FIXED LINK ACROSS FEHMARNBELT

Trafikministeriet, København

Bundesministerium für Verkehr, Bau- und Wohnungswesen, Berlin

Financial Analysis, Traffic Forecast and Analysis of Railway Payment

Summary Report

March 2003

FIXED LINK ACROSS FEHMARNBELT

Financial Analysis, Traffic Forecast and Analysis of Railway Payment

Summary Report

March 2003

Commissioned by:

The Ministry of Transport
Frederiksholms Kanal 27
DK-1220 Copenhagen K
Tel. +45 3392 3355
www.trm.dk

The Federal Ministry of Transport,
Building and Housing
Invalidenstrasse 44
D-10115 Berlin
Tel. +49 30 20 08 0
www.bmvbw.de

Supported by:

The European Commission

TABLE OF CONTENTS PAGE

INTRODUCTION

In December 2000 the Ministries of Transport of Germany and Denmark decided to launch an Enquiry of Commercial Interest (ECI) to investigate the Private Sector's interest in implementing a Fixed Link for road and railway traffic across the Fehmarnbelt.

The result of the ECI process was published in June 2002.

The ECI process revealed that the Private Sector had a clear, positive interest in participating in the realisation of the Project, but also that important commercial risks are associated with the Project.

The forecasted future income from the Project was considered too low to support a Private Sector investment and uncertain in part due to the competition from other modes (ferries) and routes (the Great Belt).

The conclusion from the ECI is that the Project can only be realized with substantial public support either in form of guarantees or direct Government Support.

At a meeting between the Ministers of Transport of Germany and Denmark in Berlin on 13 June 2002 it was agreed to review some of the most important questions regarding the commercial risks involved in the Project, including the traffic forecasts and the revenue from both the road and railway traffic.

The studies have been supported financially by the European Union through the TEN-T Programme.

In this report the results of these studies are presented.

In Chapter 1 a summary of the most important findings and conclusions is presented.

In Chapter 2 the results of a Financial Analysis are presented based on new assumptions regarding traffic volumes, toll levels and railway operator's payments for the use of the Fixed Link. The financial calculations are made for two in principle different organisational models: a traditional BOT-model and a state guaranteed PPP-model.

In Chapter 3 the results of the updated Traffic Demand Forecast 2002 are presented.

In Chapter 4 the ongoing discussions between Germany and Denmark regarding the capacity requirements of the railway between the two countries are addressed.

In Chapter 5 the results of a study of the railway sector's ability to pay for the use of the Hamburg-Öresund Railway Corridor are summarised.

Ministry of Transport, Building and Housing, Germany

Ministry of Transport, Denmark

March 2003

1. SUMMARY

1.1 Conclusion of the new analysis

The most important conclusions form the new financial analysis, the new traffic forecast and the analysis of the railway payment are:

- The Government Support needed for a BOT-model amounts to approx. 1,500 – 1,600 m EUR (NPV), corresponding to 50-60 % of the total investment.

- The Debt Payback Period for a State Guaranteed Model will be 33-37 years and no direct financial support will be needed from the states.

- The most important factors influencing the financial viability of the project are the *toll levels* for the road traffic, the level of the *payments from the railway operators* using the Fixed Link and the *real interest rate.*

- The new traffic forecasts show no dramatic changes in total traffic across the Fixed Link compared to the previous traffic demand forecast from 1999.

- The number of road vehicles crossing the Fehmarnbelt Fixed Link in 2015 is estimated to 8.750 – 9.150 in average per day of which 1.100 – 1.200 will be lorries corresponding to 400,000 to 440,000 lorries/year transporting 6–7 mio. tons of freight per year.

- The analysis of the railway sector's ability to pay for the use of the railway on a Fixed Link shows that the possible revenue amounts to approx. 50 m EUR per year (2002-prices). This estimate is based on savings in infrastructure charges and operating costs for a 160 km shorter route.

- Approx. 4.000 passengers are expected to use the train services per day.

- The amount of railway freight transported across a Fehmarnbelt Fixed Link will be approx. 8-11 mio. tons a year, corresponding to approximately 75 % of all freight transported on the railway between Denmark/Scandinavia and the Continent.

- The traffic demand forecasted for the Fixed Link is quite insensitive to changes in assumptions regarding user cost for different transport modes, competition from ferries and changed toll levels on the Fixed Link. Lorry traffic seems to be

more sensitive to competition from Baltic Sea ferry fares, than passenger car traffic.

- Only if the difference between the toll levels of the Fixed Links across the Great Belt and the Fehmarnbelt is substantial in favour of the Great Belt, the road traffic will consider the 150 km longer route via the Great Belt.

1.2 Financial Analysis

1.2.1 Background and Objectives

In 2001/2002 an ECI (Enquiry of Commercial Interest) was carried out where the Private Sector's interest in the implementation of the Fehmarnbelt Fixed Link project was investigated. On the basis of the Private Sector's response different Business Cases were developed in order to illustrate how the Private and Public Sector could organize themselves in order to realize the project under financially viable conditions.

On basis of subsequently updated traffic forecasts (in the following called the "2002-traffic forecasts") and an assessment of the railway payment described in the following chapters a new financial analysis of two in principle different "Business Cases" have been carried out.

The first of the two Business Cases is a BOT-model (Build-Operate-Transfer), where a Private Sector Concessionaire is given the responsibility – and thus carries the major part of the risks involved - for the design, construction, operation and financing of the Fixed Link for a 30 year operation period.

The second Business Case is called a State Guaranteed Model, where the Governments carry the major part of the risks involved in the project and where the financing raised on the private international financial markets is covered by state guarantees.

1.2.2 The new financial calculations

Assumptions

The new financial calculation – in the following called the "February 2003 calculations" [Ref. 8] have - apart from the updated traffic forecasts and the assessment of the railway payment - been based upon the same financial assumptions as the previous calculations presented in the report of the "Enquiry of Commercial Interest" (ECI) from June 2002 [Ref. 4].

Among the most **important assumptions** can be mentioned:

- Real interest rate 4 % p.a.
- Inflation 2.5 % p.a.
- Risk premium 2% p.a.
- Corporate tax 34 %
- Traffic growth 1.7% p.a. (2012 – 2041)

Toll rates

The basis for **the tolls** in the updated traffic forecast has been the fares on the existing ferry line between Rødby and Puttgarden. The toll for passenger cars is the list price 46 EUR in 2002-prices (incl. VAT). This corresponds to 60 EUR in 2012 prices. However, according to the current EU VAT-laws transport of passenger cars by ferry is exempted for VAT, but the toll for passenger cars paid for passing a Fixed Link is subject to VAT. The net result of this difference is a reduced income for the project, corresponding to the VAT on tolls for passenger cars. The reduction due to VAT is 10 EUR (VAT 20.5%). Therefore the income for the project per passenger car is 50 EUR (2012-prices).

The tolls for lorries and buses are estimated average ferry fares where different forms of discounts have been taken into account.

On the basis of an analysis of the railway sectors ability to pay for the utilization of the Fixed Link across Fehmarnbelt the annual possible **payments from railway operators** gaining access to the link have been estimated to 50 m EUR, corresponding to 64 m EUR in 2012-prices.

In order to compare the financial calculations with the calculations presented in the ECI-report the toll rates and the railway payments are calculated in 2012-prices.

Table 1.1: Tolls for road traffic and railway payment for passing the Fehmarnbelt Fixed Link

EUR excl VAT 2012-prices	February 2003 calculations
Passenger cars	50
Lorries	243
Buses	268
Railway payment (m EUR)	64

2002 - Traffic forecasts

The updated forecasts are presented for two Base Cases with the following main characteristics:

Base Case A: In principle this traffic scenario follows the planning assumptions used in the ongoing German Transport Infrastructure Planning/Bundesverkehrswegeplanung (BVWP). This traffic scenario assumes higher running speeds and reduced loading/unloading and transport times for rail freight.

Base Case B: This traffic scenario is basically an extrapolation of the recent development in the transport sector, meaning that passenger car and lorry traffic will be cheaper and user costs for railway transport will be unchanged.

Both scenarios assume the same ferry routes as existed in 2002 (except for Rødby-Puttgarden).

To test the sensitivity of the traffic forecast 4 additional scenarios based on changed fares and service levels of competing Baltic Sea ferry services have been carried out.

Table 1.2: Road Traffic forecasts

Vehicles pr. year	2002-forecast Base Case A assumptions **Year 2015**	2002-forecast Base Case B assumptions **Year 2015**
Passenger cars	2,736,000	2,842,000
Trucks	413,000	452,000
Buses	47,000	47,000
Total	3,196,000	3,341,000
Average daily traffic	8,756	9,153

Due to the differences in user costs in Base Cases A and B, the road traffic volume is higher in Base Case B.

Revenues

Based on the above mentioned forecast of the expected road traffic, the assumed toll rates and the Railway sector's payment for the utilisation of the Fehmarnbelt Fixed Link, the revenue from the traffic has been calculated in table 1.3.

Table 1.3: Revenue in 2012 for the two Base Cases

M EUR 2012-prices	2002-forecast Base Case A	2002-forecast Base Case B
Passenger cars	104	108
Lorries	76	83
Buses	10	9
Income Road	190	200
Railway	64	64
Total	254	264

The revenue is calculated for an assumed opening year in 2012 taking into account that the first 4 years of operation will be a "ramp-up" period, where the traffic will be 20, 15, 10 and 5% lower than forecasted. This "ramp-up" period is introduced to reflect the fact, that customers might need some time to adjust to a new, faster and more direct transport route between Scandinavia and the Continent.

1.2.3 Conclusions of the 2003 - Financial Analysis

The results of the new financial analysis based on the updated traffic forecast, the assumed toll rates and the new railway payment for the chosen models (BOT and State Guaranteed model) are shown in table 1.4 below.

Table 1.4: Results of financial calculations for BOT-model and State Guaranteed model.

	Base Case A	Base Case B	Scenarios 1 – 4
Government Support BOT-model m EUR, NPV (2002)	1,561	1,467	1,410 – 1,851 [1)]
Debt Payback Period State Guaranteed Model (number of years)	37	33	32- 55 [1)]

1) The sensitivities are tested in 4 scenarios. A Government Support of 1,851 m EUR or a Debt Payback Period of 55 years is calculated for the least favourable scenario where a ferry service is operating in parallel to a Fixed Link Rødby-Puttgarden. A Government Support of 1.410 m EUR or a Debt Payback Period of 32 years is calculated for a scenario where fares on competing Baltic Sea ferry services are raised with 25%.

For the BOT-model a Government Support in the order of 1.500 - 1.600 m EUR (NPV) is calculated. The amount corresponds to an annual support of 258 m EUR and 243 m EUR respectively in the operation period (2012-2041) and should be viewed in relation to the total investment of app. 2.800 m EUR (NPV) 2002-prices, excl. interests.

The relevant result for the State Guaranteed model is the Debt Payback Period, which is calculated to 33-37 years.

1.3 The Fehmarnbelt Traffic Study

1.3.1 Introduction

The German and the Danish ministries of transport performed preliminary investigations for a Fixed Link across the Fehmarnbelt during 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 [Ref. 2].

The 2001-2002 Enquiry of Commercial Interest (ECI) regarding a Fehmarnbelt Fixed Link revealed among the commercial risks the likelihood of a parallel ferry operation next 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.

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

1.3.2 Background and objective

This study of the traffic demand on a fixed Fehmarnbelt link is an update of previous investigations and evaluations carried out by Fehmarnbelt Traffic Consortium (FTC) on behalf of the two national ministries of transport [Ref. 5].

The traffic study has basically three purposes:

Extension of the forecast horizon until 2015 with projections to 2025 by utilising the results of the ongoing Federal German Transport Infrastructure Planning (*Bundesverkehrswegeplanung)*.

Include the recent 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 Fehmarnbelt.

Test the sensitivity of the traffic demand on a Fixed Link towards the competing ferry supply.

In addition, the role of the Great Belt Fixed Link for the traffic demand and the Fehmarnbelt Fixed Link has been evaluated.

1.3.3 Base Cases and scenarios

The updated traffic forecasts are presented for two Base Cases with the following main characteristics:

- **Base Case A***:* in principle the so-called *Integration Scenario* under the German *Bundesverkehrswegeplanung* (German Federal Transport Infrastructure Planning) with Baltic Sea ferry supply 2002

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

Basically the difference between the two Base Cases is related to expectations to the development in user costs for the different modes of transport. For Base Case A it is assumed that the development will be in favour of railway transport and therefore more environment friendly. Base Case B assumes to a high degree that the recent development will continue, meaning that railway transport will not regain market shares lost in the past 10-15 years as expected for Base Case A.

In addition to the Base Cases, it has been decided to test how sensitive traffic on a Fixed Link is to more intense ferry competition.

To a certain degree competition for passenger car and lorry transport will exist between the Baltic Sea ferry services and the Fehmarnbelt Fixed Link.

For passenger cars competition will probably be limited as total travel costs for the routes will be less important than time consumption. But for lorry transports the competition will be stronger because lorry transport distances are longer and therefore more alternative routes are available.

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.

When changing the fares for the competing Baltic Sea ferries, the fares/tolls for crossing Øresund (by ferry or Fixed Link) are changed in the opposite direction as the Øresund crossings serve as the "feeding" routes to a Fixed Link across Fehmarnbelt for traffic between Sweden and Germany through Denmark.

The four scenarios are:

- **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.

1.3.4 Results

In table 1.7 below the results of the new traffic forecast is presented together with the figures for the Base Year 2001.

Table 1.5: Road Traffic, Fehmarnbelt Fixed Link

Vehicles/day (ADT)	Ferry Rødby-Puttgarden 2001	Forecast 2015 Base Case A	Forecast 2015 Base Case B	Sensitivity 2015 scenarios 1 – 4
Passenger cars	3,700	7,500	7,800	7,000 – 8,000
Lorries	750	1,100	1,200	900 – 1,300
Buses	100	150	150	150
Total	4,550	8,750	9,150	8,000 – 9,450

The new forecast shows for the two Base Cases that 8,750 – 9,150 road vehicles are expected to use the Fixed Link in 2015 per day. This is 1,000-1,400 more vehicles per day more than in the 1999-forecast, of which 600-700 can be ascribed to the fact that the new forecast's horizon is 2015 compared to 2010 previously.

The higher number of vehicles compared to the 1999-forecast can amongst others be ascribed to the fact that the growth in the traffic between Scandinavia and the Continent during the period 1994/96 – 2001 has been quite high, but also the general economic development, the development in user costs for the different transport modes, etc. have an influence.

The number of passenger cars crossing the Fixed Link in 2015 has furthermore grown compared to the 1999-forecast due to the assumption that the toll rate used in the forecasts is lowered to 46 EUR (same as the ferries today) from 67 EUR which was assumed in the 1999-forecast.

In 2015 the number of lorries is expected to be 1,100 – 1,200, which is considerably more than today, but lower than in the 1999-forecast. The major reason for this is that the statistical basis has been improved. The lorry transport load factor appears to be much higher, which results in a lower number of lorries required to transport more tonnes.

The drop in the bus traffic is partly a result of the tendency of air transport becoming cheaper, partly due to a general tendency for reduced international bus transport.

In table 1.6 below the new forecast for railway transport is presented.

Table 1.6: Rail Traffic Fehmarnbelt Fixed Link

Rail transport/day	Ferry Rødby-Puttgarden 2001	Forecast 2015 Base Case A	Forecast 2015 Base Case B	Sensitivity 2015 scenarios 1 – 4
Rail passengers	964	4,100	3,800	4,000 - 4,100
Rail freight per day (tons)	0 [1)]	29,700	21,900	27,600 – 32,800
Trains per day (passenger/freight)	7 / 0 [1)]	40 / 56	40 / 43	40 / 61

1) All freight trains are routed via the Great Belt

The number of Railway Passengers is expected to be 3,800 – 4,100 per day for the two Base Cases. The number is reduced in the new traffic forecast due to the general decrease in the recent years, which probably can be ascribed to the increased supply of cheap air transport. Another reason is that a high speed railway Hamburg – Copenhagen is no longer planned for.

The Railway Freight Transport is forecasted to be approx. 22,000-30,000 tons per day or 8-11 mio. tons per year in 2015. For Base Case A, which generally favours rail transport the market share for the railway will amount 32% of all freight transport between Denmark/Scandinavia – Continent. For Base Case B the market share will be 23% - or almost the same as today. Overall approx. 75% of all freight transport on rail between Scandinavia and the Continent will use the Hamburg – Fehmarn – Copenhagen/Malmö corridor.

1.3.5 Sensitivity to competition

In order to test the sensitivity to competition from ferry routes between Sweden and Germany a number of forecasts for 2015 have been run. The tests show that the lorry traffic is more sensitive to competition from competing ferries than the passenger traffic.

In general the sensitivity is rather low, meaning that even substantial differences between ferry fares and tolls on the Fixed Link only give modest changes in the traffic volumes on the Fixed Link.

The competition from the 150 km longer alternative road transport route between Hamburg – Øresund Region via the Great Belt Fixed Link has shown that:

- Only a marginal part of the existing traffic on the Great Belt is international traffic that could be transferred to the Fehmarnbelt.

- That the difference in toll levels favouring the use of the Great Belt could be quite substantial before passenger car and lorry traffic would be transferred to the Great Belt. Presently, the extra cost of travelling via the Great Belt, including travelling time cost, is for a passenger car calculated to 22-37 EUR and for a lorry transport to 100 – 125 EUR. The Great Belt Fixed Link will not be a significant competitor unless the difference in toll levels is of this magnitude.

1.3.6 Conclusion of the Traffic Study

The traffic forecasts - run under different planning assumptions - show that the number of vehicles crossing the Fehmarnbelt Fixed Link in 2015 will be around 8,750–9,150 vehicles per day.

The train passenger traffic is expected to be around 4,000 passengers a day – corresponding to 40 nos. IC3 – units a day.

The freight transport on rail on the Fixed Link will for Base Case A gain a substantial market share from 22% to 32%. In general 75% of all rail freight transport between Scandinavia and the Continent will use the Fehmarnbelt Fixed Link. The total amount of rail freight transported across the Fehmarnbelt Fixed Link is forecasted to be approx. 8-11 mill. tons in 2015.

The traffic seems to be quite stable and not very sensitive to even substantial competition relative to other routes and modes of transport. Unless toll level on the Fehmarnbelt and the Great Belt Fixed Links are very different a competition situation will not arise.

Trend Forecasts were carried out based on the assumption that there is an annual growth in road traffic of 0.8-2.5%. The result is that the number of vehicles in 2025 will be 9,500-11,700 vehicles per day.

1.4 Improvements of the railway capacity

At present, all railway freight transport between Denmark/Scandinavia and Germany/Continent through Denmark is directed via the Great Belt Fixed Link.

The majority of the railway passenger transport between Copenhagen and Hamburg is directed via the ferry route Rødby-Puttgarden.

If a Fixed Link across the Fehmanbelt is realized it is assumed that all railway traffic between the Øresund Region (Copenhagen/Malmö) and Hamburg will be directed via the shorter route across the Fehmarnbelt Fixed Link.

In order to cope with the forecasted railway traffic an upgrading of the existing railway line on land in Germany and Denmark to double track and electrification will be needed along with a removal of certain bottlenecks in the Schleswig-Holstein area already needed today.

If the Fixed Link is realized an expansion of the railway to double track will be needed between Puttgarden – Lübeck in Germany and between Orehoved – Rødby in Denmark. Electrification would be needed between Lübeck and Ringsted.

In a situation where the Fixed Link is not realized the railway freight traffic will still be directed via the Great Belt.

In that situation a need for upgrading to double track of 2 stretches (Vamdrup – Vojens and Tinglev – Padborg) in the Southern part of Jutland together with a removal of bottlenecks in the Schleswig-Holstein area will be needed.

In the following the railway sector's ability to pay for the use of the Fixed Link in 2015 is addressed under the assumption that all passenger and freight traffic passing through Denmark on rail is directed via Fehmarnbelt.

1.5 Railway infrastructure payment

1.5.1 Background and objective

In the 1999-feasibility studies [Ref. 3] only a rough assessment of the railway sector's ability to pay was made. Therefore the Ministries of Transport have decided to carry out a more comprehensive analysis of the railway operators' ability to pay for the use of the railway corridor via the Fehmarnbelt Fixed Link [Ref. 6].

The analysis is based on the prevailing market conditions, which means that the present systems of railway infrastructure charges and the present operating costs are the basis for the calculations.

The types of savings that are evaluated as a basis for calculating the potential income from the railway sector are: savings in railway infrastructure payments to the respective railway infrastructure managers, savings in operating costs (expressed as cost/km, incl. capital costs, operation cost, staff costs, and overheads) and value of time savings.

The savings in railway operating costs for the railway operators materialize due to the fact that the route via the Fixed Link across the Fehmarnbelt is approx. 160 km shorter than the route via the Great Belt.

1.5.2 Results

Based on the updated traffic forecast and indicative plans of operation for the two Base Cases A and B, where Base Case A in general favour railway transportation table 1.9 shows the possible revenue from both railway passenger and freight traffic in 2015.

Table 1.7: Key figures, Railway traffic and potential income from railway, 2015

M EUR, Price level 2002	Base Case A	Base Case B
Number of passengers per year	1.5 mill	1,4 mill
Number of trains per year		
- Passenger trains	14,600	14,600
- Freight trains	20,400	15,700
Rail freight per year	11 mill tons	8 mill tons
Annual income passenger trains m EUR	10.4	10.4
Annual income freight trains m EUR	45.0	34.6
Total possible income per year m EUR	**55.4**	**45.0**

As can be seen from the table the maximum potential payment from railway passenger traffic is calculated to 10.4 m EUR for both Base Cases.

For freight trains the savings in infrastructure charges and operating costs are estimated to 35-45 m EUR, distributed with 50% from each. The total income based on calculated savings for both passenger and freight trains is estimated to 45 to 55 m EUR.

The final infrastructure payment per train must reflect that competition exists between several routes and transport modes. It is evident that the Fehmarnbelt Fixed Link has a major advantage of being the most direct and fastest route. An excessively high infrastructure payment for using the Fixed Link may jeopardize the possibilities of exploiting the competitive advantages the Fixed Link will introduce. It is assumed that the charges will be based only on savings related to infrastructure payment and operating costs, excluding value of savings in travel time. The lowest level would on the other hand be determined of only the savings in infrastructure payment.

1.5.3 Conclusion of the Railway Payment Analysis

If the potential “value of time saving“ is not included in the estimate the potential income from railway traffic crossing the Fehmarnbelt Fixed Link will be between 45.0 and 55.4 m EUR per year (Price level 2002). If “value of time saving” is included the total savings would amount to 58-72 m EUR, but it is evaluated that time savings

should not be included if the railway sector shall be able to maintain or even improve its market share.

For the financial evaluation and analysis it has been decided to assume an annual income of 50 m EUR from the railway.

2. FINANCIAL ANALYSIS

In 2001/2002 an ECI (Enquiry of Commercial Interest) was carried out to investigate the Private Sector's interest in participating in the implementation of the Fehmarnbelt Fixed Link project. On the basis of the Private Sector's response different Business Cases were developed in order to illustrate how the Private and Public Sector could organise themselves in order to realise the project under financially viable conditions.

In continuation of the ECI report [Ref. 4] a number of analyses related to the Fehmarnbelt project have been carried out. Among these an updating of the 1999-traffic forecast and new assessments of the railway payment on the Fixed Link have given rise to recalculate two of the previously reported Business Cases for the Fehmarnbelt Fixed Link project. The new financial calculations (February 2003 – Calculations) are summarized in the following [Ref. 8]. Below in section 2.1 the new assumptions regarding traffic forecast and railway payment are stated. In section 2.2 the summarized financial results of the recent recalculation of the BOT-model and the State Guaranteed model will be presented as well as the consequences for the Governments' economy. In section 2.3 the financial results of four alternative traffic scenarios are stated. The calculations of the sensitivities are presented in section 2.4 and section 2.5 contains a comparison to the ECI Business Cases. Finally, section 2.6 summarizes the conclusions of the financial analysis.

2.1 Updated traffic forecast and new assessment of railway payment

The updated traffic forecast has been prepared by Fehmarnbelt Traffic Consortium (FTC) [Ref. 5] under two different sets of assumptions regarding the future development of the transport sector (Base Case A, Base Case B) as described in Chapter 3.

For the financial calculations the forecasted road traffic for a possible opening year 2012 has been stipulated. The financial model operates with a four year ramp-up period meaning that the level of the traffic forecast is reduced with 20%, 15%, 10% and 5%, respectively, in the first 4 years of operation. This "ramp-up" period is introduced to reflect the fact, that customers might need some time to adjust to a new, faster and more direct transport route between Scandinavia and the Continent.

Further, it is assumed that the traffic has an underlying growth of 1.7% per year in the operation period. This assumption is maintained from the ECI-calculations and it is the mid-point in the FTC-trend forecast where the range is defined to be 0.8-2.5% per year.

The stipulated traffic forecast in the first year of operation (year 2012) is as follows:

Table 2.1: Stipulated traffic forecasts for year 2012 (incl. ramp-up effect)

Thousand vehicles	Base Case A assumptions	Base Case B assumptions
Passenger cars	2,081	2,161
Lorries	314	344
Buses	36	36
Total	2,431	2,541

The table shows that the forecasts stipulate a total number of vehicles between 2,431,000 and 2,541,000 vehicles in 2012. The difference between the two forecasts is 80,000 passenger cars and 30,000 lorries more in Base Case B in year 2012.

The underlying set of toll rates used to determine the traffic volumes in the updated forecast is as follows:

Table 2.2: Tolls for passing the Fixed Fehmarnbelt Link

EUR excl VAT 2012-prices	Updated forecast
Passenger cars	50
Lorries	243
Buses	268
Railway payment (m EUR)	64

The basis for the tolls in the 2002-forecast has been the fares on the existing ferry line between Rødby and Puttgarden. The toll for passenger cars is the list price - 46 EUR in 2002-prices. This assumption covers the expectation that frequent users probably will be granted a certain discount and users with caravans or trailers have to pay an extra charge. The tolls for lorries and buses are estimated average ferry fares where different forms of discounts have been taken into account.

It has been assumed that the development in the tolls will follow the assumed general inflation of 2.5% p.a. from the opening year and to the end of the operation period.

It should be noted that present ferry fare for a passenger car corresponds to 60 EUR (2012-prices excl. VAT). However, it has been assumed that the consumer expenditure for crossing the Fehmarnbelt after opening of the Fixed Link has to be unchanged compared with the ferry services. According to the current EU VAT-laws transport of passenger cars by ferry is exempted for VAT, but the toll for passenger cars paid for passing a Fixed Link is subject to VAT. The net result of this difference is a reduced income for the project, corresponding to the VAT on tolls for passenger cars. The reduction due to VAT is 10 EUR (VAT 20.5%). Therefore the income for the project per passenger car is 50 EUR (2012-prices).

The railway payment has been investigated by Tetraplan. The assessment has been made on basis of the stipulated railway traffic and takes different forms of savings that arise from the change of route from the Great Belt Fixed Link to the Fehmarnbelt into consideration. The savings consist of “savings in operation”, “saving in infrastructure charges” and “value of time savings”. All elements are considered for passenger trains as well as for freight trains. The result is a minimum annual railway payment of 45 m EUR (2002-prices) excluding value of time savings and a maximum annual railway payment of 71.8 m EUR if all three elements are included.

The Ministries of Transport of Denmark and Germany have decided to leave value of time savings out of account and have set an income for the project from the railway operators of both passenger and freight traffic to 50 m EUR per year (2002 prices) for financial calculation purposes, corresponding to 64 m EUR (2012-prices) for both investigated Base Cases.

The revenue of the project is illustrated by the expected income in the opening year 2012.

Table 2.3: Revenue in 2012

M EUR 2012-prices	2002-forecast Base Case A	2002-forecast Base Case B
Passenger cars	104	108
Lorries	76	83
Buses	10	9
Income Road	190	200
Railway	64	64
Total	254	264

It can be concluded that the revenues based on the 2002-forecast in year 2012 amounts to 254 – 264 m EUR depending on the underlying assumptions. The revenues for the rest of the period are assumed to rise by the inflation and the traffic growth.

2.2 Main results of Financial Calculations

2.2.1 Assumptions

The February 2003 calculations have been based upon the same financial assumptions as the calculations in the ECI-report. Among the most important assumptions can be mentioned:

- Real interest rate 4 % p.a.
- Inflation 2.5 % p.a.
- Risk premium 2% p.a.[1)]
- Corporate tax 34 %
- Traffic growth 1.7% p.a. (2012-2041)

A more comprehensive list of assumptions is shown in Appendix I.

1) The risk premium to be paid for a commercial loan depends directly on the risk structure of the project. In combination with the assumed real interest rate and inflation rate the risk premium of 2% reflects the interest rate obtainable for a single A-rated company.

In the BOT-model the needed Government Support is determined by the requirement of the financial sector to the size of the cash flow and by the requirement of the concessionaire to an internal rate of return on equity of 17%. It has been assumed that the Government Support is paid to the Private Sector concessionaire as a fixed annual payment during a 30 year concession period.

In the State Guaranteed model no equity is needed and the funding is obtained in the international financial market and is backed by Government guarantees.

The Debt Payback Period is determined by the period from operation start to the year where the net debt equals zero.

2.2.2 Financial results for the two models

The results of the financial analysis based on the 2002 traffic forecast, the assumed toll rates and the new railway payment for the chosen models are shown in table 2.4 below.

Table 2.4: Results of financial calculations for BOT-model and State Guaranteed model

	Base Case A	Base Case B	Scenarios 1 – 4
Government Support BOT-model m EUR, NPV (2002)	1,561	1,467	1,410 – 1,851 [1)]
Debt Payback Period State Guaranteed Model (number of years)	37	33	32- 55 [1)]

1) The sensitivities are tested in 4 scenarios. A Government Support of 1,851 m EUR or a Debt Payback Period of 55 years is calculated for the scenario where a ferry service is operating in parallel to a Fixed Link Rødby-Puttgarden. A Government Support of 1.410 m EUR or a Debt Payback Period of 32 years is calculated for a scenario where fares on competing Baltic Sea ferry services are raised with 25%.

For the BOT-model a Government Support in the order of 1.500 - 1.600 m EUR (NPV) is calculated. The amount should be evaluated in relation to the total investment of 2,820 m EUR, NPV (2002) corresponding to 5,176 m EUR in current prices[1]. The amount corresponds to an annual support of 258 m EUR and 243 m EUR respectively in the operation period (2012-2041).

1 The investment amounts to 4,304 m EUR excluding financial costs and 5,176 m EUR including financial costs. The last figure corresponds to 2,820 m EUR calculated as net present value using a discount rate of 9.7%.

The Debt Payback Period for the State Guaranteed model is calculated to 33-37 years. A Debt Payback Period of this length is in line with the Debt Payback Periods known from the Øresund and the Great Belt projects.

2.2.3 Impact on Governments' Economy

The impact on Governments' economy is a result of the support to a private concessionaire and the income from VAT, tax payment, etc., illustrating the total economy for the two Governments seen in a more macroeconomic perspective. The table below summarizes this so-called surplus/deficit (IV) for the two selected Business Cases under the two different traffic forecasts. More details regarding support and revenues for the two Governments are presented in the Appendix II.

Table 2.5: Surplus/Deficit (IV) for the two Governments under different forecast assumptions

NPV (2002), M EUR	2002-forecast Base Case A assumptions	2002-forecast Base Case B assumptions
BOT-model	-1,253	-1,132
State Guaranteed model	195	264

The total Government Economy shows in the BOT model a deficit of 1,132 – 1,253 EUR m (NPV) and a surplus in the State Guaranteed model case of 195 – 264 EUR m (NPV).

In the ECI-report it was stated that the difference between the BOT-model and the State Guaranteed model could be seen as an expression of the price for the Governments of transferring different forms of risks to the Private Sector. This difference adopting the new traffic forecast and the new assessment of railway payment amounts to 1,448 m EUR and 1,396 m EUR (NPV).

The financial results of the two different organizational models are not directly comparable, because in the State Guaranteed model the Government will handle the majority of the risks associated with the project, while in the BOT-model most of the risks are carried by the Private Sector.

The value of those risks is a product of the cost and probability of such risks materializing, thus their associated costs. In theory a full comparison of the BOT-model and the State Guaranteed model would require a pricing of all risks.

2.3 Alternative traffic Scenarios

In order to test the sensitivity of the calculated traffic demand forecasts of the traffic on the Fixed Link in 2015 for four alternative traffic scenarios have been carried out. The four scenarios are described in detail in Chapter 3.

The scenarios are only investigated for Base Case A assumptions and result in the following predicted average daily traffic in year 2015:

Table 2.6: Average daily traffic for the different scenarios, 2015

Number of vehicles	Base Case A	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Average daily traffic	8,756	8,395 (-4%)	8,014 (-8%)	9,449 (+8%)	7,359 (-16%)

Note: In brackets the percentage change in relation to the Base Case A.

In spite of the fact that the ferry fares and the tolls in the scenarios vary considerably the predicted average daily traffic varies only between + 8 % and -16 %. It can be concluded that the demand for crossing the Fehmarnbelt is fairly stable and inelastic.

The corresponding Government Support needed for the BOT-model is shown in table 2.7:

Table 2.7: Government Support needed in the different scenarios

m EUR (NPV 2002)	Base Case A	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Government Support	1,561	1,627 (+4%)	1,724 (+10%)	1,410 (-10%)	1,851 (+19%)

Note: In brackets the percentage change in relation to the Base Case A.

The needed Government Support is varying inversely with the average daily traffic and the maximum support is calculated to 1,851 m EUR in scenario 4 where a ferry service is assumed to operate in parallel to the Fixed Link and the minimum support is calculated to 1,410 m EUR in scenario 3 where fares on competing Baltic Sea ferry services are assumed to rise with 25%. These amounts should be seen in relation to the total investment of app. 2,825 m EUR (NPV).

The Debt Payback Period in the State Guaranteed model shows corresponding changes.

Table 2.8: Debt Payback Period for the different scenarios for State Guaranteed model

Number of Years	Base Case A	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Debt Payback Period	37	40	45	32	55

The State Guaranteed model shows the same effect as for the BOT-model. For scenario 4 the maximum Debt Payback Period is calculated to 55 years and the minimum period is calculated to 32 years for scenario 3.

2.4 Financial sensitivities

2.4.1 Partial sensitivities

In order to test the sensitivity of the financial results calculations have been carried out with the following individual changes:

Sensitivity: Railway payment changed by +/- 20% to 40/60 m EUR pr. year

Sensitivity: Real interest rate changed with +/- 1% to 3% or 5 % p.a.

Sensitivity: Traffic growth changed with +/- 0.5% to 1.2 % or 2.2 % pr. year

The results of the sensitivity calculations for the BOT-model are:

Table 2.9: Sensitivity: Government Support needed for a BOT-model

NPV (2002), M EUR	Base Case A assumptions	Base Case B assumptions
February 2003 calculations BOT model - Railway payment: 50 m EUR pr. year - Real Interest rate: 4% p.a. - Traffic growth: 1.7 % p.a.	1,561	1,467
Sensitivity: Railway payment		
60 m EUR pr. year	1,479 (-5%)	1,391 (-5%)
40 m EUR pr. year	1,633 (+5%)	1,546 (+5%)
Sensitivity: Real Interest Rate		
3 % p.a.	1,301 (-20%)	1,213 (-17%)
5 % p.a.	1,827 (+17%)	1,739 (+18%)
Sensitivity: Traffic Growth		
2,2 % pr. year	1,503 (-4%)	1,410 (-4%)
1,2 % pr. year	1,615 (+3%)	1,519 (+3%)

Note: In brackets the percentage change in relation to the February 2003 calculation is stated

The partial sensitivity analysis shows that 20% change in railway payment and approx. 30% change in traffic growth result in small changes (3-5%) in the Government Support. On the other hand a 25% changes in the real interest rate shows a significant change (17-20%) in the Government Support.

The results of similar sensitivity calculations for the State Guaranteed model are:

Table 2.10: Sensitivity: Debt Payback Period, State Guaranteed model

Number of years	Base Case A assumptions	Base Case B assumptions
February 2003 calculations State Guaranteed Model - Railway payment: 50 m EUR pr. year - Real Interest rate: 4% p.a. - Traffic growth: 1.7 % p.a.	37	33
Sensitivity: Railway payment		
60 m EUR pr. year	34 (-3)	31 (-2)
40 m EUR pr. year	40 (+3)	36 (+3)
Sensitivity: Real Interest Rate		
3 % p.a.	30 (-7)	28 (-5)
5 % p.a.	52 (+15)	45 (+12)
Sensitivity: Traffic Growth		
2.2 % pr. year	33 (-4)	30 (-3)
1.2 % pr. year	43 (+6)	38 (+5)

Note: In brackets the change in numbers of years in relation to the February 2003 calculation.

Similar to the BOT model the sensitivity analysis shows that 20% change in railway payment and approx. 30% change in traffic growth result in small changes (3-6 years) in the Debt Payback Period. It also shows that a 25% change in the real interest rate has an impact of 5-15 years change in the Debt Payback Period.

2.4.2 Borderline scenarios

As a supplement to the sensitivity analysis mentioned above the financial viability of the Fehmarnbelt project for two “borderline” scenarios has been evaluated.

The scenarios are regarded as a “best/optimistic” case and a “worst/pessimistic” case. In each of the scenarios a few decisive parameters are chosen to be changed simultaneously in the financial calculation. The parameters are set on basis of the

experience from the construction and operation of the Fixed Links across the Great Belt and the Øresund. The changed parameters are not the same for the two cases.

The likelihood of a development where all parameters are developing in a positive or a negative direction simultaneously has not been estimated but it is probably small. It should be noted that the revised financial calculations must be regarded as cautious due to the relatively high real interest rate, the four years ramp up period for the traffic, relative high operation and maintenance costs as well as the reduced income flow resulting from cautious setting of the toll rates and the railway payment. The Projects financial sensitivity is further discussed in Chapter 6. The results of the financial calculations for the BOT-model and the State Guaranteed model will form the basis for the calculations.

The “best/optimistic” case is defined as:

1. Base Case B traffic assumptions
2. Real Interest Rate decreases by 1% to 3%
3. The traffic growth is set to 2.5% per year
4. Railway payment is set to 60 m EUR per year
5. Operation and maintenance costs reduced with 10 m EUR per year.

The “worst/pessimistic” case is defined as:

1. Base Case A traffic assumptions
2. The investment cost is increased by 15 %
3. Traffic growth is set to 1.2%
4. Railway payment is set to 40 m EUR per year.

The results of the calculations are:

Table 2.11: Financial results of the "best/optimistic" and "worst/pessimistic" cases

	Best/Optimistic case	February 2003 calculations	Worst/Pessimistic case
Government Support in the BOT-model measured as (m EUR,NPV 2002)	995	1,561	2,710
Debt Payback Period in the State Guaranteed model in years	23	33	66

The two scenarios show that the Fehmarnbelt project in the optimistic case could be paid back in 23 years, which is extraordinary well for a project of this type and scale. However the pessimistic case shows that organising the project as a BOT-project becomes even more expensive for the Governments and a 66 years Debt Payback Period in the State Guaranteed model would probably not be regarded as acceptable.

2.5 Comparison to the ECI Business Cases

In order to illustrate the impact of the new traffic forecast, the new tolls and the new railway payment a comparison with the two Business Cases calculated in the ECI-report is carried out.

2.5.1 Changed assumptions

Table 2.12: Stipulated traffic forecasts year 2012 (incl. ramp-up effect)

Thousand vehicles	1999-forecast ECI report	2002-forecast Base Case A assumptions	2002-forecast Base Case B assumptions
Passenger cars	1,877	2,081 (+11%)	2,161 (+15%)
Lorries	398	314 (-21%)	344 (-14%)
Buses	49	36 (-25%)	36 (-25%)
Total	2,324	2,431 (+5%)	2,541 (+9%)

Note: In brackets the percentage change in relation to the ECI report.

The table shows that both 2002 traffic forecasts stipulate a higher total number of vehicles than the 1999-forecast. However, the composition of vehicles is changed with a 11-15% higher volume of passenger cars paying the low toll and a 14-21% smaller volume of lorries and 25% smaller volume for buses both paying the high toll.

Compared to the 1999- traffic forecast the new traffic forecast is based on a new set of assumed toll rates for passing the Fixed Fehmarnbelt Link. The new set of toll rates is the underlying toll rates used to determine the traffic volumes in the 2002-forecast.

Table 2.13: Tolls for passing the Fixed Fehmarnbelt Link

EUR excl VAT 2012-prices	1999-forecast ECI report	Updated forecast
Passenger cars	71	50
Trucks	257	243
Buses	257	268
Railway payment (m EUR)	113	64

In comparison with the assumptions in the ECI, the new financial analyses imply that the toll rate for passenger cars has been reduced by 30% and for the assumed income from the railway sector by 43%.

The consequences of these changes for the revenue of the project are illustrated by the changes in the expected income in the opening year 2012.

Table 2.14: Revenue in 2012

M EUR 2012-prices	1999-forecast ECI report	2002-forecast Base Case A	2002-forecast Base Case B
Passenger cars	134	104	108
Lorries	102	76	83
Buses	13	10	98
Income Road	249	190	200
Railway	113	64	64
Total	362	254	264

It can be concluded that the revenues arising from the reduced tolls in year 2012 are reduced by 27-30% depending on the underlying Base Case assumptions compared to the 1999-forecast in the ECI-report. The revenues for the rest of the period are assumed to rise by the inflation and the traffic growth both in the ECI calculation and in the revised calculations. Consequently, the total revenues in the revised calculations are reduced by 27-30% compared to the ECI calculation for the whole operation period.

The consequences for the BOT-model and the State Guaranteed model are presented below. Compared to the previous ECI Business Cases all other assumptions for the financial calculations remain unchanged, including opening year in 2012 and the 30 years concession period.

2.5.2 Financial results for the BOT model

Using the 2002 traffic forecast, the new toll assumptions and the new railway payment the financial calculations show the following changes compared to the ECI calculations in Government Support to the project for the BOT model:

Table 2.15: Government Support in the BOT model

NPV (2002), m EUR	Base Case A assumptions	Base Case B assumptions
ECI report	805	805
Changes in traffic volumes	+85	-24
Changes in tolls	+393	+408
Changes in railway payment	+278	+278
Revised calculation	1,561[1)]	1,467[2)]

1) Corresponding to 258 m EUR/year in the operation period

2) Corresponding to 243 m EUR/year in the operation period.

The table shows that the need for Government Support has increased considerably for both Base Cases to 1,561 m EUR and 1,467 m EUR (net present values) depending on the underlying traffic forecast assumptions. These amounts correspond to an annual support of 258 m EUR and 243 m EUR in the operation period (2012-2041).

2.5.3 Financial results for the State Guaranteed model

For the State Guaranteed model the Debt Payback Period is the most relevant result of the financial calculation. In the table below the changes arising from each of the changed assumptions are stated as well as the total period for the February 2003 calculations in respect to the Debt Pay Back period.

Table 2.16: Debt Payback Period in the State Guaranteed model

Number of years	Base Case A assumptions	Base Case B assumptions
ECI report	23	23
Changes in traffic volumes	+1	-1
Changes in tolls	+8	+6
Changes in railway payment	+5	+5
February 2003 calculation	37	33

The financial calculations show that the updated traffic forecast, the new toll rates and the new railway payments result in an extension of the Debt Payback Period with 10-14 years depending of the underlying forecast assumptions. For the State Guaranteed model it has been necessary to expand the calculation period to more than the previously assumed 30 years.

The impact coming from the traffic volumes differs due to the changes in the composition of the traffic. In Base Case A the reduction in the expected traffic volumes for trucks paying the high tolls is greater than the reduction in Base Case B because of the different assumptions about user costs in the two Base Cases. In addition the rise in number of passenger cars is greater in Base Case B than in Base Case A. These two facts result in an increase of one year in Debt Payback Period for Base Case A and a reduction of one year in Base Case B.

The impact coming from reduction in tolls is bigger for Base Case A than for Base Case B due to lower total traffic volumes especially a lower number of trucks.

The impact coming from a reduction in railway payment is obviously the same for the two cases.

2.6 Conclusions of the Financial Analysis

The February 2003 financial calculations show that the BOT-model needs Government Support in the order of 1.500 - 1.600 m EUR (NPV). In relation to the total investment of app. 2.800 m EUR (NPV)[2] a Government Support of this magnitude indicates that the BOT-model under the stated assumptions hardly can be characterized as a privately financed project.

The Debt Payback Period for the State Guaranteed model is calculated to 33-37 years. A Debt Payback Period of this length is in line with the Debt Payback Periods known from previous and actual calculations of the Øresund and the Great Belt projects under similar assumptions.

The new traffic forecast predicts a higher total number of vehicles but also a changed composition of categories. In total these changes have only small impacts on the financial result of the project.

2 The investment amounts to 4,304 m EUR excluding financial costs and 5,176 m EUR including financial costs. The last figure corresponds to 2,820 m EUR calculated as net present value using a discount rate of 9.7%.

But the changed assumptions of tolls and lower railway payment have a significant impact on the financial result of the project. The changed tolls result in approximately a 50 % increase in the needed Government Support in the BOT-model and an increase in the Debt Payback Period of 6-8 years in the State Guaranteed model. The impacts from the changed tolls show that the determination of the toll level is of the utmost importance for the financial viability of the project. The changed railway payment results in an increased Government Support in the BOT-model amounting to 278 m EUR (NPV) and an increased Debt Payback Period of 5 years in the State Guaranteed model.

The traffic scenarios with varying degrees of competition from the ferries across the Baltic Sea show that even dramatic changes in the price relation between the ferry fares and the tolls on the Fixed Link result in moderate changes in the traffic demand and correspondingly in the financial result.

The sensitivity analysis demonstrates that the financial result of the project is sensitive to changes in the real interest rate.

The analysis shows indeed that the financial result will be strongly affected by a row of changes all pointing in the same direction.

If the optimistic approach is chosen it can be seen that the Government Support in the BOT-model amounts to 995 m EUR corresponding to approx. two thirds of the February 2003 calculation. For the State Guaranteed model the Debt Payback Period is reduced by 10 years to 23 years.

On the other hand the project is not viable if the pessimistic approach is chosen. This is illustrated by the Debt Payback Period of 66 years, which normally would be regarded as unacceptable even for a public infrastructure investment. For the BOT-model the pessimistic scenario leads to an increase in Government Support to 2,710 m EUR (NPV) corresponding to app. 95 % of the total investment costs of app. 2,825 m EUR (NPV).

The financial results of the two different organizational models are not directly comparable, as it must be emphasized that in the State Guaranteed model the Government will handle the majority of the risks associated with the project, while in the BOT-model most of the risks are carried by the Private Sector.

3. RESULTS OF THE UPDATED TRAFFIC DEMAND FORECAST, 2002

3.1 Study Objectives

This Chapter summarises the results of the updated traffic demand forecasts for the Fehmarnbelt Fixed Link that was performed in 2002 [Ref. 5]. The forecasts are an update of the traffic forecasts that were documented by the Fehmarnbelt Traffic Consortium (FTC) in a report to the national transport ministries in Germany and Denmark in 1999[3].

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 Fehmarnbelt and the relevant ferry connections across the Baltic Sea for a number of technical alternatives of a Fehmarnbelt 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[4].

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 Fehmarnbelt 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.

---

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

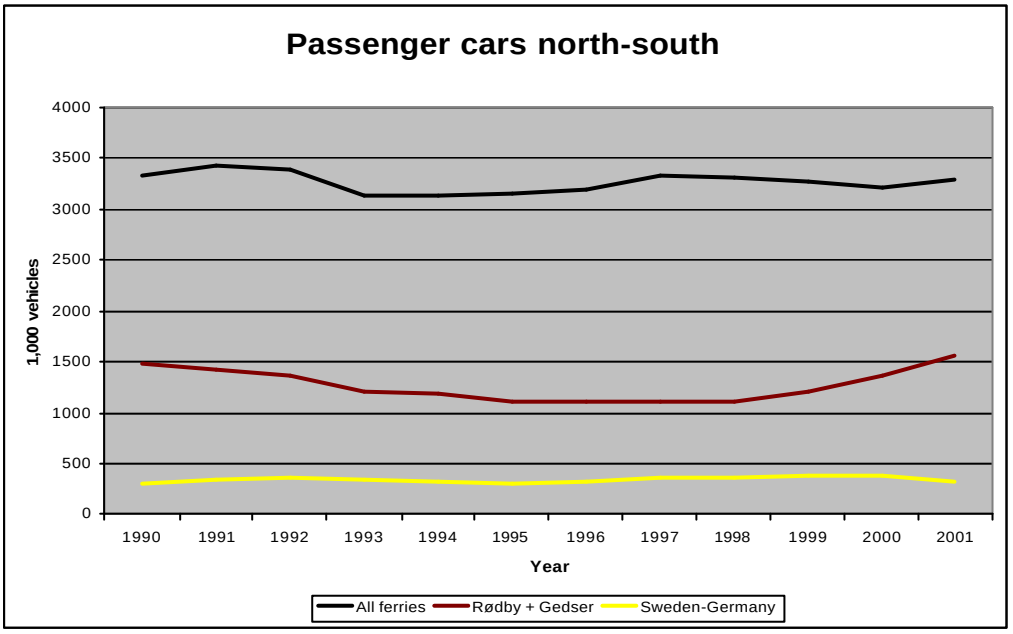
[4] *Femer Bælt-forbindelsen, forundersøgelser – Resumérapport. Trafikministeriet*, March 1999 (printed both in Danish and in German [Ref. 3].

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.

3.1.1 Trends in Traffic across the Baltic Sea

Figure 3.1: Number of passenger cars/year crossing the Baltic Sea north-south

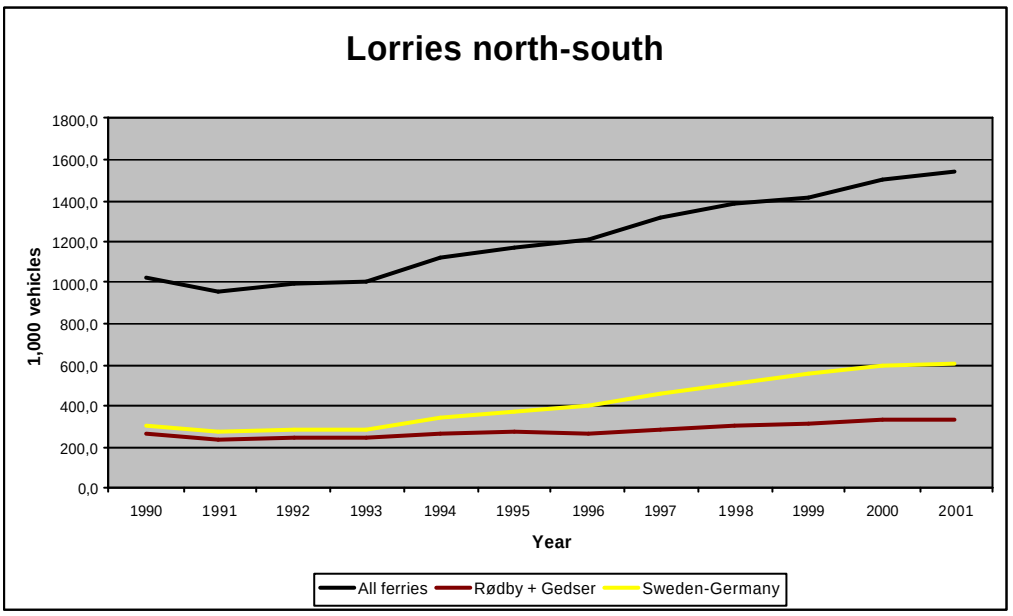


The fall of the Iron Curtain gave rise to rather optimistic expectations about the development of trade and passenger interaction with the former communist countries – expectations that had to be revised after a while. The 1999 forecast of traffic and trade across the Baltic Sea was partially influenced 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 3.1 (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 3.2: 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 3.2).

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.

3.1.2 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. The most important changes are:

- 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 has 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.

3.2 Forecast Preparation and Model Runs

3.2.1 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 Jutland 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 is assumed that it will not be affected by the existence of a Fixed Fehmarnbelt Link.

3.2.2 Forecast Assumptions

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).

Figure 3.3: Ferry Lines

The toll levels for a Fehmarnbelt Fixed Link were set at the present (2002) Rødby-Puttgarden ferry fare (list price) for cars (46 EUR) and lorries (259 EUR) 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, and 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 3.1 presents an overview of the user costs assumptions in the two Base Cases.

Table 3.1: Key variables for user costs and traffic operations for Base Case A and Base Case B

	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

3.2.3 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 Fehmarnbelt having a double-track railway and a four-lane motorway.

In addition to the Base Cases, it has been decided to test how sensitive traffic on a Fixed Link is to more intense ferry competition.

To a certain degree competition for passenger car and lorry transport will exist between ferry services in the Baltic Sea and the Fehmarnbelt Fixed Link.

For passenger cars competition will probably be limited as total travel costs for the routes will be less important than time consumption. But for lorry transports the competition will be stronger because lorry transport distances are longer and therefore more alternative routes are available.

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.

When changing the fares for the competing Baltic Sea ferries, the fares/tolls for crossing Øresund (by ferry or Fixed Link) are changed in the opposite direction as the Øresund crossings serve as the “feeding” routes to a Fixed Link across Fehmarnbelt for traffic between Sweden and Germany through Denmark.

The four scenarios are:

- **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.

Table 3.2: Basic definition of scenarios

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Fehmarnbelt 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 [1)]	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[5]	as in 2002	+25 %	-25 %	+25 %

1) 'Ferry services' regards the ferry connections across the Baltic Sea east of the Fehmarnbelt

3.3 Main Results

3.3.1 Passenger Traffic

Table 3.3 shows the distribution of the total passenger flows between Denmark /Scandinavia and the continent by mode for the base year 2001, the 1999 forecast with horizon 2010, the two Base Case forecasts and the four scenarios for 2015.

[5] Ferries between Helsingør and Helsingborg

Table 3.3: Total traffic between Denmark/Scandinavia and the continent, by mode

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	5.134	4.211	3.899	4.186	4.178	4.244	4.178
Car passengers	23.282	32.882	32.992	34.047	33.058	33.156	32.833	33.184
Bus passengers	7.504	9.915	8.145	8.049	8.145	8.140	8.151	8.148
Air passengers	27.137	35.356	46.090	47.564	46.090	46.063	46.118	46.063
Walk-on passengers	5.285	7.548	5.068	5.068	5.266	5.408	4.734	5.877
Total passengers	65.548	90.836	96.507	98.627	96.745	96.945	96.079	97.449

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 96.5 – 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 a Fixed Fehmarnbelt 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.

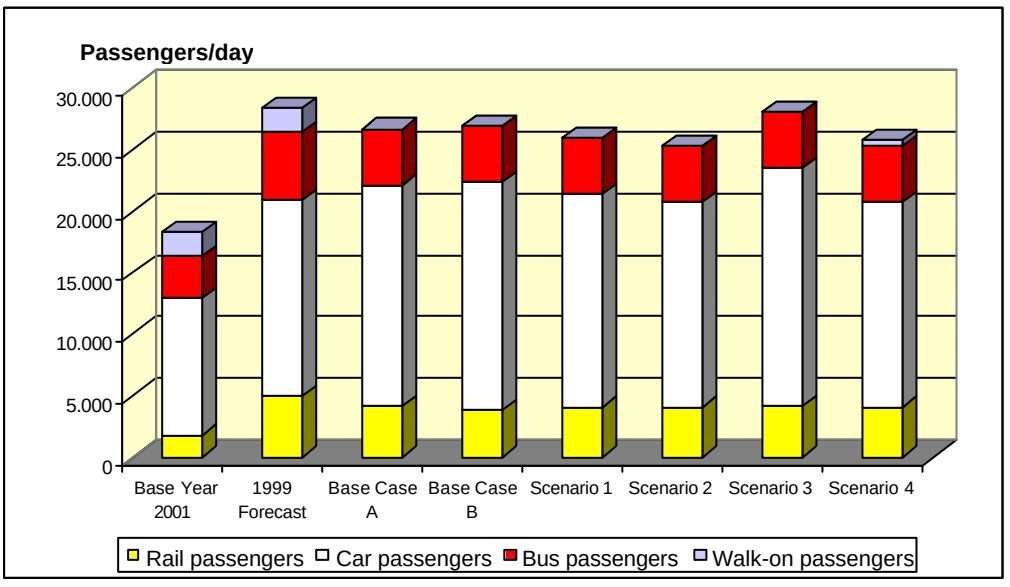
There are only small differences in the results for the other forecast scenarios for 2015 if one looks at the total number of trips between Denmark/Scandinavia and the continent but the traffic using the Fehmarnbelt Fixed Link will vary depending upon the scenario assumptions about service level and fares for the competing ferries (see table 3.3).

Table 3.4: Person traffic across the Fehmarnbelt, passengers per average day

Passenger Traffic	Base year	1999 Forecast	Base Case A	Base Case B	Scenario Forecasts 2015			
pass./day	2001	2010	2015	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 3.4 and figure 3.4 show the number of persons crossing the Fehmarnbelt on an average day in 2001 and in the different forecasts.

Figure 3.4: Person traffic across the Fehmarnbelt



About 25.000 passengers will cross the Fehmarnbelt 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 Fehmarnbelt 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.

3.3.2 Freight Traffic across the Fehmarnbelt

The total freight flows between Denmark/Scandinavia and the continent are shown in table 3.5.

Table 3.5: Total freight transport by road and rail between Denmark/Scandinavia and the continent

Freight traffic	Base year	1999 Forecast	Base Case A	Base Case B	Scenario Forecasts 2015			
t/day	2001	2010	2015	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

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.

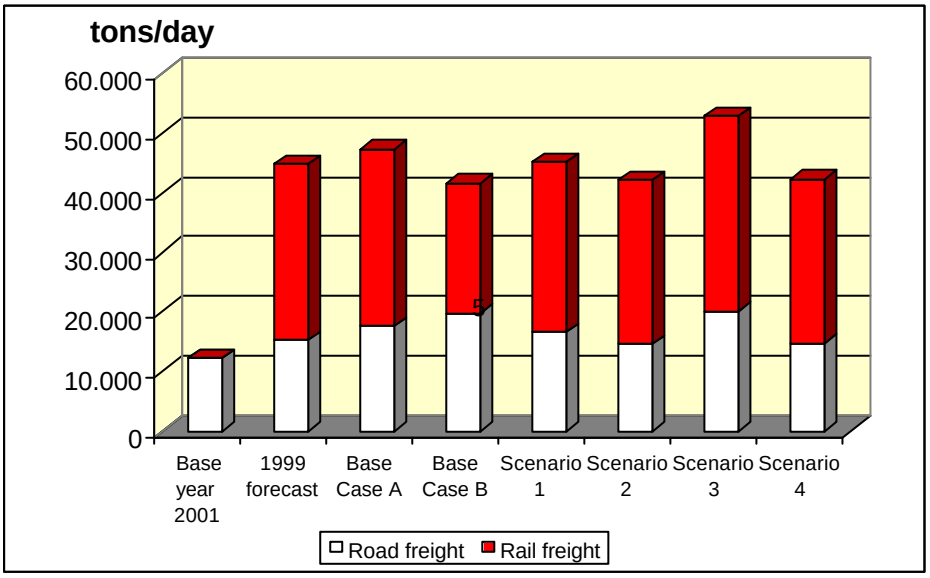
Looking at the Fehmarnbelt traffic, greater variations are evident between the scenarios and the Base Cases with Scenario 3 having the largest volumes both for road and rail freight (see table 3.6).

Table 3.6: Freight transport across the Fehmarnbelt, tons per average day

Freight traffic	Base year	1999 Forecast	Base Case A	Base Case B	Scenario Forecasts 2015			
t/day	2001	2010	2015	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

The increase from 2001 to 2015 ranges from 29,466 t/day to 40,723 t/day, or 240-335% more than in 2001.

Figure 3.5: Freight transport across the Fehmarnbelt



The freight volumes across the Fehmarnbelt 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 this applies to both road and rail transport (see figure 3.5).

In 2001 no rail freight is transported via Fehmarnbelt.

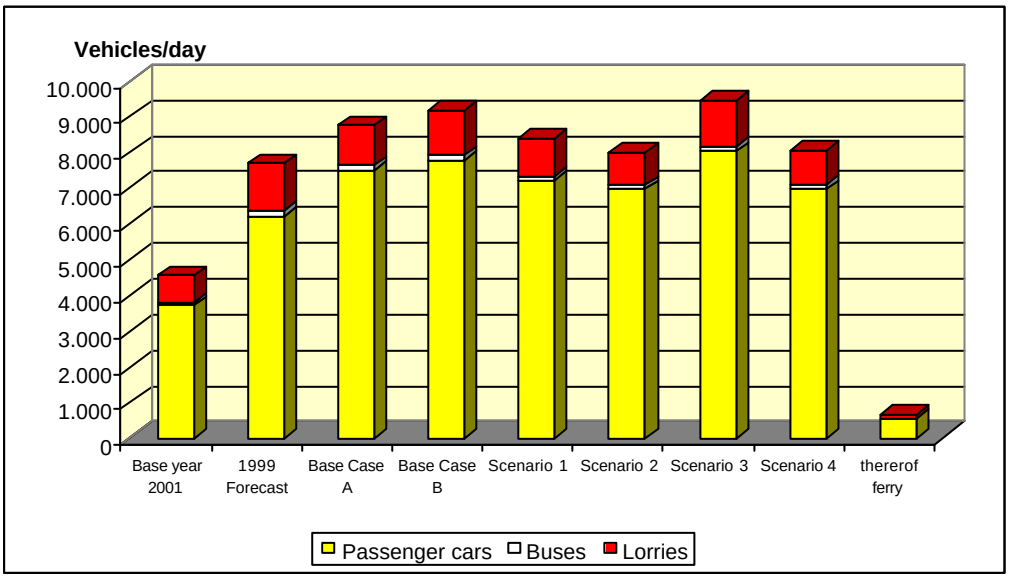
3.3.3 Total traffic across the Fehmarnbelt

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.

Table 3.7: Total number of road vehicles across the Fehmarnbelt, vehicles/day

Total road vehicles/day across the Fehmarnbelt	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

Figure 3.6: Number of road vehicles across the Fehmarnbelt



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 3.7 and figure 3.6)

Table 3.8 and figure 3.7 show the number of trains across the Fehmarnbelt.

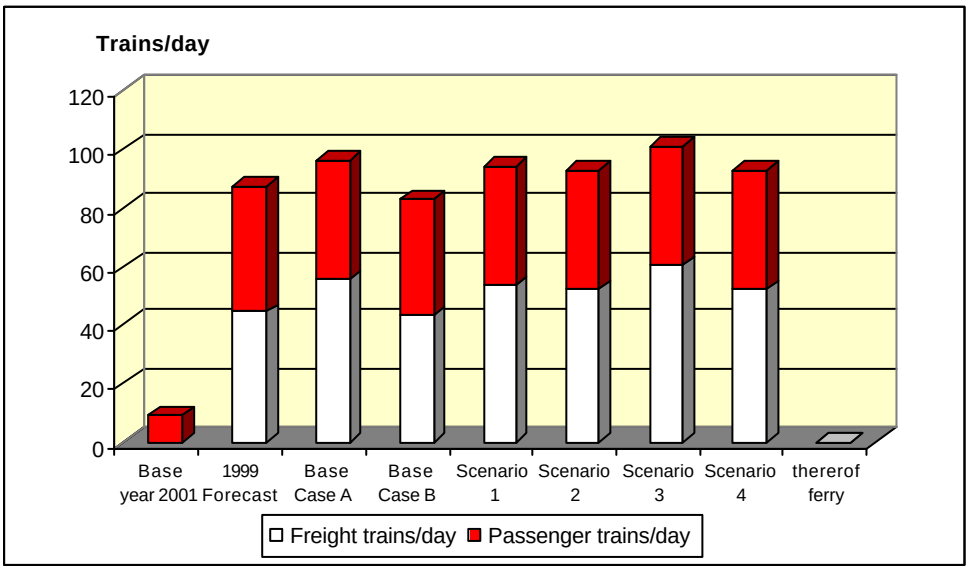
Here it must be noted that the number of freight trains is model output as it is calculated according to the amount of freight forecasted while, on the other hand, the number of passenger trains is input to the passenger model and is a result of the assumed passenger train schedule, which is constant 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.

Table 3.8: Number of trains across the Fehmarnbelt, trains per average day, both directions together

Total rail traffic across the Fehmarnbelt	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

Figure 3.7: Number of trains across the Fehmarnbelt



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.

3.3.4 Conclusions

The general conclusion of the new forecasts is that there are no dramatic changes in the Fehmarnbelt 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 Fehmarnbelt 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.

Table 3.9:Traffic across the Fehmarnbelt

Fehmarnbelt traffic/day	Base Case A 2015	Base Case B 2015
Passenger cars	7.496	7.786
Lorries	1.132	1.238
Freight trains	56	43

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 3.9)

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.

Table 3.10: Traffic across the Fehmarnbelt. Scenarios 2015

Fehmarnbelt 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 Fehmarnbelt = Fixed Link + ferry*

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 Fehmarnbelt 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.

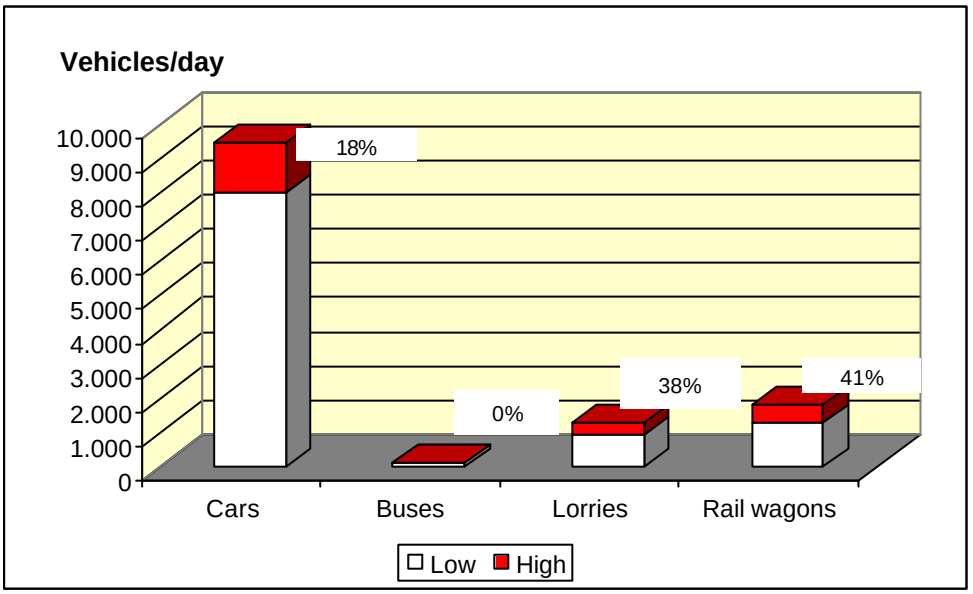
A parallel ferry between Rødby and Puttgarden would – with the same assumptions as in Scenario 2 – add a little extra traffic to the Fehmarnbelt total, as compared to Scenario 2, but the ferry would take 560 cars and 120 lorries of that total. (It has not been analysed if a ferry operation with the calculated 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 than the number of lorries.

Likely Range of Demand

Figure 3.8 shows the likely range of traffic demand for cars, buses, lorries and freight wagons across the Fehmarnbelt 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).

Figure 3.8: Range of traffic demand according to the 2015 forecasts



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.

Comparison with 1999 Forecast

The number of private cars across the Fehmarnbelt 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.

Table 3.11: Base Case A and Base Case B compared with 1999 forecast.

Fehmarnbelt 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

The new forecast for the number of lorries, both in general and for the Fehmarnbelt, 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 Fehmarnbelt 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 new forecast figures for the Fehmarnbelt.

3.4 Discussion of the Results

3.4.1 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 Fehmarnbelt 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 plays an important role for car and lorry traffic across the Fixed Link. The competing ferries are the ferry connections across the Baltic Sea east of the Fehmarnbelt, 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 Fehmarnbelt is influenced to some extent.

3.4.2 Market share for a Fixed Link

The following three figures illustrate the share of the Fehmarnbelt 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 3.9: Distribution of passenger cars

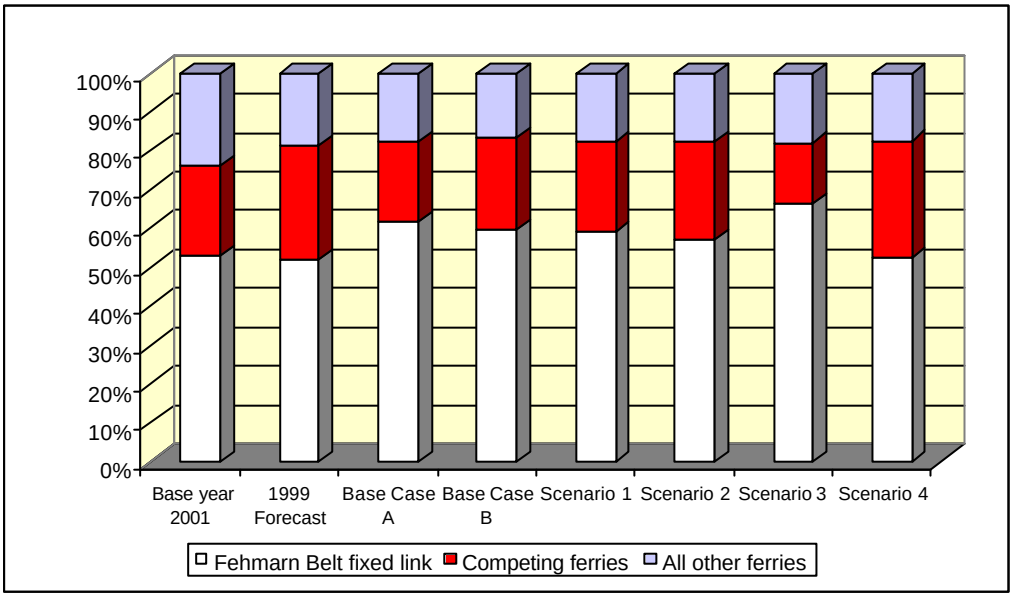


Figure 3.9 shows the distribution of passenger cars between Denmark/Scandinavia and the continent. Today, the Fehmarnbelt has approximately 50 percent of the car traffic, and this share may increase in the 2015 forecasts depending upon the competing ferries.

Figure 3.10: Distribution of lorry traffic

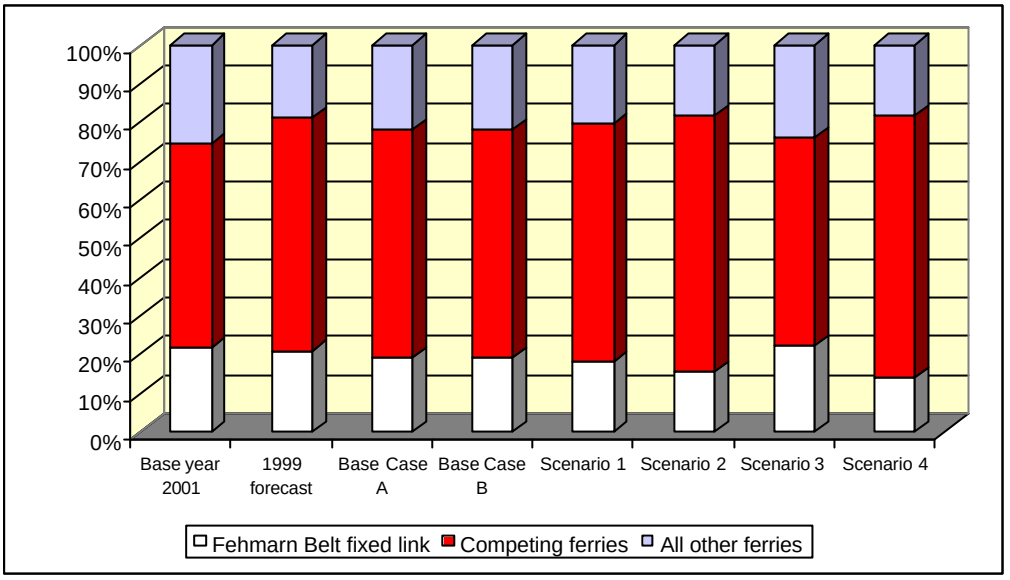


Figure 3.10 shows the distribution of the lorry traffic that is highly dominated by the competing ferries whereas the other ferries (Skagerrak, Kattegat and Poland ferries) have a little higher share than in car traffic.

Figure 3.11: Distribution of railway freight

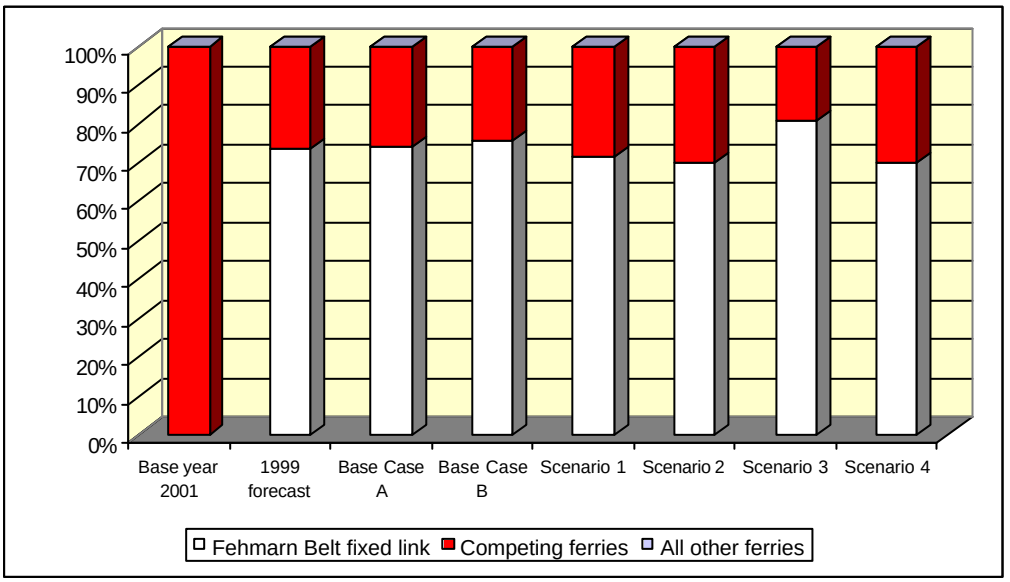


Figure 3.11 illustrates the distribution of railway freight. There are only two groups: the Fehmarnbelt and the Sweden-Germany ferries. The latter ones carry about 30 percent of the traffic, less in Scenario 3 and almost 40 percent in Scenarios 2 and 4 in 2015. In

2001, no rail freight crosses the Fehmarnbelt. On the passenger side, the Fehmarnbelt dominates the railway market. In 2015 96-97 percent of the railway passengers are forecasted to cross the Fehmarnbelt (not shown).

3.5 Trend Forecast 2025

3.5.1 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 Fehmarnbelt gives rise to a high degree of integration leading to a stronger increase per year than prior to the establishment of the Fixed Link.

3.5.2 Results and Conclusions

Table 3.12: Trend projections for traffic based upon Base Case A and Base Case B

		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

The figures 3.12 and 3.13 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 3.12.

Figure 3.12: Base Case A

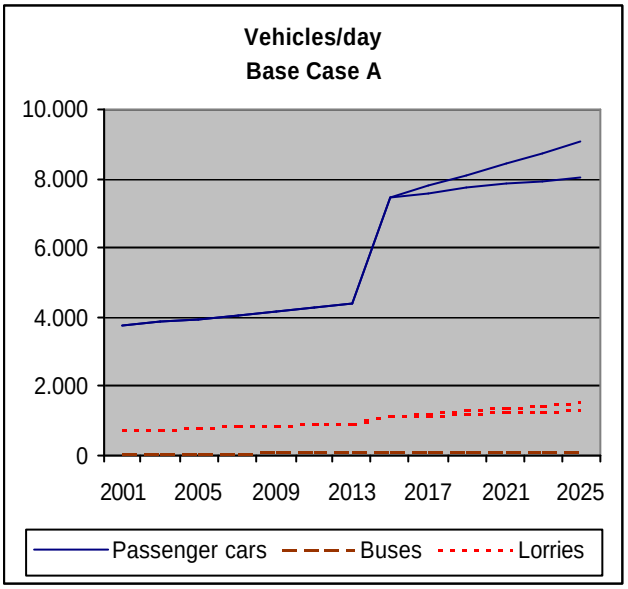
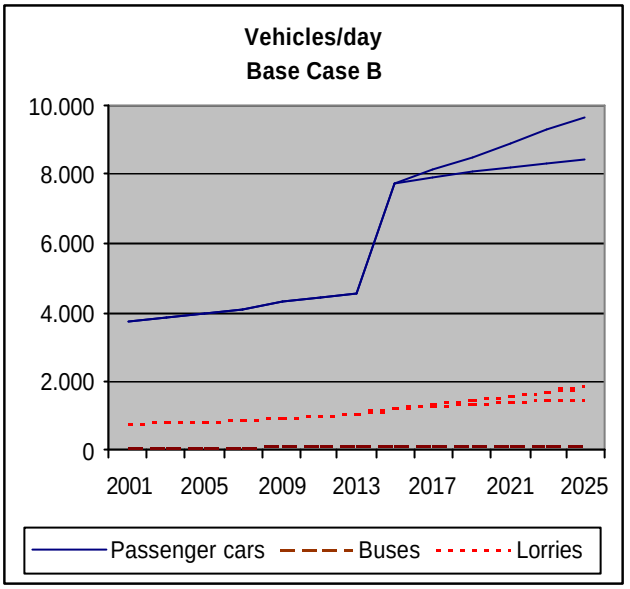


Figure 3.13: Base Case B



3.6 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 Fehmarnbelt 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

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 Fehmarnbelt 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 Fehmarnbelt Link in 2010.

The above shows, that at Fehmarnbelt 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 Fehmarnbelt 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 EUR, which is substantially higher than the ferry fare at Rødby-Puttgarden of 46 EUR. 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 Fehmarnbelt Link.

4. IMPROVEMENTS OF THE RAILWAY CAPACITY BETWEEN GERMANY AND DENMARK

4.1 Introduction

Since 1991, when Germany and Denmark agreed to electrify the railway between the cities of Hamburg and Odense, it has been considered to remove a number of bottlenecks identified on the railway line.

Since 1997 when all freight traffic on rail passing Denmark has been routed via the Great Belt Fixed Link the railway capacity of some stretches of the Jutland route has been identified as insufficient.

4.2 New Government Agreement

In relation to the ongoing infrastructure investment planning in the two countries, including the actual consideration concerning a Fixed Link across Fehmarnbelt it is necessary to coordinate cross border planning of improvement of the railway between the two countries.

This required coordination will be formalized in an agreement between the Ministries of Transport.

As basis for the agreement a study of the capacity and the bottlenecks on the railway line Copenhagen – Padborg – Hamburg respectively Copenhagen - Rødby – Hamburg has been carried out.

The analysis shows that the benefit cost ratio of investments in removals of the identified bottlenecks is very high.

Due to the uncertainty regarding the realisation of the Fixed Link across Fehmarnbelt it has been necessary to plan for two scenarios.

Depending on the transport development a reopening of the railway line Bad Oldesloe – Neumünster is included in the German planning, which will mean that the railway traffic will be lead east of Hamburg thereby avoiding the bottleneck in the Hamburg area.

In the scenario with a Fixed Link the agreement will consist of an expansion of the railway between Orehoved-Rødby and between Puttgarden and Lübeck (except for the Fehmarnsund Bridge) to double track and electrification Ringsted-Lübeck.

The scenario assumes double track on the Fixed Link across Fehmarnbelt.

In the scenario without a Fixed Link an expansion to double track Vamdrup-Vojens and Tinglev-Padborg in Denmark is planned.

The agreement for this scenario includes that the high bridge crossing the Kiel Channel at Rensburg after finalisation of ongoing maintenance and upgrading works will be double tracked and able to carry rail freight trains according to international axle load standards.

The agreement states that it is assumed that the uncertainty regarding the preferred scenario will be removed within a short period of time.

5. STUDY OF THE RAILWAY SECTOR'S ABILITY TO PAY

5.1 Assessment of railway payment

In the following an assessment carried out in 2002 by Tetraplan A/S [Ref. 6] of the infrastructure changes for rail on the Fixed Link and a corresponding assessment of the potential income from operation of the railway of a Fixed Link are summarized.

An important assumption, which lies behind all the presented figures is that calculated savings in infrastructure fees are based on present systems for infrastructure payments, and operating cost savings are based on the presently available transport means and technology. Future changes in this assumption will influence the assessment of the railway's ability to pay for crossing the Fehmarnbelt Fixed Link.

Two different Base Cases are analysed in the new traffic forecasts: Base Case A and Base Case B. The main assumptions in both Base Cases are availability of a Fixed Link with a 4 lane road and a two lane railway, ferry schedules as available in summer 2002 and infrastructure in the hinterland as planned and committed presently. Further the two Base Cases differ in the assumptions concerning user costs. In general rail transportation is favoured in Base Case A, whereas car traffic is favoured in Base Case B.

In the assessments carried out in 2002 the following traffic volumes have been envisaged for rail transport across Fehmarnbelt:

Table 5.1. Forecasts for traffic across Fehmarnbelt according to the Fehmarnbelt Traffic Study 2002

- 1,000 -	Base year 2001	4+2 2015 A	4+2 2015 B
Rail passengers (pass/year)	352	1,497	1,386
All passengers (pass/year)	6,376	9,753	9,833
Rail freight (tons/year)	5,138[1)]	10,843	7,983
All freight (tons/year)	9,572	17,269	15,189

1) Traffic directed via the Danish - German land border

Passenger traffic in the new 2015 forecasts is lower than in the former 2010 forecasts. Freight forecasts in terms of tonnes are also lower in Base Case B, but the

number of freight trains has increased because the new forecasts take the latest development in rail goods types into consideration resulting in a lower average load per wagon.

Table 5.2. Assessment of potential annual railway payments for using a Fehmarnbelt Fixed Link, 2002 price level

Possible annual railway payment in M EUR in 2002 price level	2015 Base Case A	2015 Base Case B
Passenger trains		
Savings in infrastructure charges	7.5	7.5
Savings in operating costs	2.9	2.9
Total railway payments – passenger trains	**10.4**	**10.4**
Value of time savings	-	-
Freight trains		
Savings in infrastructure charges	22.5	17.3
Savings in operating costs	22.5	17.3
Total railway payments – freight trains	**45.0**	**34.6**
Value of time savings	16.4	12.6
All trains		
Savings in infrastructure charges	30.0	24.8
Savings in operating costs	25.4	20.2
Total railway payments	**55.4**	**45.0**
Value of time savings	16.4	12.6
Existing assessment in 1996 prices (2002 price level)	*76 (88)*	

If payment for using the Fixed Link is based on a charge evaluated from saved infrastructure payments the total revenue will be about 25 m EUR to 30 m EUR. If savings in operating costs are also included revenue will increase to a range of 45 m EUR and 55 m EUR. Finally, if time savings are included the range depicted by the two Base Cases is 58 m EUR to 72 m EUR. In comparison, a rough estimate made in 1999 was 88 m EUR (76 m EUR in 1996-prices) or almost twice as much as the current estimate based on savings in operating costs and infrastructure charges.

Freight trains will be levied the major parts of the payments. In Base Case A freight trains will be accounting for about 85% of the payments, whereas the percentage is slightly lower in Base Case B (about 80%).

The final infrastructure payment per train should be established taking into account that competition exists between several routes and transport modes. It is evident that the Fehmarnbelt Link has a major advantage of being the most direct and fastest route. An excessively high infrastructure payment for using the Fixed Link may jeopardise the possibilities of exploiting the competitive advantages the Fixed Link will introduce. It is considered reasonable to assume that the charges will be based only on savings related to infrastructure payment and operating costs, excluding saving in travel time. The lowest level would on the other hand be determined of only the savings in infrastructure payment.

Another aspect related to the structure of the infrastructure changes in Denmark concerns the present payments for the utilization of the Great Belt Fixed Link and the Ringsted – Padborg route.

A consequence of the transfer of railway traffic from the Great Belt Fixed Link to Fehmarnbelt Fixed Link is the loss of revenue for the Danish National Railways Agency caused by the redirection of train traffic. This problem is mainly related to freight traffic, because all international freight traffic transiting Denmark is presently led across the Great Belt link.

The redirection of trains will lead to a limited loss in revenue at the Great Belt Fixed Link from passenger traffic operation but a considerable loss from freight transport operation. Based on the available forecasts the total loss has been estimated to about 13.2 m EUR measured in 2002 prices. 95% are related to freight traffic. The lost revenue accounts for about 15% of the total payment from The Danish National Railways Agency to Sund & Bælt. Reduced payment to the National Railway Agency from rail operators for passage of the Great Belt Link may be linked to a reduction in payment to the Sund & Bælt company. When the agreement on charges for passing

the Great Belt connection was made, about 1/3 of the payment was attributable to rail traffic redirected from Fehmarnbelt to the Great Belt. With a Fehmarnbelt Fixed Link this traffic is taken back to its original route, and therefore - it could be argued - should the size of the payment from the National Railway Agency to Sund & Bælt be reconsidered.

Apart from the loss in direct payments for the passage of the Fixed Link, the Danish National Railways Agency will be inflicted a loss related to diversion of traffic from the route Ringsted – Padborg. On this route a surcharge is being paid by the operators as an indirect payment for financing the Great Belt Fixed Link and the Øresund Fixed Link. An assessment based on the available forecasts indicates a loss of surcharge of about 4.8 M EUR (36 M DKK) of which almost 90% is attributable to rail freight traffic.

However, it is possible to compensate some of this loss with introduction of a similar surcharge on the link between Ringsted and Rødby. The revenue estimates in table 5.1 has been made under the assumption that no surcharge will be levied on the passenger trains, but a surcharge similar to the km-charge applicable on the route Ringsted – Padborg will be applied also on the route Ringsted – Rødby for the freight trains. The available forecasts indicate that the surcharge on this section will about compensate the losses on the route Ringsted - Padborg, thus creating an extra revenue of 1 m EUR in Base Case A and no extra revenue in Base Case B for the Danish National Railways Agency.

5.2 Reassessment of revenue related to rail traffic

In the following section the possible savings in infrastructure charges, cost of operation and the value of time savings will be assessed for passenger and freight railway traffic respectively.

5.2.1 Passenger trains

Passenger transport by rail via a Fehmarnbelt Fixed Link will be faster and excludes specific costs related to ferry transport. Further, it is assumed that departures routed via the Great Belt in the “Without a Fixed Fehmarnbelt Link” case will be redirected to the Fehmarnbelt with a Fixed Link.

It is assumed that the savings in operating costs, infrastructure payments and time can be transformed to infrastructure payment for passing the Fixed Fehmarnbelt Link. However, the assessments have been made under the assumption that the

infrastructure payment per train per km on the main line Copenhagen - Rødby is raised to the same level as applicable to Copenhagen – Padborg.

The cost of operation of a passenger train set is composed of capital costs, operating costs, staff costs and overhead costs.

It must be emphasized that the assessment is based on quite uncertain assumptions regarding the way the future passenger traffic will be organized. For that reason the assessment of the potential revenue is only indicative.

Based on indicative plans of operations for the two 2015 cases for which forecasts have been prepared following potential revenues have been assessed.

Table 5.3. Potential revenue attributable to rail passenger traffic 2015. Price level 2002

	2015 Base Case A	2015 Base Case B
Number of rail passengers	1,497,000	1,386,000
Number of trains per year	14,600	14,600
Annual income based on saving in infrastructure payments m EUR	7.5	7.5
Annual income based on savings in operating costs m EUR	2.9	2.9
Total based on savings in infrastructure payments and operating costs m EUR	**10.4**	**10.4**
Annual income based on savings in travel time m EUR	-	-

The total potential revenue attributable to rail passenger traffic is about 10.4 m EUR, if all expected savings are included in the payment

5.2.2 Freight trains

Rail freight transport will gain from the introduction of a Fixed Link. Speed will be increased, distances between Scandinavia and the Continent will be shorter, thus cutting transport costs. It is expected that traffic will switch from the Great Belt route to the Fehmarnbelt route. However, the shift of route will among other things be determined of the infrastructure payments along the two routes.

For freight transport similar types of cost savings have been considered as for the passenger trains that are savings in infrastructure payments, savings in operating costs and time savings for the goods transported.

Costs of operation have been assessed to 7.0 – 7.8 EUR per km per goods train with 30 units, depending on the gross weight of the train.

Savings in operational costs for choosing the Fehmarnbelt route in stead of the Great Belt route have been assessed to 1,100 EUR per train.

Savings related to infrastructure charges for using the Fehmarnbelt Link in stead of the Great Belt link have been assessed to 1,100 EUR per train.

Savings related to value of time for using the Fehmarnbelt Fixed Link in stead of the Great Belt link have been assessed to 800 EUR per train. Time savings are evaluated based on a value of time of 0.76 EUR per ton per hour.

Based on the above following potential annual payments can be assessed for rail freight traffic using the Fixed Link across Fehmarnbelt.

Table 5.4. Potential revenue attributable to rail freight traffic 2015. Price level 2002

	2015 Base Case A	2015 Base Case B
Number of trains per year	20,440	15,695
Annual income based on saving in infrastructure payments m EUR	22.5	17.3
Annual income based on savings in operating costs m EUR	22.5	17.3
Total based on savings in infrastructure payments and operating costs m EUR	**45.0**	**34.6**
Annual income based on savings in travel time m EUR	16.4	12.6

The total potential revenue attributable to freight trains is in the range of 34.6 – 45 m EUR (excluding savings due to reduced travel time).

5.3 Interviews in Scandinavia

Interviews were carried out with a number of freight operators and with the Danish National Railways Agency in order to evaluate the expectations to a future link across Fehmarnbelt, and also in order to investigate the level of charging which could be expected to render a reasonable traffic. It was considered more important to interview freight operators than passenger traffic operators. Rail freight revenues were in the 1999 analysis considered to make up the majority of the total revenue. Thus, the decision was made to concentrate on the reactions of the freight operators.

The respondents all agreed that a number of problems existed today and all pointed out that the capacity problems related to the line between Copenhagen and Ringsted are serious, as are the capacity problems on the main line between Lunderskov and Kolding. Problems also exist in Schleswig-Holstein. The Rendsburg Bridge crossing the North East Channel creates a bottleneck due to the limited total weight in terms of load per meter track and axle load. Train length cannot exceed 600 m on the link between Neumünster and Hamburg due to the length of overtaking tracks, and there is limited capacity in the network around Hamburg.

It was discussed whether it would be possible to transform a time saving into operational changes and whether such change could be utilised by the customers. In order to utilise a time saving it is necessary to be able to improve time windows for delivery and loading. If rescheduling of a train leads to substantial time savings in some relations the time saving could be utilised and an extra charge could possibly be obtained.

The interviewees were asked which of the possible improvements related to the development of the Fixed Link across Fehmarnbelt was most wanted. The answer was improvement of regularity in deliveries. Customers ask for a high quality in performance, and the most important aspect was timely deliveries in the specified time windows.

All agreed that a Fixed Link could increase the number of operating companies. It was however stated that it is a rather difficult market to enter because the capital requirements for purchasing traction are high. One operator pointed out that in order to establish operation between Sweden, Denmark and Germany it is necessary to equip the engines with safety systems and traction systems fitted to different requirements in the three different countries. Another operator mentioned that the new operators most likely would be in the market for operation of system trains.

All agreed that in principle a Fixed Link would improve the competitiveness of rail transport in relation to road transport. However, Fehmarnbelt could not be seen as an isolated link. Capacity problems and problems of regularity are prevailing in the rail network in both Denmark and Germany. Therefore it would be necessary to improve other sections as well in order to maintain the competitiveness of the railways, and improve the speed of freight trains.

As to the Fixed Link payment it was pointed out that with the present cost level the railways are just able to keep the price competition with the road transport. Therefore, none of the interviewees felt inclined to consider price increases. They rather saw the Fehmarnbelt Fixed Link as a possibility within existing price levels to obtain an advantage in the competition with road transport.

The subsequent question concerning customers' willingness to pay for faster trains and improved reliability therefore was considered not adequate, because the operating companies did not feel they would be able to increase prices without reducing the relative competitiveness of rail transport.

Some of the companies, however, concede that new types of high value goods, like express goods, parcels, etc would come within reach of the railways with an improved route via the Fehmarnbelt. These types of solutions could be able to generate new and higher income.

All the participants found a freight transport corridor would be a good solution. It was however important that the Fehmarnbelt corridor was connected to the other important rail freight corridors in Germany in order to have as undisturbed a route as possible.

5.4 Interviews in Germany

With the purpose to take a closer look at the role of the railways and especially the level of potential revenue from the railway, the Federal Ministry of Transport, Building and Housing has held talks with DB Netz AG which, in turn, has established further contacts with railway undertakings.

Current situation at Fehmarnbelt

Since the opening of the Fixed Link across the Great Belt, there has been a shift of rail traffic between Zealand and Germany. All freight trains, plus some passenger trains, that formerly used the ferry crossings on the Fehmarnbelt have been rerouted via the Great Belt link. The ferries currently in use on the Fehmarnbelt are not suitable for freight traffic (maximum axle load 14 t). Substantial investment would be required in order to operate freight services again.

Today, passenger rail services across Fehmarnbelt consist of 3 (winter timetable) or 4 (summer timetable) trains in each direction per day. The cost of the crossing for passenger trains is around 12 € per track metre on the ferry.

Evaluation of the potential revenue from railway operations

To find out which elements could be included in the maximum infrastructure charge for crossing the Fehmarnbelt Fixed Link, DB Netz AG held talks with railway undertakings. The assessment is as follows:

- Capacity utilization on the existing link across the Great Belt is only 50 % today.

- The journey time reduction of 2 hours across the Fehmarnbelt Fixed Link will hardly have an impact on the market, if only because of the continuing need for transitions to fixed paths.

- Only if it was possible in the future for the locomotive to run through from Sweden to Hamburg-Maschen, it would be possible to reduce the journey time by a total of around 4 hours in conjunction with a Fixed Link across Fehmarnbelt. This might provide opportunities for new transport chains.

- It is not the reduced journey time that is attractive, but the shorter distance if it results in lower running costs for rail freight.

- Rail freight's competitors in the road haulage sector can easily use alternative ferry routes (such as Lübeck – Malmö, Rostock – Trelleborg and Swinoujscie –Ystad); high road tolls might result in HGVs (heavy goods vehicles) using other ferries and might not produce a modal shift to the railways.

- The Fixed Link across Fehmarnbelt offers road haulage the same time advantage as rail freight. It is unlikely that sizeable amounts of traffic will shift from the roads to the railways.

- The railway operators will always prefer to have several routes to/from Scandinavia available in order not to be dependent on pricing on one route.

- Already today the railway charges on the Oeresund crossing are so high that it may be more attractive for rail freight operators to use the ferries.

Taking this assessment by the German railway undertakings into account, the present track charge for rail freight services via the Jutland Line would be the maximum charge for a Fixed Link across Fehmarnbelt that would be in conformity with market conditions.

*Table 5.5: Copenhagen – Great Belt – Flensburg – Hamburg (**Jutland Line**) track charges in 2002:*

Approx. infrastructure charges for freight services between Copenhagen and Hamburg across the Great Belt	**EUR**
Copenhagen – Padborg (via Great Belt)	420
Additional toll for use of Great Belt	820
Flensburg (border) – Maschen	460
Approx. total costs for infrastructure use	**1,700**

Table 5.6: Copenhagen – fixed link across Fehmarnbelt – Hamburg track charges

Approx. infrastructure charges for freight services between Copenhagen and Hamburg across the Fehmarnbelt Fixed Link and resulting maximum toll for the Fehmarnbelt Fixed Link	**EUR**
Approx. total costs for infrastructure use	1,700
Minus infrastructure charge for Copenhagen – Rødby Faerge	-140
Minus infrastructure charge for Puttgarden – Hamburg Hbf	-360
Max. toll per freight train for Fehmarnbelt Fixed Link	1,200

The maximum price for use of the infrastructure over the entire route via Fehmarnbelt would thus be 1,700 EUR/rail freight train, the same as for the Link via the Jutland Line (Copenhagen – Great Belt – Hamburg). From this, it follows that, taking the current pricing system as a basis and after deducting the track charges for the sections from Copenhagen to Rødby and Puttgarden to Hamburg, the maximum “toll” for the Fixed Link across Fehmarnbelt could be 1,200 EUR/freight train.

Operating cost savings and time savings have not been included.

APPENDIX I: General assumption in the financial calculations

Construction costs (m EUR current prices)	4,304
Operation costs (m EUR 2012-prices)	67
Real Interest Rate	4%
Risk Premium	2%
Inflation Rate	2.5%
Annual Debt Service Coverage Ratio (ADSCR)	1.4
Discount Rate	9.7%
Depreciation	Historical costs
Debt Instalment Profile	Annuity
Corporate Tax	34%
Traffic Growth	1.7%
Lending Fees	1.5%
Ramp-up-period	4 years
TEN support (m EUR current prices)	450
Railway payment (m EUR 2012-prices)	64
Opening year	2012
Concession period for BOT-model	30 years
Internal Rate of Return (IRR)	17%

APPENDIX II: Support and Revenues for the two Governments

In the ECI-report four different forms of surplus/deficits for the two Governments economy were defined.

In order to be able to compare the February 2003 calculation to the ECI figures the same definition has been used in the tables below where the support and revenues for the BOT-model and the State Guaranteed model is stated. In this connection it has to be mentioned that the railway payment now is an assessment of the payment ability of the railway sector where it in the ECI-report was regarded as a state guaranteed payment.

Government Support and revenues in the BOT-model

NPV (2002), m EUR	Base Case A	Base Case B
Government Investment	0	0
Government Subsidy	1,561[1)]	1,467[2)]
TEN Support	248	248
Railway Payment	336	336
Total Public Support	**2,145**	**2,051**
Concession Fee	0	0
NPV from the Project Cash Flow	0	0
Total Government Revenues	**0**	**0**
Surplus/Deficit I	**-2,145**	**-2,051**
EU Support (TEN) received	248	248
Surplus/Deficit II	**-1,897**	**-1,803**
Railway Payment re-gained	336	336
Surplus/Deficit III	**-1,561**	**-1,467**
Corporate Tax	15	24
VAT	293	310
Surplus/Deficit IV	**-1,253**	**-1,132**

1) Corresponding to 258 m EUR/year in the operation period

2) Corresponding to 243 m EUR/year in the operation period.

Government Support and revenues in the State Guaranteed model

NPV (2002), m EUR	**Base Case A**	**Base Case B**
Government Investment	0	0
Government Subsidy	0	0
TEN Support	248	248
Railway Payment	336	336
Total Public Support	**584**	**584**
Concession Fee	0	0
NPV from the Project Cash Flow	-98	-46
Total Government Revenues	**-98**	**-46**
Surplus/Deficit I	**-682**	**-630**
EU Support (TEN) received	248	248
Surplus/Deficit II	**-434**	**-382**
Railway Payment re-gained	336	336
Surplus/Deficit III	**-98**	**-46**
Corporate Tax	0	0
VAT	293	310
Surplus/Deficit IV	**195**	**264**

REFERENCES

1. Fehmarnbelt Traffic Consortium, Fehmarnbelt Traffic Demand Survey and Forecast, January 1999.

2. Trafikministeriet, Femer Bælt-Forbindelsen, Forundersøgelser – Resumérapport, marts 1999.
(Dänisches Verkehrsministerium, Die Verbindung über den Fehmarnbelt, März 1999).

3. Trafikministeriet und Bundesministerium für Verkehr, Femer Bælt-Forbindelsen, Økonomiske undersøgelser, August 1999.
(Dänische Verkehrsministerium, Die Verbindung von Küste zu Küste – Ökonomische Untersuchungen, 1999).

4. Fehmarnbelt Development Joint Venture, Fehmarnbelt, Finance and Organisation, June 2002.

5. Fehmarnbelt Traffic Consortium, Fehmarn Belt Forecast 2002, March 2003.

6. TetraPlan A/S, Fehmarn Belt Fixed Link, Analysis of Rail Infrastructure Payment, March 2003.

7. Beratergruppe Verkehr + Umwelt GmbH (BVU), Verkehrsstudie Korridor Hamburg – Öresund Region, March 2003.

8. Sund & Bælt A/S, Fehmarnbelt Fixed Link, Financial Analysis - February 2003, Main Results, March 2003