Ministry of Transport, Denmark

Fehmarn Belt Fixed Link

Analysis of Rail Infrastructure Payment

March 2003

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Document no.: 1100531.001
Revision no.: 3.2.1
Published. 09.03.2003

Prodyced by: MSP
Controlled: MH
Approved:

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Table of Contents

1. Introduction

The present report has been written on behalf of the Danish Ministry of Transport. The report has been requested as a consequence of the report "Finance and organisation, Enquiry of commercial interest" published by Fehmarn Belt Development Joint Venture in June 2002. In the Enquiry of Commercial Interest, the private sector emphasised that the most important risk regarding the financing of a Fehmarn Belt fixed link is the risk associated with traffic revenues – both revenues from rail traffic and road traffic. It was therefore decided to have a closer look at both revenue sources.

This report analyses the railway's ability to pay for the use of a fixed link across Fehmarn Belt. The main purpose of the present report is to substantiate whether the foreseen payment for using the rail track on the Fehmarn Belt fixed link (76 M EUR/560 M DKK in 1996 prices) can be expected to materialise.

The assessment is based on following analyses:

An analysis of possible infrastructure payments for crossing a Fehmarn Belt fixed link based on savings in infrastructure charges, savings in operating costs and value of time savings for redirecting trains from the Great Belt route to the Fehmarn Belt route (chapter 6).

An analysis based on interviews with train operators and other bodies on their views on the effect of a Fehmarn Belt fixed link for the rail freight traffic (chapter 7).

It should be emphasised that assumptions concerning expected passenger and freight rail traffic are being based on the Fehmarn Belt Traffic Consortium (FTC)'s forecasts for 2015. Assumptions concerning time-schedules, number of trains and ticket prices/freight transport fees have been based on the same source. These assumptions may have to be elaborated further in the future.

The summary and conclusions of the work is described in chapter 2. Chapter 3 describes infrastructure charges for both passenger trains and freight trains in Denmark, Sweden and Germany, while chapter 4 outlines the operating costs for passenger trains and freight trains. Value of time for passenger trains and freight trains is described in chapter 5. In general payments and incomes are quoted in both EUR and DKK. The conversion rate applied is 1 EUR = 7.45 DKK.

2. Summary and Conclusion

2.1 Conclusion

The present report has been written as part of the Danish Ministry of Transport's assessment of the financial viability of a Fehmarn Belt fixed link. The Ministry is updating the traffic forecasts to 2015. The present study is carried out in parallel with the 2015 forecasts and this study comprises an assessment of the infrastructure charges for rail on the fixed link, and therefore also an assessment of the potential income of operation of a 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 Fehmarn Belt:

Table 2.1. Forecasts for traffic across Fehmarn Belt according to the Fehmarn Belt Traffic Study 2002.

	Base year 2001	4+2 2015 A	4+2 2015 B
Rail passengers ('000 pass/year)	352	1497	1386
All passengers ('000 pass/year)	6376	9753	9833
Rail freight ('000 tons/year)	5138[1)]	10843	7983
All freight ('000 tons/year)	9572	17269	15189

1)Traffic directed via the Danish - German land border
Source: Fehmarn Belt forecast 2002, Final report, 2003

The former (1999) analysis estimated the payment ability of the rail operators using the fixed Fehmarn Belt link to 76 M EUR in 1996 fixed prices (88 M EUR in 2002 fixed prices). The present analysis indicates a lesser payment ability. The payment ability reflects the traffic. 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 in-

creased because the new forecasts take the latest development in rail goods types into consideration resulting in a lower average load per wagon.

Table 2.2. Assessment of potential annual railway payments for using a Fehmarn Belt 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 25M EUR (185 M DKK) to 30 M EUR (224 M DKK). If savings in operating costs are also included revenue will increase to a range of 45 M EUR (336 M DKK) and 55 M EUR (414 M DKK) or about 50 – 60% of the amount estimated in 1999. Finally, if time savings are included the range depicted by the two Base cases is 58 M EUR (430 M DKK) to 72 M EUR (537 M DKK). In comparison the amount estimated in 1999 was 88 M EUR 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 Fehmarn Belt 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 op-

erating costs, excluding saving in travel time. The lowest level would on the other hand be determined of only the savings in infrastructure payment.

Following payment ranges could therefore be proposed for crossing the Fehmarn Belt fixed link:

Per passenger train: 515 EUR (3,830 DKK) – 715 EUR (5,310 DKK)

Per freight train: 1,100 EUR (8,200 DKK) – 2,200 EUR (16,400 DKK)

Based on these rates the rail traffic will contribute between 30 M EUR and 55 M EUR annually to the financing of the fixed link in Base Case A and 25 M EUR to 45 M EUR in Base Case B.

A resulting problem related to the transfer of traffic from the Great Belt fixed link to Fehmarn Belt 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 (98 M DKK) 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 Fehmarn Belt to the Great Belt. With a Fehmarn Belt 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 2.1 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 (7.5 M DKK) in Base Case A and no extra revenue in Base Case B for the Danish National Railways Agency.

The main uncertainty is related to the forecasts. Will a fixed link reverse the trend in the rail passenger traffic? Presently the rail passenger market has been continuously declining for the last 10 years. Will the number of passengers reach the level indicated by the forecasts? As pointed out by the independent experts who analysed the passenger traffic model in 1999, the passenger forecasts are most likely rather conservative. Factors not explicitly in the model may have a considerable influence on the development of international rail travel in the future.

The freight forecasts may overstate the amount of goods to be transported between Scandinavia and the Continent. The development in goods transport flows in the period 1994 – 2000 is slower than anticipated in the former 2010 forecasts. This development, however, has been included in the most recent forecasts, where the development up to 2015 just reaches the same total levels as indicated in the former forecasts for 2010. The new forecasts take into account the development in wagon loads and change in commodity groups transported by rail. This leads to a dramatic reduction in average load per train compared to the previous forecasts established in 1999. This indicates the difficulties in taking into account all elements, which could possibly affect the forecasts, e.g. will the number of wagons per train stay the same or will the number of wagons per train decline? Also, it is difficult to foresee how the competition between road and rail will develop.

2.2 Previous assumptions concerning revenue

The previous economic and financial evaluations of a Fehmarn Belt fixed link were based on forecasts for 2010. Savings were established in relation to the reference case in 2010 for passenger and goods traffic. The 2015 forecasts have been produced recently in order to investigate further the sensitivity of the forecasts in relation to different assumptions concerning price relations on different transport modes and different routes. In this report all new assessments are based on the 2015 forecasts.

The 1999 assessment of the economic viability lead to savings in economic terms as indicated in table 2.3.

Table 2.3. Assumed annual savings for passenger and freight rail transport 2010 in economic terms (quoted in 1995 fixed prices)

4+2, 2010	M DKK	M EUR
Passenger		
Travel costs	2	0.27
Time costs	126	16.9
Goods		
Travel costs	229	30.7

Source: Femer Bælt forbindelsen, forundersøgelser - Resumérapport, 1999

Table 2.3 clearly indicates that the savings in economic terms related to passenger transport are mainly savings in time costs, whereas savings in economic terms related to goods are related to transportation costs. Travel costs and time costs were based on economic values established in accordance with the market price methodology.

In the same report a financial analysis has been carried out. The financial analysis is based on the assumption that trains passing the Fehmarn Belt fixed link have to pay for the use of the tracks. According to the final report the amount to be paid has been assessed based on commercial terms but the background for the calculations has not been published.

Tabel 2.4 Assessment of annual railway infrastructure revenue on the Fehmarn Belt fixed link in no. of trains and EUR/DKK exclusive VAT. All prices in fixed 1996 prices.

Passenger trains across the Fehmarn Belt fixed link 2010 (no. of trains per year)	16,060
- Redirected from the Great Belt route (no. of trains per year)	3,650
Freight trains across the Fehmarn Belt fixed link 2010 (no. of trains per year)	16,258
- Redirected from the Great Belt route (no. of trains per year)	16,258
Market based annual infrastructure charge (= saved operational costs due to redirection of traffic from the Great Belt route)	76 M EUR (560 M DKK)

Source: Femer bælt forbindelsen – økonomiske analyser, 1999

The assessed revenue does not take into account the value in shippers' and passengers' time savings accruing to the redirection of the trains from the longer Great Belt route to the shorter and faster Fehmarn Belt route. The report "Femer Bælt forbindelsen, forundersøgelser – Resumérapport" states that this will provide an opportunity to increase the revenue further than indicated in table 2.4.

The same report does however emphasise that some of the operating cost savings are infrastructure payment savings. It could be argued that infrastructure charges should be paid anyway and directly to the railway agencies, therefore leaving considerable less room for payments aimed specifically to contribute to the fixed link.

The report also stresses that the railway payments are assumed to constitute a politically fixed annual amount, which will not vary with the railway traffic. This payment schedule is comparable to the payment scheme for the Great Belt fixed link and the Øresund fixed link. The Danish National Railways Agency pays a fixed annual amount to the company Sund and Bælt, which owns the Danish fixed links. The railway operators pay a variable amount to the Danish National Railways Agency for using the fixed links depending on the number of trains using the fixed links. The amount paid is made up of a payment for passing the fixed links and a surcharge for using the railway between Kastrup/Copenhagen and Padborg. The amount paid by the operators does however not currently cover the amount paid by the Danish National Railways Agency to Sund & Bælt. The money to cover the deficit is transferred from the National Railways Agency's budget.

The main purpose of the present report is to substantiate whether the foreseen payment for using the rail track on the Fehmarn Belt fixed link (76 M EUR/560 M DKK in 1996 prices) can be expected to materialise. Related with this is an assessment of the increase in deficit for the Danish National Railways Agency,

which can be expected on the Great Belt fixed link when the traffic is redirected from this link to the Fehmarn Belt route.

2.3 Reassessment of revenue related to rail traffic

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 Fehmarn Belt fixed link.

2.3.1 Passenger trains

Passenger transport by rail via a Fehmarn Belt 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 Fehmarn Belt link" case will be redirected to the Fehmarn Belt 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 Fehmarn Belt 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. In this report costs are assessed based on a unit comparable to an IC 3 unit. The average costs of operation per km is estimated to about 8.9 EUR (66 DKK) in the case without fixed link and about 8.2 EUR (61 DKK) in the case with the fixed link. A shorter turn around time reduces the need for units, and this is the reason for the reduction in total costs of operation.

A detailed assessment of the different elements leads to the following savings per train passing the Fehmarn Belt fixed link based on the assumption that in the "Without a fixed Fehmarn Belt link" case 6 trains per day per direction are routed via Fehmarn Belt using ferries and one train is routed via Great Belt.

1. Saving in infrastructure payment + ferry charge: 515 EUR (3,830 DKK) per unit.

2. Saving in operating costs per unit: 200 EUR (1,480 DKK).

3. Saving in travel time value per unit: No savings will occur due to a higher fraction of business travellers in the with fixed link cases than in the without fixed link case.

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

Table 2.5. 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 (M DKK)	7.5 (56)	7.5 (56)
Annual income based on savings in operating costs M EUR (M DKK)	2.9 (22)	2.9 (22)
Total based on savings in infrastructure payments and operating costs M EUR (M DKK)	10.4 (78)	10.4 (78)
Annual income based on savings in travel time M EUR (M DKK)	-	-

Conversion rate: 1 EUR = 7.45 DKK

The total potential revenue attributable to rail passenger traffic is about 10.4 M EUR (78 M DKK), if all expected savings are included in the payment

2.3.2 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 Fehmarn Belt 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 is 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 Fehmarn Belt 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 Fehmarn Belt 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 Fehmarn Belt 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 Fehmarn Belt.

Table 2.6. 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 (M DKK)	22.5 (168)	17.3 (129)
Annual income based on savings in operating costs M EUR (M DKK)	22.5 (168)	17.3 (129)
Total based on savings in infrastructure payments and operating costs M EUR (M DKK)	45.0 (336)	34.6 (258)
Annual income based on savings in travel time M EUR (M DKK)	16.4 (123)	12.6 (94)

Conversion rate: 1 EUR = 7.45 DKK

The total potential revenue attributable to freight trains is in the range of 47.2 – 61.4 M EUR(if all expected savings are included in the payment.

2.4 Interviews

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 Fehmarn Belt, 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 Fehmarn Belt was most wanted. The an-

swer 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, Fehmarn Belt 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 Fehmarn Belt 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 Fehmarn Belt. 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 Fehmarn Belt corridor was connected to the other important rail freight corridors in Germany in order to have as undisturbed a route as possible.

3. Infrastructure charges for rail transport

The principles for infrastructure charging have been identified for Denmark, Germany and Sweden. The principles are quite different in the three countries and indicate different systems for charging.

3.1 Denmark

Infrastructure charges related to railway operation in Denmark are determined by the Ministry of Transport and consist of following items:

- A fee per train km
- Charges for use of the Great Belt fixed link and the Øresund fixed link
- Other fees related to traffic on railway lines not being used for passenger traffic

For Øresund the Danish charges cover the Danish part of the structure.

The principal Danish infrastructure charges related to passenger and freight traffic per January 1st 2002 are provided in table 3.1.

Table 3.1. Danish railway infrastructure charges, 2002.

	Passenger traffic	Freight traffic
Charges related to the main link Øresund – Korsør and Nyborg – the Danish/German border	3.03 EUR (22.57 DKK) per train km	1.23 EUR (9.14 DKK) per train km
Other links except the fixed links	0.46 EUR (3.44 DKK) per train km	0.23 EUR (1.72 DKK) per train km
Passage of the Great Belt fixed link	899 EUR (6,696 DKK) for one train passage	96.6 EUR (720 DKK) per wagon up to a maximum of 833.6 EUR (6,210 DKK)
Passage of half of the Øresund fixed link	158 EUR (1,180 DKK) for one train passage	273 EUR (2,032 DKK) for one train passage

Conversion rate: 1 EUR = 7.45 DKK
Source: Ministry of Transport, Denmark

Passenger traffic is divided in contracted traffic, e.g. subsidised public service traffic, and commercial traffic, which is carried out on market conditions. In

general in the future international passenger traffic will be categorised as commercial traffic.

As mentioned above payment for using the infrastructure is determined based on a political decision. A surcharge is levied on the route Kastrup/Copenhagen – Padborg as an indirect payment for using the Great Belt fixed link and the Øresund fixed link in addition to the specific payments for using the fixed links as indicated in table 3.1. The surcharges amount to approx. 40 M EUR (300 M DKK) annually and is aimed at co-financing the payments from the Danish National Railways Agency to the fixed links.

Use of the fixed links is regulated in laws and agreements. Sund & Bælt Holding owns, operates and maintains the fixed links through its subsidiaries A/S Storebælt and A/S Øresund. Law 1233 from 1996 determines that the government annually shall transfer 70.5 M EUR (525 M DKK) in fixed 1997 prices to A/S Storebælt as a payment for using the rail part of the Great Belt fixed link. In 2002 the amount corresponds to 79.2 M EUR (590 M DKK). The payment is made by the Danish National Railways Agency.

The 1991 agreement between the Danish and the Swedish government about the construction of the Øresund Fixed link stipulates that each country shall pay 20,2 M EUR (150 M DDK) in 1991 prices annually to Øresundsbro Konsortiet for the use of the railway tracks on the fixed link. The Danish contribution is paid by the Danish National Railways Agency and amounted to 26,3 M EUR (196 M DDK) in 2002.

Øresundsbro Konsortiet is the Danish-Swedish company responsible for constructing and operating the fixed link. The Danish part of this company is owned by A/S Øresund. A/S Øresund is also responsible for the access rail infrastructure related to the Øresund fixed link. The Danish National Railways Agency pays A/S Øresund an annual fee for using the access infrastructure, in 2002 this fee amounted to 11.3 M EUR (84 M DKK).

The Ministry of Transport also decides the fees to be collected from trains passing the fixed links. The Danish National Railways Agency collects the fixed link fees from the train operators using the fixed links. Any deficits between the collected revenues and the annual payments to Øresundsbro Konsortiet, A/S Øresund and A/S Storebælt are covered by the Danish National Railways Agency's budget.

From the above-mentioned it is clear that if a major part of the traffic is redirected from the Great Belt link the question of payments to Sund & Bælt has to be cleared in a political decision and executed by the Ministry of Transport.

3.2 Sweden

In Sweden railway charges are determined by the Ministry of Trade. Collection of charges is the responsibility of the Swedish National Railways Agency (Banverket).

In Sweden infrastructure charges related to railway operation are based on the gross weight (GT) of the train. As from January 1st, 2001 following infrastructure charges are applicable in Sweden.

For the main lines (The "trunk" network up to the national border on the Øresund fixed link and the county railways) the charges are outlined in table 3.2.

Table 3.2 Swedish railway infrastructure charges applicable to main lines, 2002

	Passenger traffic	Freight traffic
Track charge	0.00094 EUR (0.0086 SEK) per GT per km.	0.00031 EUR (0.0028 SEK) per GT per km
Information charge	0.00022 EUR (0.002 SEK) per GT per km	Not applicable
Shunting charge	0.44 EUR (4 SEK) per shunted wagon	0.44 EUR (4 SEK) per shunted wagon
Accident charge	0.12 EUR (1.10 SEK) per km and per train	0.06 EUR (0.55 SEK) per km and per train
Diesel charge	0.034 EUR (0.31 SEK) per litre fuel consumed. For small locomotives with engines manufactured later than 1990 the charge is reduced with 50%.	0.034 EUR (0.31 SEK) per litre fuel consumed. For small locomotives with engines manufactured later than 1990 the charge is reduced with 50%.
Øresund fixed link (The Swedish part)	Included in the track charge.	254 EUR (2325 SEK) per train per passage

Conversion rate: 1 EUR = 9.15 SEK
Source: National Railways Agency, Sweden (Banverket)

For other railway lines the charges are fixed at a level corresponding to 30% of the costs related to operation and maintenance of the line.

The 0.00094 EUR per GT per km payable by the passenger trains are divided in two parts, 1/3 are related to maintenance of infrastructure, and 2/3 are related to payment of the Öresund fixed link.

3.3 Germany.

The rail network in Germany is the responsibility of DB Netz AG. DB Netz AG is in charge of development and maintenance of the network. DB Netz AG is running the infrastructure based on commercial principles, which means that the users have to pay the full costs of the network operations.

The DB Netz AG system for rail infrastructure charging consists of three different components.

1. A basic charge related to category of link and the traffic categories served.

2. Service factors related to channels (Trassen)

3. Additional charges and rebates.

9 different basic charges are applicable. 6 are valid for inter city links, 2 are applicable for links connecting to the main inter city network, and the last group is applicable for S-train links. The 6 inter city link types differ in terms of technical and operational characteristics and also in terms of traffic types.

Following basic charges are applicable in the German network.

Table 3.3. German basic rail infrastructure charges, 2002

Type	Description	Charge per trassen km in EUR (DKK)
F1	Links allowing speed of more than 200 kph, mainly for high speed traffic	3.38 (25.20)
F2	Links allowing speed of 161 – 200 kph. Mixed traffic links	2.25 (16.75)
F3	Links allowing speeds of 101 – 160 kph. Mixed traffic links	2.17 (16.20)
F4	Links allowing speeds of 101 – 160, Link priority for fast inter regional traffic	2.12 (15.75)
F5	Links allowing speed of 101 – 120 kph. Link priority for slow inter regional traffic	2.05 (15.25)
F6	Links allowing speed of 101 – 160 kph and ,mainly serves city transport.	1.93 (14.40)
Z1	Links allowing speed up to 100 kph. Mixed traffic links	2.12 (15.75)
Z2	Links with only limited safety installations, allowing speed of not more than 50 kph.	2.20 (16.40)
S1	Links mainly or only used for S-trains.	1.48 (11.00)

Source: Federal Railway Authority, Germany (DB Netz AG)

All railway links in Germany have been assigned a specific type. Assessing the infrastructure charge for a rail trip between two points in Germany therefore has to take into account the detailed route (channel) choice of the trip.

The services the railway operator will offer in the selected channels determine a service factor applicable to the basic charge.

For passenger traffic following service factors are available:

- Service factor for frequency channels. Traffic in these channels is characterised by a minimum of three daily connections in both directions, and same or alternating stops for each connection. Basic charges are multiplied with 1.65.
- Service factor for express channels. These channels are the quickest and most direct links between the major centres in Germany. Express channels have highest priority in the planning and operation of traffic. Basic charges are multiplied with 1.8.
- Service factor for economy channels. These channels are cheap, and are available for repositioning of trains, for night trains and for railway companies who are not in a position to pay the more expensive express and frequency channels. Basic charges remain unaltered.

For freight traffic following service factors are available:

- Service factor for standard channels. These channels can be applied by all freight trains. Basic charges remain unaltered.

- Service factor for distribution channels. These channels are used for traffic between shunting areas and final delivery/start of journey. Basic charges are multiplied with 0.5.
- Service factors for express channels. These channels are the quickest and most direct links between the major centres in Germany. Express channels have highest priority in the planning and operation of traffic. Basic charges are multiplied with 1.65.

Specific demands from operators may result in increases or reductions in the charges calculated based on the basic charges adjusted with the service factors. Most of the specific demands will result in additional charge. Two specific demands are taken account of by multiplying with specific factors. The demands are:

- Use of steam engines and
- Operations with load or equipment exceeding the maximum weight and dimension limits applicable for the chosen route.

The additional charges are related to demands on gross weights of freight trains and axle loads for freight transport. For passenger traffic demands in relation to the use of curving techniques lead to an additional charge.

Following additional charges are valid for freight and passenger traffic:

Table 3.4. Specific additional charges for freight trains and certain types of passenger trains.

Traffic	Type	Description	Additional charge per km in EUR (DKK)
Freight traffic	Gross weight	< 1200 t	0
		1200 – 1599 t	0.51 (3.75)
		1600 – 1999 t	0.77 (5.75)
		2000 – 2399 t	1.08 (8.05)
		≥ 2400 t	1.33 (9.90)
	Axle loads	> 22.5 t	0.64 (4.75)
Passenger traffic	Curving technique		0.51 (3.75)

Source: Federal Railway Authority, Germany (DB Netz AG)

Further a regional factor will be introduced at the end of 2002. However, the magnitude of this factor has yet to be decided.

The system described above was introduced 1st of April 2001. The system has meant a reduction of the infrastructure charges. As an example DB Netz has compared the effect on payments for a high-speed passenger train and a freight train operating between Hamburg and Frankfurt according to the new system and to the old system respectively. The infrastructure payment for the passenger train is reduced with about 25% and for the freight train with about 35%.

3.4 Comparison of infrastructure charges.

From the above it is evident that there exists major differences between infrastructure charging systems in Denmark, Sweden and Germany.

In Denmark and Sweden charges are determined by the political system. The National Railway Agencies in the two countries are responsible for collecting the payments from the operators. It is however important to notice that development of the rail network, including upgrading is a question to be decided by the government in both countries.

In Germany DB Netz AG is responsible for maintenance and operation of the rail network and collects the necessary means from the operators. The national government does not support the maintenance and operation activities of DB Netz AG.

DB Netz AG is also implementing decisions on long-term infrastructure development, the so-called Bundesverkehrswegeplan (BVWP). The BVWP is agreed in the Bundestag and the necessary means to implement the plan are drawn from the national budgets.

Railway charges in Denmark and Sweden do not necessarily reflect actual costs for maintenance and operation of the railway network. In Germany there is a close relationship between costs for maintenance and operations and revenue collected from the operators using the network.

In Denmark construction, operation and financing of the fixed links have been the responsibility of Sund & Bælt. Sund & Bælt is guaranteed an income from the use of the rail infrastructure on the fixed links, and this revenue is paid by The Danish National Railways Agency. Irrespective of the size of revenue collected from passing trains on the Great Belt link and the Øresund link and on the main line from Copenhagen to Padborg, the National Railways Agency transfers the agreed payment to Sund & Bælt. A possible deficit is covered by the budget of the Danish National Railways Agency.

In Sweden the fixed Öresund link is financed in two different ways. Rail goods operators pay a fixed charge for passing the link. Rail passenger services in Sweden are levied a specific charge per gross ton km applicable to the main network in Sweden. Thus all passenger trains operating on the main network in Sweden contribute to the payment of the Öresund fixed link.

4. Assessment of operating costs for rail transport

4.1 Passenger transport

The subsequent description of the operating cost structure for passenger trains is based on a system serving the Copenhagen – Hamburg route. It is assumed that operation of the passenger train system between Copenhagen and Hamburg is organised as a commercial business covering its own costs of operation and producing a surplus to the operators. Evidently the assumptions on operating costs are quite uncertain because the future train system including its costs is not known today. The subsequent cost description is based on a passenger train unit comparable to an IC3 unit.

The FTC forecasts for 2015 have been used as a basis for a rough outline of a plan of operation.

Following forecasts have been used: 2015 Base Case A and 2015 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 general the forecasts are based on the assumption that capacity of the infrastructure is sufficient to accommodate the future traffic. This assumption implies a continuous development of the infrastructure in order to alleviate existing and future bottlenecks. In Denmark this would mean an improvement between Copenhagen and Ringsted, improvement on the western part of Funen and between Lunderskov and the Danish/German border as well as improvement of the line from Vordingborg to Rødby in case of a fixed Fehmarn Belt link.

A requirement for the passenger FTC model is a timetable indicating the number of departures per day between Copenhagen and Hamburg including the routing. The forecast model is not dynamic, which means that the number of departures is not related to the results of the forecasts. In a dynamic model a procedure would transform the passenger forecasts to a new timetable and in this way establish a balanced forecast in which the timetables were in balance with the demand for passenger trips. In the subsequent evaluations the forecasted passenger demand has been used for assessing a plan of operation in

terms of departures per day ensuring a reasonable utilisation of the equipment in terms of passenger capacity and utilisation of rolling stock. FTC has assumed in both Base Cases that the daily number of departures between Copenhagen and Hamburg per direction is 20.

Evidently, different infrastructure charging policies will lead to different plans of operation aiming at providing as big a revenue as possible. As an example, an infrastructure charge related to number of trains in stead of number of units or wagons may result in fewer departures with bigger trains. However, the number of departures has to be seen in the context of a flexible train system offering an attractive service level. The assessments carried out in the following sections anticipate that the number of departures per day is adequate but independent of the infrastructure payments.

Further, it is assumed that the operator should be able to recover a surplus of at least 10% of the total costs of the operation. If this cannot be fulfilled the outline plan of operation should be redrafted. The specified plans reveal rates of return of 11% in Base Case A and 15% in Base Case B. (as indicated in calculations in appendix 2). These results have been accepted taking into consideration the general uncertainty related to the forecast for 2015.

One of the assumptions made in the plan of operation concerns the routing of the trains. In 2001 a few trains per week between Copenhagen and Hamburg are routed via the Great Belt. The assessments made in the following sections are based on following plans of operation:

- Without a fixed Fehmarn Belt link 2015; one daily train of one unit operating via the Great Belt route while 6 trains are routed via Fehmarn Belt. The latter trains comprise 2 units.

- With a fixed Fehmarn Belt link 2015; all trains between Copenhagen and Hamburg are routed via Fehmarn Belt, and all trains comprise one unit.

The cost of operation of a passenger train set is composed of capital costs, operating costs, staff costs and overhead costs. As indicated above costs are assessed based on a unit comparable to an IC 3 unit.

The capital costs include depreciation and interest. Capital costs are assessed based on a purchase price of about 6 M EUR including VAT (45 M DKK). Assuming a 20 year pay back period and an interest of about 8% the annual payment per unit amounts to 615,000 EUR (4,583,000 DKK).

Operating costs include fuel, maintenance, repairs, etc. The operating costs amounts to approx. 2 EUR (15 DKK) per unit km.

Staff costs can be assessed to about 135 EUR (1,000 DKK) per hour of operation. This will be valid for trains composed of one unit and of two units.

Overhead costs make up all other costs for administration, insurance, safety, station services etc. Overhead costs are assumed to be 13.5 M EUR (100 M DKK) per year for the ‘without fixed link’ system. For the with fixed link systems overhead costs amounts to 17.7 M EUR (132 M DKK).

Based on the mentioned cost elements a calculation has been carried out assessing the average costs of operation for a passenger train operating between Hamburg and Copenhagen under continued ferry operations on Fehmarn Belt and under the conditions of a fixed link across Fehmarn Belt. Main characteristics for the different alternatives are depicted in table 4.1.

Table 4.1. Main service characteristics for passenger train systems Copenhagen - Hamburg

	2010 Without a fixed link[1)]	2015 Base Case A (2+4)	2015 Base Case B (2+4)
Rail passengers according to FTC forecasts	1,069,000 (82,000)	1,497,000	1,386,000
No of departures per day per direction assuming reasonable uniform utilisation of capacity	7 (1)	20	20
No of units per departure	2(1)	1	1
Travel time in hours	4,5 (5,5)	3,5	3,5
Assessment of number of units for maintaining the traffic	10	12	12

1) No forecast is available for 2015 without a fixed link. The previous 2010 forecast produced by FTC has been applied.

Note. Figures in Brackets indicate the traffic on the Great Belt route.

Based on the assumptions made in table 4.1 and the costs quoted above the average costs of operation per km is estimated to about 8.9 EUR (66 DKK) in the case without fixed link and about 8.2 EUR (61 DKK) in the case with the fixed link. A shorter turn around time reduces the need for units, and this is the reason for the reduction in total costs of operation, which in turn leads to the reduction of average costs.

Payments for using the infrastructure are not included in the calculation of operating costs.

4.2 Freight transport

Operating costs for rail freight transport is subject to similar assumptions as is the rail passenger transport. That means, costs are assessed based on fictive operation schedules, which assume that with no fixed Fehmarn Belt link all rail freight transport will use the Great Belt route. With a fixed link the rail freight transport will be redirected to Fehmarn Belt. Further, it is assumed that the necessary capacity is available in the rail network implying improvements as indicated already in the previous section, e.g. improvement of the section between Øresund and Ringsted.

Operating costs for a freight train running between Sweden and Germany via Denmark has been assessed in detail in the RECORDIT project carried out under the EU 5th Research and Development Framework Program. Operating costs

consist of fuel (electricity), wages, safety systems, maintenance and depreciation of engine and wagons.

The operating costs per km for one load unit are assessed as indicated in table 4.2.

Table 4.2. Operating costs for one load unit on railways per km, fixed costs 2002.

Depreciation:	0.07 €	0.52 DKK
Maintenance:	0.063 €	0.47 DKK
Electricity:	0.051 €	0.38 DKK
Wages:	0.028 €	0.21 DKK
Safety systems:	0.02 €	0.15 DKK
Total	0.232 €.	1.73 DKK

Source: EU 5th FWP Recordit, 2002

In the recent Fehmarn Belt forecasts the average size of the trains has been assumed to about 30 units. This indicates an average operating cost per train per km of 7.0 EUR (52 DKK).

An assessment of the costs of operation has been carried out for a heavy goods train operating between mid-Sweden and Stuttgart. For this train an average cost of operation has been estimated to about 7.8 EUR (58 DKK) per km.

5. Value of time

Value of time (VOT) relates to the user's perception of the time used for transportation. Value of time is assessed based on interviews, and value of time is applied in the transport models for describing the modal split and route choice. Value of time is also an essential part of the assessment of time saving providing an input to the economic benefits of projects.

Time saving may provide a basis for increasing transport prices. Value of time provides an indication of the willingness to pay. However, time saving may be capitalised in other ways, e.g. quicker turn around times resulting in savings in equipment and increasing number of passengers in the available faster transport modes.

5.1 Passenger transport

The passenger transport value of time has been estimated in the Fehmarn Belt traffic study. Based on this study a general value of time for leisure trips has been estimated to 9.0 EUR (67 DKK) per passenger hour. For business trips the value of time was estimated to 36.2 EUR (270 DKK) per passenger hour.

In the EUNET study carried out by the EU Commission, a general value of 4.5 EUR (33.5 DKK) per passenger hour has been proposed for non-work trips. This value is half the Fehmarn Belt value. The general value of time is applicable to all non-work trips, and not only to long distance trips. Looking at the value of time for air travel a VOT of 37.7 EUR (281 DKK) has been proposed as an EU average in the said study. This value is quite close to the Fehmarn Belt study's result for business trips.

In Germany the procedure for evaluation of major infrastructure projects (FTIP) recommends applying a value of time of 5.2 EUR (38.7 DKK) for leisure trips and 20.1 EUR (149.7 DKK) for business trips. There is a reasonable agreement between value of time for leisure trips as proposed by FTIP and EUNET. Also in the Danish evaluation of a new railway line between Copenhagen and Ringsted the value of time for long distance passenger trips with private purpose was found to 6.7 EUR (50 DKK) per hour, while value of time for business trips were found to 35.3 EUR (263 DKK). There is a rather high correlation between the Fehmarn Belt results and the Copenhagen – Ringsted results.

In general however, value of time for international trips is higher than for national trips. One of the reasons is that the international trips are longer and more

expensive. The Fehmarn Belt value of time has been used in the forecasts. In the economic study of the Fehmarn Belt fixed link in 1999 both the FTC value of time and the FTIP value of time was applied in order to analyse the sensitivity towards different values of time.

5.2 Freight transport

The value of time (VOT) has been estimated in the Fehmarn Belt traffic model and the following results were obtained for different commodity types.

Table 5.1. Value of time for different commodity groups identified in the Fehmarn Belt Traffic Study.

Commodity type	VOT (EUR/hour/ton)	VOT (DKK/hour/ton)
Agricultural products	18.2	136
Wood, cork, textiles, chemicals and paper	7.2	54
Miscellaneous articles	34.0	253
Manufactured products	24.3	181
Bulk products	7.6	57

Source: Fehmarn Belt Traffic Study, 1999

In Germany an average VOT of 0.76 EUR (5.7 DKK) per ton per hour is used for assessment of delay costs for freight rail services in the FTIP guidelines. This value is far lower than the Value of Time estimated in the Fehmarn Belt study. Differences of the same magnitude can be identified when different studies are compared. It can be argued that the time values are mainly derived from interviews with transport buyers using truck transport. Further it could be said that if time savings are able to improve lead time, that is the time from the goods leave the factory till it has been delivered at the final place of use, the VOT in the tables above may be justified. However, lead time depends on a number of different factors, among them production hours etc. Most likely time savings as expected on the Fehmarn Belt link can be utilised in some relations, but expectedly not in all relations. Therefore, and also not to overstate the effect of time savings, it is suggested to carry out the assessments based on the figure of 0.76 EUR (5.7 DKK) per ton per hour.

Further evidence for the choice of this figure can be obtained in a number of other studies. The latest known study has been carried out by RAND in France, and gave a result of 2.6 – 11.2 EUR (19.4 – 83.4 DKK) per hour and shipment. Lori Tavasszy from TNO in The Netherlands has estimated that VOT for rail freight from an economic point of view most likely should be in the interval 0.4 – 1.1 EUR (3.0 – 8.2 DKK) per hour and ton. These results do not oppose the use of an average VOT of 0.76 EUR (5.7 DKK) per ton per hour.

5.3 Conclusion

It is unlikely that a railway operator should be able to convert the full time saving into higher ticket and transport prices, and therefore it is also unlikely that the full time saving can be included in the future infrastructure payment. However, the FTIP values will be applied in order to assess a possible infrastructure payment related to time saving.

6. Assessment of rail payment on the Fehmarn Belt link

6.1 Passenger transport

Passenger transport by rail via the Fehmarn Belt link will be faster and excludes specific costs to ferry transport. Further, it is assumed that the departures routed via the Great Belt in the "Without a fixed Fehmarn Belt link" case will be redirected to the Fehmarn Belt 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 Fehmarn Belt link. Therefore, a comparison is carried out between the costs related to a trip via Fehmarn Belt with ferry, a trip via the Great Belt and a trip via a fixed Fehmarn Belt link.

Another important assumption is that the infrastructure payment per km for the link between Ringsted and Rødby will be maintained at the existing level.

The trains being redirected will experience a saving in infrastructure payments, in operating costs and in time savings. The trains already using the Fehmarn Belt link will experience a saving in ferry charges and time.

Table 6.1. Operating costs and infrastructure payment related to a passenger train led across the Great Belt route and the Fehmarn Belt route. (Price level 2002)

	Copenhagen – Hamburg via Fehmarn Belt. With ferry Existing infra-structure pay-ment level	Copenhagen – Hamburg via Great Belt Existing infra-structure pay-ment level	Copenhagen – Hamburg via Fehmarn Belt with fixed link.
Number of units per train	2	1	1
Denmark			
Distance	183	323	192
Operating costs (EUR)	2,964	2,616	1,478
Infrastructure payment (EUR)	248	1,808	248
Ferry charges (EUR)	800		
Germany			
Distance	151	183	160
Operating costs (EUR)	2,446	1,482	1,232
Infrastructure payment (EUR)	524	679	524
Total			
Distance	334	506	352
Operating costs (EUR)	5,410	4,098	2,710
Infrastructure payment (EUR)	772	2,487	772
Ferry charges (EUR)	1600		
Total costs (EUR)	7,782	6,585	3,482

A comparison of the different cost elements for a train system comprising 13 departures per day results in following savings for the system using a fixed Fehmarn Belt link:

Savings in infrastructure fees and ferry charges: 515 EUR (3,830 DKK) in average per train.

Savings in operating costs: 200 EUR (1480 DKK) in average per train.

Establishment of a fixed link leads to savings in travel time. A saving of about one hour is foreseen on the trip between Copenhagen and Hamburg via Fehmarn Belt, and a saving of 2 hours for trips redirected from the Great Belt. The average number of passengers per departure is about 113 persons without a fixed link. According to the FTC 1999 forecast about 6% of the train passengers is expected to be business travellers if a fixed link across Fehmarn Belt is not established. If a fixed link is established the percentage of business travellers is expected to increase to about 26% in Base Case A and 28% in Base Case B. The average number of passengers per departure drops to about 103 in Base Case A and 95 in Base Case B. Based on the FTIP values the value of time for business travellers is 20.1 EUR per hour and for other travellers 5.2 EUR per hour.

Based on the above and on the assumption that in the without case 12 units (6 trains) per day per direction are routed via Fehmarn Belt and one train is routed via Great Belt the result is, that no savings will occur. The reason is that a larger fraction of the travellers in Base Case A and B will be business travellers, thus producing a higher total value of time than in the 'without a fixed link' case.

Based on the plan of operations outlined in table 4.1 following revenues are calculated.

Table 6.2. 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 (M DKK)	7.5 (56)	7.5 (56)
Annual income based on savings in operating costs M EUR (M DKK)	2.9 22)	2.9 (22)
Total based on savings in infrastructure payments and operating costs M EUR (M DKK)	10.4 (78)	10.4 (78)
Annual income based on savings in travel time M EUR (M DKK)	0	0

Conversion rate: 1 EUR = 7.45 DKK

With the above-mentioned charges it will be possible to obtain at least a 10% rate of return on the operation of the train system as indicated in the calculations illustrated in appendix 2.

6.2 Freight transport

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 Fehmarn Belt route. However, the shift of route will among other things be determined of the infrastructure payments along the two routes.

Freight transport costs of operation have been assessed in chapter 4. In the present chapter a few case studies will be referred, mainly in order to investigate the difference in terms of infrastructure payment and costs of operation on the two main routes via Great Belt and via a fixed link across Fehmarn Belt, respectively.

Costs of operation were assessed to 7.0 EUR per km per goods train with 30 units. The first case study indicates the costs for running a train with 30 load units (total weight of train less than 1200 tons) between Malmö and Maschen. The second case study indicates the costs for running a train of a total weight between 1600 and 1900 tons between Östersund in Sweden and Stuttgart in Germany.

Infrastructure payment on the route from Ringsted to Rødby is assumed to increase to the level of the Copenhagen – Ringsted link.

6.2.1 Malmö – Maschen.

The route between Malmö and Maschen is the basic route for transit traffic through Denmark, and the route which most obvious will gain from an opening of the fixed link. This route therefore provides a good opportunity to analyse the possible savings and subsequent infrastructure payment for passing the fixed Fehmarn Belt link.

Table 6.3. Operating costs and infrastructure payment for a freight train operating from Malmö to Maschen via Great Belt fixed link or via Fehmarn Belt fixed link

	Malmö – Maschen via Great Belt	Malmö – Maschen via Fehmarn Belt
Sweden		
Distance	23	23
Operating costs (EUR)	161	161
Infrastructure payment (EUR)	265	265
Total (EUR)	426	426
Denmark		
Distance	343	211
Operating costs (EUR)	2,401	1,477
Infrastructure payment (EUR)	1,490	509 excl. fixed link
Total (EUR)	3,891	1,986
Germany		
Distance	202	179
Operating costs (EUR)	1,414	1,253
Infrastructure payment (EUR)	454	360 excl. fixed link
Total (EUR)	1,868	1,613
Total		
Distance	568	413
Operating costs (EUR)	3,976	2,891
Infrastructure payment (EUR)	2,209	1,134 excl. Fixed link
Total (EUR)	6,185	4,025

The difference in infrastructure payments between the two routes without a Fehmarn Belt charge comes to 1,075 EUR. Difference in operating costs is 1,085 EUR. Finally, a 2 hours saving for about 520 tons of goods could be assessed to 790 EUR using the FTIP value of 0.76 EUR per hour per tons.

6.2.2 Östersund - Stuttgart

For the purpose of the analysis costs and infrastructure payment have been assessed along different routes between Östersund and Stuttgart. The present route via the Great Belt is in total 2.239 km while the route via a fixed Fehmarn Belt link is only 2.065 km.

The case study has been based on average parameters and costs used in calculations of rail traction, such as fuel supply, staff costs, locomotive and wagon leasing costs, maintenance, insurance, shunting, overhead, etc. Further the cost level is based on the valid level in year 2002.

For an adequate and realistic split of the large fixed costs for locomotives, wagons and staff etc. the costs are based on the assumption that the trains will operate 2 roundtrips between Östersund and Stuttgart per week. Which in total gives 180 single trips per year.

Operating costs in this case study are based on actual operation. Unit costs of operation is different in the different countries because of differences in wages, fuel prices, shunting, etc. That means the costs of operation per km vary between 6.5 EUR in Denmark and 8.9 EUR in Germany. The average cost of operation is assessed to 7.8 EUR.

The figures presented in table 6.3 include the infrastructure payment in the respective countries based on a normal direct routing, wherefore minor deviations in the routing can result in minor differences in the mentioned infrastructure payment. For example the German infrastructure payment are dependent on which exact railway lines are used, i.e. high-speed lines are more expensive than normal lines etc. Also the German fees are dependent on the total weight of the train. In this case study a train with a total weight of 1600-1900 tons has been used.

In the comparison no infrastructure payment for the future Fehmarn Belt link has been calculated, in order to establish the possible level. For the operational costs however, 18 km extra are calculated, for fuel etc.

An ordinary diesel locomotive has been used as basis for the calculations.

Table 6.4. Operating costs and infrastructure payment for a freight train operating from central Sweden to south Germany via Great Belt fixed link or via Fehmarn Belt fixed link

	Östersund – Stuttgart via Great Belt	Östersund – Stuttgart via Fehmarn Belt
Sweden		
Distance	1,052	1,052
Operating costs (EUR)	7,520	7,520
Infrastructure payment (EUR)	787	787
Total (EUR)	8,307	8,307
Denmark		
Distance	343	211
Operating costs (EUR)	2,229	1,371
Infrastructure payment (EUR)	1,487	509 excl. fixed link
Total (EUR)	3,716	1,880
Germany		
Distance	844	802
Operating costs (EUR)	7,526	7,138
Infrastructure payment (EUR)	2,749	2,573 excl. fixed link
Total (EUR)	10,275	9,711
Total		
Distance	2,239	2,065
Operating costs (EUR)	17,275	16,029
Infrastructure payment (EUR)	5,023	3,869 excl. Fixed link
Total (EUR)	22,298	19,898

The difference in infrastructure payments excluding a fixed Fehmarn Belt link is assessed to 1,154 EUR, whereas difference in operating costs for the two routings is assessed to 1,246 EUR. Finally is the time savings assessed to 2 hours, and it is anticipated that the average load is about 800 tons implying a total timesaving of about 1,200 EUR using the FTIP value of 0.76 EUR per ton per hour.

6.2.3 Evaluation of savings

Seen in relation to case study 1 amounts are slightly higher for the train in case study 2. There are two reasons 1) the train has a heavier weight, thus the infrastructure payment in Germany is higher, and the saving related to a shorter route is bigger than in the case study one. The operating costs are also slightly higher in case study 2, giving a marginally higher saving for a shorter route.

Based on the case studies it is proposed to assess the average saving in infrastructure payment to 1,100 EUR and the average saving in operating costs to 1,100 EUR for using a route across Fehmarn Belt in stead of the current route across the Great Belt..

The expected saving of using the Fehmarn Belt connection in stead of the Great Belt connection can be assessed to about 2 hours. With a value of time of 0.76 EUR per hour and ton the VOT savings in the two cases varies between about 800 EUR and 1,200 EUR. Assuming the average weight of loads as indicated by the FTC 2015 forecasts the time saving could be capitalised to 800 EUR.

Based on the above case studies following annual payments can be assessed for rail freight traffic using the fixed link across Fehmarn Belt.

Table 6.5. Potential revenue attributable to rail freight traffic 2015. Price level 2002

	2015 Base case A	2015 Base case B
Number of trains according to forecast	20,440	15,695
Annual income based on saving in infrastructure payments M EUR (M DKK)	22.5 (168)	17.3 (129)
Annual income based on savings in operating costs M EUR (M DKK)	22.5 (168)	17.3 (129)
Total based on savings in infrastructure payments and operating costs M EUR (M DKK)	45.0 (336)	34.6 (258)
Annual income based on savings in travel time M EUR (M DKK)	16.4 (123)	12.6 (94)

Conversion rate: 1 EUR = 7.45 DKK

6.3 Summary of assessment of payment

In the previous sections infrastructure payment for a passage of the fixed Fehmarn Belt fixed link for passenger trains and freight trains have been assessed. Table 6.6 summarises the revenues expected in 2015 based on the FTC forecasts.

Table 6.6. Potential revenues from rail traffic for a fixed Fehmarn Belt link based on the forecasts for 2015. Price level 2002.

	Revenue, passenger transport M EUR (M DKK)	Revenue, freight transport M EUR (M DKK)	Revenue, total M EUR (M DKK)
Base case A			
Annual income based on saving in infrastructure payments	7.5 (56)	22.5 (168)	30.0 (224)
Annual income based on savings in operating costs	2.9 (22)	22.5 (168)	25.4 (190)
Total	**10.4 (78)**	**45.0 (336)**	**55.4 (414)**
Annual income based on savings in travel time	0.0	16.4 (123)	16.4 (123)
Base case B			
Annual income based on saving in infrastructure payments	7.5 (56)	17.3 (129)	24.8 (185)
Annual income based on savings in operating costs	2.9 (22)	17.3 (129)	20.2 (151)
Total	**10.4 (78)**	**34.6 (258)**	**45.0 (336)**
Annual income based on savings in travel time	0.0	12.6 (94)	12.6 (94)

Seen in relation to the 1999 estimate of 76 M EUR in 1996 fixed prices (88 M EUR in 2002 fixed prices) the above-mentioned figures indicate less income. Evidently, the revenue reflects the traffic. Passenger traffic in the new 2015 forecasts is lower than in the original 2010 forecasts. Freight forecasts in terms of tonnes are also lower, 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 6.6 indicates that if payment for using the fixed link is based on a charge evaluated from saved infrastructure payments the total revenue will be about 25M EUR (185 M DKK) to 30 M EUR (224 M DKK). If savings in operating costs are also included revenue will increase to a range of 45 M EUR (336 M DKK) and 55 M EUR (414 M DKK). Finally, if time savings are included the range depicted by the two Base cases is 58 M EUR (430 M DKK) to 72 M EUR (537 M DKK). In comparison the amount estimated in 1999 was 88 M EUR or almost twice as much as the current estimate based on savings in operating costs and infrastructure charges.

Further table 6.6 indicates that freight trains will be levied the major parts of the payments. In Base case A freight trains will be responsible 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 Fehmarn Belt 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.

Following payment ranges could therefore be proposed for a train crossing the Fehmarn Belt fixed link:

Per passenger train: 515 EUR (3,830 DKK) – 715 EUR (5,310 DKK)

Per freight train: 1,100 EUR (8,200 DKK) – 2,200 EUR (16,400 DKK)

Based on these rates the rail traffic will contribute between 30 M EUR and 55 M EUR annually to the financing of the fixed link in Base Case A and 25 M EUR to 45 M EUR in Base Case B.

A resulting problem related to the transfer of traffic from the Great Belt fixed link to Fehmarn Belt 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 (98 M DKK) measured in 2002 prices. 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 train 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 Fehmarn Belt to the Great Belt. With a Fehmarn Belt 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 2.1 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 (7.5 M DKK) in Base Case A and no extra revenue in Base Case B for the Danish National Railways Agency.

The main uncertainty is related to the forecasts. Will a fixed link reverse the trend in the rail passenger traffic? Presently the rail passenger market has been continuously declining for the last 10 years. Will the number of passengers reach the level indicated by the forecasts? As pointed out by the independent experts who analysed the passenger traffic model in 1999, the passenger forecasts are most likely rather conservative. Factors not explicitly in the model may have a considerable influence on the development of international rail travel in the future.

The freight forecasts may overstate the amount of goods to be transported between Scandinavia and the Continent. The development in goods transport flows in the period 1994 – 2000 is slower than anticipated in the former 2010 forecasts. This development, however, has been included in the most recent forecasts, where the development up to 2015 just reaches the same total levels as indicated in the former forecasts for 2010. The new forecasts take into account the development in wagon loading and change in commodity groups transported by rail. This leads to a dramatic reduction in average load per train compared to the previous forecasts established in 1999. This indicates the difficulties in taking into account all elements, which could possibly affect the forecasts, e.g. will the number of wagons per train stay the same or will the number of wagons per train decline? Also, it is difficult to foresee how the competition between road and rail will develop.

7. Assessment of Ability to Pay for Freight Trains

In the previous chapters the infrastructure payment applicable to the Fehmarn Belt fixed link has been assessed based on considerations concerning savings in operating costs, savings in infrastructure payment and value of time savings for passenger and freight trains. As indicated in chapter 6 the major part of the payments would be contributed by freight transport according to the forecasts. However, the development in the amounts of railway goods dispatched between Scandinavia and the Continent indicates that the competitive power of the railway is inadequate. A number of reasons for this can be identified, e.g. missing interoperability between national railways, capacity problems in terms of traffic, loads and train length, limited competition, expensive operation, etc.

In order to investigate this particular aspect further a number of operators and The Danish National Railways Agency have been questioned concerning their experiences with the actual situation and their expectations to a possible link across Fehmarn Belt.

7.1 Interviews

7.1.1 Participants

Interviews have been carried out with a number of operators and with the Danish National Railways Agency and the freight forwarders' association in Denmark. Following operators have been interviewed:

Railion Denmark

Green Cargo, Sweden

Traxion, Denmark

A guideline for the interviews was established in order to present the interviewees with a set of questions, before the interviews were carried out. The guideline is shown in Appendix 1.

Interviewing was carried out by the Ministry of Transport in co-operation with the consultants.

7.1.2 Present situation

- What are considered to be the main problems regarding the current routes across Storebælt and through the southern part of Jutland amongst the current operators?

The different respondents agreed that a number of problems existed. The operating companies mentioned capacity problems in Denmark at the link from the Øresund border to Ringsted, at the main line in West Funen and between Lunderskov and Padborg. Capacity problems were identified in the Great Belt tunnel due to heavy maintenance work necessitating the closure of one tunnel pipe every night.

In Germany the major problems are:

- The Rendsburg Bridge crossing the North East Channel creating a bottleneck due to the limited total weight in terms of load per meter track (1300 GT/300 m) and axle load,

- The limited train length (615 m) on the link between Neumünster and Hamburg due to the length of overtaking tracks. In general the limit is 700 m, which means that a train could load 12% more if this was improved.

- Heavy traffic and limited capacity in the network around Hamburg.

One operating company stated that they required 10 GT per m, and presently this can only be fulfilled with the direct ferries operating between Sweden and Germany. After opening of the fixed Øresund link the direct ferries have had a decreasing but still significant share of the Scandinavian – Continent market (50%). A number of operators mentioned that there was a wish to operate on two different main routes between Scandinavia and the Continent. However, one operator conceded that if they were able to offer unbroken traction from Sweden to Germany they would consider strongly to using only the route via Denmark.

One operator mentioned Maschen as a problem, because all trains passing Hamburg are directed via Maschen, even if they are in transit. This causes a considerable delay.

One company pointed out that the gradients applied in the Great Belt tunnel and on the Øresund fixed link led to a need for very powerful traction, which is very expensive, and therefore difficult for smaller companies to afford.

Lack of interoperability between the different countries creates a need for advanced engines equipped with three different safety systems and for electrical engines switching automatically between different current systems. This aspect makes it difficult to purchase a ready made locomotive. Major changes are always required, pushing the price, and thus making the railways less competitive. The agency mentioned directly that with only one operator being able to offer an unbroken service between Sweden and Germany competition is too narrow, and customers are reluctant to choose the railway if only one operator is available. Ikea rail has got an exemption and is able to carry through their traffic with a diesel engine operating on the Øresund fixed link.

The agency pointed out that interoperability should have a high priority in the Fehmarn Belt project, because lack of or limited interoperability has a severe effect on the operators in terms of expensive equipment, and difficult operating conditions. It was mentioned that the shift between the Danish and the Swedish electrical systems takes place at Lernacken on the Swedish side. It would have been far better to have such a change at one of the shunting stations in either Malmö or Kastrup.

A particular problem was mentioned concerning break in operation on the Øresund Bridge due to strong winds. The agency mentioned that the accounts showed 60 days with break in operation in shorter or longer periods during 2001. This has a severe impact on the reliability of rail services, and reduces the competitive power of rail services.

7.1.3 Expected effects of the Fehmarn Belt fixed link

- Which of the possible improvements connected with a Fehmarn Belt fixed link (time savings, capacity improvements, larger trains, improved regularity, others) are most appreciated by the different groups of respondents (rail-operators, logistics companies etc)?

An improvement of reliability and regularity was considered as being a main advantage of the Fehmarn Belt fixed link. However, several operators stated that an increase in speed would be required in order to utilise in full the potential of the fixed link. Rail customers ask for a high quality in performance, and the most important aspect is timely deliveries in the specified time windows.

Next to regularity price is a core variable to consider. A number of operators feel that competition with sea transport is unequal because sea transport including ferry transport uses tax and duty free fuel.

In order to obtain the full effect of a Fehmarn Belt fixed link a change in the logistical systems is required. Rail solutions should be developed and integrated in transport solutions. Forwarders and logistical companies should serve as freight integrators, and develop transport solutions based on rail services. This requires reliable, regular and fast services.

Development of a fixed link would mean that a train length of 700 m would be standard.

- Would a time saving produce operational changes? Could/would a time saving of this size be of use for the customers?

A discussion was carried out as to the possibilities of transforming a time saving into operational changes and whether such a change could be utilised by the customers. Time savings would evidently be an advantage. However, in order to utilise a time saving it is necessary to be able to improve time tables and time windows for delivery and loading.

Establishment of a fixed link could extend the commercially interesting area of influence, opening up the possibility for a service over night between Ruhr and Mid-Sweden. Such a concept could probably be interesting enough to provide the rail services with a competitive advantage against the lorry transport.

- Is there any willingness to pay more for transport solutions that reduces the travelling time? If so, is the willingness connected to specific periods or types of goods?

In general the operators were reluctant to answer this question. Customers are using the railway because there is a trade-off between prices on one hand and reliability and speed in deliveries on the other hand. Evidently an improvement of services could be capitalised in terms of higher prices. However, the price should always be compared to the lorry transport price for a similar 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 Fehmarn Belt. These types of goods would be able to generate new and higher income.

It was also said that for goods with a high value of time a fast and direct transport by rail would be an advantage and therefore generating a possible higher income. This scenario, however, requires that not only Fehmarn Belt is constructed, but also that the necessary channels are available on the route through Denmark and Germany. If the speed is improved the number of turn-arounds can be increased, thus reducing the need for equipment. In this way savings in operating costs can be created. Faster services will also create savings related to the capital value of the goods being transported.

- Would a fixed link strengthen the competitiveness of rail products compared to road transport as a result of improved infrastructure quality and improved speed.

In principle a fixed link will improve the competitiveness of rail transport in relation to road transport. However, Fehmarn Belt could not be seen as an isolated piece of infrastructure. Capacity problems and problems of regularity were prevailing in the rail network in both Denmark and Germany. Therefore it would be necessary to improve other links as well in order to upkeep the competitive power of the railways, and improve the speed of freight trains.

One interviewee pointed out that particular strengthening of the freight corridors in Germany would be of major importance. Another said that overcoming the capacity problems between Copenhagen and Ringsted was as important as constructing a Fehmarn Belt link.

- If the price level for lorries on the current links; across Storebælt, from Rødby and Gedser and the Swedish routes, is assumed at the current level what would then be considered a realistic (and competitive price) for a freight train (pr. wagon) on a fixed link?

On the question as to a fair price for using the Fehmarn Belt link there were not many answers. In general it was pointed out that with the present cost level the railways was just able to keep the price competition with the road transport. Therefore, none of the interviewees felled inclined to consider price increases. They rather saw the Fehmarn Belt fixed link as a possibility within existing price levels to obtain an advantage in the competition with road transport.

Several of the interviewees mentioned the new German infrastructure fee for road transport. This new fee has already resulted in more inquiries concerning rail transport solutions. There was however a fear that the German rail infrastructure agency would use the new fee on road transport to increase also the infrastructure payment for using the rail infrastructure, because DB Netz is having a deficit on operation and maintenance of the infrastructure. The competitive advantage the rail would be gaining with introduction of a road fee may therefore be neutralised.

- Is it expected that a fixed link would increase the number of operators and hence the competition?

A fixed link is expected to increasing 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 was necessary to equip the engines with safety systems and traction systems fitted to different requirements in the three different countries. It would be rather costly, and therefore the judgement was that only major operators would probably be attracted to set up services between Sweden and Germany/the Continent. Another operator mentioned that new operators most likely would be in the market for operation of system trains.

It was mentioned that faster connections between Sweden and the Continent would most likely attract new operators. However, the experience from Sweden had shown that although new operators had entered the market, the number of customers had not increased.

- To what extent would your view on a Fehmarn Belt fixed link change if the project is realized as a dedicated freight corridor?

All the participants found a freight transport corridor would be a good solution. It was however important that the Fehmarn Belt corridor was connected to other important rail freight corridors in Germany in order to have as undisturbed a route as possible. And it was also stated that it was important to remove other bottlenecks than the crossing across the Fehmarn Belt, e.g. the capacity restrictions on the Copenhagen - Ringsted link, capacity restrictions around Hamburg and in the German network beyond Hamburg.

One operator mentioned that the link across Fehmarn Belt could be established as a single track, if the sufficient capacity can be established. The operator recommended more detailed capacity studies to be carried out.

Another operator did not attach great importance to a freight corridor if only the services could be scheduled and the speed could be carried out with 180 kph.

- What is the importance of electrification in relation to a Fehmarn Belt fixed link?

In general all found that it was evident that the connection being electrified. The economy in an electrical engine is better seen over a period of time than in diesel traction. A few mentioned however, that it would be an advantage if diesel traction would be allowed on the fixed link. A diesel locomotive is able to drive

in Sweden, Denmark and Germany, and new engines are continuously developed in order to reduce environmental effects.

7.2 Conclusion

Based on the interviews it seems likely that the railway operators will not be able to pay a charge based on all savings incurred by redirecting the route from Great Belt to Fehmarn Belt. Most likely the charge should reflect the savings in infrastructure charges and then a certain part of the operating costs savings. Some of the interviewees point out that it would be possible to include value of time in charge increases if new types of products are transferred to the railway, e.g. high speed express goods. In order for a such a development to materialise it would be necessary to have dedicated corridors for goods transport from Sweden to central places in Germany, primarily Ruhr and south west Germany.

The operators' demands to the fixed link could be summarised as:

- The fixed link should be equipped with an electrified double track. A single track could be accepted if it is ascertained that the necessary capacity is available.
- The loading capacity should be 10 tons per m.
- Loading profile should be C
- Train length of at least 700 m and preferably 750 m should be allowed
- Speed of or above 180 kph should be allowed.

It is important to solve the present capacity problems in the infrastructure. These problems prevail on the links between Copenhagen and Ringsted, and in the infrastructure around Hamburg. Irrespective of a future decision concerning development of a fixed link it would also be necessary to consider upgrading and improvement of the link from Lunderskov to Padborg, improvement of the Rendsburg Bridge and improvement of the line from Neumünster to Hamburg.

Evidently a fixed link will have a positive effect on the competitive power of the railways. It is a concern for the operating companies that the advantage gained with the faster and more direct connection is not jeopardised by a strongly increased infrastructure payment. In general the operating companies meant the limits for payments of infrastructure charges had been reached.

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Appendix 1: Interview guide

Questions for operating companies and others concerning the rail infrastructure charges related to the fixed link across Fehmarn Belt.

Interview guide

- What are considered to be the main problems regarding the current routes across Storebælt and through the southern part of Jutland amongst the current operators?
- Which of the possible improvements connected with a Fehmern fixed link (time savings, capacity improvements, larger trains, improved regularity, others) are most appreciated by the different groups of respondents (rail-operators, logistics companies etc)?
- Would a time saving produce operational changes? Could/would a time saving of this size be of use for the customers?
- Is there any willingness to pay more for transport solutions that reduces the travelling time? If so, is the willingness connected to specific periods or types of goods?
- Would a fixed link strengthen the competitiveness of rail products compared to road transport as a result of improved infrastructure quality and improved speed.
- If the price level for lorries on the current links; across Storebælt, from Rødby and Gedser and the Swedish routes, is assumed at the current level what would then be considered a realistic (and competitive price) for a freight train (pr. wagon) on a fixed link?
- Is it expected that a fixed link would increase the number of operators and hence the competition?
- To what extent would your view on a Fehmarn Belt fixed link change if the project is realized as a dedicated freight corridor?
- What is the importance of electrification in relation to a Fehmarn Belt fixed link?

Appendix 2. Evaluation of passenger train payment

In the recent forecasts produced by FTC a number of assumptions has been made concerning the development of rail passenger traffic. These assumptions are listed in the following and they are reviewed in the light of expected costs for building and operating a passenger transport system between Copenhagen and Hamburg via the Fehmarn Belt fixed link.

Three cases are analysed: 2015 no fixed link, 2015 Base Case A and 2015 Base Case B.

No forecasts have been made concerning the 2015 no fixed link. Therefore the passenger loads produced for 2010 no fixed link has been used as the base for this case.

In the Base Case A and in the Base Case B it has been assumed in the forecasts that the number of departures per day per direction is 20 between Copenhagen and Hamburg. It has not been specified how correspondence with routes serving Germany/rest of Europe and Scandinavia respectively is in Hamburg and Copenhagen.

Number of passengers per year are forecasted as indicated below:

	No. of passengers	No of departures per day per direction	Average utilisation of capacity
2010 No fixed link	1,069,000	7 of which 1 via Great Belt	78%
2015 Base Case A	1,497,000	20	71%
2015 Base Case B	1,386,000	20	66%

An important assumption concerns the number of units necessary to carry out the traffic. Following assumptions have been made.

	No of units necessary to maintain operations	Spare units	Units in all
2010 No fixed link	9	1	10
2015 Base Case A	10	2	12
2015 Base Case B	10	2	12

Ticket price is an important parameter for evaluating the income potential. The ticket price for a trip between Hamburg and Copenhagen is assumed to have the following characteristics.

	Ticket price business trips	Percentage business travellers	Ticket price leisure trips	Percentage leisure travellers
2010 No fixed link	507 DKK	6% (2%)	276 DKK	94% (98%)
2015 Base Case A	585 DKK	26%	274,25 DKK	74%
2015 Base Case B	585 DKK	28%	322,50 DKK	72%

The table indicates that in Base Case A is the average reduction in ticket prices for leisure trips 15%, assuming that short trips are not reduced, and long trips are reduced with 30% as is indicated in the forecast assumptions. The share of business travellers has been assumed based on the results of the former Fehmarn Belt forecasts.

As for the cost items following basic assumptions have been made, based on approximate costs for an IC3 unit. It should however be mentioned that the IC3 unit is a fairly old train set, and it is foreseeable that new train sets will be deployed on the route between Hamburg and Copenhagen. However, the cost structure of these future train sets is not known.

Variable costs: 15 DKK per unit per km.

Staff costs: 1000 DKK per unit per hour.

Capital costs: 4.583 M DKK per unit per year.

Overhead costs: 100 M DKK per year in the alternative without fixed link. For Base Case A and B overhead costs are estimated to 132 M DKK.

Further it is assumed that a surplus of 10% of the total costs of operation of the system should be obtained. However, in the without fixed link alternative the rate of return is about 0 and the deficit is 1 M DKK. If this deficit is not covered the train operation will not exist in the without fixed link alternative. Therefore in the with fixed link alternatives another 1 M DKK may be added to the result.

The surplus may also be increased in other ways e.g. the trains operating between Hamburg and Copenhagen may also serve national traffic to a limited scale, e.g. between Nykøbing F and Copenhagen and between Lübeck and Hamburg. This could provide an extra income, which could be added to the gross result. However, no assumptions have been made as to the future organisation of the passenger train services.

	2015 No fixed link	2015 No fixed link	2015 Base Case A	2015 Base Case B
	Fehmarn Belt	Great Belt	Fehmarn Belt	Fehmarn Belt
Passengers ('000)	**987**	**82**	**1,497**	**1,386**
No. of depart per day	6	1	20	20
Track length (km)	334	506	352	352
No of depart per year (2 dir)	4,380	730	14,600	14,600
Pass per departure	225	112	103	95
Production ('000 unit km per year)	2,925.8	369.4	5,139.2	5,139.2
Travel time (hours)	4.5	5.5	3.5	3.5
No of units per depart.	1	1	1	1
No of units available	9	1	12	12
Annual costs				
Capital costs (M DKK)	41.2	4.6	55.0	55.0
Operational costs (M DKK)	43.9	5.5	77.1	77.1
Staff costs (M DKK)	19.7	4.0	51.1	51.1
Overhead (M DKK)	100.0		132.1	132.1
Total system costs (M DKK)	219.0		315.3	315.3
Track fees (M DKK)	25.2	8.6	84.0	84.0
Fee, ferry or fixed link (M DKK)	52.6	4.9	77.5	77.5
Total costs (M DKK)	**310.3**		**476.8**	**476.8**
Pct business travellers	**6**	**2**	**26**	**28**
Total income (M DKK)	**309.1**		**531.4**	**548.9**
Surplus (M DKK)	**-1.2**		**54.6**	**72.1**
Average ticket price (DKK)	**290**	**281**	**355**	**396**
Total cost per km (DKK)	66.5		61.3	61.3
Surplus in % of total costs	**0**		**11**	**15**
Track fee, per train (DKK)	5,750	11,832	5,750	5,750
Passage fee, ferry or Great Belt, per train (DKK)	12,000	6,696		
Possible additional fee for using Ringsted - Puttgarden, per train (DKK)			**5,310**	**5,310**