany-Finland	0,5	1,5	1.530	1.477
Denmark/Sweden-Poland	3,5	3,8	463	502
Total/average	**117,5**	**161,6**	**165**	**154**

Table 4.3: Summary of ferry supply in the 1999 forecast and the 2002 forecast based upon table 4.2.

The main differences between the ferry supply assumed for the Denmark-Sweden lines in the forecasts made in 2002 as compared to the 1999 forecasts are that the 2002 forecasts take into account the existing ferry supply on the Helsingør – Helsingborg connections, which is considerably higher than assumed in the 1999 forecasts (91 daily departures instead of 45).

As far as the Germany – Sweden lines are concerned the main difference lies in the more intense use of fast ferries in the 1999 forecasts than in the 2002 forecasts. In the 1999 forecasts 14 fast ferry departures per day on two routes were expected as compared to only 4 departures on one route in the 2002 forecasts. The fast ferry departures in the 1999 forecast are mainly replaced by conventional ferries in the 2002 forecasts leading to a difference of only 1 departure per day but a 33% longer average travel time between the two forecasts.

The fares stated are list prices; many truck operators receive considerable discounts. Some of the ferry operators have communicated (confidentially) the magnitude of these discounts. Where the discount is known to the FTC they have been applied in the calculations.

Due to the differences between ferry routes and incomplete fare information it is not possible to present a correct summary of average fares. Looking at table 4.2, it appears that the fares for cars and passengers have increased (in real terms) at most of the ferries excluding the Denmark-Germany ferries. One reason for the increase is the elimination of duty-free sales on most of the ferries that forced the ferry operators to raise fares. On Rødby-Puttgarden, the passenger car fares have been reduced since the 1999 forecast while the lorry fares were raised. On Gedser-Rostock it is vice versa. The 2002 fares for Rødby-Puttgarden are used for the fixed link in 2015 (in real prices).

The fares for goods vehicles show an uneven development: some have increased while others have been reduced.

4.2.2 Basic Infrastructure Supply 2015

A fixed link is assumed between Rødbyhavn and Puttgarden consisting of a double-track railway and a four-lane motorway (2+4) for all forecasts for the year 2015.

The basic assumptions for the infrastructure supply on land in the study area (roads, railways and buses) and in air transport refer on the continent to the *Bezugsfall BVWP* and additional projects listed by the BMVBW as shown below.

North of the Baltic Sea the committed projects are assumed open by 2015. Both the Danish, Swedish and Norwegian infrastructure plans for roads and railways are under revision and new plans are expected to be published in 2003. The projects listed for the three countries are therefore mainly referring to existing plans.

The major differences between the 1999 forecasts and the 2002 forecasts as far as the Nordic countries are concerned are that the railway line Hamburg-Copenhagen is assumed to be improved to 160 km/h in the 2002 forecasts in stead of 200 km/h in the 1999 forecasts, leading to a longer travel time for the railway between Hamburg and Copenhagen in the 2002 forecasts compared with the 1999 forecasts.

On the continent, the road and rail infrastructure has been adjusted according to the *BVWP*. The following lists contain the *BVWP* projects to be implemented by 2015 with relevance to the Fehmarn Belt traffic. Of major differences as compared to the previous forecast it can be mentioned that the 'Transrapid' between Hamburg and Berlin has been taken off the plan. Instead, the present railway line is being upgraded to allow 230 km/h.

Basic Infrastructure Rail - Continent

Hamburg – Lübeck - Puttgarden
Double-track Hamburg-Rothenburgsort – Hamburg-Wandsbek 80 km/h
3 tracks Hamburg-Wandsbek – Ahrensburg 160 km/h
Double-track Hamburg – Lübeck – Puttgarden (except Fehmarnsund bridge), electrified 160 km/h

Lübeck/Hagenow Land – Stralsund
Reconstruction 160 km/h

Pinneberg – Elmshorn
Reconstruction Bahnhof Elmshorn

Hamburg – Büchen - Berlin
Reconstruction 230 km/h

Stelle – Lüneburg
3rd track

Hannover – Lehrte

Reconstruction

Basic Infrastracture Rail - Nordic Countries

Rødby – Copenhagen
Generally 2-track electrified with max. 160 km/h except for Guldborgsund and Storstrømmen

Ringsted – Copenhagen
Reconstruction to required capacity

Copenhagen – Stockholm (Södra Stambanan)
Reconstruction Malmö-Stockholm to 250 km/h
Malmö City tunnel

Sturup-Pendeln
Malmö C – Sturup Airport

Göteborg – Stockholm
Reconstruction to 250 km/h

Malmö – Göteborg (Västkustbanan)
Reconstruction to 200 km/h

Oslo – Göteborg
Introduction of tilting trains

Basic Infrastructure Road - Continent

A1 Oldenburg – Puttgarden
Widening 2 to 4 lanes

A20 North/west bypass Hamburg
Between Lübeck and A21

A21 Eastern bypass Hamburg
Widening B404/A21 to 4 lanes between A1 and A24

A20 Lübeck - Szeczin
Under construction

B96 Sassnitz - Berlin
Strelasund bridge, eastern bypass Stralsund

A241 Wismar – Schwerin
New construction

A71/73 (Halle/Leipzig -) Sangershausen - Erfurt - Schweinfurt/Bamberg
New construction

Basic Infrastructure Road – Nordic Countries

E47 Rødby – Copenhagen
Upgrading to minimum 4-lanes

E39 North of Aalborg
According to plans

Vejle – Herning
New construction 4 lanes

Ballerup – Frederikssund
New construction 4 lanes

Motorways around Copenhagen
Upgrading to 6/8 lanes, still low speed expected in rush hours

E6 Oslo – Göteborg – Malmö
Partial new construction of 4-lane motorway

E4 Helsingborg – Stockholm
Partial new construction of 4-lane motorway

For the road network there are no major differences in the Nordic countries between the 1999 and the 2002 forecasts.

Basic Infrastructure Bus

The *BVWP* assumes with regard to long distance bus traffic a status quo in 2015 compared to 1997. That means:

- no changes with regard to user cost levels both for charter buses and scheduled buses
- no change in the supply structure, that means in Germany, apart from some existing lines (Berlin), no development of a widespread intercity bus network as it is existing today in some European countries, for example in Sweden, Norway, Britain and Spain,
- international scheduled bus routes in Europe keep their modest role as low-cost border crossing public transport between major city pairs. In international travel charter bus traffic remains much more important than scheduled traffic.

These assumptions are in line with the 1999 FTC forecast. Apart from that the supply structures have not changed since the base year of the FTC-study for scheduled bus services (two daily services each for Copenhagen to Hamburg and Copenhagen to Berlin and weekly services to Prague, Vienna and Budapest).

Basic Infrastructure Air

With regard to infrastructure and airspace capacity no relevant restrictions are assumed in North-South traffic in the *BVWP*. Since the FTC base year forecasts (and even since the *BVWP* forecasts) were made some changes with regard to air supply have evolved, which – to a certain extent – are relevant to consider:

- The role of low-cost airlines on some relevant airports (Stockholm, Oslo-Torp, Malmö-Sturup, Lübeck, Berlin-Schönefeld). For these lines, fares are assumed 25 % lower than other lines.
- The Star Alliance, which on the one hand is concentrating the intercontinental traffic (away from Scandinavian airports) to Frankfurt/Main but on the other hand the distribution in Northern Europe (partly away from Hamburg and Stockholm) to Copenhagen-Kastrup.

Table 4.4 shows the expected number of daily flights between German and Danish/Scandinavian airports in the year 2000 and in the year 2015. The total number of connections is expected to increase by 60 %.

	2000										
	Denmark			Norway			Sweden				
German airports	Copen-hagen	Aalborg	Billund	Oslo	Bergen	Trond-heim	Stock-holm	Göte-borg	Malmö	Sunds-vall	Sum
Kiel	0	0	0	0	0	0	0	0	0	0	0
Hamburg	4	0	0	3	0	0	3	3	2	0	15
Bremen	2	0	0	0	0	0	0	0	0	0	2
Hannover	6	0	0	0	0	0	0	0	0	0	6
Frankfurt	8	0	3	5	0	0	6	4	0	0	26
Rostock	0	0	0	0	0	0	0	0	0	0	0
Berlin	6	0	0	1	0	0	2	0	0	0	9
Sum	**26**	**0**	**3**	**9**	**0**	**0**	**11**	**7**	**2**	**0**	**58**
	2015										
	Denmark			Norway			Sweden				
German airports	Copen-hagen	Aalborg	Billund	Oslo	Bergen	Trond-heim	Stock-holm	Göte-borg	Malmö	Sunds-vall	Sum
Kiel	2	0	0	0	0	0	1	0	0	0	3
Hamburg	4	1	1	3	1	1	4	2	0	0	17
Bremen	2	0	0	1	0	0	2	0	0	0	5
Hannover	6	0	1	2	0	0	2	1	0	0	12
Frankfurt	9	2	4	6	2	1	8	4	0	0	36
Rostock	2	0	0	0	0	0	2	0	0	0	4
Berlin	5	1	2	3	1	0	3	1	0	0	16
Sum	**30**	**4**	**8**	**15**	**4**	**2**	**22**	**8**	**0**	**0**	**93**

Table 4.4: Daily air connections between Germany and Denmark/Scandinavia (without low-cost flights). *BVWP* assumptions

For low-cost air connections the following list presents the assumptions used for 2015 as set up by *Intraplan*.

Relevant airports in Northern Europe:
Malmö Sturup (= Copenhagen II)
Stockholm Skavsta
Oslo Torp

Relevant airports on the Continent
Cologne
Hahn
Lübeck
Leipzig
Brussels Charleroi

Connections (1 per weekday)
Malmö – Cologne
Malmö – Hahn
Malmö – Brussels
Stockholm – Cologne
Stockholm – Hahn
Stockholm – Lübeck
Stockholm – Leipzig
Oslo – Cologne
Oslo – Hahn
Oslo – Brussels

Fares: 25 % lower price level than conventional flights

4.2.3 Economic and Demographic Data

A summary of the key variables is presented in table 4.5. For comparison with the 2010 Fehmarnbelt forecast the relevant figures are given, too.

Variable	2001	2010 Fehmarn Fore-cast	2010 *BVWP*	2015 *BVWP*/ Fehmarn Fore-cast[14]
Population (mill.)				
Germany	82.207	82.588	83.324	83.479
Denmark	5.357	5.497	5.364	5.363
Sweden	8.909	9.238	9.309	9.335
Norway	4.479	4.671	4.648	4.716
Finland	5.188	5.253	5.303	5.293
Employment (mill.)				
Germany	36.816	35.697	35.233	34.473

[14] Adjusted in Scandinavia according to latest national forecasts

Denmark	2.541	2.993	-	-
Sweden	4.239	4.396	-	-
Norway	2.278	2.337	-	-
Finland	2.367	2.559	-	-
GDP (1.000 mill.€, 2001 prices[15])				
Germany	1.929	n.a.	2.493	2.757
Denmark	183	204	211	233
Sweden	236	249	284	324
Norway	184	n.a.	242	258
Finland	136	n.a.	163	191
Car ownership (cars/1.000 inh.)				
Germany	540	572	583	597
Denmark	361	396	409	420
Sweden	442	461	514	546
Norway	418	421	458	486
Finland	416	482	469	498

Table 4.5: Basic demographic and economic assumptions. Where numbers are substituted by '-' the variable is not required for the forecast.

[15] Exchange rates of 2001

4.2.4 Transport Policy

The common transport policy assumptions used in the forecasts are shown in table 4.6. These assumptions refer to the *Bundesverkehrswegeplanung*.

Policy Items	**Base Case Assumptions**
Non-price subjects of transport policy	
Basically: Free choice of transport means will continue	yes
1 Rail Deregulation of market access - National / international transport (de jure) - Market power of national railways (de facto)	 yes / to limited extent little change
2 Bus (Stronger) Market entry of long distance operators	 no change
3 Air Anti-trust policy	 no change
Transport supply policy (other than infrastructure)	
All means of transport Decrease of border resistances	 -2 to -3 % p.a. (Western Europe)
1 Road (General) speed limits Parking search time (incl. walk time) Increase of capacity (due to technology)	 no change 0 to +7,5 min. (depending on type of region) +10 %
2 Rail freight Transport speed on the national network Reliability Decrease of border crossing times Combined transport	 Increase in Base Case A, no change in Base Case B Increase in Base Case A, no change in Base Case B Decrease in Base Case A, no change in Base Case B New site location concept in Base Case A, no change in Base Case B
3 Air Air space capacity restrictions	 no change
4 Intermodality Rail/Air Substitution of short-distance flight supply by train services, in connection with integration of services	 no change
5 Freight transport across Baltic Sea Increase in freight transport	 +76 % (+3,2 % p.a.)

Table 4.6: Overview of transport policy assumptions, Base Case A and B
Growth rates relate to the period 1997-2015; Base Case A and B are defined in section 5.1

As regards user transport costs, two sets of assumptions have been defined for Base Case A and B, respectively. These are shown in the next chapter.

5 BASE CASE FORECASTS

5.1 Transport Cost Variables

For the transport cost assumptions two different sets of basic assumptions have been applied in order to test the effects of (1) the *Bundesverkehrswegeplanung Integration* assumption with the changes about low-cost airlines (see 4.2.2) and (2) an extrapolation of the assumptions of the 1999 Fehmarn Belt forecasts including important changes. For rail freight, different assumptions are used for transport speed, reliability and combined transport (see table 4.6).

With these two sets of cost assumptions and the common assumptions presented in section 4.2 forecasts have been run for the year 2015, named Base Case A and Base Case B, respectively. The specific user costs assumptions are shown in sections 5.2.1 and 5.3.1, respectively.

It was decided to use Base Case A as the reference for the scenario tests.

5.2 Base Case A

The user costs assumptions are shown in table 5.2.1.

5.2.1 Transport User costs

Cost Item	Base Case Assumptions A
1 Car	
World crude oil price	+33 %
(No policy item, but relevant for fuel price)	
Mineral oil tax rates	+68 %
Total fuel price	+56 %
Specific fuel consumption	-26 %
Fuel costs (price * consumption)	**+15** %
Road user fees	
- Toll road fees	in some countries
- General mileage-related fees passenger cars	no charge/km but vignettes in some countries
User costs	**+15 %**
2 Lorry	
Total fuel price	+50 %
Specific fuel consumption	-9 %
Fuel costs (price * consumption)	+36 %
Truck highway toll in Germany	0,20 €/km
Truck highway toll in Denmark	0
Productivity	+18%
User costs	**-4 %**
3 Rail	
User costs passengers	**-30 %** in private long-distance traffic
User costs freight (productivity improvement and/or subsidies)	**-18 %**
4 Bus user costs	**no change**
5 Air	
Price impact of productivity (in general)	decrease
Price differentiations (Yield-Management-Systems)	more differentiation
Impacts of competition / alliances	increase
Landing / Take-off charges / Passenger handling charges	stronger increase
Implementation of kerosine tax	no change
Changes of international treaties that prevent kerosine taxation	no change
Implementation of VAT on international flights	yes
Implementation of VAT on international flights from Denmark	no
User costs	**9 %** (average) **25 % lower** on low-cost routes

Table 5.2.1: Overview user costs assumptions, Base Case A
Growth rates relate to the period 1997-2015, all cost items are in constant prices

5.2.2 Passenger Traffic

The following tables and graphs summarise the Base Case A forecast for 2015. Where figures are readily available, data for the base year of the traffic demand study (1996) and the 1999 forecast are presented for comparison. The 2001 data represent the results of the latest model calibration mentioned in section 4.1.2 and constitutes, therefore, the base year for the new forecasts.

Main mode	1.000 Passengers/year	Modal Split percent
Year 1996		
Rail	899	4,1%
Car	7.326	33,0%
Bus	2.945	13,3%
Air	7.504	33,8%
Walk-on	3.508	15,8%
Total	**22.182**	**100,0%**
Base Year 2001		
Rail	854	3,6%
Car	8.498	35,5%
Bus	2.739	11,4%
Air	9.905	41,4%
Walk-on	1.929	8,1%
Total	**23.925**	**100,0%**
1999 Forecast for 2010 (2+4)		
Rail	1.874	5,7%
Car	12.002	36,2%
Bus	3.619	10,9%
Air	12.905	38,9%
Walk-on	2.755	8,3%
Total	**33.155**	**100,0%**
Base Case A, 2015		
Rail	1.537	4,4%
Car	12.042	34,2%
Bus	2.973	8,4%
Air	16.823	47,7%
Walk-on	1.850	5,3%
Total	**35.225**	**100,0%**

Table 5.2.2: Total number of trips between Denmark/Scandinavia and the Continent by mode, Base Case A, 2015

Comparing the 1996 and 2001 figures that summarise observed traffic in the two years, it can be seen that the mode split has changed towards a larger share of car and, especially, of air travellers while the bus and mainly walk-on modes have lost shares.

The air traffic between Germany and Scandinavia has exploded between 1996 and 2001. This is partly due to transfer traffic (Star Alliance using Frankfurt, Copenhagen, Munich as hubs), but the growth of air traffic is considerable also for point-to-point-traffic between Scandinavia and Germany. Additionally, low-cost flights between some continental airports and the major cities in Scandinavia will even increase air traffic (tendencies can be seen from 2001 on).

The substantial growth of car traffic between the years 1996 and 2001 is due to higher motorisation and GDP. The number of car trips will increase to 2015 but it can barely keep its share of the total.
For comparison, the 1999 forecast is shown, too.

In the 1999 forecast high-speed train service (200 km/h) was assumed across the Fehmarn Belt link with extensions to Stockholm, Oslo and to major continental centres. The new base cases assume a maximum of 160 km/h and the necessity to change trains in Hamburg, which affects the forecast of train passengers.

Bus traffic has declined considerably between 1996 and 2001. In 1999, we had expected that a portion of walk-on passengers (border crossing shoppers) would use bus services. We do not see this being likely any more.

Figure 5.2.1 gives an overview of the main factors responsible for the forecast results including for the traffic growth between the base year and the forecast year. It illustrates the different model steps and their contributions to the forecast results (absolute changes in million passenger trips/year). Most of the individual contributions are small with the economic growth as the most significant growth generator for the overall traffic development, especially for air traffic. Another important factor is the EU integration and, for car and rail traffic, the supply changes by the fixed link project itself. This leads to modal split changes and induced traffic. The illustration is representative of all the new forecasts, therefore, it is only shown here.

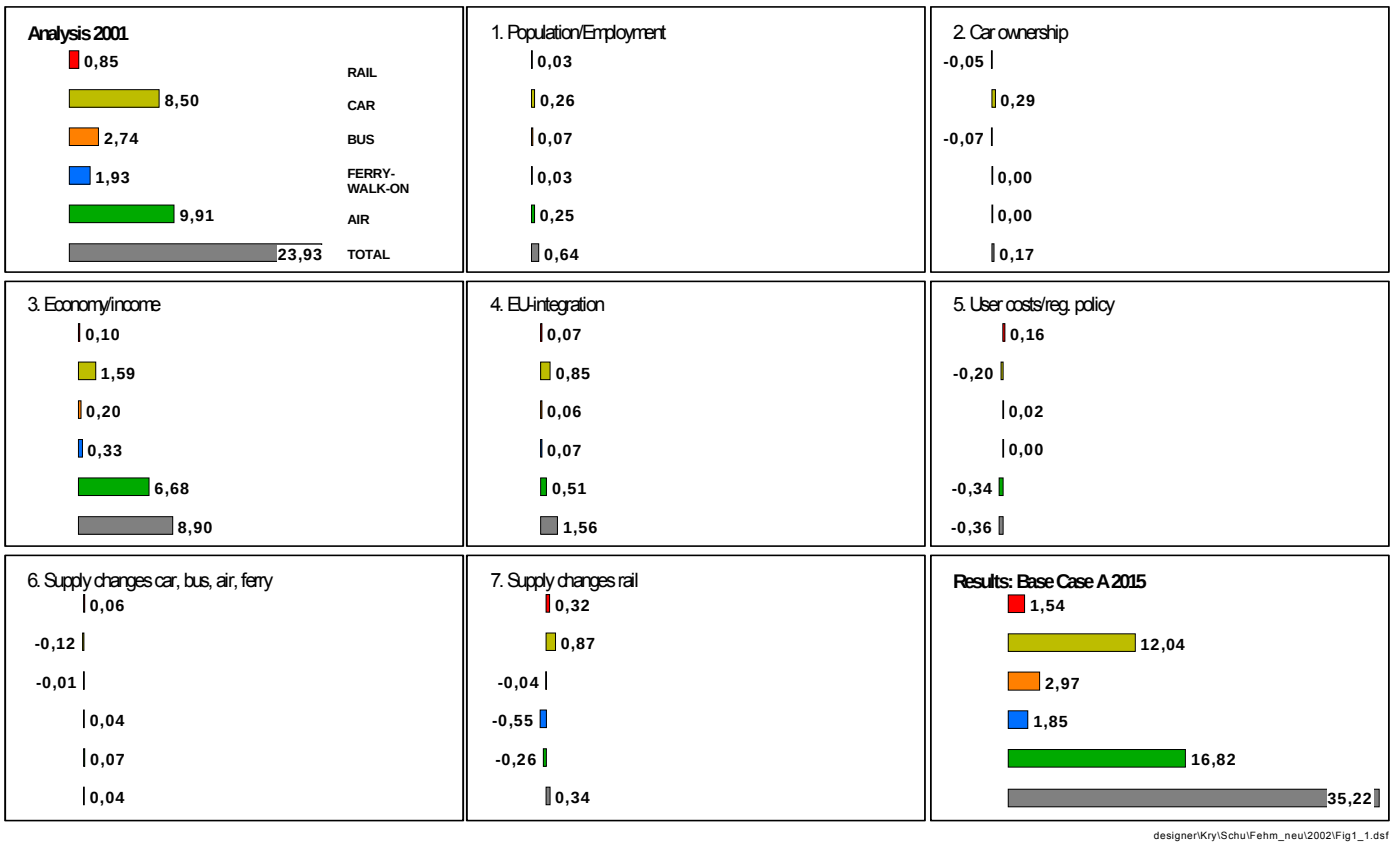

Figure 5.2.1: Contribution of the different model steps for Base Case A, 2015, total number of passenger trip (millions) between Denmark/Scandinavia and the continent

Trip Purpose	Base year 2001		Base Case A	
1.000 passengers/year	abs.	percent	abs.	percent
commuter work	16	0,1%	109	0,3%
shopping	348	1,5%	347	1,0%
business	5.991	25,0%	8.371	23,8%
holidays (>8 days)	9.420	39,4%	12.736	36,2%
day excursion	780	3,3%	1.472	4,2%
short holiday (≤8 days)	3.540	14,8%	5.647	16,0%
visit friend/relatives	2.699	11,3%	5.238	14,9%
weekend commuting	700	2,9%	966	2,7%
ferry excursion	431	1,8%	339	1,0%
Total	**23.925**	**100,0%**	**35.225**	**100,0%**

Table 5.2.3: Purpose distribution for passenger trips, Base Case A, 2015

The relative distribution by trip purpose shows moderate changes with slight increases in day excursions, short holidays and private visits.

1.000 passenger trips/year		Mode					
between:	and:	Rail	Car	Air[1]	Bus	Walk-on	Total
Germany	E.Denmark[2]	747	4.512	1.207	1.363	660	8.489
Germany	Sweden	348	3.166	2.102	660	755	7.031
Germany	Norway	15	1.007	1.103	151	31	2.307
Germany	Finland	4	225	520	28	69	846
W.Europe[3]	E.Denmark[2]	198	573	3.685	151	0	4.607
W.Europe[3]	Sweden	88	990	4.014	271	0	5.363
W.Europe[3]	Norway	5	521	1.674	70	0	2.270
W.Europe[3]	Finland	1	99	975	18	0	1.093
E.Europe[4]	E.Denmark[2]	48	158	564	54	56	880
E.Europe[4]	Sweden	75	592	644	152	279	1.742
E.Europe[4]	Norway	7	133	189	45	0	374
E.Europe[4]	Finland	1	66	146	10	0	223
Germany total		1.114	8.910	4.932	2.202	2.202	18.673
W. Europe total		292	2.183	10.348	510	510	13.333
E. Europe total		131	949	1.543	261	261	3.219
East Denmark[2] total		993	5.243	5.456	1.568	1.568	13.976
Sweden total		511	4.748	6.760	1.083	1.083	14.136
Norway total		27	1.661	2.966	266	266	4.951
Finland total		6	390	1.641	56	56	2.162
Total		**1.537**	**12.042**	**16.823**	**2.973**	**2.973**	**35.225**

Table 5.2.4: Aggregated passenger flows, Base Case A, 2015, two way totals, trips/year

[1] Traffic to and from Copenhagen, Oslo and Stockholm airports only. [2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Table 5.2.4 shows the aggregated O/D flows for the Base Case A. The Denmark (east of the Great Belt) and Sweden traffic to and from the continent is almost equal in size, they account for approximately 40 percent each of the total traffic across the Baltic Sea.

The next table presents the Fehmarn Belt traffic for Base Case A compared with the observed traffic in 2001. The largest change is expected in rail passengers that increase their share by 50 percent.

1.000 passengers/year	Base Year 2001 abs.	Base Year 2001 percent	Base Case A, 2015 abs.	Base Case A, 2015 percent	Change percent change
Rail passengers	352	5,5%	1.497	15,3%	124,4%
Car passengers	4.058	63,6%	6.598	67,7%	62,6%
Bus passengers	1.248	19,6%	1.658	17,0%	32,9%
Walk-on pass.	718	11,3%	0	0,0%	-100,0%
1.000 passengers/year	**6.376**	**100,0%**	**9.753**	**100,0%**	**45,8%**
Passengers/day	**17.468**		**26.721**		
Cars/day	3.718		7.496		101,6%
Buses/day	88		129		46,9%

Table 5.2.5 Fehmarn Belt traffic, Base Case A, 2015

Traffic/year	1.000 Passengers Total	1.000 Passengers Rail pass.	1.000 Cars	Percent Of cars
Base Year 2001				
Norway/Sweden-Jylland	873	-	244	9,5%
Oslo/Göteborg-Germany	1.056	-	175	6,8%
Fehmarn Belt	6.376	352	1.357	52,9%
Other Denmark-Germany	1.172	-	195	7,6%
Finland/Sweden-Germany	2.175	73	396	15,4%
Denmark/Sweden-Poland	863	-	198	7,7%
Total	**12.515**	**425**	**2.565**	**100,0%**
1999 Forecast 2010 (2+4)				
Norway/Sweden-Jylland	1.314	-	386	8,8%
Oslo/Göteborg-Germany	1.516	-	283	6,5%
Fehmarn Belt	10.362	1.835	2.268	51,8%
Other Denmark-Germany	2.684	-	522	11,9%
Finland/Sweden-Germany	2.918	0	771	17,6%
Denmark/Sweden-Poland	649	-	149	3,4%
Total	**19.443**	**1.835**	**4.379**	**100,0%**
Base Case A, 2015				
Norway/Sweden-Jylland	980	-	301	6,8%
Oslo/Göteborg-Germany	1.181	-	213	4,8%
Fehmarn Belt	9.753	1.497	2.736	61,7%
Other Denmark-Germany	1.867	18	278	6,2%
Finland/Sweden-Germany	2.598	22	640	14,4%
Denmark/Sweden-Poland	1.181	-	271	6,1%
Total	**17.560**	**1.537**	**4.439**	**100,0%**

Table 5.2.6: No. of passengers and cars by ferry corridors, Base Case A, 2015[16], traffic/year

[16] The total number of trips in table 5.2.6 does not exactly match the total passenger flows according to table 5.2.4 because 5.2.4 includes trips using the land border between Germany and Denmark. This applies to all similar tabulations of forecast results in this report

In table 5.2.6 the number of passengers crossing the Baltic Sea by surface transport is summarised for the base year 2001, the 1999 forecast and the Base Case A.

Air traffic has the highest growth in Base Case A (table 5.2.2). As a consequence, the share of car, bus and rail passengers is smaller in this forecast than in the 1999 forecast. Another reason for the lower number of rail passengers is that the new forecast does not assume high-speed rail service as the 1999 forecast does.

As the ferry supply between Sweden and Germany and between Denmark and Germany apart from the Fehmarn Belt has been reduced since 1999 the Fehmarn Belt gets a higher share of the total car traffic than previously. This, together with the latest trend of lower car utilisation, yields a considerably larger forecast of cars over the Fehmarn Belt than in the 1999 forecast.

The resulting numbers of rail passengers and cars are illustrated in figures 5.2.2 and 5.2.3.

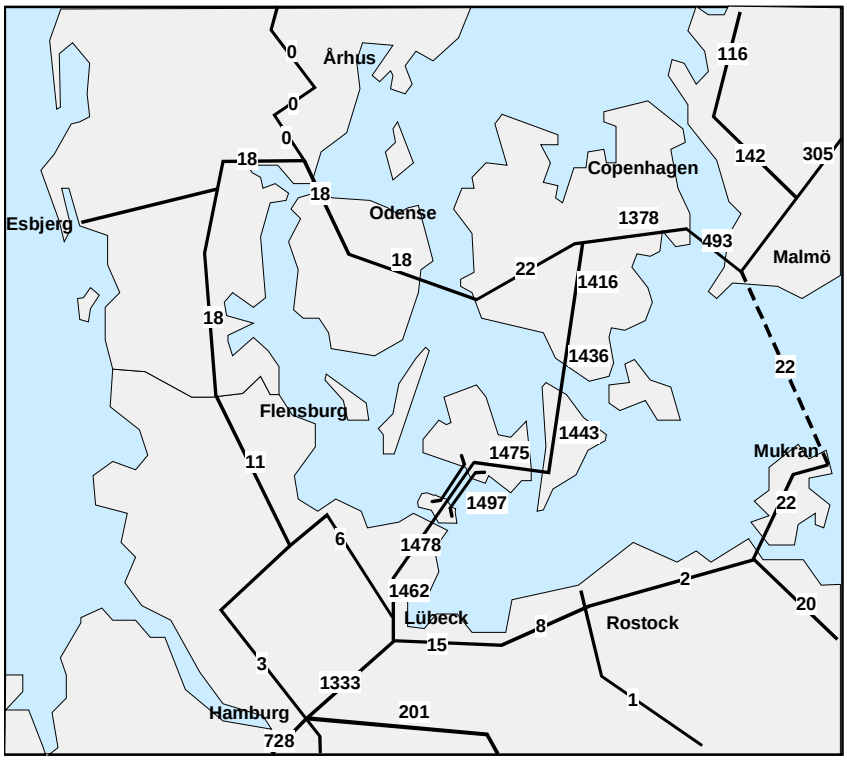

Figure 5.2.2: Number of passengers on major links of the railway system, Base Case A, 1.000 passengers/year

The relative distribution of passengers over the railway network remains approximately constant throughout the scenario forecasts presented in Chapter 6 even if the number of passengers crossing the Fehmarn Belt varies slightly. Therefore, this diagram (figure 5.2.2) is representative for the four scenarios.

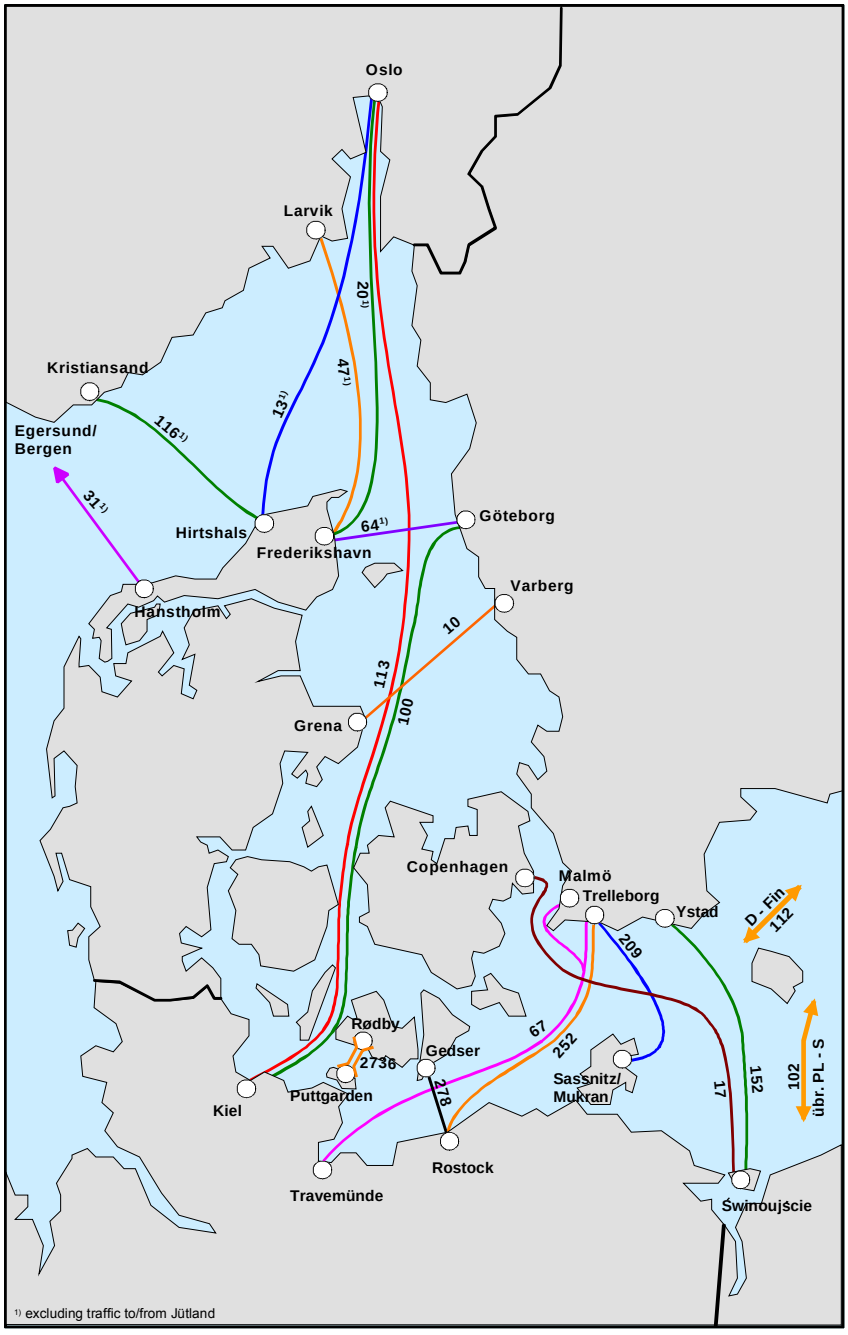

Figure 5.2.3: Number of passenger cars by ferry line, Base Case A, 2015, 1.000 cars /year

5.2.3 Freight Traffic

In this section, the results of the freight forecast, Base Case A, are presented.

The total freight flows by road and rail between Denmark/Scandinavia and the continent are presented in table 5.2.7. The average growth rate between 2001 and 2015 is 3,2 % p.a. as in the BVWP forecast, which may be compared to the 3,5 % p.a. in the 1999 forecast.

Looking at the commodity distribution it is evident that especially the groups foodstuff and fodder, transport equipment and other manufactured articles are increasing in quantities while mostly bulk goods are becoming less important. This follows the trends experienced world-wide.

	Commodity Group 1.000 t Freight/year	**Year 1994**	**Base Year 2001**	**1999 Forecast 2010 (2+4)**	**Base Case A 2015**
0	Cereals, fruits + vegetables	1.110	1.004	1.630	1.382
1	Foodstuff + animal fodder	1.444	2.266	2.075	3.081
2	Wood + cork, textiles	2.707	2.759	5.254	4.840
3	Fuels	206	126	259	121
4	Ore, metals	3.316	3.980	5.043	5.013
5	Building materials	631	654	1.006	735
6	Fertilizers + chemicals	3.280	3.195	5.808	4.550
7	Transport equipment + machinery	1.838	3.580	3.386	5.360
8	Other manufactured articles	5.639	8.404	10.195	14.240
9	Paper pulp + waste paper	1.104	759	1.886	1.344
10	Miscellaneous articles	3.269	2.884	6.137	5.257
	Total	**24.544**	**29.611**	**42.679**	**45.923**

Table 5.2.7: Total freight between Denmark/Scandinavia and the Continent by commodity group. Base Case A, 2015, 1.000 tons/year

Table 5.2.8 shows the modal distribution of all freight (except sea freight) for the years 1994 (base year of the 1999 forecasts), 2001 (base year of the new forecasts), 2010 (1999 forecast alternative 2+4) and the Base Case A forecast for 2015.

In the period 1994-2001 rail transport has lost a large share of the total transport in tons. Because of different average loading weights the number of rail wagons cannot be compared directly.

For road transport, the average load per lorry has increased in the same period, which leads to the fact that more freight is carried by fewer lorries in the new forecast. This development, which is found in the statistical records for recent years (that are more accurate than the 1994 statistics, compare section 4.1.2), is mainly relevant for long-distance shipments where a high utilisation of the lorry capacity is a must in a situation with high competition between forwarders.

In the 1999 forecast great improvements were assumed in rail freight transport that would let the rail regain its share of the total. The same is forecasted with the base case scenario A that assumes significant improvements in freight train speed, precision and freight fares as compared to today. Similarly, for road transport, increased effectivity is assumed.

Mode Tons or vehicles/year	1.000 t	1.000 Vehicles	Vehicles percent
Year 1994			
Road	16.276	1.383	78,0%
Rail conventional	6.568	283	16,0%
Rail combined	1.700	106	6,0%
Total	**24.544**	**1.772**	**100,0%**
Base Year 2001			
Road	23.034	1.502	79,9%
Rail conventional	5.579	277	14,7%
Rail combined	999	102	5,4%
Total	**29.612**	**1.881**	**100,0%**
1999 Forecast 2010 (2+4)			
Road	28.007	2.461	78,0%
Rail conventional	11.643	509	16,1%
Rail combined	3.029	184	5,8%
Total	**42.679**	**3.154**	**100,0%**
Base Case A, 2015			
Road	31.315	2.155	72,0%
Rail conventional	12.587	645	21,5%
Rail combined	2.021	194	6,5%
Total	**45.923**	**2.994**	**100,0%**

Table 5.2.8: Total freight flows between Denmark/Scandinavia and the continent by mode, Base Case A, 2015, 1.000 tons or vehicles/year

1.000 t freight/year		Mode			
between:	and:	Road	Rail conv.	Rail comb.	Total
Germany	E. Denmark[2]	1.795	845	239	2.878
Germany	Sweden	9.762	5.733	247	15.742
Germany	Norway	2.224	460	145	2.829
Germany	Finland	2.206	17	18	2.241
W. Europe[3]	E. Denmark[2]	2.786	332	1.175	4.292
W. Europe[3]	Sweden	7.944	4.245	194	12.383
W. Europe[3]	Norway	1.809	294	2	2.105
W. Europe[3]	Finland	334	1	1	336
E. Europe[4]	E. Denmark[2]	400	143	1	543
E. Europe[4]	Sweden	1.727	451	1	2.179
E. Europe[4]	Norway	274	68	0	342
E. Europe[4]	Finland	53	0	0	53
Germany total		15.987	7.055	649	23.690
W. Europe[3] total		12.873	4.872	1.372	19.116
E. Europe[4] total		2.454	662	2	3.117
East Denmark[2] total		4.981	1.320	1.415	7.713
Sweden total		19.433	10.429	442	30.304
Norway total		4.307	822	147	5.276
Finland total		2.593	18	19	2.630
Total		**31.315**	**12.587**	**2.021**	**45.923**

Table 5.2.9: Freight flows by region, Base Case Scenario A, 2015.

[2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

In table 5.2.9 the geographical relations of the transport flows are summarised. It shows that Sweden is by far the greatest sender/receiver of freight across the Baltic Sea. Eastern Denmark is no. 2 followed by Norway.

Table 5.2.10 summarises by mode the freight using the Fehmarn Belt. Road transport increases by 50 percent from 2001 to 2015 in Base Case A whereas rail freight grows by 140 percent.

	2001		2015 Base Forecast A		Percent change	
Mode	**freight**	**1.000**	**freight**	**1.000**	**freight**	**vehicles**
	1.000 t	vehicles	1.000 t	vehicles	%	%
Road	4.434	274	6.426	413	44,9%	50,7%
Rail	4.447*	255*	10.843	610	143,8%	139,2%
Total	**8.881**	**529**	**17.269**	**1.023**	**94,4%**	**93,4%**

* These transports are routed via the Great Belt

Table 5.2.10: Fehmarn Belt freight transport, Base Case A, 2015, 1.000 tons or vehicles/year

	1.000 t			1.000 Lorries	No. of Trains
	Road	**Rail**	**Total**		
Annual traffic	Base Year 2001				
Norway/Sweden-Jylland	1.496	-	1.496	81	-
Oslo/Göteborg-Germany	2.258	-	2.258	140	-
Fehmarn Belt	4.434	-	4.434	274	-
Other Denmark-Germany	995	-	995	62	-
Finland/Sweden-Germany	10.901	2.131	13.032	626	3.361
Denmark/Sweden-Poland	1.686	-	1.686	104	-
Total	**22.205**	**2.131**	**24.336**	**1.487**	**3.361**
	1999 Forecast 2010 (2+4)				
Norway/Sweden-Jylland	1.686	-	1.686	146	-
Oslo/Göteborg-Germany	1.572	-	1.572	138	-
Fehmarn Belt	5.553	10.773	16.326	481	16.258
Other Denmark-Germany	548	-	548	48	-
Finland/Sweden-Germany	14.870	3.899	18.769	1.325	4.960
Denmark/Sweden-Poland	1.744	-	1.744	151	-
Total	**30.724**	**14.799**	**45.523**	**2.289**	**21.218**
	Base Case A, 2015				
Norway/Sweden-Jylland	1.958	-	1.958	113	-
Oslo/Göteborg-Germany	2.909	-	2.909	192	-
Fehmarn Belt	6.426	10.843	17.269	413	20.346
Other Denmark-Germany	1.324	-	1.324	86	-
Finland/Sweden-Germany	16.162	3.765	19.927	1.175	5.940
Denmark/Sweden-Poland	2.366	-	2.366	153	-
Total	**31.145**	**14.608**	**45.753**	**2.143**	**26.286**

Table 5.2.11: t freight and vehicles by ferry corridors, Base Case A, 2015[17], annual traffic

[17] The total number of trips in table 5.2.6 does not exactly match the total passenger flows according to table 5.2.4 because 5.2.4 includes trips using the land border between Germany and Denmark

The distribution of freight traffic by ferry is summarised in table 5.2.11 and illustrated in figures 5.2.4 and 5.2.5. Compared to the 1999 forecast, road freight in 2015 is only slighty larger in 2015 (+1,4 %) whilst the number of lorries is significantly reduced (-6,4 %) due to the more effective road haulage system assumed in Base Case A. The rail transport volumes are nearly identical whilst the numbers of wagons and trains are greater because of reduced net weight of the freight trains.

Figure 5.2.4: Number of freight trains/year by ferry line, Base Case A, 2015

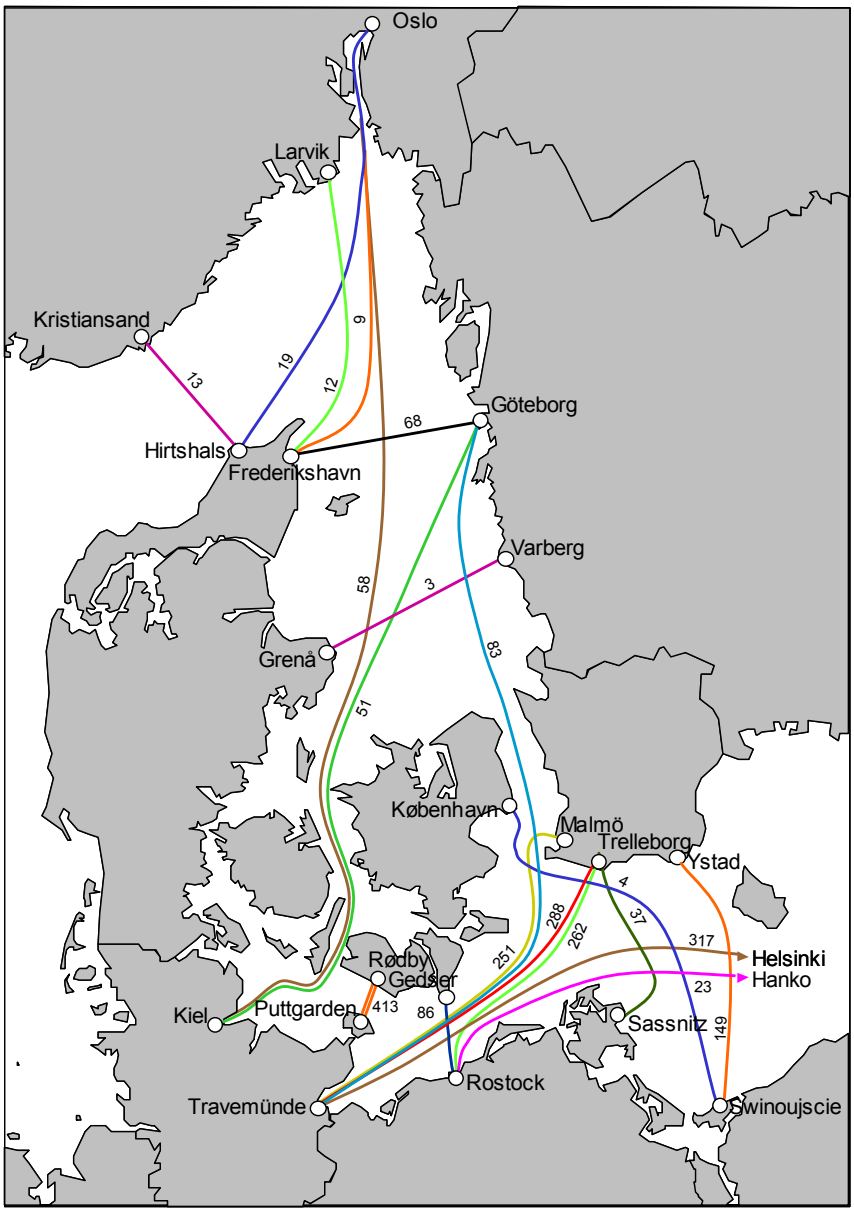

Figure 5.2.5: Number of lorries by ferry line, Base Case A, 2015, 1.000 lorries/year

5.3 Base Case B

Base Case B differs from A in the user costs assumptions. The assumptions chosen represent the values that were used with the 1999 forecasts in order to allow a comparison between the Base Case A assumptions, which in many respects represent a more environment-friendly transport policy, with the more conservative assumptions used with the previous forecasts.

5.3.1 Transport User costs

Cost Item	Base Case Assumptions B
User costs	
1 Car	
World crude oil price (no policy item, but relevant for fuel price)	0 %
Total fuel price	**+15 %**
Specific fuel consumption	-22%
Fuel costs (price * consumption)	**-10%**
Road user fees	
- Toll road fees	in some countries
- General mileage-related fees passenger cars	no charge/km but vignettes in some countries
User costs	**-10 %**
2 Lorry	
Total fuel price	+15 %
Specific fuel consumption	no change
Fuel costs (price * consumption)	
Truck highway toll in Germany	0,15 €/km
Truck highway toll in Denmark	0
Productivity	+14%
User costs	**-6 %**
3 Rail	
User costs passengers	**no change**
User costs freight	**no change**
4 Bus	
User costs	**no change**
5 Air	
User costs	**no change** **25 % lower** on low-cost routes

Table 5.3.1: Overview of transport user cost assumptions for Base Case B

All other assumptions except the assumptions for rail freight (table 4.6) are the same in Base Case A and B.

5.3.2 Passenger Traffic Base Case B

The following tables and graphs summarise the Base Case B forecast for 2015. In most cases, the Base Case A results are presented for comparison. In other cases, we refer to section 5.2.2.

Main mode 1.000 trips/year	1.000 Passengers/year	Modal split percent
Base Case A, 2015		
Rail	1.537	4,4%
Car	12.042	34,2%
Bus	2.973	8,4%
Air	16.823	47,8%
Walk-on	1.850	5,3%
Total	**35.225**	**100,0%**
Base Case B, 2015		
Rail	1.423	4,0%
Car	12.427	34,5%
Bus	2.938	8,2%
Air	17.361	48,2%
Walk-on	1.850	5,1%
Total	**35.999**	**100,0%**

Table 5.3.2: Total number of trips between Denmark/Scandinavia and the continent by mode, Base Case B, 2015, 1.000 trips/year

Base Case B with its lower car user costs and lower air fares than Base Case A will generate more car and air passengers, while the number of rail passengers will be smaller. There is little difference in bus and walk-on traffic. In total, there are 2 percent more passenger trips in Base Case B than in Base Case A due to the generally lower user costs, and, as can be seen in table 5.3.3, these generate more private trips than business trips.

Trip Purpose	1.000 passengers/year			
	Base Case A		Base Case B	
	abs.	percent	abs.	percent
commuter work	109	0,3%	109	0,3%
shopping	347	1,0%	353	1,0%
business	8.371	23,8%	8.415	23,4%
holidays (>8 days)	12.736	36,2%	12.950	36,0%
day excursion	1.472	4,2%	1.551	4,3%
short holiday (≤8 days)	5.647	16,0%	5.838	16,2%
visit friend/relatives	5.238	14,9%	5.454	15,2%
weekend commuting	966	2,7%	990	2,8%
ferry excursion	339	1,0%	339	0,9%
Total	**35.225**	**100,0%**	**35.999**	**100,0%**

Table 5.3.3: Purpose distribution for passenger trips, Base Case B, 2015, 1.000 passenger trips/year

1,000 passenger trips		Mode					
between:	and:	Rail	Car	Air[1]	Bus	Walk-on	Total
Germany	E.Denmark[2]	710	4.706	1.271	1.344	660	8.691
Germany	Sweden	324	3.260	2.191	653	755	7.183
Germany	Norway	9	1.023	1.144	151	31	2.358
Germany	Finland	2	230	540	28	69	869
W.Europe[3]	E.Denmark[2]	187	582	3.777	150	0	4.696
W.Europe[3]	Sweden	75	1.005	4.115	269	0	5.464
W.Europe[3]	Norway	0	529	1.716	69	0	2.314
W.Europe[3]	Finland	1	100	995	18	0	1.112
E.Europe[4]	E.Denmark[2]	44	163	592	53	56	908
E.Europe[4]	Sweden	68	622	671	149	279	1.789
E.Europe[4]	Norway	5	138	197	44	0	384
E.Europe[4]	Finland	0	69	152	10	0	231
Germany total		1,045	9.219	5.146	2.176	1.515	19.101
W. Europe total		261	2.216	10.603	506	0	13.586
E. Europe total		117	992		256	335	3.312
East Denmark[2] total		941	5.451	5.640	1.547	716	14.295
Sweden total		467	4.887	6.977	1.071	1.034	14.436
Norway total		14	1.690	3.057	264	31	5.056
Finland total		1	399	1.687	56	69	2.212
Total		**1.423**	**12.427**	**17.361**	**2.938**	**1.850**	**35.999**

Table 5.3.4: Aggregated passenger flows, Base Case B, 2015, two way totals, 1.000 trips/year

[1] Traffic to and from Copenhagen, Oslo and Stockholm airports only. [2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Geographically, the relative distribution of passenger trips is very similar in Base Cases A and B (cf. tables 5.2.5 and 5.3.4).

	Base Case A, 2015		Base Case B, 2015		Difference
1.000 passengers/year	abs.	percent	abs.	percent	percent change
Rail passengers	1.497	15,3%	1.386	14,1%	-7,4%
Car passengers	6.598	67,7%	6.809	69,2%	3,2%
Bus passengers	1.658	17,0%	1.638	16,7%	-1,2%
Walk-on pass.	0	0,0%	0	0,0%	-
1.000 passengers/year	**9.753**	**100,0%**	**9.833**	**100,0%**	**0,8%**
Passengers/day	**26.721**		**26.940**		
Cars/day	7.496		7.786		3,9%
Buses/day	129		129		0,0%

Table 5.3.5: Fehmarn Belt traffic, Base Case B, 2015

The difference in overall modal split is reflected in the Fehmarn Belt traffic, table 5.3.5, and in Base Case B the number of cars across the Fehmarn Belt is almost 4 percent higher than in Base Case A.

Passengers or cars/year	1.000 Passengers Total	Rail Pass.	1.000 Cars	Cars %
	Base Case A, 2015			
Norway/Sweden-Jylland	980	-	301	6,8%
Oslo/Göteborg-Germany	1.181	-	213	4,8%
Fehmarn Belt	9.753	1.497	2.736	61,7%
Other Denmark-Germany	1.867	18	278	6,2%
Finland/Sweden-Germany	2.598	22	640	14,4%
Denmark/Sweden-Poland	1.181	-	271	6,1%
Total	**17.560**	**1.537**	**4.439**	**100,0%**
	Base Case B, 2015			
Norway/Sweden-Jylland	1.003	-	308	6,7%
Oslo/Göteborg-Germany	1.208	-	218	4,7%
Fehmarn Belt	9.833	1.386	2.842	61,9%
Other Denmark-Germany	1.915	16	287	6,3%
Finland/Sweden-Germany	2.684	21	661	14,4%
Denmark/Sweden-Poland	1.199	-	275	6,0%
Total	**17.842**	**1.423**	**4.591**	**100,0%**

Table 5.3.6: Number of passengers and cars by ferry corridors, Base Case B, 2015[18], 1.000 passengers or cars per year

The relative distribution of traffic by ferry corridors is almost the same for the two base cases.

[18] The total number ... according to table 5.2.4 because ... hark

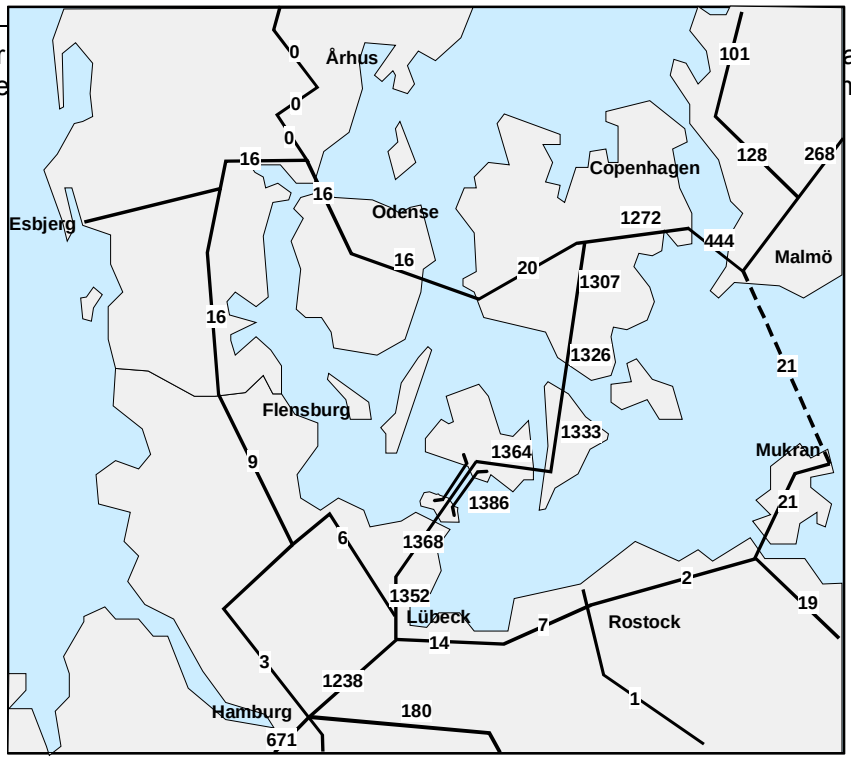

Figure 5.3.1: Number of passengers on major links of the railway system, Base Case B, 2015, 1.000 passengers/year

Figures 5.3.1 and 5.3.2 show the number of railway passengers on major links and the number of cars by ferry line.

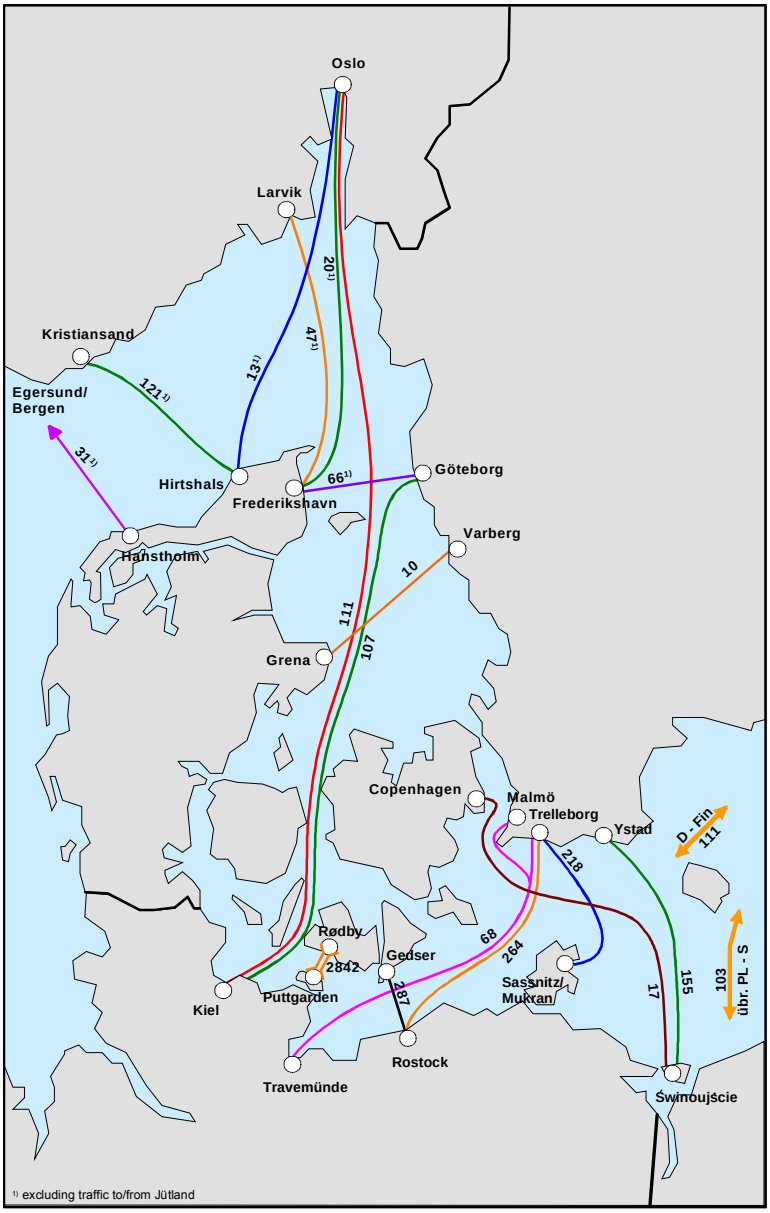

Figure 5.3.2: Number of passenger cars by ferry line, Base Case B, 2015, 1.000 cars/year

5.3.3 Freight Traffic

	1.000 t freight/year Commodity Group	Base Case A 2015	Base Case B 2015
0	Cereals, fruits + vegetables	1.382	1.382
1	Foodstuff + animal fodder	3.081	3.081
2	Wood + cork, textiles	4.840	4.840
3	Fuels	121	121
4	Ore, metals	5.013	5.013
5	Building materials	735	735
6	Fertilizers + chemicals	4.550	4.550
7	Transport equipment + machinery	5.360	5.360
8	Other manufactured articles	14.240	14.240
9	Paper pulp + waste paper	1.344	1.344
10	Miscellaneous articles	5.257	5.257
	Total	**45.923**	**45.923**

Table 5.3.7: Total freight between Denmark/Scandinavia and the continent by commodity group. Base Case B, 2015, 1.000 tons freight/year

In the Fehmarn Belt model, the forecast of total amount of freight does not depend upon the transport costs, therefore, the calculated freight by commodity group is exactly the same in the two base cases, table 5.3.7.

The modal split, on the other hand, is highly controlled by the transport costs as becomes clear in table 5.3.8: Base Case B has the most dominant amount of road traffic and a minor share of rail freight as compared to Base Case A.

Mode 1.000 tons or vehicles/year	1.000 t	1.000 Vehicles	Vehicles percent
Base Case A, 2015			
Road	31.315	2.155	72,0%
Rail conventional	12.587	645	21,5%
Rail combined	2.021	194	6,5%
Total	**45.923**	**2.994**	**100,0%**
Base Case B, 2015			
Road	35.381	2.348	78,8%
Rail conventional	8.677	447	15,0%
Rail combined	1.865	183	6,1%
Total	**45.923**	**2.978**	**100,0%**

Table 5.3.8: Total freight flows between Denmark/Scandinavia and the continent by mode, Base Case B, 2015, 1.000 tons or vehicles/year

1.000 t freight/year		Mode			
between:	and:	Road	Rail conv.	Rail comb.	Total
Germany	E. Denmark[2]	1.903	771	205	2.878
Germany	Sweden	11.668	3.866	208	15.742
Germany	Norway	2.393	316	120	2.829
Germany	Finland	2.227	8	6	2.241
W. Europe[3]	E. Denmark[2]	2.952	196	1.144	4.292
W. Europe[3]	Sweden	9.286	2.915	182	12.383
W. Europe[3]	Norway	1.954	150	0	2.105
W. Europe[3]	Finland	336	0	0	336
E. Europe[4]	E. Denmark[2]	431	112	0	543
E. Europe[4]	Sweden	1.889	289	1	2.179
E. Europe[4]	Norway	289	53	0	342
E. Europe[4]	Finland	53	0	0	53
Germany total		18.191	4.961	539	23.690
W. Europe[3] total		14.528	3.261	1.326	19.116
E. Europe[4] total		2.662	454	1	3.117
East Denmark[2] total		5.286	1.079	1.349	7.713
Sweden total		22.843	7.070	391	30.304
Norway total		4.636	519	120	5.276
Finland total		2.616	8	6	2.630
Total		**35.381**	**8.677**	**1.865**	**45.923**

Table 5.3.9: Freight flows by region, Base Case Scenario B, 2015.
[2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

The geographical distribution of the total freight movements is the same as in Base Case A (due to the model structure) whereas the modal split varies considerably. In Base Case B relatively more freight is moved by road than in Base Case A.

The difference in modal split is evident in table 5.3.10 for the transport crossing the Fehmarn Belt. Road transport has a much higher share of the total in Base Case B than in Base Case A.

	Base Case A, 2015		Base Case B, 2015		Percent change	
Mode	**freight**	**1.000**	**freight**	**1.000**	**freight**	**vehicles**
	1.000 t	vehicles	1.000 t	vehicles	%	%
Road	6.426	413	7.206	452	12,1%	9,4%
Rail	10.843	610	7.983	469	-26,4%	-23,1%
Total	**17.269**	**1.023**	**15.189**	**921**	**-12,0%**	**-10,0%**

Table 5.3.10: Fehmarn Belt freight transport, Base Case B, 2015, 1.000 tons or vehicles/year

The distribution of freight traffic by ferry corridor is shown in table 5.3.11, and figures 5.3.3 and 5.3.4 indicate the load on each ferry line.

Annual traffic	1.000 t			1.000 Lorries	No. of Trains
	Road	Rail	Total		
	Base Case A, 2015				
Norway/Sweden-Jylland	1.958	-	1.958	113	-
Oslo-Göteborg-Germany	2.909	-	2.909	192	-
Fehmarn Belt	6.426	10.843	17.269	413	20.346
Other Denmark-Germany	1.324	-	1.324	86	-
Finland/Sweden-Germany	16.162	3765	19.927	1.175	5.940
Denmark/Sweden-Poland	2.366	-	2.366	153	-
Total	**31.145**	**14608**	**45.753**	**2.143**	**26.286**
	Base Case B, 2015				
Norway/Sweden-Jylland	2.243	-	2.243	136	-
Oslo/Göteborg-Germany	3.339	-	3.339	211	-
Fehmarn Belt	7.206	7.983	15.189	452	15.645
Other Denmark-Germany	1.484	-	1.484	93	-
Finland/Sweden-Germany	18.218	2.559	20.777	1.275	4.129
Denmark/Sweden-Poland	2.700	-	2.700	170	-
Total	**35.190**	**10.542**	**45.732**	**2.337**	**19.774**

Table 5.3.11: t freight and vehicles by ferry corridors, Base Case B, 2015[19], annual traffic

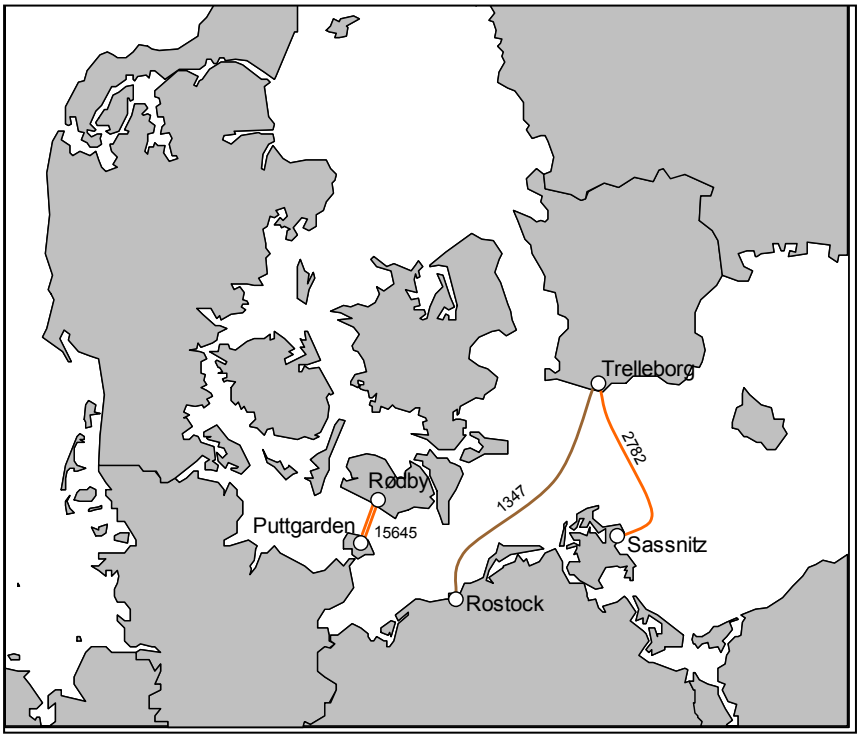

Figure 5.3.3: Number of freight trains/year, Base Case B, 2015

[19] The total number of trips in table 5.2.6 does not exactly match the total passenger flows according to table 5.2.4 because 5.2.4 includes trips using the land border between Germany and Denmark

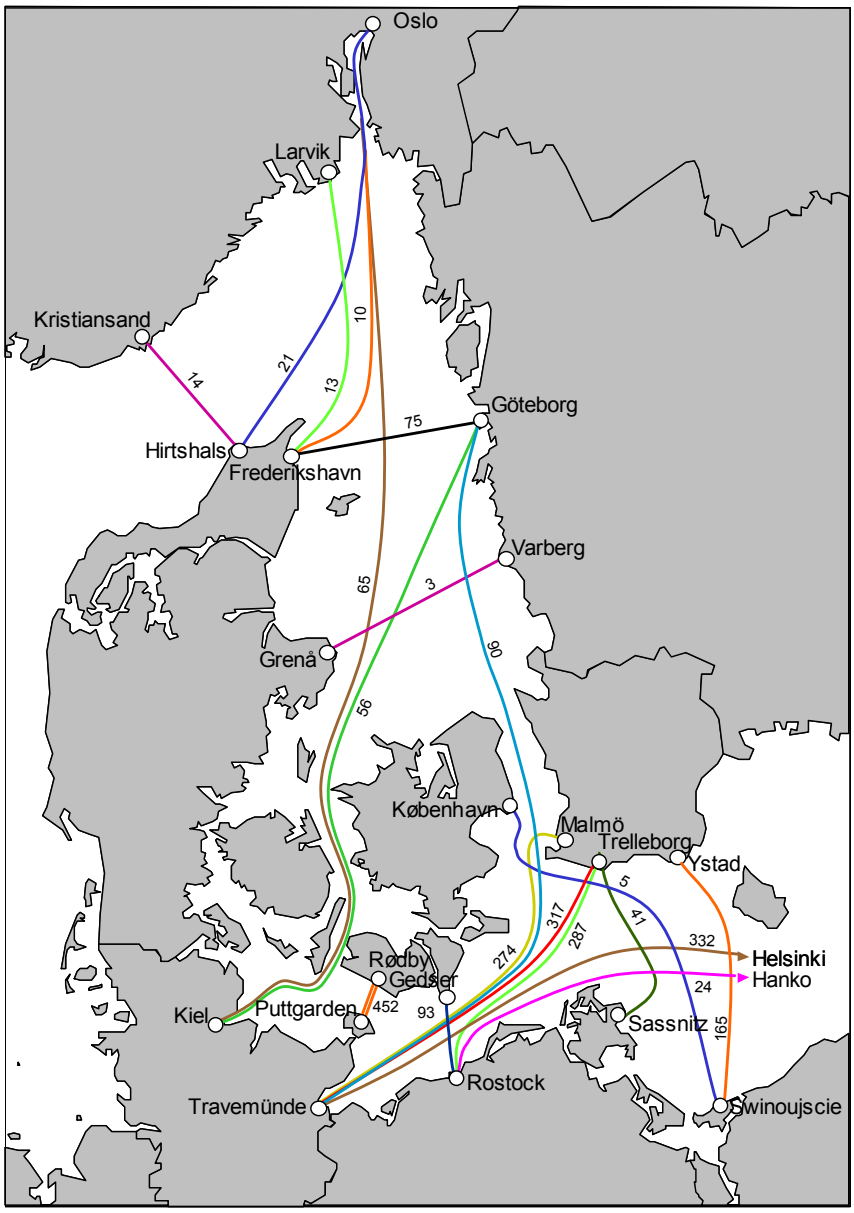

Figure 5.3.4: Number of lorries by ferry line, Base Case B, 2015, 1.000 lorries/year

5.4 Comparison of Base Cases A and B – Fehmarn Belt Traffic

In table 5.4.1 the different user costs and traffic operations assumptions are summarised for Base Case A and B.

The passenger train speed assumption refers to trains between the Copenhagen and Hamburg(Copenhagen-Rødby 160 km/h, Puttgarden-Hamburg 150 km/h). It is stated here for comparison with the 200 km/h assumption in the 1999 forecast.

	Base Case A	Base Case B
Road traffic:		
Car user costs	+15 %	-10 %
Lorry user costs	-4 %	-6 %
Bus user costs	No change	No change
Rail traffic:		
Rail pass. user costs	-30 % private long-dist.	No change
Rail freight user costs	-18 %	No change
Pass. train speed	max. 160 km/h	max. 160 km/h
Freight train operation	highly effective loading /unloading, short transfer times	No change
Air traffic:		
Air passenger costs	Average +9 % 25 % lower for low-cost routes	Average no change 25 % lower for low-cost routes

Table 5.4.1: Key variables for user costs and traffic operations for Base Case A and B

The main results for the calculated Fehmarn Belt traffic are shown in table 5.4.2.

Vehicles/day	Base Case A	Base Case B	Difference %
Cars	7.496	7.786	3,9%
Buses	129	129	0,0%
Lorries	1.131	1.238	9,4%
Road vehicles	8.756	9.153	4,5%
Rail Freight wagons	1.671	1.285	-23,1%
Total	**10.427**	**10.438**	**-0,1%**

Table 5.4.2: Fehmarn Belt traffic, Base Cases A and B, 1.000 vehicles/day

The greatest differences occur in freight traffic, especially in the number of rail freight wagons due to the lower road user costs assumed in Base Case B and the more effective train operation in Base Case A. The total number of road vehicles is a little higher in Base Case B as a consequence of the lower car user costs and higher rail passenger costs.

6 SCENARIO FORECASTS 2015

6.1 Introduction and Basic Assumptions

In order to test the sensitivity of the calculated traffic demand on the fixed link forecasts have been run for different scenarios. The four scenarios represent variations in the ferry service across the Baltic Sea – either increased or reduced ferry supply and fare levels varying by ±25 percent.

Regarding the common assumptions for ferry supply, infrastructure, economic and demographic data are used as shown in Section 4.2. For the transport policy and user costs assumption the Base Case A, as outlined in Section 5.2, has been chosen. In table 6.1.1 the scenarios are defined in principle.

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Fehmarn Bælt fixed link tolls	as ferry fares in 2002	as ferry fares in 2002	as ferry fares in 2002	as ferry fares in 2002
Ferry services	increased ferry services	increased ferry services	reduced ferry services	increased ferry services + ferry Rødby-Puttgarden
Ferry fares	as in 2002	-25 %	+25 %	-25 %
Øresund tolls and ferry fares[20]	as in 2002	+25 %	-25 %	+25 %

Table 6.1.1: Basic definition of scenarios
'Ferry services' regards the ferry connections across the Baltic Sea east of the Fehmarn Belt

The increased ferry services assumed in scenarios 1 and 2 define a situation with an improved ferry service on the north-south routes in order to test the sensitivity of the fixed link against increased ferry competition. In scenario 2 the Øresund ferry fares and the bridge tolls are increased making the Scandinavia-Continent route through Denmark even more expensive.

In contrast, Scenario 3 defines a situation with a reduced ferry service in order to test the sensitivity of the fixed link against reduced ferry competition.

Scenario 4 uses the same fare assumptions and ferry services as Scenario 2 with the exception that a ferry line parallel to the Fehmarn Belt fixed link is assumed in Scenario 4.

6.2 **Scenario 1:** improved ferry services, existing fares

6.2.1 Scenario Assumptions

In Scenario 1 it is assumed that an increased ferry service is established with the existing fares unchanged in real prices.

[20] Ferries between Helsingør and Helsingborg

The assumptions for the increased services are inspired by the Scandlines concept: “Via Mare Balticum” – also called “The Blue Motorways”. This concept first of all concentrates on new, bigger and faster vessels for the freight traffic (Ro/Ro and Lo/Lo) on the long routes in the Baltic Sea from Germany to the Eastern coast of Sweden, to Finland, Russia and the Baltic countries, partly assuming new harbours.

This Scandlines concept could not be the only one improving ferry supply and operations. Modern vessels with more efficient engines, and more effective port operations will speed up operations and contribute to higher frequencies.

As a consequence, the scenario assumes an increase in ferry frequency by about 25% and a reduction in sailing time of about 20% on all routes between Germany and Denmark (except Bornholm), the Swedish East Coast and all other countries in the Baltic Sea, as compared to the 2002 situation. The improved service speed only counts for conventional vessels and not for fast speed ships. The reduced travel times correspond to the service speeds of the new proposed vessels in “Via Mare Balticum”.

The proposed key figures for the increased ferry service are shown in table 6.2.1. All changes as compared to the base case are shown in **bold**.

The passenger traffic results are presented in section 6.2.2 and the freight results in 6.2.3.

Forecast assumptions **Scenario 1, 2015**	**Frequency** departures	**Travel time** minutes	**Pass.** €	**Freight** €	**Railway** R
Denmark-Norway					
Frederikshavn-Oslo	1	540	210	446	
Frederikshavn-Larvik/Moss	2	300	210	551	
Hirtshals-Oslo	1	750	210	551	
Hirtshals-Kristianssand	3-4	170-240	210	541	
Hanstholm-Egersund/Bergen	1	990	355	940	
Copenhagen-Oslo	1	960	631	no info	
Germany-Norway					
Kiel-Oslo	1	1.140	422	878	
Denmark-Sweden					
Frederikshavn-Göteborg	5	210	111	380	
Frederiksh. - Göteborg FF	2	120	128	n.a.	
Grenå-Varberg	3	270	111	396	
Helsingør-Helsingborg HH	36	20	29	99	
Helsingør-Helsingborg Scand	55	20	31	116	
Rønne-Ystad	2	150	120	270	
Rønne-Ystad FF	3	80	85	n.a.	
Øresundsbron	bridge	11	17-30	92	R
Germany-Denmark					
Rødby-Puttgarden bridge	bridge	12	46	259	R
Gedser-Rostock	**12**	**120**	82	259	
Rønne-Sassnitz	0,7	210	151	348	
Rønne-Mukran	1	210	151	348	
Havneby-List	6	55	43	161	
Germany-Sweden					
Kiel-Göteborg	1	840	418	540	
Travemünde-Malmö	**2,5**	**430**	100	375	
Travemünde-Göteborg	1	900	n.a.	562	
Travemünde-Trelleborg TT	**2,5**	**360**	189	n.a.	
Travemünde-Trelleborg Scand	**2,5**	**380**	n.a.	562	
Rostock-Trelleborg TT	**3,7**	**290**	189	n.a.	
Rostock-Trelleborg TT FF	**5**	180	189	n.a.	
Rostock-Trelleborg Scand	**3,7**	**290**	115	464	(freight) R
Sassnitz-Trelleborg	**5,2**	**180**	88	348	R
Germany-Finland					
Lübeck-Helsinki	**0,31**	**1.580**	1.177	1.250	
Rostock-Hanko	**1**	**1.060**	421	1.142	
Rostock-Helsinki	**0,55**	**1.200**	340	n.a.	
Poland					
Copenhagen-Swinoujscie	0,7	540	128	480	
Copenhagen-Trelleborg-Gdansk	0,5	1.080	142	n.a.	
Rønne-Swinoujscie	0,14	360	177	480	
Swinoujscie-Ystad	2	390-480	227	604	(freight) R
Gdynia-Karlskrona	1	630	278	n.a.	

Table 6.2.1: Key information for Scenario 1.
FF= fast ferry, HH = HH Line, TT= TT Line, Scand = Scandlines, n.a. = transport not available, no info = no information available

[21] One-way fare for a passenger car and 4 persons incl. cabin where applicable, 2002 prices
[22] One-way fare excl. VAT for a trailer incl. handling charge where applicable, 2002 prices

6.2.2 Passenger Traffic Scenario 1, 2015

Main mode	1.000 Passengers/year	Modal split percent
Base Case A, 2015		
Rail	1.537	4,4
Car	12.042	34,2
Bus	2.973	8,4
Air	16.823	47,8
Walk-on	1.850	5,3
Total	**35.225**	**100,0**
Scenario 1, 2015		
Rail	1.528	4,3
Car	12.066	34,2
Bus	2.973	8,4
Air	16.823	47,6
Walk-on	1.922	5,4
Total	**35.312**	**100,0**

Table 6.2.2: Total number of trips between Denmark/Scandinavia and the continent by mode, Scenario 1, 2015, 1.000 passenger trips/year

The total number of trips and the modal distribution of Scenario 1 are very close to the Base Case A figures. The same applies to the purpose distribution.

Trip Purpose	1.000 passengers/year			
1.000 passengers/year	Base Case A		Scenario 1	
	abs.	percent	abs.	percent
commuter work	109	0,3%	109	0,3%
shopping	347	1,0%	355	1,0%
business	8.371	23,8%	8.375	23,7%
holidays (>8 days)	12.736	36,2%	12.746	36,1%
day excursion	1.472	4,2%	1.486	4,2%
short holiday (≤8 days)	5.647	16,0%	5.668	16,1%
visit friend/relatives	5.238	14,9%	5.252	14,9%
weekend commuting	966	2,7%	971	2,7%
ferry excursion	339	1,0%	350	1,0%
Total	**35.225**	**100,0%**	**35.312**	**100,0%**

Table 6.2.3: Purpose distribution for passenger trips, Scenario 1, 2015, 1.000 passenger trips/year

1.000 passenger trips/year		Mode					
between:	and:	Rail	Car	Air[1]	Bus	Walk-on	Total
Germany	E.Denmark[2]	741	4.529	1.207	1.363	709	8.549
Germany	Sweden	345	3.173	2.102	660	777	7.057
Germany	Norway	15	1.007	1.103	151	31	2.307
Germany	Finland	4	225	520	28	70	847
W.Europe[3]	E.Denmark[2]	198	573	3.685	151	0	4.607
W.Europe[3]	Sweden	88	990	4.014	271	0	5.363
W.Europe[3]	Norway	5	521	1.674	70	0	2.270
W.Europe[3]	Finland	1	99	975	18	0	1.093
E.Europe[4]	E.Denmark[2]	48	158	564	54	56	880
E.Europe[4]	Sweden	75	592	644	152	279	1.742
E.Europe[4]	Norway	7	133	189	45	0	374
E.Europe[4]	Finland	1	66	146	10	0	223
Germany total		1.105	8.934	4.965	2.202	2.202	18.760
W. Europe total		292	2.183	10.348	510	510	13.333
E. Europe total		131	949	1.543	261	261	3.219
East Denmark[2] total		987	5.260	5.456	1.568	1.568	14.036
Sweden total		508	4.755	6.760	1.083	1.056	14.162
Norway total		27	1.661	2.966	266	31	4.951
Finland total		6	390	1.641	56	70	2.163
Total		**1.528**	**12.066**	**16.823**	**2.973**	**1.922**	**35.312**

Table 6.2.4: Aggregated passenger flows, Scenario 1, 2015, two way totals, 1.000 passengers/year

[1] Traffic to and from Copenhagen, Oslo and Stockholm airports only. [2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Except for a very small re-distribution of trips between Germany and Denmark and Sweden the trip matrix resembles closely the matrix for Base Case A (table 5.2.4).

	Base Case A		Scenario 1		Change
1.000 passengers/year	abs.	percent	abs.	percent	percent change
Rail passengers	1.497	15,3%	1.488	15,7%	-0,6%
Car passengers	6.598	67,7%	6.331	66,9%	-4,0%
Bus passengers	1.658	17,0%	1.641	17,3%	-1,0%
Walk-on pass.	0	0,0%	0	0,0%	-
1.000 passengers/year	**9.753**	**100,0%**	**9.460**	**100,0%**	**-3,0%**
Passengers/day	**26.721**		**26.740**		
Cars/day	7.496		7.197		-4,0%
Buses/day	129		129		0,0%

Table 6.2.5: Fehmarn Belt traffic, Scenario 1, 2015

The increased ferry services between Sweden and Germany show some effect in the Fehmarn Belt traffic and, consequently, the Sweden-Germany ferry corridor (tables 6.2.5 and 6.2.6). Also the 'other Denmark-Germany' ferry (Gedser-Rostock) is more attractive.

1.000 passengers/year and cars/year	1.000 Passengers		1.000	
	Total	Rail Pass.	Cars	Car percent
Base Case A, 2015				
Norway/Sweden-Jylland	980	-	301	6,8%
Oslo/Göteborg-Germany	1.181	-	213	4,8%
Fehmarn Belt	9.753	1.497	2.736	61,7%
Other Denmark-Germany	1.867	18	278	6,2%
Sweden*-Germany	2.598	22	640	14,4%
Denmark/Sweden-Poland	1.181	-	271	6,1%
Total	**17.560**	**1.537**	**4.439**	**100,0%**
Scenario 1, 2015				
Norway/Sweden-Jylland	972	-	298	6,7%
Oslo/Göteborg-Germany	1.179	-	212	4,8%
Fehmarn Belt	9.460	1.488	2.627	59,1%
Other Denmark-Germany	1.998	18	320	7,2%
Finland/Sweden-Germany	2.868	22	723	16,3%
Denmark/Sweden-Poland	1.173	-	268	6,0%
Total	**17.650**	**1.528**	**4.448**	**100,0%**

Table 6.2.6: Number of passengers and cars by ferry corridors, Scenario 1, 2015, 1.000 passengers and cars/year

The contribution of the different model steps to the resulting Fehmarn Belt traffic can be seen in table 6.2.7.

Model step 1.000 passengers/year	**Car passengers/ year**	**Bus passengers/ year**	**Rail passengers/ year**
Base Case A	6.598	1.658	1.497
Contribution from:			
Modal split change	9	0	-9
induced traffic	12	0	0
changed destination	3	0	0
from other routes	-291	-17	0
total contribution	-267	-17	-9
Scenario 1	**6.331**	**1.641**	**1.488**

Table 6.2.7: Contributions from different steps of the forecast, Scenario 1, 2015, 1.000 passengers/year

The table shows that most of the change in Fehmarn Belt traffic between Base Case A and Scenario 1 is caused by redistribution of trips between the Fehmarn Belt and other routes, in this case mainly Gedser-Rostock and the Sweden-Germany connections.

Figure 6.2.1 presents the number of cars with ferries for Scenario 1. As the forecast of railway passengers is hardly affected by the scenario assumptions the figure showing train passengers is not shown. Please refer to figure 5.1.2.

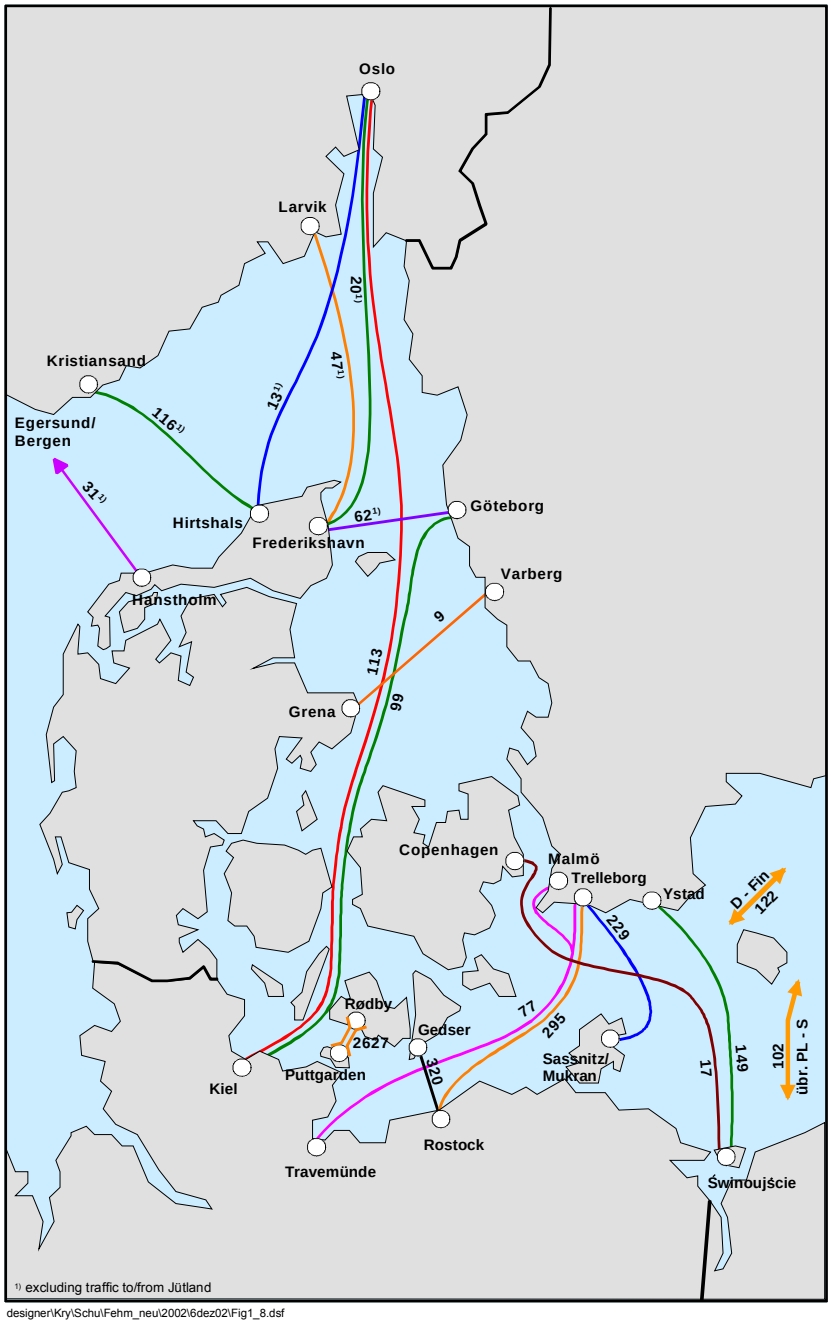

Figure 6.2.1: Number of passenger cars by ferry line, Scenario 1, 2015, 1.000 passengers/year

6.2.3 Freight Traffic Scenario 1, 2015

Compared to Base Case A, the total amount of freight between Denmark/ Scandinavia and the continent is unchanged including its distribution by commodity groups (table 5.2.7).

The modal split of all transport is presented in table 6.2.8. It shows a tiny shift towards road transport in Scenario 1

Mode 1.000 tons and vehicles/year	1.000 t	1.000 Vehicles	Vehicles %
Base Case A, 2015			
Road	31.315	2.155	72,0%
Rail conventional	12.587	645	21,5%
Rail combined	2.021	194	6,5%
Total	**45.923**	**2.994**	**100,0%**
Scenario 1, 2015			
Road	31.375	2.158	72,1%
Rail conventional	12.532	642	21,4%
Rail combined	2.016	194	6,5%
Total	**45.923**	**2.994**	**100,0%**

Table 6.2.8: Total freight flows between Denmark/Scandinavia and the continent by mode, Scenario 1, 2015, 1.000 tons and vehicles/year

1.000 t freight/year		Mode			
between:	and:	Road	Rail conv.	Rail comb.	Total
Germany	E.Denmark[2]	1.797	843	238	2.878
Germany	Sweden	9.789	5.706	246	15.742
Germany	Norway	2.225	459	144	2.829
Germany	Finland	2.209	16	16	2.241
W.Europe[3]	E.Denmark[2]	2.788	330	1.174	4.292
W.Europe[3]	Sweden	7.965	4.224	194	12.383
W.Europe[3]	Norway	1.811	293	1	2.105
W.Europe[3]	Finland	334	1	1	336
E.Europe[4]	E.Denmark[2]	400	142	1	543
E.Europe[4]	Sweden	1.729	449	1	2.179
E.Europe[4]	Norway	274	68	0	342
E.Europe[4]	Finland	53	0	0	53
Germany total		16.020	7.024	644	23.690
W. Europe total		12.898	4.848	1.370	19.116
E. Europe total		2.456	659	2	3.117
East Denmark[2] total		4.985	1.315	1.413	7.713
Sweden total		19.483	10.379	441	30.304
Norway total		4.310	820	145	5.276
Finland total		2.596	17	17	2.630
Total		**31.376**	**12.532**	**2.016**	**45.923**

Table 6.2.9: Freight flows by region, Scenario 1, 2015, 1.000 tons/year

[2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

The regional distribution of the total freight flows is the same as in Base Case A, only the distribution by mode has changed slightly.

Mode	Base Case A, 2015 freight 1.000 t	1.000 vehicles	Scenario 1, 2015 freight 1.000 t	1.000 vehicles	Percent change freight %	vehicles %
Road	6.426	413	6.070	390	-5,5%	-5,6%
Rail	10.843	610	10.412	589	-4,0%	-3,4%
Total	**17.269**	**1.023**	**16.482**	**979**	**-4,6%**	**-4,3%**

Table 6.2.10: Fehmarn Belt freight transport, Scenario 1, 2015, 1.000 tons and vehicles/year

The Fehmarn Belt attracts a few percent less freight traffic in Scenario 1 than in Base Case A, both for road and rail freight, table 6.2.10.

The distribution of freight traffic by ferry corridor is shown in table 6.2.11, and figures 6.2.2 and 6.2.3 indicate the load on each ferry line.

Annual traffic	1.000 t Road	Rail	Total	1.000 Lorries	No. of Trains
Base Case A, 2015					
Norway/Sweden-Jylland	1.958	-	1.958	124	-
Oslo/Göteborg-Germany	2.909	-	2.909	192	-
Fehmarn Belt	6.426	10.843	17.269	413	20.346
Other Denmark-Germany	1.324	-	1.324	86	-
Finland/Sweden-Germany	16.162	3.765	19.927	1.175	5.940
Denmark/Sweden-Poland	2.366	-	2.366	153	-
Total	**31.145**	**14.608**	**45.753**	**2.143**	**26.286**
Scenario 1, 2015					
Norway/Sweden-Jylland	1.849	-	1.849	115	-
Oslo/Göteborg-Germany	2.745	-	2.745	181	-
Fehmarn Belt	6.070	10.412	16.482	390	19.632
Other Denmark-Germany	1.417	-	1.417	91	-
Finland/Sweden-Germany	16.900	4.136	21.036	1.225	6.551
Denmark/Sweden-Poland	2.233	-	2.233	144	-
Total	**31.214**	**14.548**	**45.762**	**2.146**	**26.183**

Table 6.2.11: t freight and vehicles by ferry corridors, Scenario 1, 2015, annual traffic

The competing ferries (Other Denmark-Germany and Finland/Sweden-Germany) attract more freight traffic – both road and rail – than in Base Case A due to the improved service on these ferries in Scenario 1. The ferries across the Skagerrak and Kattegat loose some traffic, too.

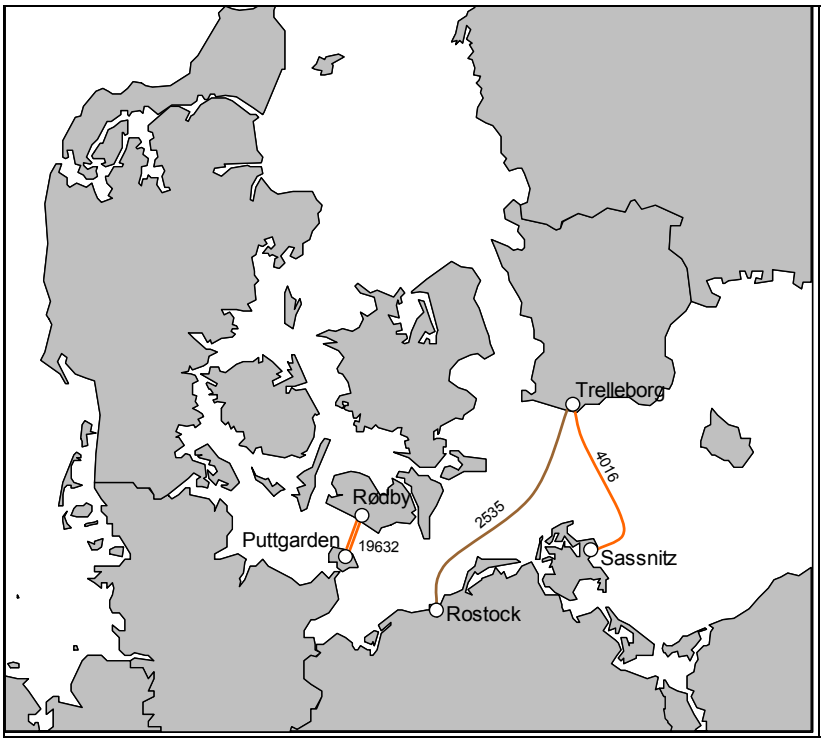

Figure 6.2.2: Number of freight trains/year, Scenario 1, 2015

The improved ferry service affects the road vehicles more than the freight trains. The number of trains is reduced by 100/year as compared to Base Case A with some shift from the Fehmarn Belt to the ferries calling on Trelleborg.

The shift of lorry traffic from the Fehmarn Belt towards the Baltic Sea ferries becomes clear when comparing figure 6.2.3 with figure 5.2.5.

6.2.4 Conclusion of Scenario 1

The only deviation in basic assumptions from Base Case A is that in Scenario 1, for the ferries between southern Sweden and Germany, between Finland and Germany and for the Gedser-Rostock line an increased supply (25 % higher frequency and 20 % lower sailing time) is assumed (table 6.2.1). In other words, the ferry lines that would compete with a fixed Fehmarn Belt link offer an improved level of service compared to the present.

Compared to Base Case 1, the number of rail passengers over the fixed link would decrease by 0,6 %, the number of car passengers by 4,0 % and the number of bus passengers by 1,0 %. The number of passenger cars over the fixed link would be 4,0 % smaller (table 6.2.5). The competing ferries would gain about 12 % passenger cars.

In freight, the fixed link would loose 5,5 % road freight and 4,0 % rail freight. In vehicles this would correspond to -5,6 % lorries and -3,4 % rail wagons. The competing ferries would gain freight traffic of a similar quantity.

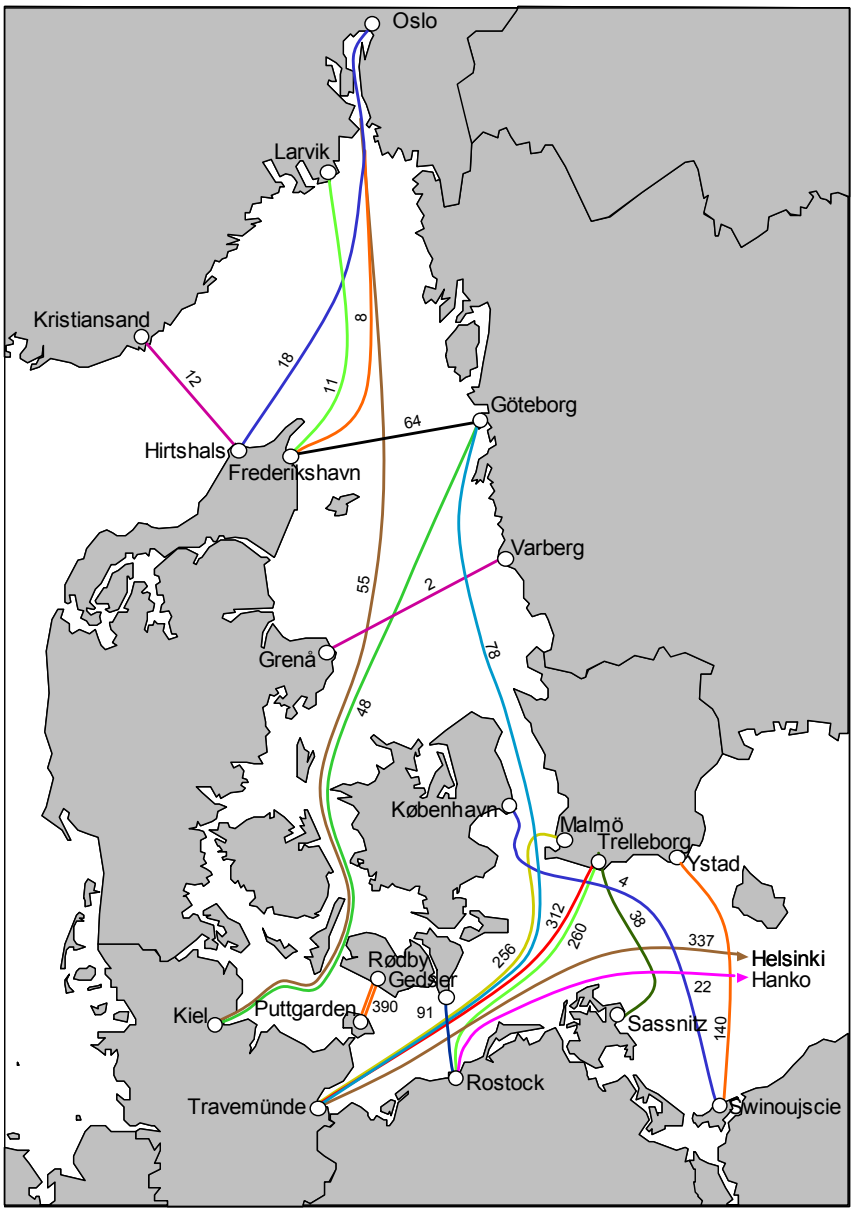

Figure 6.2.3: Number of lorries by ferry line, Scenario 1, 2015, 1.000 lorries/year

6.3 **Scenario 2:** increased ferry supply, reduced ferry fares, increased tolls on the Øresund link

6.3.1 Scenario Assumptions

In this scenario, the ferry supply is the same as in scenario 1 combined with a 25% reduction of the fares for all north-south ferries that directly compete with a fixed Fehmarnbelt link. The fixed Øresund link tolls and the Øresund ferry fares are increased by 25 %.

The assumed key figures for the ferry services in scenario 2 are shown in table 6.3.1. All changes as compared to the base case are shown in **bold.**

Forecast assumptions	**Frequency**	**Travel time**	**Pass. Fare[23]**	**Freight fare[24]**	**Railway**
Scenario 2, 2015	departures /day	minutes	€	€	R
Denmark-Norway					
Frederikshavn-Oslo	1	540	210	446	
Frederikshavn-Larvik/Moss	2	300	210	551	
Hirtshals-Oslo	1	750	210	551	
Hirtshals-Kristianssand	3-4	170-240	210	541	
Hanstholm-Egersund/Bergen	1	990	355	940	
Copenhagen-Oslo	1	960	631	no info	
Germany-Norway					
Kiel-Oslo	1	1.140	422	878	
Denmark-Sweden					
Frederikshavn-Göteborg	5	210	111	380	
Frederiksh. - Göteborg FF	2	120	128	n.a.	
Grenå-Varberg	3	270	111	396	
Helsingør-Helsingborg HH	36	20	**36**	**124**	
Helsingør-Helsingborg Scand	55	20	**39**	**145**	
Rønne-Ystad	2	150	120	270	
Rønne-Ystad FF	3	80	85	n.a.	
Øresundsbron	bridge	11	**21-38**	**115**	R
Germany-Denmark					
Rødby-Puttgarden bridge	bridge	12	46	259	R
Gedser-Rostock	**12**	**120**	**62**	**194**	
Rønne-Sassnitz	0,7	210	151	348	
Rønne-Mukran	1	210	151	348	
Havneby-List	6	55	43	161	
Germany-Sweden					
Kiel-Göteborg	1	840	418	540	
Travemünde-Malmö	**2,5**	**430**	**75**	**281**	
Travemünde-Göteborg	1	900	n.a.	562	
Travemünde-Trelleborg TT	**2,5**	**360**	**142**	n.a.	
Travemünde-Trelleborg Scand	**2,5**	**380**	n.a.	**422**	
Rostock-Trelleborg TT	**3,7**	**290**	**142**	n.a.	
Rostock-Trelleborg TT FF	**5**	180	**142**	n.a.	
Rostock-Trelleborg Scand	**3,7**	**290**	**86**	**348**	(freight) R
Sassnitz-Trelleborg	**5,2**	**180**	**66**	**261**	R
Germany-Finland					
Lübeck-Helsinki	**0,31**	**1.580**	1.177	1.250	
Rostock-Hanko	**1**	**1.060**	421	1.142	
Rostock-Helsinki	**0,55**	**1.200**	340	n.a.	
Poland					
Copenhagen-Swinoujscie	0,7	540	128	480	
Copenhagen-Trelleborg-	0,5	1.080	142	n.a.	
Rønne-Swinoujscie	0,14	360	177	480	
Swinoujscie-Ystad	2	390-480	227	604	(freight) R
Gdynia-Karlskrona	1	630	278	n.a.	

Table 6.3.1: Key information for Scenario 2.
FF= fast ferry, HH = HH Line, TT= TT Line, Scand = Scandlines, n.a. = transport not available, no info = no information available

[23] One-way fare for a passenger car and 4 persons incl. cabin where applicable, 2002 prices
[24] One-way fare excl. VAT for a trailer incl. handling charge where applicable, 2002 prices

6.3.2 Passenger Traffic Scenario 2, 2015

Main mode 1.000 trips/year	1.000 Passengers/year	Modal split in percent
Base Case A, 2015		
Rail	1.537	4,4
Car	12.042	34,2
Bus	2.973	8,4
Air	16.823	47,8
Walk-on	1.850	5,3
Total	**35.225**	**100,0**
Scenario 2, 2015		
Rail	1.525	4,3
Car	12.102	34,2
Bus	2.971	8,4
Air	16.813	47,5
Walk-on	1.974	5,6
Total	**35.385**	**100,0**

Table 6.3.2: Total number of trips between Denmark/Scandinavia and the continent by mode, Scenario 2, 2015, 1.000 trips/year

The total number of person trips is slightly greater in Scenario 2 than in Base Case A, the extra trips being concentrated on the car and walk-on modes.

	1.000 passengers/year			
	Base Case A		Scenario 2	
Trip Purpose	abs.	percent	abs.	percent
commuter work	109	0,3%	109	0,3%
shopping	347	1,0%	359	1,0%
business	8.371	23,8%	8.375	23,7%
holidays (>8 days)	12.736	36,2%	12.750	36,0%
day excursion	1.472	4,2%	1.503	4,2%
short holiday (≤8 days)	5.647	16,0%	5.680	16,1%
visit friend/relatives	5.238	14,9%	5.263	14,9%
weekend commuting	966	2,7%	973	2,7%
ferry excursion	339	1,0%	373	1,1%
Total	**35.225**	**100,0%**	**35.385**	**100,0%**

Table 6.3.3: Purpose distribution for passenger trips, Scenario 2, 2015, 1.000 passenger trips/year

Looking at the purpose distribution, the increase is dominated by short, private trips.

1.000 passenger trips/year		Mode					
between:	**and:**	**Rail**	**Car**	**Air[1]**	**Bus**	**Walk-on**	**Total**
Germany	E.Denmark[2]	741	4.540	1.204	1.362	734	8.581
Germany	Sweden	342	3.198	2.095	659	804	7.098
Germany	Norway	15	1.007	1.103	151	31	2.307
Germany	Finland	4	225	520	28	70	847
W.Europe[3]	E.Denmark[2]	198	573	3.685	151	0	4.607
W.Europe[3]	Sweden	88	990	4.014	271	0	5.363
W.Europe[3]	Norway	5	521	1.674	70	0	2.270
W.Europe[3]	Finland	1	99	975	18	0	1.093
E.Europe[4]	E.Denmark[2]	48	158	564	54	56	880
E.Europe[4]	Sweden	75	592	644	152	279	1.742
E.Europe[4]	Norway	7	133	189	45	0	374
E.Europe[4]	Finland	1	66	146	10	0	223
Germany total		1.102	8.970	4.922	2.200	1.639	18.833
W. Europe total		292	2.183	10.348	510	0	13.333
E. Europe total		131	949	1.543	261	335	3.219
East Denmark[2] total		987	5.271	5.453	1.567	790	14.068
Sweden total		505	4.780	6.753	1.082	1.083	14.203
Norway total		27	1.661	2.966	266	31	4.951
Finland total		6	390	1.641	56	70	2.163
Total		**1.525**	**12.102**	**16.813**	**2.971**	**1.974**	**35.385**

Table 6.3.4: Aggregated passenger flows, Scenario 2, 2015, two way totals, 1.000 trips/year

[1] Traffic to and from Copenhagen, Oslo and Stockholm airports only. [2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

In the geographical relations, the trips between Denmark and Sweden north of the Baltic Sea and Germany south of the Baltic Sea show a slight increase as compared to Base Case A, and the increase is slightly greater than in Scenario 1.

1.000 passengers/year	Base Case A		Scenario 2		Change
	abs.	percent	abs.	percent	percent change
Rail passengers	1.497	15,3%	1.485	16,1%	-0,8%
Car passengers	6.598	67,7%	6.099	66,1%	-7,6%
Bus passengers	1.658	17,0%	1.639	17,8%	-1,1%
Walk-on pass.	0	0,0%	0	0,0%	-
1.000 passengers/year	**9.753**	**100,0%**	**9.223**	**100,0%**	**-5,4%**
Passengers/day	**26.721**		**25.268**		
Cars/day	7.496		6.953		-7,2%
Buses/day	129		129		0,0%

Table 6.3.5: Fehmarn Belt traffic, Scenario 2, 2015

Whereas the Fehmarn Belt car passengers dropped by 4,0 percent in Scenario 1 (as compared to Base Case A) this group declines further in Scenario 2, where, in addition to the improved services on the competing ferries, the ferry fares are reduced by 25 percent. The difference in car passengers to Base Case A is -7,6 percent, and the number of cars drop by 7,2 percent.

1.000 passengers/year or 1.000 vehicles/year	**1.000 Passengers**		**1.000**	
	Total	**Rail Pass.**	**Cars**	**Cars %**
Base Case A, 2015				
Norway/Sweden-Jylland	980	-	301	6,8%
Oslo/Göteborg-Germany	1.181	-	213	4,8%
Fehmarn Belt	9.753	1.497	2.736	61,7%
Other Denmark-Germany	1.867	18	278	6,2%
Finland/Sweden-Germany	2.598	22	640	14,4%
Denmark/Sweden-Poland	1.181	-	271	6,1%
Total	**17.560**	**1.537**	**4.439**	**100,0%**
Scenario 2, 2015				
Norway/Sweden-Jylland	977	-	300	6,7%
Oslo/Göteborg-Germany	1.179	-	212	4,8%
Fehmarn Belt	9.223	1.485	2.538	56,9%
Other Denmark-Germany	2.118	18	349	7,8%
Finland/Sweden-Germany	3.069	22	795	17,8%
Denmark/Sweden-Poland	1.171	-	267	6,0%
Total	**17.974**	**1.525**	**4.461**	**100,0%**

Table 6.3.6: Number of passengers and cars by ferry corridors, Scenario 2, 2015, 1.000 passengers or vehicles/year

Comparing table 6.3.6 with table 6.2.6 it is seen that the Fehmarn 'looses' even more traffic in favour of the Baltic Sea ferries in Scenario 2 (56,9 % of the cars in Scenario 2 as opposed to 59,1 % in Scenario 1).

The contribution of the different model steps to the resulting Fehmarn Belt traffic can be seen in table 6.3.7.

Model step 1.000 passengers/year	**Car passengers/ year**	**Bus passengers/ year**	**Rail passengers/ year**
Base Case A	6.598	1.658	1.497
Contribution from:			
Modal split change	24	-2	-12
induced traffic	29	0	0
changed destination	7	0	0
from other routes	-559	-17	0
total contribution	-499	-19	-12
Scenario 2	**6.099**	**1.639**	**1.485**

Table 6.3.7: Contributions from different steps of the forecast, Scenario 2, 2015, 1.000 passengers/year

The table shows that most of the change in Fehmarn Belt traffic between Base Case A and Scenario 1 is caused by redistribution of trips between the Fehmarn Belt and other routes, in this case mainly Gedser-Rostock and the Sweden-Germany connections.

The Fehmarn Belt 'looses' about 200.000 cars/year in Scenario 2 as compared to Base Case A, and this traffic is transferred to the other ferries Denmark-Germany (Gedser-Rostock) and the Sweden-Germany ferries. The remaining ferry corridors are hardly affected nor are rail passengers.

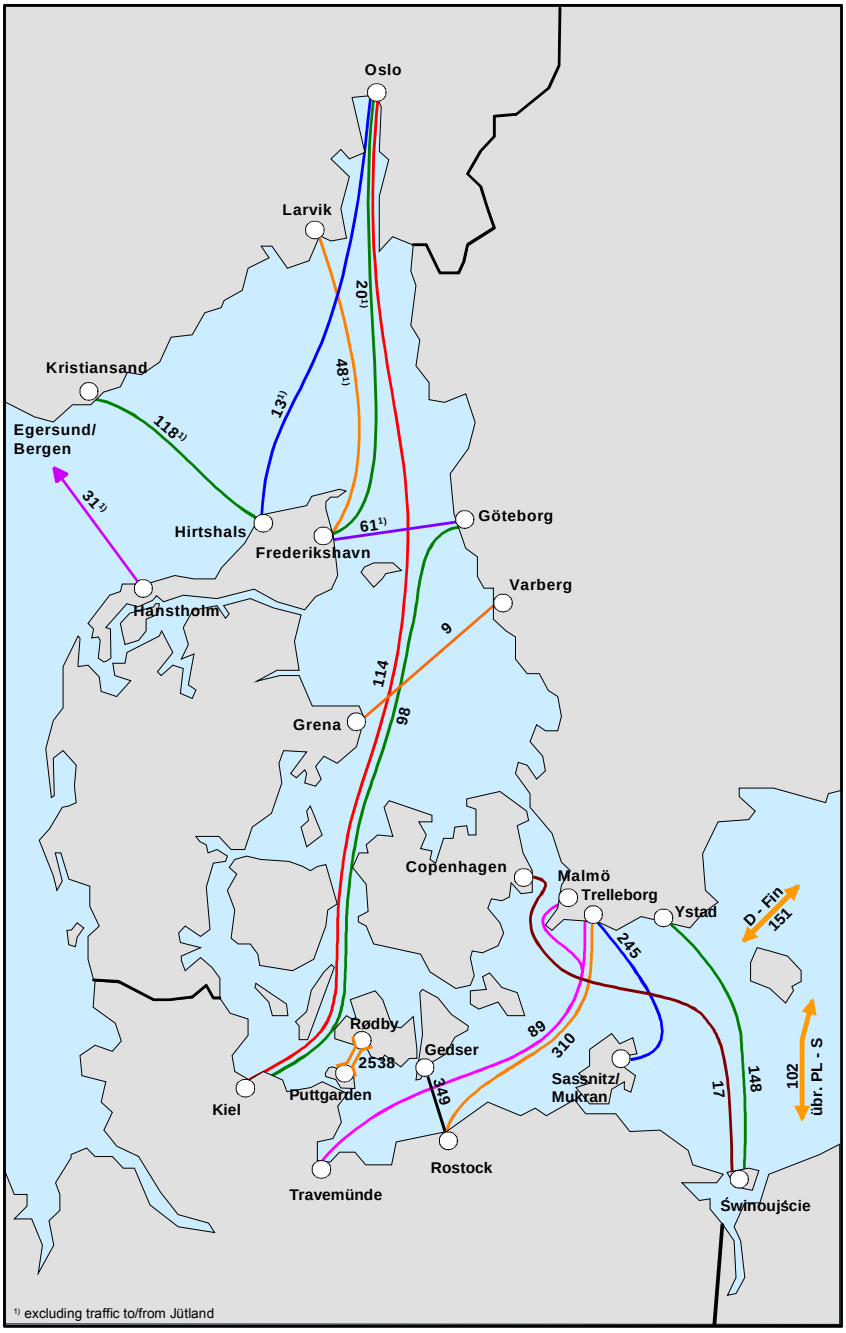

Figure 6.3.1: Number of cars by ferry link, Scenario 2, 2015, 1.000 cars/year

Figure 6.3.1 shows the number of cars by ferry link. As the forecast of railway passengers is hardly affected by the scenario assumptions the figure showing train passengers is not shown. Please refer to figure 5.1.2.

6.3.3 Freight Traffic Scenario 2, 2015

Compared to Base Case A and Scenario 1, the total amount of freight and its distribution by commodity groups is unchanged (cf. table 5.2.7).

Mode 1.000 tons or vehicles/year	1.000 t	1.000 Vehicles	Vehicles %
Base Case A, 2015			
Road	31.315	2.155	72,0%
Rail conventional	12.587	645	21,5%
Rail combined	2.021	194	6,5%
Total	**45.923**	**2.994**	**100,0%**
Scenario 2, 2015			
Road	31.537	2.166	72,3%
Rail conventional	12.377	634	21,2%
Rail combined	2.009	194	6,5%
Total	**45.923**	**2.994**	**100,0%**

Table 6.3.8: Total freight flows between Denmark/Scandinavia and the continent by mode, Scenario 2, 2015, 1.000 tons or vehicles/year

The modal split of all freight transport, table 6.3.8, reflects a minor shift towards road transport.

1.000 t freight/year		Mode			
between:	and:	Road	Rail conv.	Rail comb.	Total
Germany	E.Denmark[2]	1.804	840	235	2.878
Germany	Sweden	9.862	5.635	244	15.742
Germany	Norway	2.232	453	143	2.829
Germany	Finland	2.209	16	16	2.241
W.Europe[3]	E.Denmark[2]	2.795	324	1.173	4.292
W.Europe[3]	Sweden	8.021	4.169	193	12.383
W.Europe[3]	Norway	1.815	289	1	2.105
W.Europe[3]	Finland	334	1	1	336
E.Europe[4]	E.Denmark[2]	401	141	1	543
E.Europe[4]	Sweden	1.736	442	1	2.179
E.Europe[4]	Norway	275	67	0	342
E.Europe[4]	Finland	53	0	0	53
Germany total		16.107	6.944	638	23.690
W. Europe total		12.965	4.783	1.368	19.116
E. Europe total		2.465	650	2	3.117
East Denmark[2] total		5.000	1.305	1.409	7.713
Sweden total		19.619	10.246	438	30.304
Norway total		4.322	809	144	5.276
Finland total		2.596	17	17	2.630
Total		**31.537**	**12.377**	**2.009**	**45.923**

Table 6.3.9: Freight flows by region, Scenario 2, 2015, 1.000 tons/year

[2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Mode	Base Case A, 2015 freight 1.000 t	1.000 vehicles	Scenario 2 2015 freight 1.000 t	1.000 vehicles	Percent change freight %	vehicles %
Road	6.426	413	5.292	340	-17,6%	-17,7%
Rail	10.843	610	10.065	573	-7,2%	-6,1%
Total	**17.269**	**1.023**	**15.357**	**913**	**-11,1%**	**-10,8%**

Table 6.3.10: Fehmarn Belt freight transport, Scenario 2, 2015, 1.000 tons freight or vehicles/year

In Scenario 2, the Fehmarn Belt freight traffic is almost 11 percent behind Base Case A. Most of the reduction is in road transport.

The distribution of freight traffic by ferry corridor is shown in table 6.3.11, and figures 6.3.2 and 6.3.4 indicate the load on each ferry line.

Annual traffic	1.000 t Road	Rail	Total	1.000 Lorries	No. of Trains
Base Case A, 2015					
Norway/Sweden-Jylland	1.958	-	1.958	124	-
Oslo/Göteborg-Germany	2.909	-	2.909	192	-
Fehmarn Belt	6.426	10.843	17.269	413	20.346
Other Denmark-Germany	1.324	-	1.324	86	-
Finland/Sweden-Germany	16.162	3.765	19.927	1.175	5.940
Denmark/Sweden-Poland	2.366	-	2.366	153	-
Total	**31.145**	**14.608**	**45.753**	**2.143**	**26.286**
Scenario 2, 2015					
Norway/Sweden-Jylland	1.681	-	1.681	104	-
Oslo/Göteborg-Germany	2.489	-	2.489	163	-
Fehmarn Belt	5.292	10.065	15.357	340	19.111
Other Denmark-Germany	1.377	-	1.377	89	-
Finland/Sweden-Germany	18.545	4.322	22.867	1.329	6.822
Denmark/Sweden-Poland	2.011	-	2.011	130	-
Total	**31.395**	**14.387**	**45.782**	**2.155**	**25.933**

Table 6.3.11: t freight and vehicles by ferry corridors, Scenario 2, 2015, annual traffic

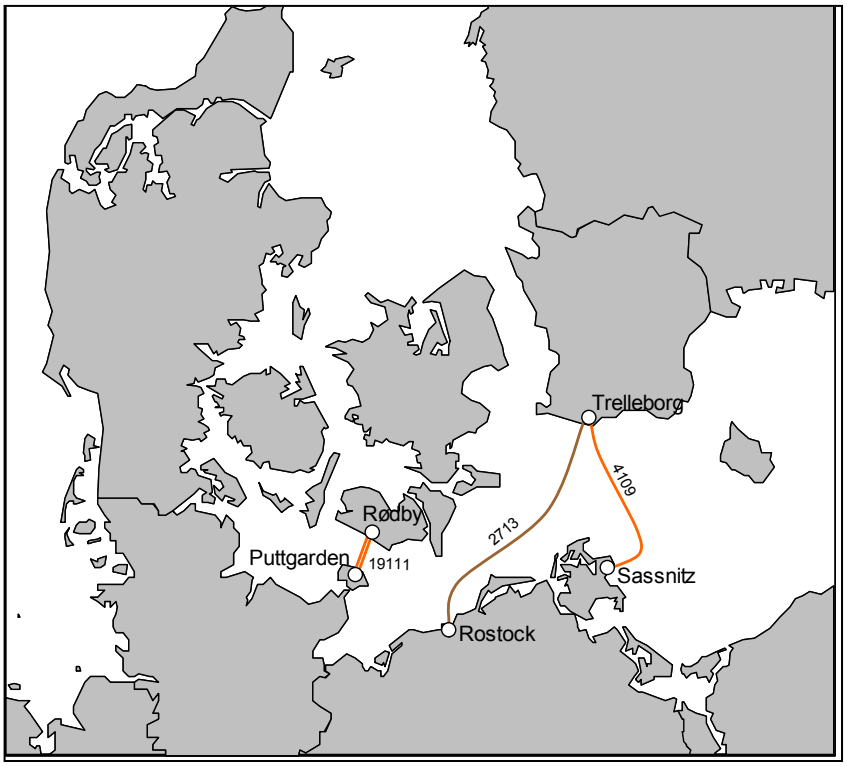

Figure 6.3.2: Number of freight trains/year, Scenario 2, 2015

6.3.4 Conclusion of Scenario 2

For Scenario 2 it is assumed that in addition to the improved ferry supply in Scenario 1 the fares for the same competing ferries is reduced by 25 %. Thus, these ferries compete even stronger with the fixed Fehmarn Belt link than they do in Scenario 1. At the same time, the fares/toll for the Øresund connections are increased by 25 %.

Comparing Scenario 2 passenger results with Base Case A the fixed link would loose about twice as much train and car traffic as in Scenario 1: -0,8 % rail passengers, -7,6 % car passengers and -1,1 % bus passengers. The number of cars crossing the fixed link would drop by 7,2 % (table 6.3.5). The competing ferries would gain about 18 % of car traffic as compared to Base Case A.

The amount of road freight and lorries across the Fehmarn Belt would decrease by almost 18 % and rail freight by 7,2 % or 6,1 % while the competing ferries would attract extra 13 % lorry traffic and 15 % rail wagons more than in Base Case A (tables 6.3.10 and 6.3.11).

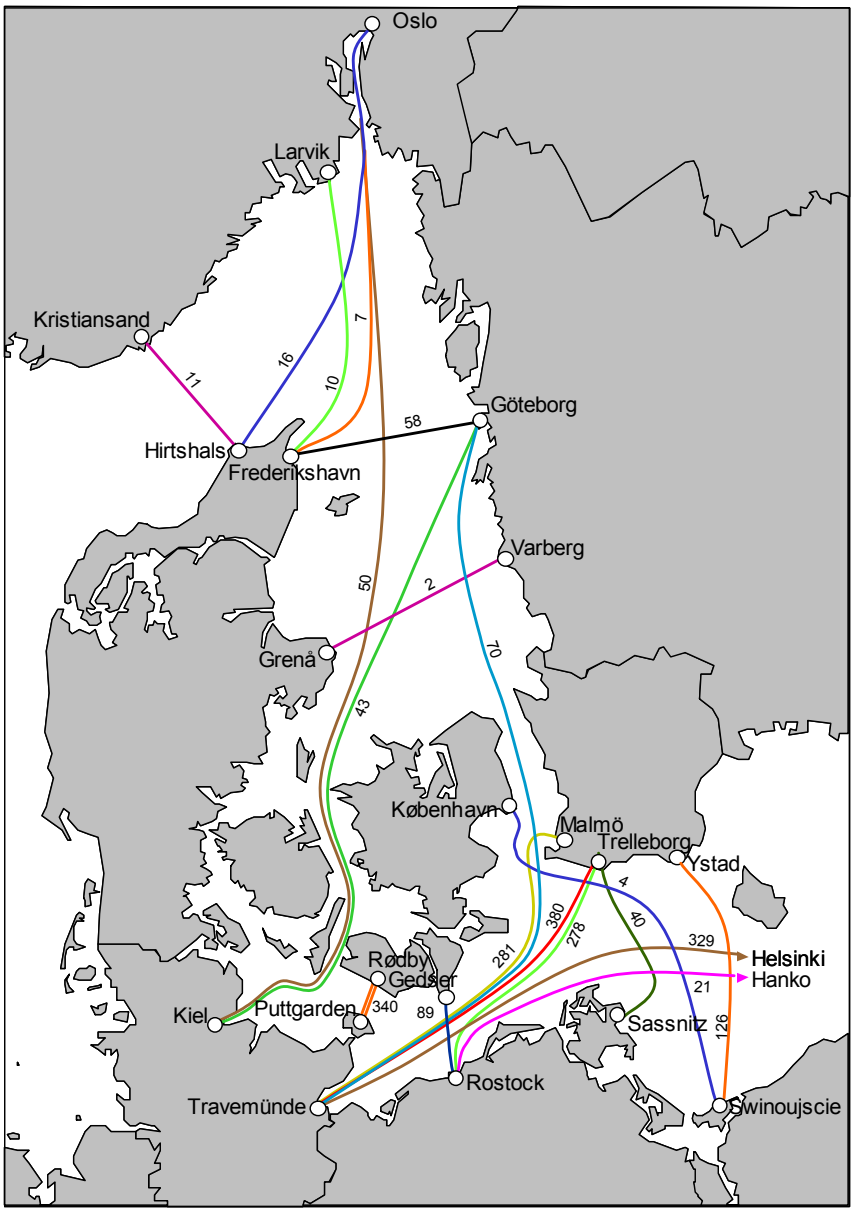

Figure 6.3.3: Number of lorries by ferry line, Scenario 2, 2015, 1.000 lorries/year

6.4 **Scenario 3:** reduced ferry service, increased ferry fares and reduced tolls on the Øresund link

6.4.1 Scenario Assumptions

In this scenario, it is assumed that the ferry supply is reduced and the fares are increased by 25% in real prices. The fixed Øresund link tolls and the Øresund ferry fares are reduced by 25 %.

The proposed key figures for the ferry services in scenario 3 are shown in table 6.4.1. All changes from the base case are shown in **bold.**

Forecast assumptions **Scenario 3, 2015**	**Frequency** departures /day	**Travel time** minutes	**Pass. Fare**[25] €	**Freight fare**[26] €	**Railway** R
Denmark-Norway					
Frederikshavn-Oslo	1	540	210	446	
Frederikshavn-Larvik/Moss	2	300	210	551	
Hirtshals-Oslo	1	750	210	551	
Hirtshals-Kristianssand	3-4	170-240	210	541	
Hanstholm-Egersund/Bergen	1	990	355	940	
Copenhagen-Oslo	1	960	631	no info	
Germany-Norway					
Kiel-Oslo	1	1.140	422	878	
Denmark-Sweden					
Frederikshavn-Göteborg	5	210	111	380	
Frederiksh. - Göteborg FF	2	120	128	n.a.	
Grenå-Varberg	3	270	111	396	
Helsingør-Helsingborg HH	36	20	**22**	**74**	
Helsingør-Helsingborg Scand	55	20	**23**	**87**	
Rønne-Ystad	2	150	120	270	
Rønne-Ystad FF	3	80	85	n.a.	
Øresundsbron	bridge	11	**13-22**	**69**	R
Germany-Denmark					
Rødby-Puttgarden Bridge	bridge	12	46	259	R
Gedser-Rostock	**6,75**	**145**	**102**	**324**	
Rønne-Sassnitz	0,7	210	151	348	
Rønne-Mukran	1	210	151	348	
Havneby-List	6	55	43	161	
Germany-Sweden					
Kiel-Göteborg	1	840	418	540	
Travemünde-Malmö	**1.5**	540	**125**	**469**	
Travemünde-Göteborg	1	900	n.a.	499	
Travemünde-Trelleborg TT	**1,5**	450	**236**	n.a.	
Travemünde-Trelleborg Scand	**1.5**	480	n.a.	**703**	
Rostock-Trelleborg TT	**2.25**	360	**236**	n.a.	
Rostock-Trelleborg TT FF	**3**	180	**236**	n.a.	
Rostock-Trelleborg Scand	**2,25**	360	**144**	**580**	(freight) R
Sassnitz-Trelleborg	**3,75**	225	**110**	**435**	R
Germany-Finland					
Lübeck-Helsinki	0,25	1.980	1177	1250	
Rostock-Hanko	0,86	1.320	421	1142	
Rostock-Helsinki	0,43	1.500	340	n.a.	
Poland					
Copenhagen-Swinoujscie	0,7	540	128	480	
Copenhagen-Trelleborg-	0,5	1.080	142	n.a.	
Rønne-Swinoujscie	0,14	360	177	480	
Swinoujscie-Ystad	2	390-480	227	604	(freight) R
Gdynia-Karlskrona	1	630	278	n.a.	

Table 6.4.1: Key information for Scenario 3.
FF= fast ferry, HH = HH Line, TT= TT Line, Scand = Scandlines, n.a. = transport not available, no info = no information available

[25] One-way fare for a passenger car and 4 persons incl. cabin where applicable, 2002 prices
[26] One-way fare excl. VAT for a trailer incl. handling charge where applicable, 2002 prices

6.4.2 Passenger Traffic

Main mode	1.000 Passengers/ year	Modal split percent
Base Case A, 2015		
Rail	1.537	4,4
Car	12.042	34,2
Bus	2.973	8,4
Air	16.823	47,8
Walk-on	1.850	5,3
Total	**35.225**	**100,0**
Scenario 3, 2015		
Rail	1.549	4,4
Car	11.984	34,2
Bus	2.975	8,5
Air	16.833	48,0
Walk-on	1.728	4,9
Total	**35.069**	**100,0**

Table 6.4.2: Total number of trips between Denmark/Scandinavia and the continent by mode, Scenario 3, 2015, 1.000 passengers/year

The total number of person trips is slightly smaller in Scenario 3 than in Base Case A with only marginal changes in the modal split.

Trip Purpose	1.000 passengers/year			
	Base Case A		Scenario 3	
	abs.	percent	abs.	percent
commuter work	109	0,3%	109	0,3%
shopping	347	1,0%	335	1,0%
business	8.371	23,8%	8.367	23,9%
holidays (>8 days)	12.736	36,2%	12.722	36,3%
day excursion	1.472	4,2%	1.442	4,1%
short holiday (≤8 days)	5.647	16,0%	5.614	16,0%
visit friend/relatives	5.238	14,9%	5.214	14,9%
weekend commuting	966	2,7%	959	2,7%
ferry excursion	339	1,0%	307	0,9%
Total	**35.225**	**100,0%**	**35.069**	**100,0%**

Table 6.4.3: Purpose distribution for passenger trips, Scenario 3, 2015, 1.000 passengers/year

Also the purpose distribution shows only very small changes.

1.000 passenger trips/year		Mode					
between:	**and:**	**Rail**	**Car**	**Air[1]**	**Bus**	**Walk-on**	**Total**
Germany	E.Denmark[2]	753	4.485	1.210	1.364	588	8.400
Germany	Sweden	354	3.135	2.109	661	706	6.965
Germany	Norway	15	1.007	1.103	151	31	2.307
Germany	Finland	4	225	520	28	68	845
W.Europe[3]	E.Denmark[2]	198	573	3.685	151	0	4.607
W.Europe[3]	Sweden	88	990	4.014	271	0	5.363
W.Europe[3]	Norway	5	521	1.674	70	0	2.270
W.Europe[3]	Finland	1	99	975	18	0	1.093
E.Europe[4]	E.Denmark[2]	48	158	564	54	56	880
E.Europe[4]	Sweden	75	592	644	152	279	1.742
E.Europe[4]	Norway	7	133	189	45	0	374
E.Europe[4]	Finland	1	66	146	10	0	223
Germany total		1.126	8.852	4.942	2.204	1.393	18.517
W. Europe total		292	2.183	10.348	510	0	13.333
E. Europe total		131	949	1.543	261	335	3.219
East Denmark[2] total		999	5.216	5.459	1.569	644	13.887
Sweden total		517	4.717	6.767	1.084	985	14.070
Norway total		27	1.661	2.966	266	31	4.951
Finland total		6	390	1.641	56	68	2.161
Total		**1.549**	**11.984**	**16.833**	**2.975**	**1.728**	**35.069**

Table 6.4.4: Aggregated passenger flows, Scenario 3, 2015, two way totals, 1.000 trips/year

[1] Traffic to and from Copenhagen, Oslo and Stockholm airports only. [2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

The reduced number of trips in Scenario 3 as compared to Base Case A is approximately evenly distributed on trips to and from Sweden and Denmark.

	Base Case A		**Scenario 3**		**Change**
1.000 passengers/year	abs.	percent	abs.	percent	percent change
Rail passengers	1.497	15,3%	1.509	14,7%	0,8%
Car passengers	6.598	67,7%	7.082	69,0%	7,3%
Bus passengers	1.658	17,0%	1.677	16,3%	1,1%
Walk-on pass.	0	0,0%	0	0,0%	-
1.000 passengers/year	**9.753**	**100,0%**	**10.268**	**100,0%**	**5,3%**
Passengers/day	**26.721**		**28.132**		
Cars/day	7.496		8.027		7,1%
Buses/day	129		132		2,1%

Table 6.4.5: Fehmarn Belt traffic, Scenario 3, 2015

The Fehmarn Belt attracts some 7 % more car traffic in Scenario 3 as compared to Base Case A. Among the scenarios tested this scenario may be called the ‘best case’.

1.000 passengers/year 1.000 cars/year	1.000 Passengers		1.000	
	Total	Rail Pass.	Cars	Cars %
Base Case A, 2015				
Norway/Sweden-Jylland	980	-	301	6,8%
Oslo/Göteborg-Germany	1.181	-	213	4,8%
Fehmarn Belt	9.753	1.497	2.736	61,7%
Other Denmark-Germany	1.867	18	278	6,2%
Finland/Sweden-Germany	2.598	22	640	14,4%
Denmark/Sweden-Poland	1.181	-	271	6,1%
Total	**17.530**	**1.537**	**4.439**	**100,0%**
Scenario 3 , 2015				
Norway/Sweden-Jylland	983	-	302	6,8%
Oslo/Göteborg-Germany	1.183	-	214	4,8%
Fehmarn Belt	10..268	1.509	2.930	66,3%
Other Denmark-Germany	1.623	18	208	4,7%
Finland/Sweden-Germany	2.140	22	488	11,0%
Denmark/Sweden-Poland	1.191	-	275	6,2%
Total	**17.388**	**1.549**	**4.417**	**100,0%**

Table 6.4.6: Number of passengers and cars by ferry corridors, Scenario 3, 2015, 1.000 passengers or cars/year

In Scenario 3 the Fehmarn Belt attracts almost 200.000 cars more than in Base Case A. The 'Other Denmark-Germany' (Gedser-Rostock) and 'Sweden-Germany' corridors carry less traffic and the total number of cars crossing the Baltic Sea is smaller in this scenario.

Model step 1.000 passengers/year	**Car passen-gers/year**	**Bus passen-gers/year**	**Rail passen-gers/year**
Base Case A	6.598	1.658	1.497
Contribution from:			
Modal split change	-24	2	12
induced traffic	-27	0	0
changed destination	-7	0	0
from other routes	542	17	0
total contribution	484	19	12
Scenario 3	**7.082**	**1.677**	**1.509**

Table 6.4.7: Contributions from different steps of the forecast, Scenario 3, 2015, 1.000 passengers/year

Table 6.4.7 shows that the increase in Fehmarn Belt traffic between Base Case A and Scenario 3 is caused by redistribution of trips between the Fehmarn Belt and other routes, in this case mainly Gedser-Rostock and the Sweden-Germany connections. At the same time there are small, negative contributions due to modal split and destination changes and less induced traffic.

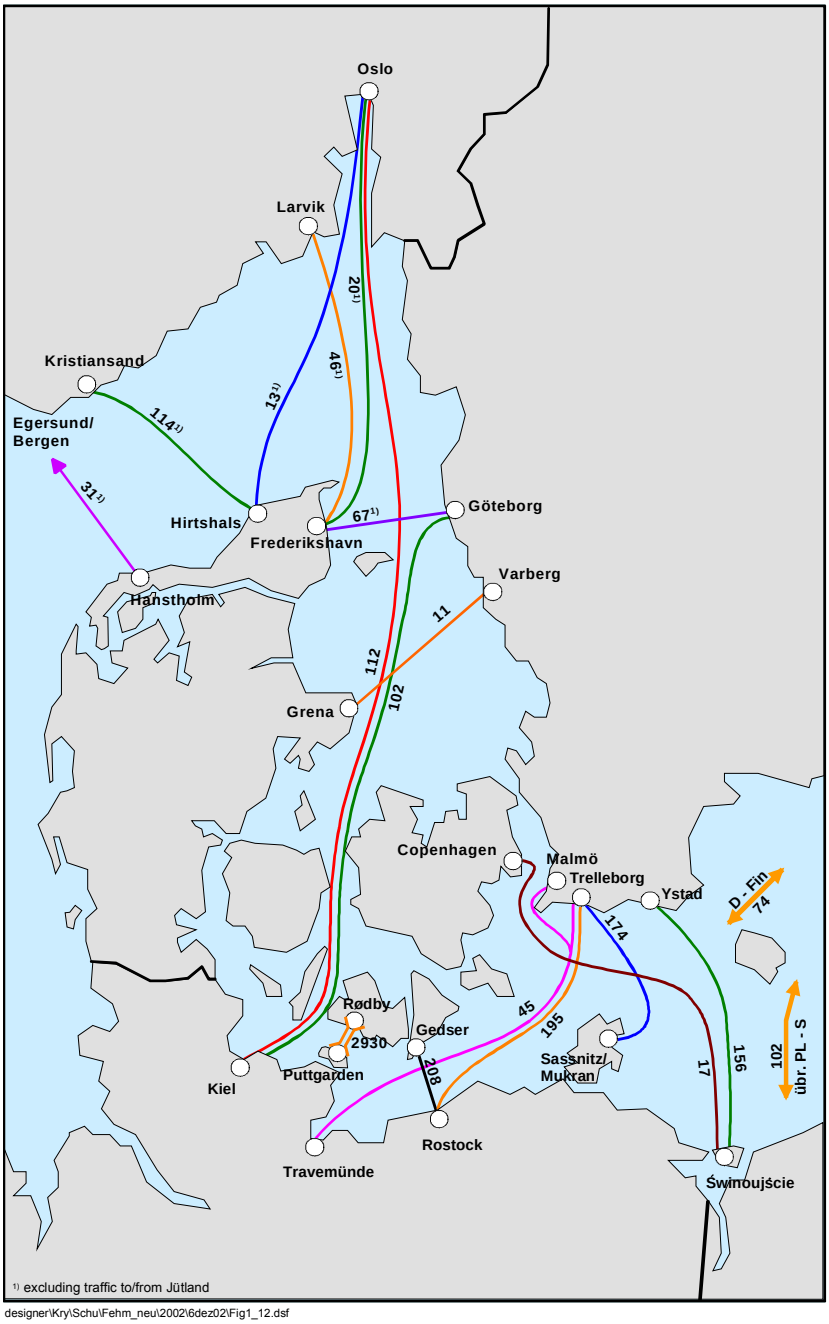

Figure 6.4.1: Number of passenger cars by ferry line, Scenario 3, 2015, 1.000 cars/year

Figure 6.4.1 shows the number of cars by ferry link. As the forecast of railway passengers is hardly affected by the scenario assumptions the figure showing train passengers is not shown. Please refer to figure 5.2.2.

6.4.3 Freight Traffic Scenario 3, 2015

Compared to Base Case A, the total amount of freight is unchanged including its distribution by commodity groups (which can be seen in table 5.2.7).

The modal split of all transport is presented in table 6.4.8. It shows a minor shift towards rail transport in Scenario 3. This is opposite to Scenarios 2 and 4 where the improved ferry service and lower fares generate a higher share of road freight.

Mode **1.000 tons or vehicles/year**	**1.000 t**	**1.000 Vehicles**	**Vehicles %**
Base Case A, 2015			
Road	31.315	2.155	72,0%
Rail conventional	12.587	645	21,5%
Rail combined	2.021	194	6,5%
Total	**45.923**	**2.994**	**100,0%**
Scenario 3, 2015			
Road	31.136	2.145	71,6%
Rail conventional	12.760	654	21,8%
Rail combined	2.027	195	6,5%
Total	**45.923**	**2.994**	**100,0%**

Table 6.4.8: Total freight flows between Denmark/Scandinavia and the continent by mode, Scenario 3, 2015, 1.000 tons or vehicles/year

1.000 t freight/year		**Mode**			
between:	**and:**	**Road**	**Rail conv.**	**Rail comb.**	**Total**
Germany	E.Denmark[2]	1.790	848	241	2.878
Germany	Sweden	9.675	5.818	249	15.742
Germany	Norway	2.219	464	146	2.829
Germany	Finland	2.206	17	18	2.241
W.Europe[3]	E.Denmark[2]	2.780	337	1.175	4.292
W.Europe[3]	Sweden	7.879	4.309	195	12.383
W.Europe[3]	Norway	1.806	297	2	2.105
W.Europe[3]	Finland	334	1	1	336
E.Europe[4]	E.Denmark[2]	399	143	1	543
E.Europe[4]	Sweden	1.720	458	1	2.179
E.Europe[4]	Norway	274	68	0	342
E.Europe[4]	Finland	53	0	0	53
Germany total			7.147	654	23.690
W. Europe total			4.944	1.373	19.116
E. Europe total			669	2	3.117
East Denmark[2] total			1.328	1.417	7.713
Sweden total			10.585	445	30.304
Norway total			829	148	5.276
Finland total			18	19	2.630
Total		**31.316**	**12.760**	**2.027**	**45.923**

Table 6.4.9: Freight flows by region, Scenario 3, 2015, 1.000 tons/year

[2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Mode	Base Case A, 2015 freight 1.000 t	1.000 vehicles	Scenario 3, 2015 freight 1.000 t	1.000 vehicles	Percent increase freight %	vehicles %
Road	6.426	413	7.332	471	14,1%	14,0%
Rail	10.843	610	11.966	663	10,4%	8,7%
Total	**17.269**	**1.023**	**19.298**	**1.134**	**11,7%**	**10,9%**

Table 6.4.10: Fehmarn Belt freight transport, Scenario 3, 2015, 1.000 tons or vehicles/year

The Fehmarn Belt receives some 10 percent more freight vehicles in Scenario 3 than in Base Case A, most of it in road traffic, table 6.4.10.

The distribution of freight traffic by ferry corridor is shown in table 6.4.11, and figures 6.4.2 and 6.4.3. The extra 2 million t freight that the Fehmarn Belt attracts in Scenario 3 as compared to Base Case A are mainly taken from the Finland/Sweden-Germany corridor.

Annual traffic	1.000 t Road	Rail	Total	1.000 Lorries	No. of Trains
Base Case A, 2015					
Norway/Sweden-Jylland	1.958	-	1.958	124	-
Oslo/Göteborg-Germany	2.909	-	2.909	192	-
Fehmarn Belt	6.426	10.843	17.269	413	20.346
Other Denmark-Germany	1.324	-	1.324	86	-
Finland/Sweden-Germany	16.162	3.765	19.927	1.175	5.940
Denmark/Sweden-Poland	2.366	-	2.366	153	-
Total	**31.145**	**14.608**	**45.753**	**2.143**	**26.286**
Scenario 3, 2015					
Norway/Sweden-Jylland	2.136	-	2.136	133	-
Oslo/Göteborg-Germany	3.176	-	3.176	209	-
Fehmarn Belt	7.332	11.966	19.298	471	22.105
Other Denmark-Germany	1.153	-	1.153	74	-
Finland/Sweden-Germany	14.538	2.822	17.360	1.074	4.462
Denmark/Sweden-Poland	2.609	-	2.609	169	-
Total	**30.944**	**14.788**	**45.732**	**2.130**	**26.567**

Table 6.4.11: t freight and vehicles by ferry corridors, Scenario 3, 2015, annual traffic

Both the number of lorries and freight trains with the fixed link are larger in this scenario than in Base Case A. The ferries calling on Jylland and Poland attract more traffic in this scenario, too.

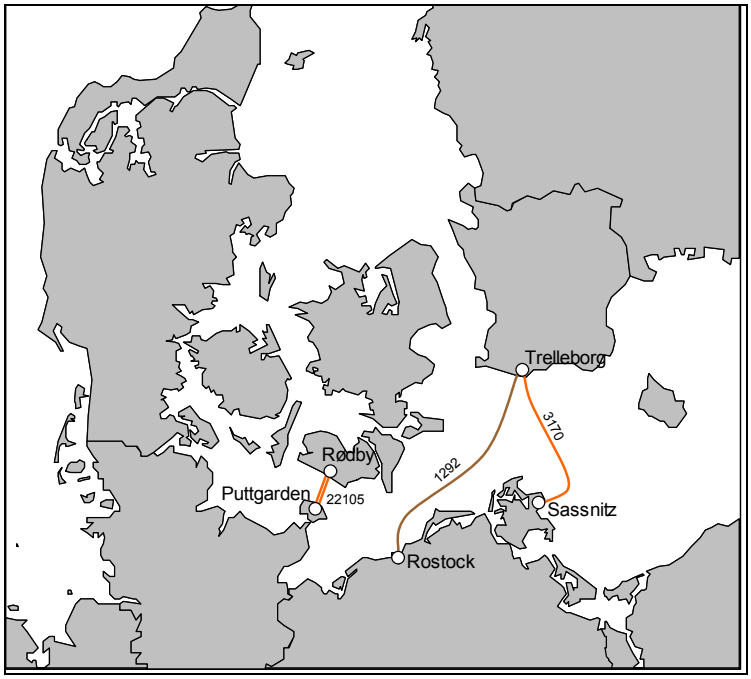

Figure 6.4.2: Number of freight trains/year, Scenario 3, 2015

The redistribution of road and rail traffic to the Fehmarn Belt becomes clear when comparing figures 6.4.2 and 6.4.3 with figures 5.2.4 and 5.2.5, respectively.

6.4.4 Conclusion of Scenario 3

In Scenario 3, the assumption for the competing ferries (between southern Sweden and Germany, between Finland and Germany and Gedser-Rostock) is that the level of service is assumed improved and the fares increased by 25 % over the present level. At the same time, the fares/toll rates for the Øresund connections are reduced by 25 %.

The results of this scenario are almost exactly opposite to the Scenario 2 results: Rail passengers on the Fehmarn link go up by 0,8 %, car passengers by 7,3 % and bus passengers by 1,1 %. The number of cars over the fixed link would be 7,1 % greater than in Base Case A (table 6.4.5). The competing ferries would loose about 25 % of the number of cars in Base Case A.

In freight traffic the results are similar. The amount of road freight and the number of lorries over the Fehmarn Belt link would be 14 % larger than in Base Case A and the amount of rail freight 10,4 % larger corresponding to 8,7 % more rail wagons (table 6.4.10).

With respect to traffic demand on the fixed link this scenario can be called the best case among the four scenarios tested.

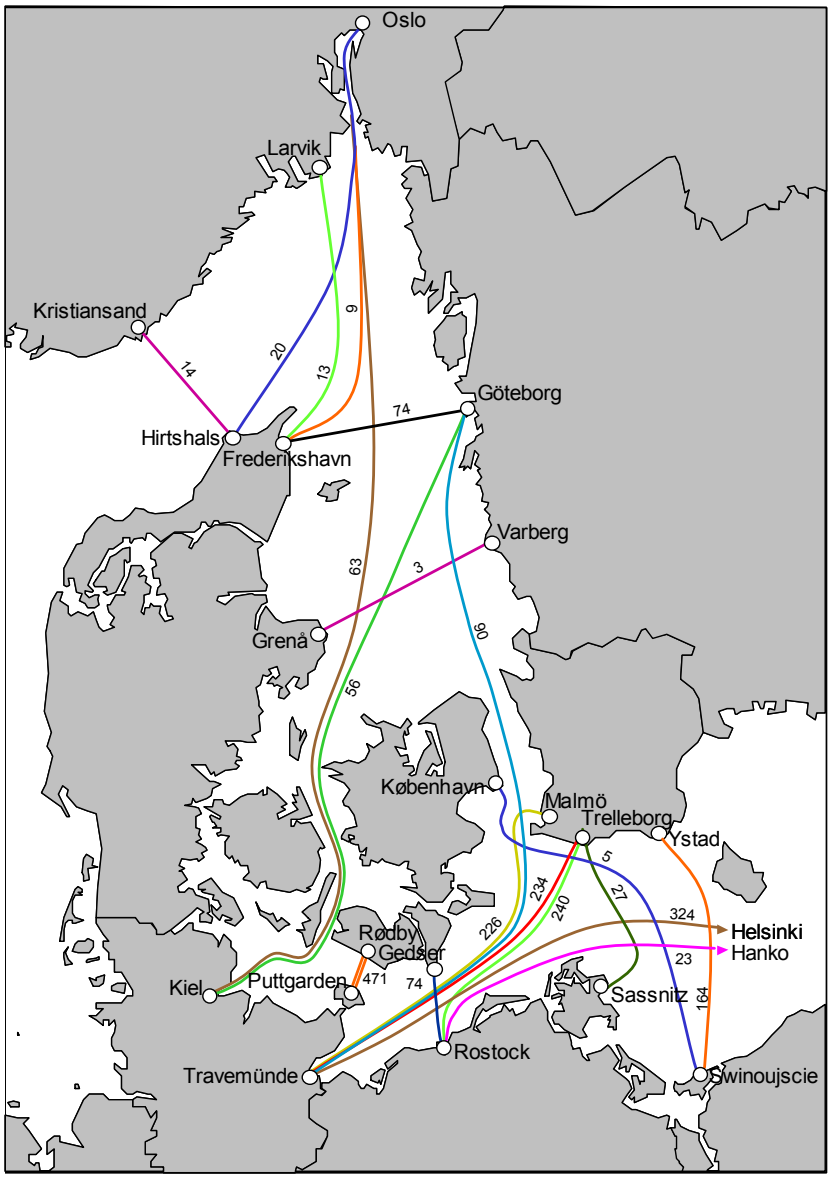

Figure 6.4.3: Number of lorries by ferry line, Scenario 3, 2015, 1.000 lorries/year

6.5 **Scenario 4:** improved ferry service, reduced ferry fares, increased tolls on the Øresund link, parallel ferry Rødby-Puttgarden

6.5.1 Scenario Assumptions

This scenario is exactly the same as Scenario 2 with one exception: To test the attractivity of a ferry service parallel to the fixed Fehmarn Belt link a ferry line has been assumed between Rødby and Puttgarden with 12 departures per day in each direction. The car and lorry fares of this ferry have been set equal to the present ferry fares minus 25 percent like the other competing ferries.

Forecast assumptions **Scenario 4, 2015**	**Frequency** departures /day	**Travel time** minutes	**Pass. Fare**[27] €	**Freight fare**[28] €	**Railway** R
Denmark-Norway					
Frederikshavn-Oslo	1	540	210	446	
Frederikshavn-Larvik/Moss	2	300	210	551	
Hirtshals-Oslo	1	750	210	551	
Hirtshals-Kristianssand	3-4	170-240	210	541	
Hanstholm-Egersund/Bergen	1	990	355	940	
Copenhagen-Oslo	1	960	631	no info	
Germany-Norway					
Kiel-Oslo	1	1.140	422	878	
Denmark-Sweden					
Frederikshavn-Göteborg	5	210	111	380	
Frederiksh. - Göteborg FF	2	120	128	n.a.	
Grenå-Varberg	3	270	111	396	
Helsingør-Helsingborg HH	36	20	**36**	**124**	
Helsingør-Helsingborg Scand	55	20	**39**	**145**	
Rønne-Ystad	2	150	120	270	
Rønne-Ystad FF	3	80	85	n.a.	
Øresundsbron	bridge	11	**21-38**	**115**	R
Germany-Denmark					
Rødby-Puttgarden bridge	bridge	12	46	259	R
Rødby-Puttgarden	**12**	**52**	**34**	**194**	
Gedser-Rostock	**12**	**120**	**62**	**194**	
Rønne-Sassnitz	0,7	210	151	348	
Rønne-Mukran	1	210	151	348	
Havneby-List	6	55	43	161	
Germany-Sweden					
Kiel-Göteborg	1	840	418	540	
Travemünde-Malmö	**2,5**	**430**	**75**	**281**	
Travemünde-Göteborg	1	900	n.a.	562	
Travemünde-Trelleborg TT	**2,5**	**360**	**142**	n.a.	
Travemünde-Trelleborg Scand	**2,5**	**380**	n.a.	**422**	
Rostock-Trelleborg TT	**3,7**	**290**	**142**	n.a.	
Rostock-Trelleborg TT FF	**5**	180	**142**	n.a.	
Rostock-Trelleborg Scand	**3,7**	**290**	**86**	**348**	(freight) R
Sassnitz-Trelleborg	**5,2**	**180**	**66**	**261**	R
Germany-Finland					
Lübeck-Helsinki	**0,31**	**1.580**	1.177	1.250	
Rostock-Hanko	**1**	**1.060**	421	1.142	
Rostock-Helsinki	**0,55**	**1.200**	340	n.a.	
Poland					
Copenhagen-Swinoujscie	0,7	540	128	480	
Copenhagen-Trelleborg-	0,5	1.080	142	n.a.	
Rønne-Swinoujscie	0,14	360	177	480	
Swinoujscie-Ystad	2	390-480	227	604	(freight) R
Gdynia-Karlskrona	1	630	278	n.a.	

Table 6.5.1: Key information for Scenario 4.
FF= fast ferry, HH = HH Line, TT= TT Line, Scand = Scandlines, n.a. = transport not available, no info = no information available

The proposed key figures for the ferry services in scenario 4 are shown in table 6.5.1. All changes as compared to the base case are shown in **bold.**

[27] One-way fare for a passenger car and 4 persons incl. cabin where applicable, 2002 prices
[28] One-way fare excl. VAT for a trailer incl. handling charge where applicable, 2002 prices

6.5.2 Passenger Traffic Scenario 4, 2015

Main mode	1.000 Passengers/year	Modal split percent
Base Case A, 2015		
Rail	1.537	4,4%
Car	12.042	34,2%
Bus	2.973	8,4%
Air	16.823	47,8%
Walk-on	1.850	5,3%
Total	**35.225**	**100,0%**
Scenario 4, 2015		
Rail	1.525	4,3%
Car	12.112	34,1%
Bus	2.974	8,4%
Air	16.813	47,3%
Walk-on	2.145	6,0%
Total	**35.569**	**100,0%**

Table 6.5.2: Total number of trips between Denmark/Scandinavia and the continent by mode, Scenario 4, 2015, 1.000 passengers/year

The total number of trips is slightly greater in Scenario 4 than in Base Case A and even greater than in Scenario 2. The increase is concentrated on the car and walk-on modes.

Trip Purpose	1.000 passengers/year			
	Base Case A		Scenario 4	
	abs.	percent	abs.	percent
commuter work	109	0,3%	109	0,3%
shopping	347	1,0%	359	1,0%
business	8.371	23,8%	8.375	23,5%
holidays (>8 days)	12.736	36,2%	12.750	35,8%
day excursion	1.472	4,2%	1.531	4,3%
short holiday (≤8 days)	5.647	16,0%	5.680	16,0%
visit friend/relatives	5.238	14,9%	5.265	14,8%
weekend commuting	966	2,7%	973	2,7%
ferry excursion	339	1,0%	527	1,5%
Total	**35.225**	**100,0%**	**35.569**	**100,0%**

Table 6.5.3: Purpose distribution for passenger trips, Scenario 4, 2015, 1.000 passengers/year

The ferry excursion purpose shows the largest increase relative to Base Case A. This, of course, is a consequence of the parallel ferry Rødby-Puttgarden.

1.000 passenger trips/year		Mode					
between:	and:	Rail	Car	Air[1]	Bus	Walk-on	Total
Germany	E.Denmark[2]	741	4.550	1.204	1,365	905	8.765
Germany	Sweden	342	3.198	2.095	659	804	7.098
Germany	Norway	15	1.007	1.103	151	31	2.307
Germany	Finland	4	225	520	28	70	847
W.Europe[3]	E.Denmark[2]	198	573	3.685	151	0	4.607
W.Europe[3]	Sweden	88	990	4.014	271	0	5.363
W.Europe[3]	Norway	5	521	1.674	70	0	2.270
W.Europe[3]	Finland	1	99	975	18	0	1.093
E.Europe[4]	E.Denmark[2]	48	158	564	54	56	880
E.Europe[4]	Sweden	75	592	644	152	279	1.742
E.Europe[4]	Norway	7	133	189	45	0	374
E.Europe[4]	Finland	1	66	146	10	0	223
Germany total		1.102	8.980	4.922	2,203	1.810	19.017
W. Europe total		292	2.183	10.348	510	0	13.333
E. Europe total		131	949	1.543	261	335	3.219
East Denmark[2] total		987	5.281	5.453	1,570	961	14.252
Sweden total		505	4.780	6.753	1,082	1.083	14.203
Norway total		27	1.661	2.966	266	31	4.951
Finland total		6	390	1.641	56	70	2.163
Total		**1.525**	**12.112**	**16.813**	**2,974**	**2.145**	**35.569**

Table 6.5.4: Aggregated passenger flows, Scenario 4, 2015, two way totals, 1.000 trips/year

[1] Traffic to and from Copenhagen, Oslo and Stockholm airports only. [2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Table 6.5.4 shows the aggregated O/D flows for Scenario 4. Compared with Base Case A (table 5.2.4), in this scenario the travel relations to and from Denmark are more intense (by almost 300.000 trips), and also the Sweden traffic shows a minor increase.

	Base Case A		Scenario 4, 2015				Change
1.000 passengers/year	total	Percent	(Fixed Link)	ferry	total	Percent	percent change
Rail passengers	1.497	15,3%	1.485	0	1.485	15,8%	-0,8%
Car passengers	6.598	67,7%	5.607	502	6.109	64,9%	-7,4%
Bus passengers	1.658	17,0%	1.602	41	1.643	17,5%	-0,9%
Walk-on pass.	0	0,0%	0	172	172	1,8%	-
1.000 passengers/year	**9.753**	**100,0%**	**8.694**	**715**	**9.409**	**100,0%**	**-3,5%**
Passengers/day	**26.721**		**23.819**	**1.959**	**25.778**		
Cars/day	7.496		6.408	559	6.967		-7,1%
Buses/day	129		126	3	129		0,0%

Table 6.5.5: Fehmarn Belt traffic, Scenario 4, 2015

On the Fehmarn Belt, the ferry would attract some 500.000 car passengers, 40.000 bus passengers and 170.000 walk-on passengers. The fixed link would 'loose' almost 1 million car passengers relative to Base Case A and 400.000 relative to Scenario 2 (table 6.3.5).

1.000 passengers/year 1.000 cars/year	1.000 Passengers Total	 Rail Pass.	1.000 Cars	 Cars per-cent
Base Case A, 2015				
Norway/Sweden-Jylland	980	-	301	6,8%
Oslo/Göteborg-Germany	1.181	-	213	4,8%
Fehmarn Belt	9.753	1.497	2.736	61,7%
Other Denmark-Germany	1.867	18	278	6,2%
Finland/Sweden-Germany	2.598	22	640	14,4%
Denmark/Sweden-Poland	1.181	-	271	6,1%
Total	**17.560**	**1.537**	**4.439**	**100,0%**
Scenario 4, 2015				
Norway/Sweden-Jylland	977	-	300	6,7%
Oslo/Göteborg-Germany	1.179	-	212	4,7%
Fehmarn Belt fixed link	8.694	1.485	2.339	52,4%
Fehmarn Belt Ferry	715	-	204	4,6%
Other Denmark-Germany	2.116	18	348	7,8%
Finland/Sweden-Germany	3.039	22	795	17,8%
Denmark/Sweden-Poland	1.171	-	267	6,0%
Total	**17.891**	**1.525**	**4.465**	**100,0%**

Table 6.5.6: Number of passengers and cars by ferry corridors, Scenario 4, 2015, 1.000 passengers or cars/year

Comparing table 6.3.6 (Scenario 2 ferry corridors) to table 6.5.6, it becomes evident that the total Fehmarn Belt car traffic in both scenarios is almost the same, the only difference being that the parallel ferry in Scenario 4 attracts about 200.000 cars/year, which is subtracted from the total Belt traffic. The load on all other corridors remains unchanged in Scenario 4. Also the number of train passengers in Scenario 4 is the same as in Scenario 2.

In table 6.5.7 the redistribution of trips between Scenario 4 and Base Case A is shown.

Model step 1.000 passengers/year	Car passengers/ year	Bus passengers/ year	Rail passengers/ year
Base Case A	6.598	1.658	1.497
Contribution from:			
Modal split change	18	1	-12
induced traffic	45	0	0
changed destination	7	0	0
from other routes	-1.061	-57	0
total contribution	-991	-56	-12
Scenario 4	**5.607**	**1.602**	**1.485**

Table 6.5.7: Contributions from different steps of the forecast, Scenario 4, 2015, 1.000 passengers/year

The changes between Base Case A and this scenario are mainly due to redistribution of trips between the fixed link and ferry lines.

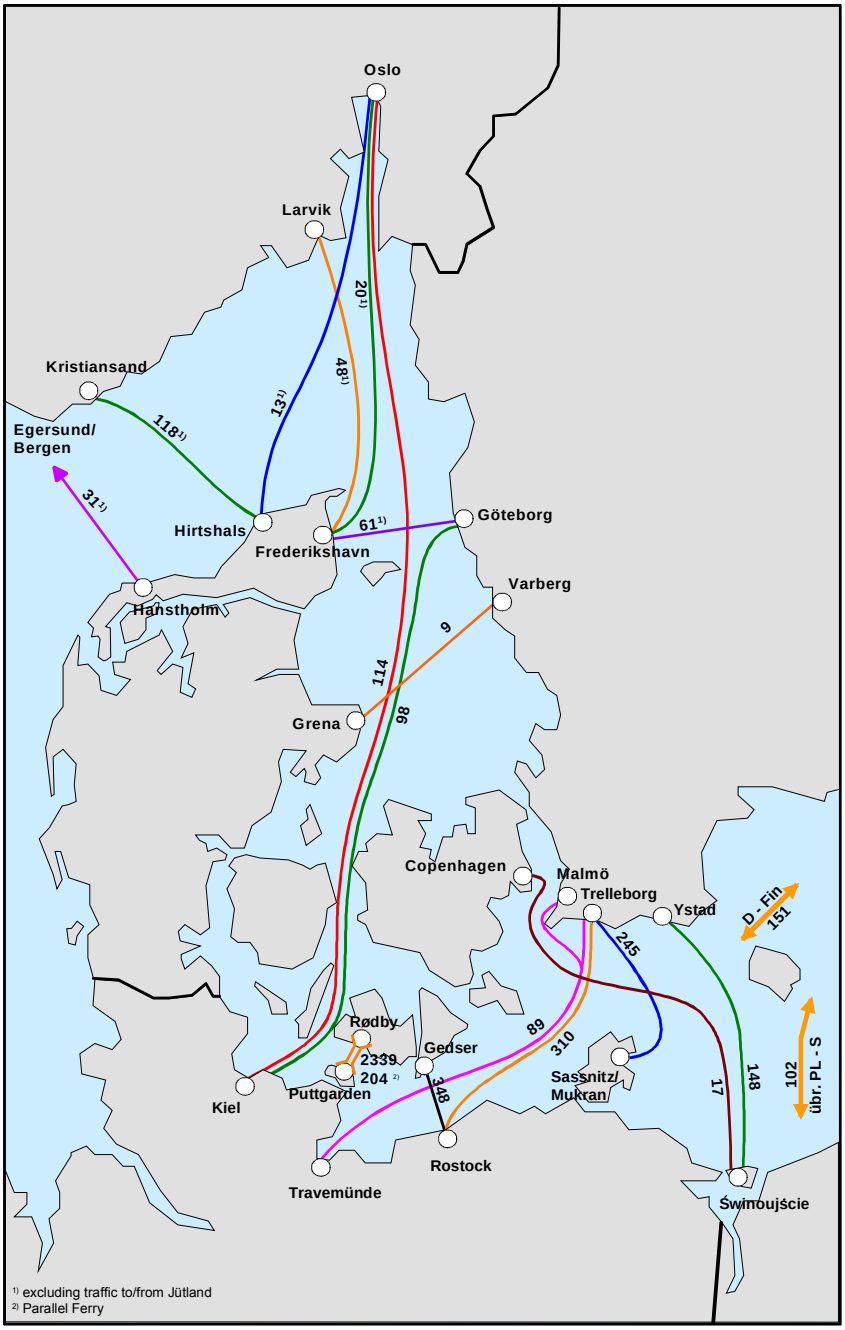

Figure 6.5.1: Number of passenger cars by ferry line, Scenario 4, 2015, 1.000 cars/year

Figure 6.5.1 shows the number of cars by ferry link. As the forecast of railway passengers is hardly affected by the scenario assumptions the figure showing train passengers is not shown. Please refer to figure 5.2.2.

6.5.3 Freight Traffic

Compared to Base Case A, the total amount of freight is unchanged including its distribution by commodity groups (table 5.2.7).

The modal split of all transport is presented in table 6.5.8. It shows a minor shift towards road transport in Scenario 4.

Mode 1.000 tons or vehicles/year	1.000 t	1.000 Vehicles	Vehicles %
Base Case A, 2015			
Road	31.315	2.155	72,0%
Rail conventional	12.587	645	21,5%
Rail combined	2.021	194	6,5%
Total	**45.923**	**2.994**	**100,0%**
Scenario 4, 2015			
Road	31.539	2.166	72,3%
Rail conventional	12.376	634	21,2%
Rail combined	2.009	194	6,5%
Total	**45.923**	**2.994**	**100,0%**

Table 6.5.8: Total freight flows between Denmark/Scandinavia and the continent by mode, Scenario 4, 2015, 1.000 tons or vehicles/year

The modal split in Scenario 4 is exactly the same as in Scenario 2 (compare tables 6.3.8 and 6.5.8).

1.000 t freight/year		Mode			
between:	and:	Road	Rail conv.	Rail comb.	Total
Germany	E.Denmark[2]	1.804	840	235	2.878
Germany	Sweden	9.863	5.634	244	15.742
Germany	Norway	2.232	453	143	2.829
Germany	Finland	2.209	16	16	2.241
W.Europe[3]	E.Denmark[2]	2.795	324	1.173	4.292
W.Europe[3]	Sweden	8.021	4.168	193	12.383
W.Europe[3]	Norway	1.815	289	1	2.105
W.Europe[3]	Finland	334	1	1	336
E.Europe[4]	E.Denmark[2]	401	141	1	543
E.Europe[4]	Sweden	1.736	442	1	2.179
E.Europe[4]	Norway	275	67	0	342
E.Europe[4]	Finland	53	0	0	53
Germany total		16.108	6.943	638	23.690
W. Europe total		12.965	4.782	1.368	19.116
E. Europe total		2.465	650	2	3.117
East Denmark[2] total		5.000	1.305	1.409	7.713
Sweden total		19.620	10.244	438	30.304
Norway total		4.322	809	144	5.276
Finland total		2.596	17	17	2.630
Total		**31.539**	**12.376**	**2.009**	**45.923**

Table 6.5.9: Freight flows by region, Scenario 4, 2015, 1.000 tons/year

[2] Traffic by Baltic Sea ferries only, i.e. mainly with relation to Eastern parts of Denmark. [3] Western Europe: Benelux, France, Spain, Portugal, Switzerland, Austria, Italy, UK and Ireland, Greece, Turkey. [4] Eastern Europe: Poland, Baltic countries, CIS, Czech Republic, Slovakian Republic, Hungary, Ex-Yugoslavia, Romania, Bulgaria.

Mode	Base Case A, 2015 freight 1.000 t	1.000 vehicles	Scenario 4, 2015 freight 1.000 t	1.000 vehicles	Percent increase freight %	vehicles %
Road	6.426	413	5.370	345	-16,4%	-16,5%
Rail	10.843	610	10.063	573	-7,2%	-6,1%
Total	**17.269**	**1.023**	**15.433**	**918**	**-10,6%**	**-10,3%**

Table 6.5.10: Fehmarn Belt freight transport, Scenario 4, 2015, 1.000 tons freight or vehicles/year

The 'loss' of freight traffic in Scenario 4 is slightly less than in Scenario 2 (compare tables 6.3.10 and 6.5.10), but table 6.5.10 represents the sum of traffic using the fixed link and the parallel ferry. The traffic on this ferry can be seen in table 6.5.11.

The distribution of freight traffic by ferry line is shown in figures 6.5.2 and 6.5.3.

Annual traffic	1.000 t Road	Rail	Total	1.000 Lorries	No. of Trains
	Base Case A, 2015				
Norway/Sweden-Jylland	1.958	-	1.958	124	-
Oslo/Göteborg-Germany	2.909	-	2.909	192	-
Fehmarn Belt	6.426	10.843	17.269	413	20.346
Other Denmark-Germany	1.324	-	1.324	86	-
Finland/Sweden-Germany	16.162	3.765	19.927	1.175	5.940
Denmark/Sweden-Poland	2.366	-	2.366	153	-
Total	**31.145**	**14.608**	**45.753**	**2.143**	**26.286**
	Scenario 4, 2015				
Norway/Sweden-Jylland	1.675	-	1.675	104	-
Oslo/Göteborg-Germany	2.483	-	2.483	163	-
Fehmarn Belt fixed link	4.685	10.063	14.748	301	19.110
Fehmarn Belt ferry	685	-	685	44	-
Other Denmark-Germany	1.372	-	1.372	89	-
Finland/Sweden-Germany	18.493	4.321	22.814	1.327	6.820
Denmark/Sweden-Poland	2.005	-	2.005	130	-
Total	**31.398**	**14.384**	**45.782**	**2.158**	**25.930**

Table 6.5.11: t freight and vehicles by ferry corridors, Scenario 4, 2015, annual traffic

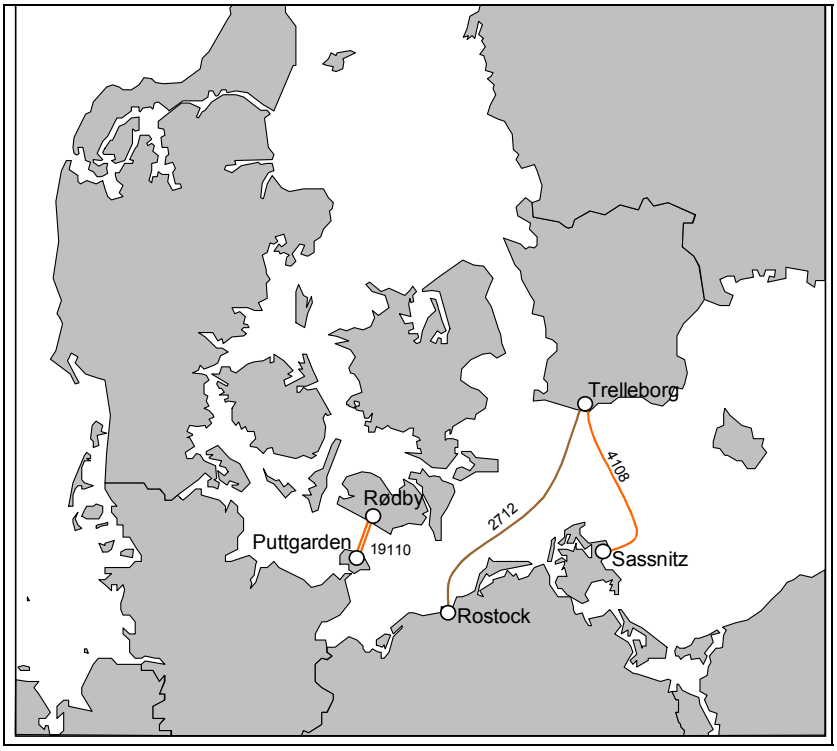

Figure 6.5.2: Number of freight trains/year, Scenario 4, 2015

6.5.4 Conclusions of Scenario 4

Scenario 4 uses almost the same assumptions as Scenario 2 with the addition of a car ferry line between Rødby and Puttgarden parallel to the fixed link.

As far as the total traffic across the Fehmarn Belt is concerned the results are similar to the Scenario 2 results but a portion of this total will be carried by the parallel ferry. The ferry would attract about 500.000 car passengers /year (=1.400 car passengers/day), and the fixed link would loose almost 1 million car passengers/year (=2.700 car passengers/day) relative to Base Case A (table 6.5.5).

The Fehmarn Belt would loose 16-17 % road freight and lorries as compared to Base Case A and 7,2 % rail freight or 6,1 % freight wagons.

Seen from the fixed link, this scenario would be the worst case among the scenarios tested.

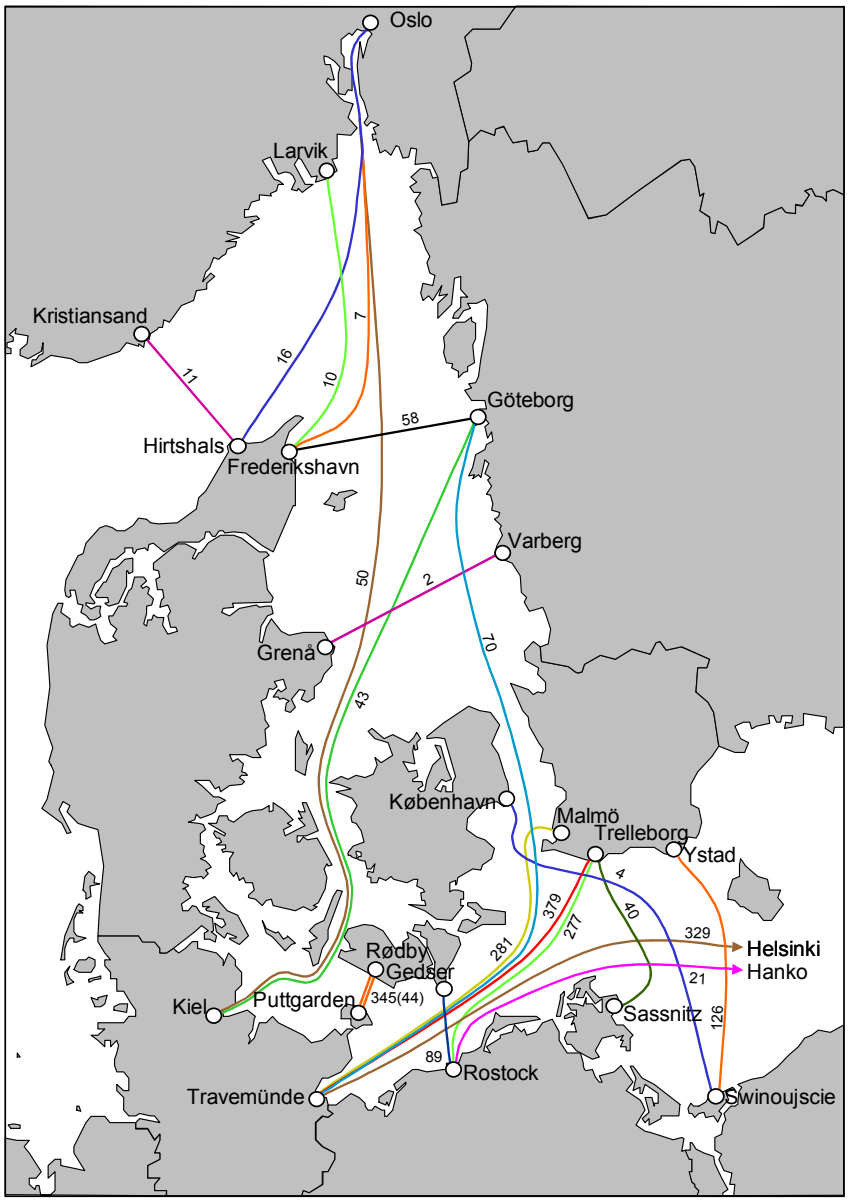

Figure 6.5.3: Number of lorries by ferry line, Scenario 4, 2015, 1000 lorries/year

In conclusion about Scenario 4 it can be said that the parallel ferry Rødby-Puttgarden, according to the model calculations, will make the Fehmarn Belt crossings a little more attractive in total than a fixed link only, which is assumed in Scenario 2. The ferry though is on an average day expected to carry about 8 % of the total number of passengers and only about 4 % of the freight flow.
The ferry will – with the specifications chosen – on an average day carry about 560 cars, 3 buses and 120 lorries. In comparison, in 2001 the Rødby-Puttgarden ferry connection carried 3.700 cars, 88 buses and 750 lorries.

The financial viability of the ferry connection has not been investigated.

7 FORECAST COMPARISON

In this chapter, the results of the different scenario tests are compared with each other and with the two base cases.

To sum up, the six different forecast runs for 2015 represent the following planning assumptions:

- *Base Case A*: in principle the *Integration Scenario* under the *Bundesverkehrswegeplanung*
- *Base Case B*: in principle the assumptions used for the 1999 forecasts of traffic demand on the Fehmarn Belt link with significant changes.
- *Scenario 1*: Base Case A assumptions with increased ferry supply for competing ferries
- *Scenario 2*: Base Case A assumptions with increased ferry supply and reduced fares for competing ferries
- *Scenario 3*: Base Case A assumptions with reduced ferry supply and raised fares for competing ferries
- *Scenario 4*: Base Case A assumptions with increased ferry supply and reduced fares for competing ferries (like Scenario 2) and a parallel ferry service between Rødby and Puttgarden.

7.1 Passenger Traffic

Table 7.1.1 summarises the total passenger flows between Denmark/Scandinavia and the continent by mode for the different forecasts.

Passenger traffic	**Base year**	**1999 Forecast**	**Base Case**	**Base Case**	**Scenario Forecasts 2015**			
1.000 pass./year	**2001**	**2010**	**A 2015**	**B 2015**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Rail passengers	854	1.069	1.537	1.423	1.528	1.525	1.549	1.525
Car passengers	8.498	10.612	12.042	12.427	12.066	12.102	11.984	12.112
Bus passengers	2.739	3.388	2.973	2.938	2.973	2.971	2.975	2.974
Air passengers	9.905	13.905	16.823	17.361	16.823	16.813	16.833	16.813
Walk-on pass.	1.929	3.085	1.850	1.850	1.922	1.974	1.728	2.145
Total passengers	**23.925**	**32.059**	**35.225**	**35.999**	**35.312**	**35.385**	**35.069**	**35.569**

Table 7.1.1: Total passenger flows between Denmark/Scandinavia and the continent, 1.000 passengers/year

The table reveals that the total number of passengers in 2015 is about 10 percent larger than the 1999 forecast for 2010 and that it only varies slightly between the scenarios.

The share of the different modes, though, varies somewhat, mainly for car passengers that have the highest numbers in scenarios 2 and 4. Both car and air passengers show a faster growth in the 2015 forecasts due to expectations of greater car ownership growth and lower air fares than in the old forecast.

Looking at the Fehmarn Belt passenger traffic larger variations of up to 1 mill. passengers can be found with the highest number for Scenario 3. In this scenario, the competing ferries are assumed to offer reduced services and high fares.

Passenger Traffic 1.000 pass./year	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	 Scenario 2	 Scenario 3	 Scenario 4
Rail passengers	352	1.835	1.497	1.386	1.488	1.485	1.509	1.485
Car passengers	4.058	5.792	6.598	6.809	6.331	6.099	7.082	6.109
Bus passengers	1.248	2.055	1.658	1.638	1.641	1.639	1.677	1.643
Walk-on pass.	718	680	0	0	0	0	0	172
1.000Passengers/year	**6.376**	**10.362**	**9.753**	**9.833**	**9.460**	**9.223**	**10.268**	**9.409**
Passengers/day	**17.468**	**28.389**	**26.720**	**26.940**	**25.918**	**25.268**	**28.132**	**25.778**

Table 7.1.2: Number of passengers crossing the Fehmarn Belt

This tendency is further illustrated by table 7.1.3 that presents both the number of persons travelling (by car, rail, bus and walk-on) and the number of cars in the relevant corridors between Denmark/Scandinavia and the continent. The largest number of cars using the fixed Fehmarn Belt link occurs in Scenario 3, and it has its lowest value in Scenario 4 where the parallel ferry carries about 200.000 cars/year (which is similar to the present traffic with the Gedser-Rostock line).

Passengers/Cars 1.000 units/year	Base year 2001	1999 Forecast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	 Scenario 2	 Scenario 3	 Scenario 4
Passenger traffic								
Norway/Sweden-Jylland	873	1.314	980	1.003	972	977	983	977
Oslo/Göteborg-Germany	1.056	1.516	1.181	1.208	1.179	1.179	1.183	1.179
Fehmarn Belt fixed link	6.376	9.682	9.753	9.833	9.460	9.223	10.268	8.694
Fehmarn Belt ferry	0	680	0	0	0	0	0	715
Other Denmark-Germany	1.172	2.684	1.837	1.915	1.998	2.118	1.623	2.116
Finland/Sweden-Germany	2.175	2.918	2.598	2.684	2.868	3.069	2.140	3.039
Denmark/Sweden-Poland	863	649	1.181	1.199	1.173	1.171	1.191	1.171
Total	**12.515**	**19.443**	**17.530**	**17.842**	**17.650**	**17.974**	**17.388**	**17.891**
Passenger cars								
Norway/Sweden-Jylland	244	386	301	308	298	300	302	300
Oslo/Göteborg-Germany	175	283	213	218	212	212	214	212
Fehmarn Belt fixed link	0	2.268	2.736	2.842	2.627	2.538	2.930	2.339
Fehmarn Belt ferry	1.357	0	0	0	0	0	0	204
Other Denmark-Germany	195	522	278	470	320	349	208	348
Finland/Sweden-Germany	396	771	640	661	723	795	488	795
Denmark/Sweden-Poland	198	149	271	275	268	267	275	267
Total	**2.565**	**4.379**	**4.439**	**4.774**	**4.448**	**4.461**	**4.417**	**4.465**

Table 7.1.3: Passenger traffic and cars by ferry corridors, 1.000 passengers or cars/year

Correspondingly, the competing ferries (Other Denmark-Germany and Finland/Sweden-Germany) have their lowest value in Scenario 3.

7.2 Freight Traffic

The total amount of freight by surface transport between Denmark/Scandinavia and the continent does not vary between the forecasts because it is not affected by transport costs. This is an attribute of the freight model that traffic generation does not depend on transport cost. This variable, however, controls traffic distribution, modal split and assignment.
Opposite to person traffic, Scenario 3 has the lowest amount of road transport while the railway attracts the largest share. This is due to the higher ferry fares for lorries in this scenario.

Freight traffic	**Base year**	**1999 Forecast**	**Base Case**	**Base Case**	**Scenario Forecasts 2015**			
1.000 t/year	**2001**	**2010**	**A 2015**	**B 2015**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Road	23.034	28.007	31.315	35.381	31.375	31.537	31.136	31.315
Rail conventional	5.579	11.643	12.587	8.677	12.532	12.377	12.760	12.587
Rail combined	999	3.029	2.021	1.865	2.016	2.009	2.027	2.021
Total freight	**29.612**	**42.679**	**45.923**	**45.923**	**45.923**	**45.923**	**45.923**	**45.923**

Table 7.2.1: Total freight flows between Denmark/Scandinavia and the continent, 1.000 tons

Freight traffic across the Fehmarn Belt (table 7.2.2) shows some variation between the scenarios with Scenario 3 at its highest for both road and rail transport. The lowest total value occurs with Scenario 2 because of the small amount of road freight.

Freight traffic	**Base year**	**1999 Forecast**	**Base Case**	**Base Case**	**Scenario Forecasts 2015**			
1.000 t/year	**2001**	**2010**	**A 2015**	**B 2015**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Road freight	4.434	5.553	6.426	7.206	6.070	5.292	7.332	5.370*
Rail freight	0	10.773	10.843	7.983	10.412	10.065	11.966	10.063
Total, 1.000t/year	**4.434**	**16.326**	**17.269**	**15.189**	**16.482**	**15.357**	**19.298**	**15.433**
Tons/day	**12.148**	**44.729**	**47.312**	**41.614**	**45.156**	**42.074**	**52.871**	**42.282**

* thereof 685.000 t by ferry

Table 7.2.2: Freight transport across the Fehmarn Belt

The number of lorries using the Fehmarn Belt varies considerably between the scenarios as a result of the fare and service variations of the competing ferries, table 7.2.3. The largest number of lorries over the fixed link occurs in Scenario 3. The parallel ferry in Scenario 4 would carry 44.000 lorries/year.

Freight traffic	Base year	1999 Forecast	Base Case	Base Case	Scenario Forecasts 2015			
1.000 lorries/year	2001	2010	A 2015	B 2015	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Norway/Sweden-Jylland	81	146	124	136	115	104	133	104
Oslo/Göteborg-Germany	140	138	192	211	181	163	209	163
Fehmarn Belt fixed link	0	481	413	452	390	340	471	301
Fehmarn Belt ferry	274	0	0	0	0	0	0	44
Other Denmark-Germany	62	48	86	93	91	89	74	89
Finland/Sweden-Germany	608	1.325	1.175	1.275	1.225	1.329	1.074	1.327
Denmark/Sweden-Poland	104	151	153	170	144	130	169	130
Total	**1.269**	**2.289**	**2.143**	**2.337**	**2.146**	**2.155**	**2.130**	**2.158**

Table 7.2.3: Number of lorries by ferry corridor, 1.000 lorries/year

7.3 Total Traffic on the Fehmarn Belt

The total road traffic consisting of cars, buses and lorries varies between 2,92 and 3,45 mill. vehicles/year in the four scenarios corresponding to between 8.000 and 9.450 vehicles on an average day.

Traffic across the Fehmarn Belt	Base year 2001	1999 Fore-cast 2010	Base Case A 2015	Base Case B 2015	Scenario Forecasts 2015 Scenario 1	Scenario 2	Scenario 3	Scenario 4 Total	Scenario 4 ferry only
1.000 Pass. cars/year	1.357	2268	2.736	2.842	2.627	2.538	2.930	2.543	204
1.000 Buses/year	32	59	47	47	47	47	48	47	1
1.000 Lorries/year	274	481	413	452	390	340	471	344	44
Total	**1.663**	**2808**	**3.196**	**3.341**	**3.064**	**2.925**	**3.449**	**2.935**	**249**
1.000 road vehicles/year									
Average daily traffic	**4.556**	**7693**	**8.756**	**9.153**	**8.395**	**8.014**	**9.449**	**8.041**	**682**
Vehicles/day									

Table 7.3.1: Total number of vehicles across the Fehmarn Belt

The 1999 forecast gave 7.700 vehicles/day in 2010 with a lower share of cars and a higher share of lorries (due to the smaller load factor in the old forecast).

The percentage of cars and lorries remain approximately the same through the scenarios.

In comparison with these numbers, it may be stated that the Great Belt fixed link in its first full year of operation, 1999, carried 18.800 vehicles/day. The Øresund fixed link carried 8.100 vehicles/day in its first full year of operation, 2001.

The next table shows the number of rail wagons and freight trains across the Fehmarn Belt. Here it must be noted that the number of freight wagons is model output as it is calculated according to the amount of freight forecasted while, on the other hand, the number of passenger trains is input to the passenger model and is a result of the assumed passenger train schedule. Therefore, the number of passenger train wagons is not calculated by the model.

The number of freight rail wagons is calculated to between 570.000 and 660.000 (19.100 to 22.100 trains) per year with its maximum in Scenario 3 where the low level of service and high fares of competing ferries cause a mode shift from road to rail across the Fehmarn Belt.

Traffic across the Fehmarn Belt	**Base year 2001**	**1999 Forecast 2010**	**Base Case A 2015**	**Base Case B 2015**	**Scenario Forecasts 2015**				
					Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4 Total**	**Scenario 4 ferry only**
1.000 Freight wagons/yr.	0	519	610	469	589	573	663	573	0
Freight trains/year	0	16.258	20.346	15.645	19.632	19.111	22.105	19.110	0
Passenger trains/year	3.280	15.660	14.740	14.740	14.740	14.740	14.740	14.740	0
Total number of trains Trains/year	**3.280**	**31.918**	**35.086**	**30.385**	**34.372**	**33.851**	**36.845**	**33.850**	**0**
Average daily traffic Trains/day*	**9**	**87**	**96**	**83**	**94**	**93**	**101**	**93**	**0**

* annual average day

Table 7.3.2: Rail traffic across the Fehmarn Belt

7.4 Evaluation of the likely Range of Traffic Demand

The different scenario assumptions may be characterised as follows:

- Scenario 4 seems unrealistic because it seems unlikely that a parallel ferry would be financially viable (Chapter 9).
- Scenario 3 seems very optimistic. A reduced ferry service would not be combined with higher fares.
- Scenarios 1 and 2 could represent likely reactions by ferry operators. The fare reduction could probably be the first action.
- Base Case B represents a much more liberal transport policy than Base Case A, which is the official government policy in Germany today.
- The amount of person and freight traffic depends upon the general economic development and traffic growth, especially in the light of the European integration.

Based upon these considerations and the scenario results the following range of fixed link traffic in the year of 2015 should be considered:

Units	Units/year	Units/day
Rail passengers	1,2-1,6 mill.	3.300-4.400
Car passengers	5,5-7,0 mill.	15.000-19.000
Bus passengers	1,5-1,8 mill.	4.100-4.900
Cars	2,3-3,0 mill.	6.300-8.200
Buses	0,05 mill.	140
Road freight	5,3-7,3 mill. tons	14.500-20.000
Rail freight	10,0-12,0 mill. tons	27.000-33.000
Lorries	0,34-0,47 mill.	940-1.300
Rail freight wagons	0,57-0,66 mill.	1.550-1.800
No. of vehicles on the fixed link	2,7-3,5 mill.	7.400-9.600

Table 7.4.1: Likely ranges of Fehmarn Belt traffic in 2015 based upon the tested forecast assumptions

7.5 Elasticities

7.5.1 Definition

The sensitivity of the traffic demand can be described by using elasticities. The elasticity expresses the percent change in the calculated traffic volumes due to a percent change in one of the parameters that have influence upon the traffic volume on the fixed link.

Calculations have been carried out for the influence that prices and supply level on the competing ferries have on the traffic volume on the Fehmarn Belt fixed link – the so-called cross-elasticity.

The cross-elasticities have been calculated for passenger traffic as well as for lorries.

7.5.2 Passenger Traffic

The influence of the ferry supply – cross-supply elasticity – has been calculated by comparing Base Case A and Scenario 1. In the same way the cross-price elasticity has been calculated by comparing Scenarios 1 and 2, respectively Base Case A and Scenario 3.

The calculations have been carried out for passenger cars, buses, and rail passengers.

Cross supply elasticities
In Scenario1 the ferry supply on the competing routes is improved by 25%, which resulted in a reduction in traffic volume on the fixed link. The calculations are shown in the following table 7.5.1:

	Traffic on fixed link Base Case A	Traffic on fixed link Scenario 1	Change in traffic	% Change in supply	Cross supply elasticity
Passenger cars /day	7.496	7.197	-4,0%	25,0%	-0,16
Buses/day	129	129	-	25,0%	n/a
Rail Passengers/day	4.101	4.077	-0,6%	25,0%	-0,02

Table 7.5.1: Cross-supply elasticities

Cross price elasticity

The cross-price elasticities have been calculated for higher and lower fares on the competing ferries. In Scenario 2, compared with Scenario 1, the fares on the competing ferries are 25% lower and, at the same time, the tolls on the Øresund connections are 25% higher. As these two effects cannot be separated, the elasticity shows the combined effect only.

The cross-price elasticities for lower ferry fares are calculated in table 7.5.2.

	Traffic on fixed link Scenario 1	Traffic on fixed link Scenario 2	Change in traffic	% Change in ferry fares	Cross price elasticity
Passenger cars /day	7.197	6.953	-3,4%	-25,0%	0,14
Buses/day	129	129	-	-25,0%	n/a
Rail Passengers/day	4.077	4.068	-0,2%	-25,0%	0,01

Table 7.5.2: Cross-price elasticities for lower fares on the competing ferries

In Scenario 3, compared with Base Case A (and Scenario 1), the fares on the competing ferries are 25% higher and, at the same time, the tolls on the Øresund connections are 25% lower. As these two effects cannot be separated, the elasticity shows the combined effect only

The cross-price elasticities for increased ferry fares are calculated in table 7.5.3.

	Traffic on fixed link Base Case A	Traffic on fixed link Scenario 3	Change in traffic	% Change in ferry prices	Cross price elasticity
Passenger cars /day	7.496	8.028	7,1%	25,0%	0,28
Buses/day	129	132	2,1%	25,0%	0,08
Rail Passengers/day	4.101	4.134	0,8%	25,0%	0,03

Table 7.5.3: Cross-price elasticities for increased fares on the competing ferries

The tables 7.5.1-7.5.3 show that the relative changes in the number of rail passengers are much smaller than the changes in the number of passenger cars. The tables also show a tendency towards higher relative changes in the traffic volumes from upward changes in the fares on the competing ferries compared to down ward changes and changes in the supply of the competing ferries. One has to bear in mind, though, that the calculations at the same time assume changes in the prices on the competing ferries and on the Øresund connections, and it is not possible to isolate the influence of these two changes of opposite directions.

7.5.3 Freight Traffic

Cross-supply elasticity
In Scenario1, the ferry supply is improved by 25% on the competing routes, which leads to a decrease in traffic volume on the fixed link. The calculation is shown in the following table 7.5.4:

	Traffic on fixed link Base Case A	Traffic on fixed link Scenario 1	Change in traffic	% Change in supply	Cross supply elasticity
Lorries/day	1.132	1.068	-5,6%	25,0%	-0,22
Freight wagons/day	1.671	1.614	-5,0 %	25,0 %	-0,22

Table 7.5.4: Cross-supply elasticity for lorries and freight wagons

Cross-price elasticities
The cross-price elasticities have been calculated by increasing the fares on the competing ferries as well as for decreased fares. In Scenario 2, compared with Scenario 1, the fares on the competing ferries are 25% lower and, at the same time, the tolls on the Øresund connections are 25% higher. As these two effects cannot be separated, the elasticity shows the combined effect only.

The cross-price elasticities for decreased ferry fares are calculated in table 7.5.5

	Traffic on fixed link Scenario 1	Traffic on fixed link Scenario 2	Change in traffic	% Change in ferry prices	Cross price elasticity
Lorries/day	1.068	932	-12,8%	-25,0%	0,51
Freight wagons/day	1.614	1.570	-2,7 %	-25 %	0,11

Table 7.5.5: Cross-price elasticity from decreased fares on the competing ferries

In Scenario 3, compared with Base Case A, the fares on the competing ferries are 25% higher and, at the same time, the tolls on the Øresund connections are 25% lower.

The cross-price elasticity for increased ferry fares are calculated in table 7.5.6.

	Traffic on fixed link Base Case A	Traffic on fixed link Scenario 3	Change in traffic	% Change in ferry prices	Cross price elasticity
Lorries/day	1.132	1.290	14,0%	25,0%	0,56
Freight wagons/day	1.671	1.816	8,7 %	25 %	0,35

Table 7.5.6: Cross-price elasticities from increased fares on the competing ferries

The tables show that for lorries there are much greater relative changes in the traffic from changes in the fares on the competing ferries compared to changes in the supply of the competing ferries. For rail freight wagons, this applies only for increased fares. Again, one has to bear in mind that the calculations at the same time assume changes in the fares on the competing ferries and on the Øresund connections, and it is not possible to isolate the influence of these two changes that go in opposite directions.

In most combinations, freight traffic – especially by lorry - has greater elasticities than passenger traffic, especially when looking at the influence of fares. The reason of this is that the average distance of the lorry trips is larger than for passenger car traffic and, therefore, that more alternative routes are available for truckers than for passenger car drivers. On many shorter relations, for example between Schleswig-Holstein and Eastern Denmark, a relation that has many passenger car trips, the different ferry corridors provide no real alternative. Traffic in these relations is more or less fixed to one or a few routes.

8 TREND FORECASTS FOR 2025

Two trend forecasts for the year 2025 have been carried out for each of the Base Cases A and B. The forecasts are carried out as a low and a high forecast for each Base Case.

The low forecasts are based upon the principle that the mode-specific traffic increase on the fixed link in the years 2015-2025 is equal to the increase per year from 2001 to 2015.The high forecasts are based upon the assumption that the mode-specific increase in the years 2015-2025 is at least twice as high as in the low forecasts, implying that the fixed link across Fehmarn Belt gives rise to a high degree of integration leading to a stronger increase per year than prior to the establishment of the fixed link.

The forecasts for 2015 reported above consist of both generic growth due to economic and demographic growth and to the effect of the introduction of the fixed Fehmarn Belt link, which includes a certain contribution of generated traffic. Generated traffic is here defined as the sum of induced traffic (new traffic), traffic that has changed mode, traffic that is redistributed to new destinations and rerouted to the fixed link from ferry connections – all as a consequence of the opening of the fixed link. The FTC passenger model takes account of all these contributions whilst the freight model does not include induced traffic.

Before calculating the generic growth the generated traffic is extracted from the 2015 forecast using the experience from the 1999 forecast.

8.1 Passenger Traffic

In the 1999 forecasts, the generated traffic in the 2+4 fixed link alternative in 2010 was calculated to the percentages of the total traffic in 2010 shown in table 8.1.1.

Mode	Generated traffic in 1999 forecast 2010 Percent of total traffic
Cars	41,9%
Buses	19,9%
Rail passengers	65,5%

Table 8.1.1: Generated traffic, 1999 forecast 2010 (2+4), percent of total traffic by mode

For cars and buses, the same percentages (rounded) are assumed for the generated traffic in 2015, i.e. 40% for cars and 20% for buses.

For rail passengers, a lower generated traffic is assumed as the railway system in the actual forecasts is less attractive than in the 1999 forecasts. The 1999 forecasts assumed high-speed trains between the Nordic capitals and major continental centres, compared with 'normal' IC trains Copenhagen-Hamburg and a max speed of 160 km/h in the actual forecasts. Also, the actual forecasts introduce low-fare air traffic, leading to tougher competition between rail and air traffic. On this basis, the generated traffic for rail passengers is estimated at 50% of the total traffic.

With this, the annual growth 2001-2015 without generated traffic can be calculated. In the low forecasts the average increase per year is extrapolated to 2025. In the high forecasts the increase per year is more than doubled in the period 2015-2025.

For Base Case A, the results are shown in table 8.1.2, while table 8.1.3 shows the results of Base Case B.

Mode	**Traffic 2001**	**Traffic 2015, Base Case A**		**Projection 2025, Base Case A**	
		without generated traffic	with generated traffic	low forecast	high forecast
Passenger cars /day	3.718	4.499	7.496	8.053	9.055
Buses/day	88	104	129	140	153
Rail Passengers/day	964	2.052[1]	4.101	4.261	4.500

Table 8.1.2: Number of cars, buses and rail passengers over the Fehmarn Belt link, average daily traffic, Base Case A
[1]. With redirection of trains from Great Belt to Fehmarn Belt

Mode	**Traffic 2001**	**Traffic 2015, Base Case B**		**Projection 2025, Base Case B**	
		without generated traffic	with generated traffic	low forecast	high forecast
Passenger cars /day	3.718	4.671	7.786	8.468	9.694
Buses/day	88	104	129	140	153
Rail Passengers/day	964	1.899[1]	3.797	3.848	3.924

Table 8.1.3: Number of cars, buses and rail passengers over the Fehmarn Belt link, average daily traffic, Base Case B
[1]. With redirection of trains from Great Belt to Fehmarn Belt

In order to get the number of passengers the number of cars and buses is multiplied by the average utilisation factor. This factor has been declining in recent years, and the trend is assumed to continue. In 2025, it is assumed that the average number of persons per passenger car will be 2,2 and per bus it is set at 32,8.

The resulting daily numbers of passengers and vehicles are shown in table 8.1.4 for Base Case A and in table 8.1.5 for Base Case B.

Passengers/day	Base year 2001	Base Case A 2015	Projection 2025, low	Projection 2025, high
Rail passengers	964	4.101	4.261	4.500
Car passengers	11.118	18.077	19.327	21.733
Bus passengers	3.419	4.542	4.611	5.045
Walk-on passengers	1.967	0	0	0
Total passengers	**17.468**	**26.720**	**28.199**	**31.278**
Cars/day	3.718	7.496	8.053	9.055
Buses/day	88	129	140	153

Table 8.1.4: Daily number of persons, cars and buses over the Fehmarn Belt link, Base Case A

Passengers/day	Base year 2001	Base Case B 2015	Projection 2025, low	Projection 2025, high
Rail passengers	964	3.797	3.848	3.924
Car passengers	11.118	18.655	20.323	23.266
Bus passengers	3.419	4.488	4.611	5.045
Walk-on passengers	1.967	0	0	0
Total passengers	**17.468**	**26.940**	**28.782**	**32.23593**
Cars/day	3.718	7.786	8.331	9.694
Buses/day	88	129	140	153

Table 8.1.5: Daily number of persons, cars and buses over the Fehmarn Belt link, Base Case B

8.2 Freight Traffic

In the 1999 forecasts, the generated traffic for lorries in the 2+4 fixed link alternative 2010 was calculated at 11,2 % of the total traffic in 2010. Thus, the generated traffic in the actual forecast is assumed to be 10% in 2015.

The average load per lorry in 2015 is 15,6 t. This is assumed to be applicable for 2025 too.

For rail traffic, the generated traffic in the 2+4 fixed link scenario 2010 was calculated to 7,2% of the total traffic in 2010. Thus, the generated traffic in the actual forecast is assumed to be 7% in 2015. The average increase 2001-2015 is calculated for the total rail traffic between Denmark/Scandinavia and the continent.

With these assumptions, the number of lorries, rail wagons and the transported volume of freight can be calculated as shown in the following tables.

Freight traffic	Base year 2001	Base Case A 2015	Projection 2025, low	Projection 2025, high
Road freight (1.000 t/year)	4.434	6.426	7.512	8.923
Rail freight (1.000 t/year)	4.806	10.843	14.638	18.683
Lorries per day	751	1.132	1.284	1.483
Rail wagons per day	740	1.671	2.252	2.877

Table 8.2.1: Freight traffic and daily number of vehicles on the Fehmarn Belt link, Base Case A

Freight traffic	Base year 2001	Base Case B 2015	Projection 2025, low	Projection 2025, high
Road freight (1.000 t/year)	4.434	7.206	8.718	10.684
Rail freight (1.000 t/year)	4.806	7.983	10.461	12.722
Lorries per day	751	1.238	1.499	1.836
Rail wagons per day	740	1.285	1.611	1.959

Table 8.2.2: Freight traffic and daily number of vehicles on the Fehmarn Belt link, Base Case B

8.3 Total Road Traffic

The total road traffic consists of cars, buses and lorries. Tables 8.3.1 and 8.3.2 show the total road traffic, which is illustrated in figure 8.3.1 and 8.3.2.

Daily Road Traffic across the Fehmarn Belt	Base year 2001	Base Case A 2015	Projection 2025, low	Projection high, 2025
Passenger cars	3.718	7.496	8.053	9.055
Buses	88	129	140	153
Lorries	751	1.132	1.323	1.571
Total daily traffic	**4.556**	**8.756**	**9.516**	**10.779**

Table 8.3.1: Total number of road vehicles across the Fehmarn Belt, Base Case A

Daily road traffic across the Fehmarn Belt	Base year 2001	Base Case B 2015	Projection low, 2025	Projection high, 2025
Passenger cars	3.718	7.786	8.486	9.694
Buses	88	129	140	153
Lorries	751	1.238	1.498	1.836
Total daily traffic	**4.556**	**9.153**	**10.124**	**11.683**

Table 8.3.2: Total number of road vehicles across the Fehmarn Belt, Base Case B

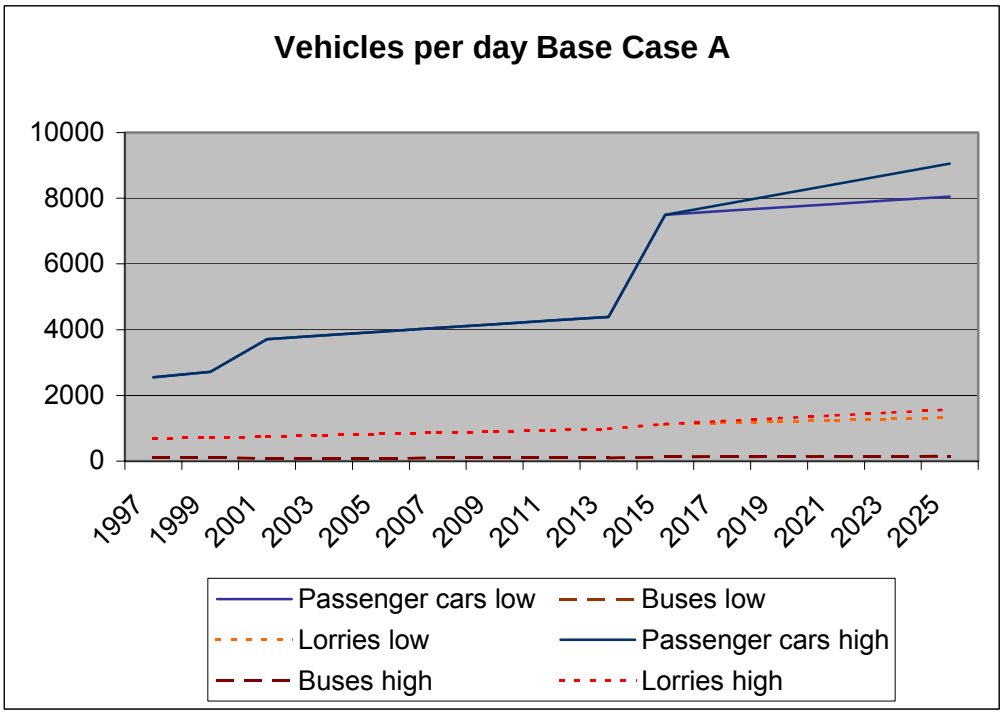

Figure 8.3.1: Trend projection to 2025 for road traffic, Base Case A, vehicles /day

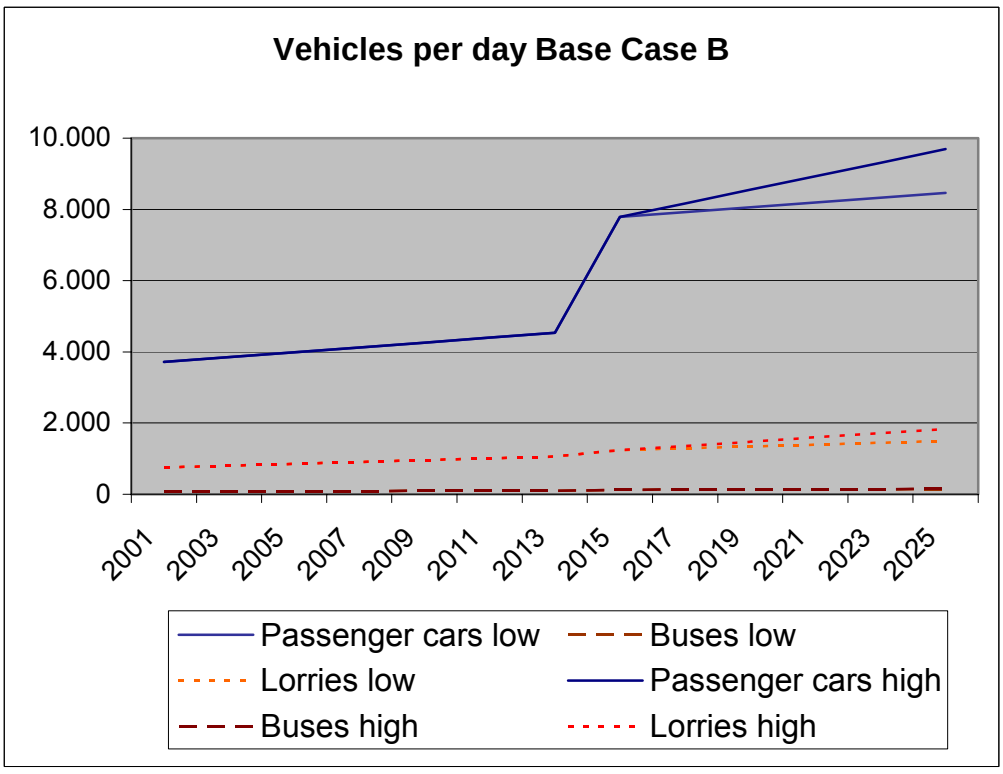

Figure 8.3.2: Trend projection to 2025 for road traffic, Base Case B, vehicles /day

9 COMPETITION FROM A FERRY PARALLEL TO THE FIXED LINK

In order to evaluate the possibility for a ferry service to attract sufficient traffic to be financially viable the experiences with parallel ferry services on the Great Belt and the Øresund after start of operation of the two fixed links have been analysed. Also experiences from the Channel Tunnel are briefly addressed.

This chapter summarises the results of the analysis. A detailed report by the *Fehmarn Bælt Development Joint Venture* can be seen in Appendix 5.

9.1 General Observations

Before evaluating the experiences, some general observations have to be made regarding the relevance of comparing the three fixed links with regard to the possibility of a ferry service running in parallel with a fixed link across the Fehmarn Belt.

The three fixed links are, due to their geographical location, oriented towards quite different 'markets'.

The Great Belt fixed link
The Great Belt Link most of all serves the purpose of a regional/national connection for road and railway traffic between the eastern and the western part of Denmark. The establishment of the fixed link as a toll road has shown that a barrier has existed between East and West Denmark as a result of the time consumption and the lack of immediate availability related to ferry services.

The vehicles crossing the fixed link travel distances of an average 200 km. It can be described as leisure passenger traffic, business traffic and lorry traffic between the two major parts of Denmark.

Due to the fact that the fixed link is a toll road local commuter traffic by car is at a quite low level. The railway serves the purpose of providing the means of transport for regular commuter traffic as the fixed link has made it possible to travel between the major cities of Denmark in a few hours.

The Øresund fixed link
From an overall point of view the Øresund fixed link is oriented towards two different markets. The first one is the local/regional market in the Øresund region with two large cities (Copenhagen and Malmö) and a quite dense population. The local market is both a market for commuter traffic and for other local traffic. It is estimated that it will take several years until the potential for integration in the region will be fully exploited. The second market consists of international traffic between Scandinavia and the continent.

The Fehmarnbelt
The crossing is situated in an area with a relatively low population density and also low industrial and commercial activity. Agriculture (on the Danish side) and the service sector (tourism) are dominating the economic activity in the local areas on both sides. The exchange of labour and trade of commodities between the two local areas is at a very low level. For that reason the traffic in the Rødby-Puttgarden corridor is dominated by long-distance transport between the central/southern part of Europe and Scandinavia, dominated by freight traffic on lorries, business travel and leisure traffic (concentrated in the summer months).

In general, it should be observed that the three links serve quite different purposes or markets. For that reason one should be very careful in comparing the development of the ferry services in the three areas before and after opening of the fixed link.

9.2 Experiences from the Great Belt and the Øresund fixed links

The Great Belt
Before the opening of the Great Belt fixed link for rail and road traffic a number of ferry routes serviced the traffic between east and west Denmark:

Great Belt Ferry routes before the fixed link:

- DSB train ferry, Korsør – Nyborg
- DSB/Scandlines ferry for road traffic, Halsskov – Knudshoved
- Vognmandsruten for road traffic, Korsør – Nyborg

As can be seen from the map (figure 9.1) ferry services on the Great Belt used the same corridor as the fixed link.

As a part of the political decision in 1986 to establish the fixed link across the Great Belt it was decided to close the two state-owned DSB ferry lines at the day of the opening of the fixed link's railway (June 1997) and motorway (July 1998).

Before the opening the motorway across the Great Belt, 'Vognmandsruten' proclaimed that it intended to continue its ferry service across the Great Belt in competition with the fixed link. The ferry line was serviced by a number of smaller Ro/Ro (double-ended) ferries offering a discount (low price and quality) product. Service time was approx. 75 minutes compared to 10-15 minutes on the fixed link.

The private ferries had their harbours very close to the centre of the cities of Korsør and Nyborg, which meant that access from hinterland motorways for private cars and lorries was not easy compared to the DSB ferry service and the fixed link, but on the other hand its route from city to city might attract 'local' traffic, especially private cars and smaller lorries.

Figure 9.1: Ferry services before opening of the Great Belt fixed link

The law governing the operation of the fixed link stated that the tolls for crossing the fixed link should be the same as the fares for the DSB ferries (subtracted the cost for driving across the fixed link).

This principle was partly abandoned for two reasons: A general popular pressure for lower prices in order to break down the barrier, that the ferry service has created and to create conditions for the Great Belt company, that would make prices on the Great Belt fixed link competitive, but still securing that the income from the traffic would make it possible for the Great Belt company to service loans obtained for financing the fixed link within a period of 30-40 years.

The table below clearly shows that a considerable growth in all traffic categories took place on the Great Belt after opening of the fixed link. The growth was composed of a transfer of traffic from other ferry routes and modes of transport (air), growth related to the general economic growth and new, induced traffic.

1.000 Vehicles per year					
Type of vehicle	**Vognmandsruten (1997) Korsør – Nyborg**	**DSB-ferry (Halsskov-Knudshoved) (1997)**	**Total Great Belt ferries (1997)**	**Great Belt fixed link (1999)**	**Change %**
Passenger cars	446	2.133	2.579	6.101	+137%
Lorries, total	141	301	443	757	+71%
Buses	3	15	18	30	+67%

Table 9.2: Number of road vehicles before (1997) and after (1999) opening of the fixed Great Belt link

Even before opening of the fixed link the ferry service 'Vognmandsruten' decided to cease operation when the motorway on the fixed link started operation in 1998.

The reason could well be that the ferry company found that, although it might be possible to offer competitive prices, it would not be able to attract sufficient traffic due to the fact that the availability of the fixed link would be superior and that the travelling time was at least one hour shorter on the fixed link.

The ferry fares (1997) and the toll rates on the fixed link (1999) are shown in the table below.

Toll rates/Ferry rates – Great Belt, DKK				
Type of vehicle	**Vognmandsruten (1997) (Korsør – Nyborg)**	**DSB-ferry ((1997) (Halsskov-Knudshoved)**	**Great Belt Tolls (1997)**	**Great Belt fixed link (1999)**
Passenger cars	270	315	285	210
Lorries (I) (<10 m)	500 – 720	504 – 840 *)	414 – 750	525
Lorries (II) (>10 m)	950 – 1,600	1,040 – 1,644 *)	950 – 1,554	835
Busses	450 – 990	N.A.	N.A.	785 – 2,335

*) Discounts of up to 23% were offered to lorry transport companies.

Table 9.3: Great Belt ferry fares and toll rates before and after opening of the fixed link

The figures are based on official information but it should be noted that the ferry companies offered several levels of discount rates for all types of vehicles, making a comparison with the toll rates on the fixed link rather difficult. For the same reason, it is also difficult to tell how much a ferry company would be able to lower the prices in order to pick up competition with a fixed link, as the actual average ferry rates are not known outside the ferry company.

Figure 9.2: fixed link and ferry routes in the Great Belt and the Kattegat, 1999

4 years after the fixed link opened still no ferry company has tried to start operation of a ferry service, even though the traffic flow across the Great Belt has grown rapidly. It might be concluded that ferry companies have found that parallel ferry service will have great difficulties in competing with a fixed link in terms of travelling time and availability.

Tolls/ferry fares are still a competitive factor in a situation where time consumption is almost the same as is the case for some of the passenger and lorry traffic between the northern part of Sjælland and the northern part of Jylland.

That is the background for the existence of the 3 ferry routes on the Kattegat. These ferry routes offer an alternative to the Great Belt fixed link.

The 3 ferry routes were all in operation before the fixed link. Due to the competition from the Great Belt fixed link the ferry company operating the three routes has upgraded its services considerable by introduction of high- speed ferries, etc. As an example the sailing time between Sjællands Odde and Ebeltoft has been reduced from 3 hours to 45 minutes.

All in all the ferries on the Kattegat routes maintain approximately 15 % of the total east-west market for lorry and passenger traffic.

A survey of travellers' choice of transport alternatives shows that about 70 % of all passengers say that the reason for choosing the Great Belt fixed link is travel time and availability, and only 10-15 % state that its is because of the price.

It should be noted that the Great Belt company is obliged to run a Kattegat ferry if private investors find it impossible to run it on a profitable basis. The same goes for the ferry service Skodsbjerg-Taars, which today is run by Scandlines but with financial support from the Great Belt company.

The Øresund fixed link
The transport system in the Øresund region is to some extent more differentiated than on the Great Belt.

Before the opening of the fixed link the following ferry services were in operation:

Copenhagen - Malmö corridor:

- Scandlines Dragør-Limhamn (vehicles and walk-on passengers)
- 'Flyvebådene' Copenhagen – Malmö (only walk-on passengers)
- 'Pilen' Copenhagen – Malmö (only walk-on passengers)

Helsingør - Helsingborg corridor:

- Scandlines for vehicles and walk-on passengers
- H-H Ferries for vehicles
- Sundbusserne for walk-on passengers
- Furthermore a railway ferry operated between Copenhagen and Helsingborg only carrying freight trains. This ferry line was closed when the fixed link opened for railway traffic and all freight trains were transferred to the fixed link.

The market for road transport across the Øresund can be divided into three parts:

- A local market for road vehicles and passenger traffic around the cities of Helsingør - Helsingborg and Copenhagen - Malmö.
- A market for international transport of goods, heavy vehicles and turists.
- A regional market more or less created on the basis of the fixed link across the Øresund.

The local market is more or less unaffected by the opening of the fixed link in the Helsingør-Helsingborg corridor, whereas the local market is expanded dramatically in the Copenhagen-Malmö area, as a direct consequence of the opening of the fixed link.

Figure 9.4: Øresund ferry routes, 1999

The international freight transport and leisure traffic across the Øresund is in total more or less unaffected by the opening of the fixed link, meaning that the transfer of traffic from the ferry routes between the southern part of Sweden to Germany has been quite limited.

The fixed link has provided a new transport corridor with faster and shorter access to and from the southern part of Sweden.

International transport companies perform their transports of goods on lorries based upon travel cost (distance) and time. For that reason, transport companies will – with the present relations of prices between the ferries and the fixed link – choose the ferries if the transports are going from/to the area north of Helsingborg in Sweden and the fixed link if transports are directed towards/from the southern part of Sweden.

As long as the frequency of the ferries is good (30 minutes between ferries) the 50 km longer distance via the fixed link to destinations north of Helsingborg the freight transport companies will tend to choose the ferries. For this traffic the fixed link will only be competitive under the assumption that the tolls on the fixed link are sufficiently low compared to the ferry fares to compensate for cost for driving the 50-60 km longer route across the fixed link.

To a large extent the same can be said for tourists going from/to Sweden to/from the continent unless there are queues on the motorway and/or the ferries, which is often the case in the summer months. Again, the availability/flexibility plays an important role for the customers.

Looking at the consequences for the ferry lines in the Øresund the following tables show the traffic before and after the opening of the fixed link:

Øresund Traffic, 1.000 units 1 July 1998 – 30 June 1999						
	Dragør-Limhamn	**Flyvebådene**	**H-H Ferries**	**Scandlines (H+H)**	**Sundbusserne**	**Total**
Passenger cars	319	-	550	1.720	-	2.589
Lorries	29	-	83	334	-	446
Buses	15	-	8	39	-	61
Walk-on passengers	-	3.421	-	-	2.018	-
Total Passengers	1.852	3.421	1.907	10.078	2.018	19.276

Table 9.4 : Number of vehicles and passengers on Øresund ferry routes, 1998/99, in 1000 units/year

Øresund Traffic, 1.000 units 1 July 2000 – 30 June 2001								
	Dragør-Limhamn	**Flyvebådene**	**H-H Ferries**	**Scandlines (H+H)**	**Sundbussern e**	**Øresundsbron Road**	**Train**	**Total**
Passenger cars	0	-	519	1.315	-	2.770	-	4.604
Lorries	0	-	111	292	-	138	-	541
Buses	0	-	6	35	-	39	-	80
Walk-on passengers	0	1.579	-		1.643	N.A.	4.858	
Total Passengers	0	1.579	1.869	8.234	1.643	8.169	4.858	26.352

Table 9.5: Number of vehicles and passengers on Øresund ferry routes and the fixed link, 2000/01, 1000 units/year

Already in November 1999, before the opening of the fixed link between Copenhagen and Malmö, Scandlines decided to stop operation of the ferry service between Dragør and Limhamn. This ferry line had as one of its primary sources of income the holiday tourism in the summer months and was probably carrying a loss in the winter months, due to low traffic volumes.

It can also be seen from tables 9.4 and 9.5 that the two ferry services between Helsingør and Helsingborg are in a strong competitive situation with each other on the one hand and with the fixed link on the other hand. The H-H ferries succeeded to expand the number of lorries carried by this ferry routes from 1998/99 to 2000/01, while the Scandlines routes lost approx. 40.000 lorries.

Flyvebådene continued after start of operation of the fixed link until November 2001. This ferry service was in direct competition with the new train services between the Central Stations of Copenhagen and Malmö for “city-to-city” transport of commuter traffic, shopping and one-day leisure traffic. The travel time was almost the same for the two traffic modes.

In November 2001 the ferry service closed down after realising a severe drop in the number of passengers from 3,9 million passengers in 1999/2000 to 1,6 million in 2000/2001.

In summary, all the ferry services in the Copenhagen – Malmö corridor have today closed down following the opening of the fixed link.

From the tables above it can be seen, that also the ferry services in the Helsingør – Helsingborg corridor have experienced a drop in the number of cars and passengers. But all the 3 ferry services are still in operation and, due to the general growth in traffic on the Øresund, the ferry services expect that in 2002 the number of cars on the two H-H routes will be back on 1999-level. The ferry services have maintained the number of ferries and the travel frequencies, which shows that the ferry companies see a high frequency/ availability as an important competition factor. Fares have been regulated downwards following the competition from the fixed link.

From the tables above it can be seen that a significant growth in total traffic across the Øresund between Denmark and Sweden took place after the opening of the fixed link. The total number of passengers (by car, train, bus) rose from 1998/99 – 2000/01 with approx. 37%. The number of vehicles rose by 64%.

It should also be noted that the fixed link across the Øresund had a market share for lorries of 30 % in 2002 compared to a market share to the ferry line Dragør-Limhamn of only 6% in 1999. On the other hand the ferries H-H have been able to maintain 68% of the lorry transport market by reducing fares.

The market shares of the Øresund fixed link are very different for passenger cars and lorries, figure 9.5.

The Øresund fixed link has a high share of the passenger car market due to the fact that two large cities are connected, which creates a market for commuter traffic, shopping and leisure traffic – while the market share for the lorry traffic to a large degree is a result of competitive transport costs between the two alternative routes. The market shares have been increasing since the opening year of the fixed link, 2000.

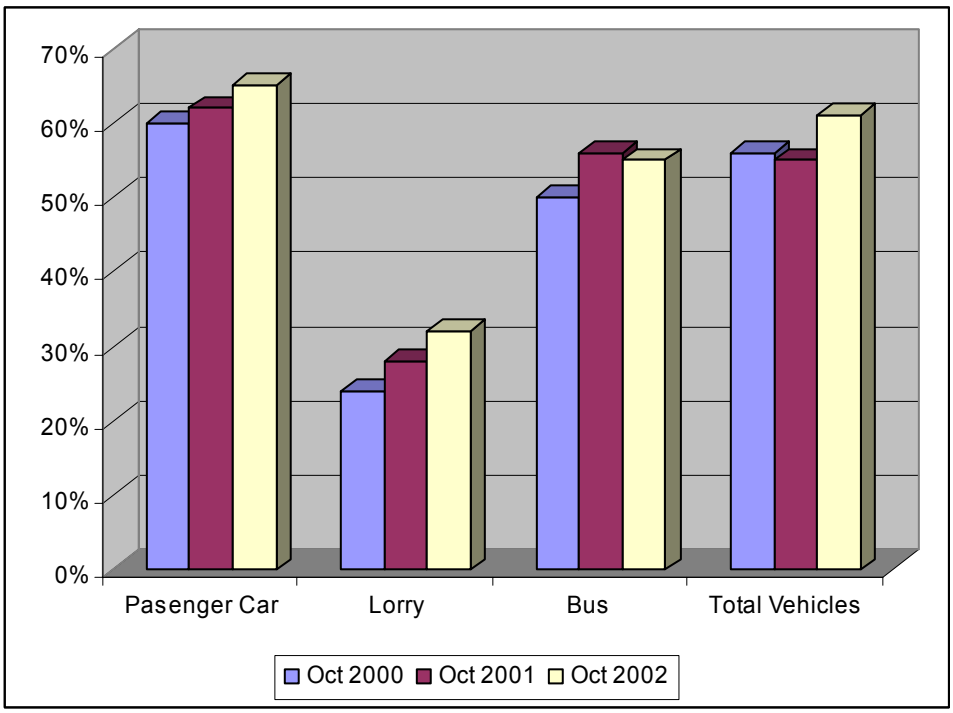

Figure 9.5: Øresundsbron's market shares 2000-2002

The Channel Tunnel Crossing
A comparison with the development of the ferry services on the English Channel after opening of the Channel tunnel might be of some relevance. It should be noted though that a shuttle train solution for transport of passenger cars, buses and lorries does not provide the same advantages as a combined fixed link for road and railway traffic in terms of availability and flexibility. In many ways, a shuttle train solution can be regarded as a transportation system similar to a ferry with respect to waiting time, travel frequency, ticket reservation, etc.

The market for transport between England and France is very different from the market between Germany and Denmark on the Fehmarn Belt. The Channel market is substantially larger and gives room for several ferry services of different quality. Alone in the Calais – Dover corridor 2 ferry services are running today in direct competition with the Channel Tunnel. One is a conventional ferry with a crossing time of 90 minutes and the other a high-speed ferry (Sea-Cat) with a crossing time of 50 minutes compared to a crossing time for the Channel Tunnel shuttle trains of approx. 35 minutes. Comparing the ferry fares with the shuttle train gives the following results:

Destination	Transport mode	Travel time in minutes	Price in Euro Passenger cars
Dover - Dunkirk	Ferry	120	170
Dover – Calais	Ferry	90	196
Dover – Calais	Sea-Cat	50	270
Channel Tunnel	Shuttle train	35	323

Table 9.6: Channel ferry services and Channel Tunnel

The ferry fares vary substantially depending on the length of the period between out- and inbound travel.
The ferry fares are substantially lower than prices on the Channel Tunnel shuttle trains when comparing prices for passenger cars.

It is not easy to draw a firm conclusion in relation to the business economy for continued ferry services parallel to a fixed link across the Fehmarnbelt on basis of the experiences from the Channel Tunnel, but one could get the impression that

- The demand at the Channel is sufficiently high to give room for several alternative ferry services sailing (almost) in parallel to the Channel Tunnel.
- The financial situation of the Channel Tunnel Company results in relatively high prices and, therefore, the business economy for the ferry companies is satisfactory.
- The competition between ferry companies, the shorter travelling time and the better availability of the Channel Tunnel results in a substantially lower price on the ferry services than for the tunnel.

9.3 General considerations and conclusions

It is clear that availability and flexibility is highly important for the customers' choice of transport route.

If it is assumed that the fixed link and a parallel ferry service compete for the same market the ferry fares will have to be set substantially lower in order to attract traffic to the ferries in the light of the fact that the fixed link provides an almost 100% availability/flexibility and a travelling time that is approximately 40 minutes faster than the ferries.

The question then is: Can a private ferry operator from a business economic point of view run a ferry service in parallel to a fixed link across the Fehmarn Belt?

The experiences from the Great Belt and the Øresund fixed links can only to a certain extent be used for assessing whether a parallel ferry route from a financial point of view would be able to survive competition from a fixed link.

The potential for walk-on passengers depends to a large degree on the differences in prices, incl. taxes, for specific consumer goods between Denmark and Germany. It is expected that today's differences will decrease with the general tendency within the EU to harmonise tax policies.

Furthermore, it is likely that bus services travelling on the fixed link would be a competitive alternative for walk-on passengers.

Train services could also be expected to win a share of this market.

A large part of the passenger car traffic forecasted on a fixed link is supposed to be business trips (25-30%). This type of traffic will most likely prefer the fixed link as this traffic is rather sensitive to availability and time consumption and less sensitive to price.

For lorry transport the decisive factors in choosing mode and route of transport are transportation costs and time consumption.

As the ferry has a travelling time of approximately 40 minutes longer than on the fixed link the ferry fares must probably be lower than the toll rates for the link to attract traffic. On the other hand, the time savings might not be that important in view of the total time consumption of a long distance lorry transport of 1000-2000 km.

For vacation and leisure traffic experience shows that travel time plays a major role for route choice. Ferry fares must be considerably lower than the toll on the fixed link to attract this type of traffic.

A decisive conclusion cannot be drawn out of the national experiences. A parallel ferry service very close to the fixed link on the Great Belt and Øresund has shown not to be able to survive, contrary to the situation on the Channel. As stated, there are great differences between these three situations, which makes it rather difficult to transfer the experiences directly to the Fehmarn Belt.

10 COMPETITION FROM THE GREAT BELT FIXED LINK

10.1 Background

The issue can be dealt with in three different ways:

1. An evaluation of the actual transfer of traffic from the ferry line Rødby-Puttgarden to the Great Belt fixed link after opening in June 1998.
2. A model based calculation of the transfer of traffic from the Great Belt fixed link to the Fehmarnbelt fixed link in the year 2015 (assumed opening year).
3. An overall evaluation of the competition relation between the two fixed links based on an evaluation of the transportation costs (incl. tolls) and the time consumption by choosing either of the two routes through Denmark.

10.2 Results of Earlier Studies

10.2.1 Sund & Bælt Evaluation

Sund & Bælt have investigated the composition of the traffic on the Great Belt fixed link, incl. a calculation of the transfer of traffic from the ferry service Rødby – Puttgarden to the fixed link[29].

In general, surveys have shown that only approx. 3% of the traffic on the Great Belt fixed link has its origin or destination in Germany. The potential transfer of car traffic to a fixed link across the Fehmarn Belt must be considered low.

The calculation shows that the transfer of traffic from the ferry line Rødby - Puttgarden to the Great Belt fixed link in 1998/1999 was as follows:

Passenger cars:
The transfer from the ferry line Rødby-Puttgarden was 1,3 % of the traffic on the Great Belt fixed link in 1999, corresponding to a reduction of 7,8 % for the Rødby - Puttgarden ferries.

Lorries:
The transfer was 2,5 % of the traffic on the Great Belt fixed link corresponding to a reduction of 6,9 % for the Rødby/Puttgarden ferries.

10.2.2 Carl Bro/FTC Evaluation

In May 2000 the Carl Bro a/s made a similar calculation based on the Fehmarn Belt traffic model[30]. The calculation made by Carl Bro illustrates the opposite process: how much of the traffic on the Fehmarnbelt fixed link in the year 2010 will be traffic transferred from the Great Belt fixed link.

[29] Sund & Bælt Holding A/S: Konkurrenceforholdet mellem Femer Bælt og *Great Belt*, notat af 23. oktober 2002 (in Danish).
[30] Carl Bro A/S: Trafik over *Great Belt* i Femerbælt modellen, Notat til Trafikministeriet, dateret 11. maj 2000 (in Danish).

The calculations showed that:

Passenger cars:
The Great Belt fixed link would loose approx. 1,9 pct. of the estimated traffic in the year 2010

Lorries:
The Great Belt fixed link would loose approx. 0,8 pct. of the estimated traffic in the year 2010

10.2.3 Overall Evaluation

The investigation made by Sund & Bælt, which was based on 1500 O/D interviews with travellers using the Great Belt, has shown that the Great Belt fixed link is most of all used by national Danish transport (approx. 97 %).

On that basis it can be concluded that only customers for whom the availability and flexibility in the transport system played a major role were transferred to the Great Belt fixed link, whereas costumers for whom the transportation cost plays a distinct role still choose the Rødby – Puttgarden route.

Vice versa, it can be concluded that the number of vehicles transferred to a fixed link across the Fehmarn Belt will be quite limited. This was confirmed by the model calculation carried out by Carl Bro.

The main reason for this is that the transport route between Sweden/Copenhagen and Hamburg via Rødby-Puttgarden is approximately 150 km shorter, than the route via the Great Belt. The transportation cost for both passenger cars and lorries - in this context defined as the cost per driven kilometre + the fare/toll – is substantially lower for the shorter route via Rødby – Puttgarden (see appendix 4).

After the opening of a fixed link across the Fehmarn Belt the competition relationship is expected to be changed back, as the two fixed links will have the same degree of availability and flexibility.

For a situation with a fixed link across both the Great Belt and the Fehmarnbelt it can, therefore, be expected that the overwhelming part of the passenger car and lorry traffic between Scandinavia and the continent passing through Denmark, as a consequence of the substantially higher cost for using the 150 km longer route via the Great Belt, will choose the Fehmarn Belt fixed link like most of them do today, unless the difference in tolls is very (unrealistically) high.

10.3 Conclusion

It can be concluded that the competition relationship between the Great Belt and a fixed link across the Fehmarn Belt is rather modest. Surveys have indicated that only approx. 3% of the road traffic on the Great Belt fixed link has its origin or destination in Germany. Furthermore, evaluations and model calculations have shown that the amount of traffic that was transferred from the ferries Rødby - Puttgarden to the Great Belt fixed link after opening in 1998 was approx. 2 %. Correspondingly, this amount can be expected to be transferred back to a Fehmarnbelt fixed link after opening.

The major part of the existing road traffic between Scandinavia (east of the Great Belt) and Northwest Germany passing through Denmark uses the considerably shorter route via Rødby-Puttgarden, because this route is much more cost-effective.

Unless the toll rates on the two fixed links will differ substantially in favour of the Great Belt, this will also be the case after establishment of a fixed link across the Fehmarn Belt.

APPENDICES

1. **Detailed Results Passenger Traffic**
2. **Detailed Results Freight Traffic**
3. **Tabulation of Ferry Load Figures**
4. **Competition between the Fehmarn Belt and the Great Belt Fixed Links**
5. **Development in Ferry Services after Start of Operation of the Fixed Links across the Great Belt and the Øresund**