

Cross-border Traffic in the Jutland Corridor

Strategic Analysis

Report nr. 586 - 2018



Vejdirektoratet



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Corridor**

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Table of contents

Background	4
Previous analyses	4
The present analysis of the Jutland Corridor	4
1 Summary	7
1.1 Main conclusions	7
1.2 Elaboration of the results	8
1.3 Constraints in the model calculations	11
2 Traffic situation in the Jutland Corridor	12
2.1 Jutland Corridor	12
2.2 Traffic today	12
2.3 Future traffic	15
2.4 Cross-border traffic	18
2.5 Truck traffic across the border	22
2.6 Summer holiday traffic	23
3 The scenarios examined	26
3.1 Alignment	26
3.2 Western scenarios	27
3.3 Eastern scenarios	28
4 Traffic impact of an extension	30
4.1 Basis and assumptions	30
4.2 Scenarios	31
4.3 Traffic calculations for the basic scenario 2030	32
4.4 Traffic calculations for scenario 1	34
4.5 Traffic calculations for scenario 2	38
4.6 Traffic calculations for scenario 3	42
4.7 Traffic calculations for scenario 4	46
5 Time gains	49
5.1 Travel time savings	49
5.2 Travel time gains	50
5.3 Access to workplaces	54

Background

At the request of the Danish Ministry of Transport, Building and Housing, the Danish Road Directorate has conducted a traffic analysis of the cross-border traffic and the future need for developing the Jutland Corridor.

The analysis was proposed by the Danish-German Transport Commission in the report "Transport Infrastructure in the Jutland Corridor" from November 2015.

In the report, the Commission recommends a number of infrastructure projects in Denmark and Germany. It is proposed to initiate an analysis which illustrates the current traffic level and the long-term need for expanding the eastern and western road corridors, see map 1.1.

The analysis provides an overview of the current traffic situation and of how traffic is expected to develop towards 2030 with and without an infrastructure development in the Jutland Corridor.

Previous analyses

The analysis is based on the previous analysis from July 2016 "Central Jutland Motorway – Recalculations Using the Danish National Traffic Model" - Report 555 - 2016.

The analysis showed that a Central Jutland motorway would, to some extent, be able to reduce congestion on E45 and that it could in itself generate substantial traffic gains.

On this basis, it was decided at the end of 2016 to initiate two detailed analyses of a Central Jutland motorway. As a result, the Danish Road Directorate will be conducting a preliminary study until 2019 at the northern section between Hobro and Give as well as an environmental impact assessment of the southern section between Give and Haderslev.

The present analysis of the Jutland Corridor

In this new analysis, a Central Jutland motorway will be extended further down to the Danish-German border and through North Germany.

The purpose is to illustrate the traffic impact of establishing a western parallel road structure as an alternative to E45/A7. The analysis is also to uncover whether accessibility can be improved on the E45 and whether it is necessary to expand the southern part of the E45 down to the border.

For analysis purposes, new traffic calculations have been made using the Danish National Traffic Model (LTM) version 1.2.

The expansion of the E45 from Aarhus S to Skanderborg S, which has already started, is included in the calculations for this analysis.

Environmental impact assessments adopted in the Budget FL18 are not included in the analysis.



What is the Jutland Corridor?

The Jutland Corridor extends from the top of North Jutland and to Hamburg in North Germany.

Map 1: Scenarios for developing the Jutland Corridor.

Western scenarios: Development of the Jutland Corridor

Scenario 1



Scenario 1

consists of:

- A Central Jutland motorway (blue alignment).
- A motorway extended down to the border between Kolding and Tønder (lighter alignment).
- An upgrade of route B5 in Germany. (lighter alignment).

1

Scenario 2



Scenario 2

consists of:

- A Central Jutland motorway (light blue alignment).
- A motorway extended down to the border between Givé and Tønder (lighter alignment).
- An upgrade of route B5 in Germany. (lighter alignment).

2

Eastern scenarios: Development of the Jutland Corridor

Scenario 3



Scenario 3

consists of:

- A Central Jutland motorway (green alignment)
- An expansion of the E45 between Haderslev and Frøslev. (lighter alignment).
- An expansion of the A7 in Germany between Frøslev and Bordesholm (lighter alignment).

3

Scenario 4



Scenario 4

consists of:

- An expansion of E45 between Aarhus N and Frøslev. (light green alignment)
- An expansion of the A7 in Germany between Frøslev and Bordesholm (light green alignment)

4

Figure 1.1: Scenarios for developing the Jutland Corridor.

1 Summary

The Jutland Corridor serves as a link between Scandinavia and Central Europe with motorway E45/A7 as the main transport corridor.

The Jutland Corridor is one of the most important corridors for transport of goods through Denmark. At the same time, the corridor plays a key role as export corridor, particularly to Germany which is Denmark's largest export market.

However, congestion on the road network is a source of delay which reduces the competitiveness of companies and delays people in their daily transport.

To study the impact of an improved infrastructure, the analysis includes four scenarios, two western and two eastern scenarios, as shown in figure 1.1.

1.1 Main conclusions

A development of the Jutland Corridor can help decongest the E45/A7, improve accessibility and serve new areas.

The main results of the analysis can be summarised as follows:

- The best accessibility on the southern part of the E45 will be ensured by establishing the motorway as described in scenario 3 or 4 as the expansion of the E45 will increase capacity to such an extent that the southern part of the E45 will no longer be congested in 2030.

- A motorway in scenario 2 will generate the highest total travel time gains but also requires the construction of the most kilometres of new motorway. Compared to the length of the scenarios, scenario 3 is initially believed to have the best economy.
- A motorway in scenarios 1, 2 and 3 will improve mobility in the western part of Jutland and improve infrastructure in the least developed part of the Jutland Corridor.
- Scenarios 1 and 2 will generate the most significant gains if the Central Jutland motorway is established to join the E45 at Christiansfeld. The branches from Give and Kolding, respectively, and down to the border will only reduce traffic volumes and decongest the E45 to a relatively limited extent compared to the actual Central Jutland motorway from Hobro to Christiansfeld.
- The construction of a motorway in scenarios 1, 2 and 3 will involve the least traffic nuisance during the construction phase as a motorway parallel to the E45 will be established rather than expanding an existing motorway.

What are scenarios 1, 2, 3 and 4?

The purpose of the analysis is to study the traffic impact of developing the Jutland Corridor based on four different scenarios.

What does the analysis tell?

The analysis mainly focuses on the traffic impact in Denmark. This includes traffic volumes on a new motorway and the decongestion of the E45.

For Germany, the traffic model (LTM) used is only able to calculate the cross-border traffic, and as a result, it is not possible to make any conclusions about traffic volumes or the decongestion of the A7.

If the impact from Germany were included, it would probably result in a minor increase in traffic in Jutland, particularly South Jutland.

Construction economy and national economy are not considered in this analysis. Moreover, the analysis does neither contain detailed alignments or assessments of the impact on nature, environment nor area and neighbour conditions.

1.2 Elaboration of the results

This section elaborates on the main results of the analysis. The results are divided into three parts; the impact of establishing a Central Jutland motorway between Hobro and Christiansfeld, an extension of this motorway down to the border and finally, infrastructure development on the German side of the border.

Traffic impact of a Central Jutland motorway

If a Central Jutland motorway is established, traffic on this section is expected to range between 18,000 and 51,000 vehicles per weekday, depending on the scenario used and the location, see table 1.1.

Scenarios	Traffic on a Central Jutland motorway	Decongestion of E45(Hobro-Kolding)
Scenario 1	18 - 50,000	6 - 36%
Scenario 2	19 - 51,000	7 - 36%
Scenario 3	22 - 51,000	6 - 36%
Scenario 4	-	-

Table 1.1: The average weekday daily traffic on a Central Jutland motorway and the decongestion of the E45 between Hobro and Kolding.

Scenarios 1, 2 and 3 will result in the most traffic on a Central Jutland motorway at Herning and Give where it joins the existing Central Jutland motorway on route 18. In 2030, there will be up to 51,000 vehicles per weekday.

An advantage of a Central Jutland motorway is that it will decongest the E45. The decongestion of the E45 will be almost the same with scenarios 1, 2 and 3 where there will be up to 36% fewer vehicles on the section between Hobro and Kolding.

The decongestion of the E45 will be most significant at the 'ends' south of Hobro and at Kolding where a Central Jutland motorway joins E45 and least significant in the middle between Aarhus and Vejle.

Traffic impact of an extended motorway

If a Central Jutland motorway is extended down to the border, the actual extension will have up to 17,000 vehicles per day with scenarios 1 and 2. This means that the traffic level will be considerably lower compared to the traffic on a Central Jutland motorway.

Scenario 3 or 4 will increase traffic on the E45 by up to 12,000 additional vehicles on the section between Christiansfeld and Padborg, corresponding to a traffic increase of 24%. As a result, scenarios 3 and 4 will not decongest the southern part of the E45 but instead increase capacity and provide better accessibility on the section as a result of the motorway expansion.

How are the results calculated?

The results are divided into three parts:

- The impact of constructing a Central Jutland motorway.
- The impact of extending a Central Jutland motorway down to the border.
- The impact of extending the main roads in Northern Germany.

What is a Central Jutland motorway?

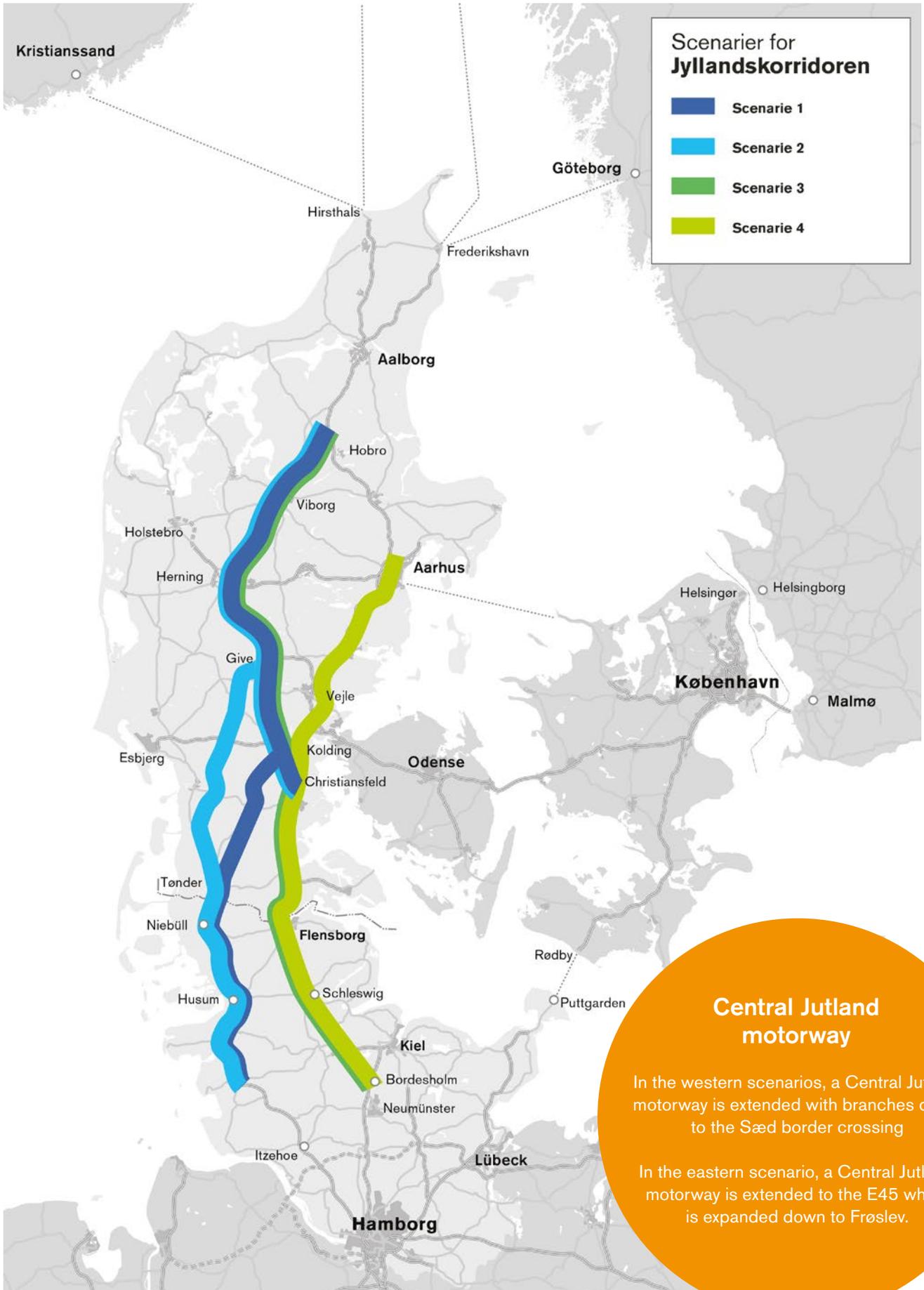
A Central Jutland motorway is a new corridor through Central Jutland that can decongest the E45 and connect some of the towns and cities which are not connected to the motorway network today. A Central Jutland motorway has most recently been studied in "Central Jutland Motorway – recalculations using the Danish National Traffic Model" - Report 555 - 2016 from July 2016 and has been continued in this analysis. Corridor A is the term used for the Central Jutland motorway.

What is an extended motorway?

As this analysis focuses on the cross-border traffic, a Central Jutland motorway has been extended down to the national border to study whether a capacity increase would be necessary on the southern part of the E45.

What does the German road development consist of?

As the analysis focuses on the entire Jutland Corridor, it has been assumed that one of the two main corridors in Germany, routes B5 and A7, is upgraded.



Map 1.1: Scenarios for extending the Jutland Corridor.

Scenarios	Traffic on an extended motorway	Decongestion of E45 (Christiansfeld-Padborg)
Scenario 1	5 - 17,000	3 - -5*%
Scenario 2	5 - 17,000	3 - -6*%
Scenario 3	1 - 12,000*	-4* - -24*%
Scenario 4	1 - 7,000*	-4* - -14*%

Table 1.2: The average weekday daily traffic on the other part of the section and the decongestion of the E45 between Christiansfeld and Padborg.

*A minus sign indicates the additional traffic on the E45 compared to a situation without extension.

Traffic impact in Northern Germany

In Germany, the cross-border traffic on routes B5 and A7 will increase by up to 3,000 vehicles per weekday, depending whether the eastern or western scenario is selected.

Time gains

If the Jutland Corridor is extended, road users will save between 15,000 and 36,000 hours on a weekday, depending on the scenario used.

As illustrated in table 1.3, the most significant time gains are achieved with scenario 2 whereas the least significant time gains are achieved with scenario 4.

Scenarios	Time gains (hours per week-day)	Scenario lengths in DK (number of km)	Time gain per km of new infrastructure (hours)
Scenario 1	32,100	300	107
Scenario 2	35,900	372	97
Scenario 3	29,200	211*	138
Scenario 4	14,600	168**	87

Table 1.3: Time gains achieved through extension of the Jutland Corridor compared to scenario lengths in Denmark. The scenario lengths only contain new motorway and/or expansion.

* Of which 65 km is an extension of the E45.

** Of which the entire scenario (168 km) is a development of existing infrastructure rather than construction of new motorway.

If the time gains are calculated for each km of infrastructure, scenario 3 results in the most significant time gains whereas the time gains for scenarios 1, 2 and 4 are almost the same.

Seen from a socio-economic point of view, the time gains should be considered in relation to the potential

Scenarios	Time gains (hours per weekday)	Motorway length in DK (number of km)	Time gain per km of new infrastructure (hours)
Central Jutland motorway	23,700	146	162

Table 1.4: Time gains for a Central Jutland motorway compared to motorway length (new motorway) in Denmark. The results are from the analysis "Central Jutland Motorway – recalculations using the Danish National Traffic Model" - report 555 - 2016 and are therefore not calculated using the Danish National Traffic Model version 1.2.

construction costs which, to a major extent, depend on the length of a new motorway and the expansion of the existing motorway.

For example, scenario 3 is one of the shortest scenarios in the analysis with respect to construction of new motorway. As a result, scenario 3 has the most significant time gains per km of new infrastructure. The shorter section will reduce the potential construction costs and thus affect the profitability of the project seen from a socio-economic point of view.

On this basis, scenario 3 is found to have the best socio-economy, although it is not possible to conclude on this basis whether the socio-economy will be positive.

If, in the same way, we compare a Central Jutland motorway with an extension of the entire Jutland Corridor, a Central Jutland motorway alone is expected to result in the best socio-economy.

As the analysis only concerns traffic calculations, the socio-economy of the project will not be considered any further.

Travel time improvements

An extension of the Jutland Corridor will bring the Danish and German regions closer to each other in terms of time and make it easier to get to and from areas in Jutland for the benefit of the population as well as trade and industry.

As illustrated on maps 1.2 and 1.3, the travel time improvements will differ geographically depending on the scenario selected.

If scenario 2 is selected, the travel time from Aalborg to large parts of West Jutland will be about 30-40 minutes shorter. Moreover, travel time from the western part of South Denmark and North Germany will be reduced by more than 40 minutes.

If the Jutland Corridor is developed as set out in scenario 3, travel time will be improved by 30-40 minutes on trips from Aalborg to south of Flensburg.

The western part of the Jutland Corridor will obviously see the most considerable improvements in travel time with the western scenarios. The reason is that with scenarios 1 and 2, a whole new motorway will be established in an area where infrastructure is not very well developed.

In scenarios 1 and 2, route B5 on the German side will be upgraded to a motorway which in itself generates more considerable travel time improvements in the western part of Schleswig Holstein compared to the eastern scenarios where the E45/A7 will be partly expanded.

1.3 Constraints in the model calculations

The traffic calculations have been made using the Danish National Traffic Model version 1.2 which has some method constraints that influence the results of the analysis.

With the Danish National Traffic Model, it is not possible to make traffic calculations for Germany. As a result, it is only possible to make calculations for the cross-border traffic which today counts about 19,000 vehicles per weekday at the Frøslev and just under 6,000 vehicles at the Sæd border crossing. If the Jutland Corridor is extended, the cross-border traffic in Germany will increase by approximately 6,000 vehicles in 2030.

As the calculations do not include the internal traffic in Germany, it is not possible to make conclusions about the road extension potential on the German side.



Map 1.2: Improved travel times from Aalborg if extension is made as set out in the western scenario (Scenario 2).



Map 1.3: Improved travel times from Aalborg if extension is made as set out in the eastern scenario (Scenario 3)

2 Traffic situation in the Jutland Corridor

2.1 Jutland Corridor

The EU highlights the Jutland Corridor as one of the key transport corridors in Europe.

Not only does the corridor link West Denmark and Germany. It also creates a connection between Scandinavia and Central Europe and serves as a thoroughfare for especially goods between the Scandinavian countries and a number of European countries.

In other words, the Jutland Corridor is of vital importance for a number of European countries, meaning that the transport infrastructure is not purely a Danish-German matter. I.e. Norway and Sweden export large volumes of goods via the ports in North Jutland which are then transported by freight trains and especially trucks across the Danish-German border and on to a number of European destinations.

Therefore, the Jutland Corridor is part of the Trans-European Networks - Transport (the TEN-T network) supported by the EU which aims to promote cross-border mobility.

2.2 Traffic today

On the Danish side, the Jutland corridor consists of the E45 which is the main thoroughfare in the Jutland infrastructure.

The motorway serves the large cities in Jutland, such as Aalborg, Aarhus, Randers, Vejle and Kolding and creates coherence not only in East Jutland – but also between the other parts of the country.

On most of the E45, traffic is between 40,000 and 80,000 vehicles per annual average daily. As illustrated on map 2.2, traffic load on the E45 is among the highest in the country outside Greater Copenhagen.

Today, parts of the motorway are congested during rush hours, see map 2.5. This is especially the case around Aalborg, the Triangle Region and on the section between Aarhus and Vejle where there is a risk of speed reduction and queues.

On the E45, congestion is particularly seen between Aarhus and Skanderborg where it is close to critical because of the high traffic volumes. However, a reduc-

tion in congestion is expected when the section is expanded from 4 to 6 lanes in the coming years.

The Jutland Corridor

The Jutland Corridor consists of:

- West Denmark (Jutland)
- The German constituent state Schleswig Holstein
- The German constituent state Hamburg

On the Danish side, the corridor mainly consists of motorway E45, whereas on the German side, it consists of motorway A7. Together, they form the backbone of the Northern European infrastructure.



Map 2.1: Road connections in the Jutland Corridor.



Map 2.2: The annual average daily traffic in 2016 on the main road network in Denmark.

To be able to handle the increasing traffic on the E45, a number of extensions have been carried out in recent years. I.e. the E45 has been expanded at Aalborg, Vejle and Kolding. The latter was done by including the emergency lane for normal traffic on a short section.

In the western part of Jutland, traffic is generally lower, see map 2.2. Route 11 between Esbjerg and Tønder, for example, has 20,000 vehicles per average day. Indeed, in this area, infrastructure is less developed.

Traffic in Germany

At the Danish-German border, the E45 becomes A7 which is the longest motorway in Germany. Motorway A7 starts in Schleswig Holstein and ends on the Austrian border.

Apart from being a key motorway in Germany, the A7 is the main corridor in North Germany with respect to international trade and tourism. Moreover, it is an important corridor for the local population of Schleswig-Holstein and for the numerous commuters travelling to and from Hamburg every day.

On the section between Rendsburg and Hamburg, there are between 40,000 and 80,000 vehicles per 24 hours, thus making it the most traffic intensive section on the A7 with the exception of the Elb Tunnel.

Today, congestion is beginning to show around Hamburg. As a result, the motorway on the German side is expanded to six lanes on a section of 65 km north of Hamburg to the branch towards Kiel.

Route B5/A23 is located in the western part of the Jutland Corridor. Route B5 is a 2 lane regional road running from the Sæd border crossing to Heide in North Germany. Then the corridor continues as motorway A23 towards Hamburg.

Compared to A7, the traffic intensity on route B5/A23 is somewhat lower with up to 20,000 vehicles per day. During the summer months, the corridor is mainly used by holiday traffic and agricultural vehicles.

Map 2.4 shows the traffic level in the two German corridors.



Map 2.3: The main road network in North Germany.

What does load mean to congestion?

Moderate load

When the traffic load ratio is moderate, road users will have less room to manoeuvre. As a result, speed will be reduced and it will be more difficult to change lanes.

High or critical load

When the traffic load ratio is high or critical, there will be a higher risk of queues and speed reductions during rush hours. Therefore, it will typically be necessary to consider how capacity on the section can be improved or used better.

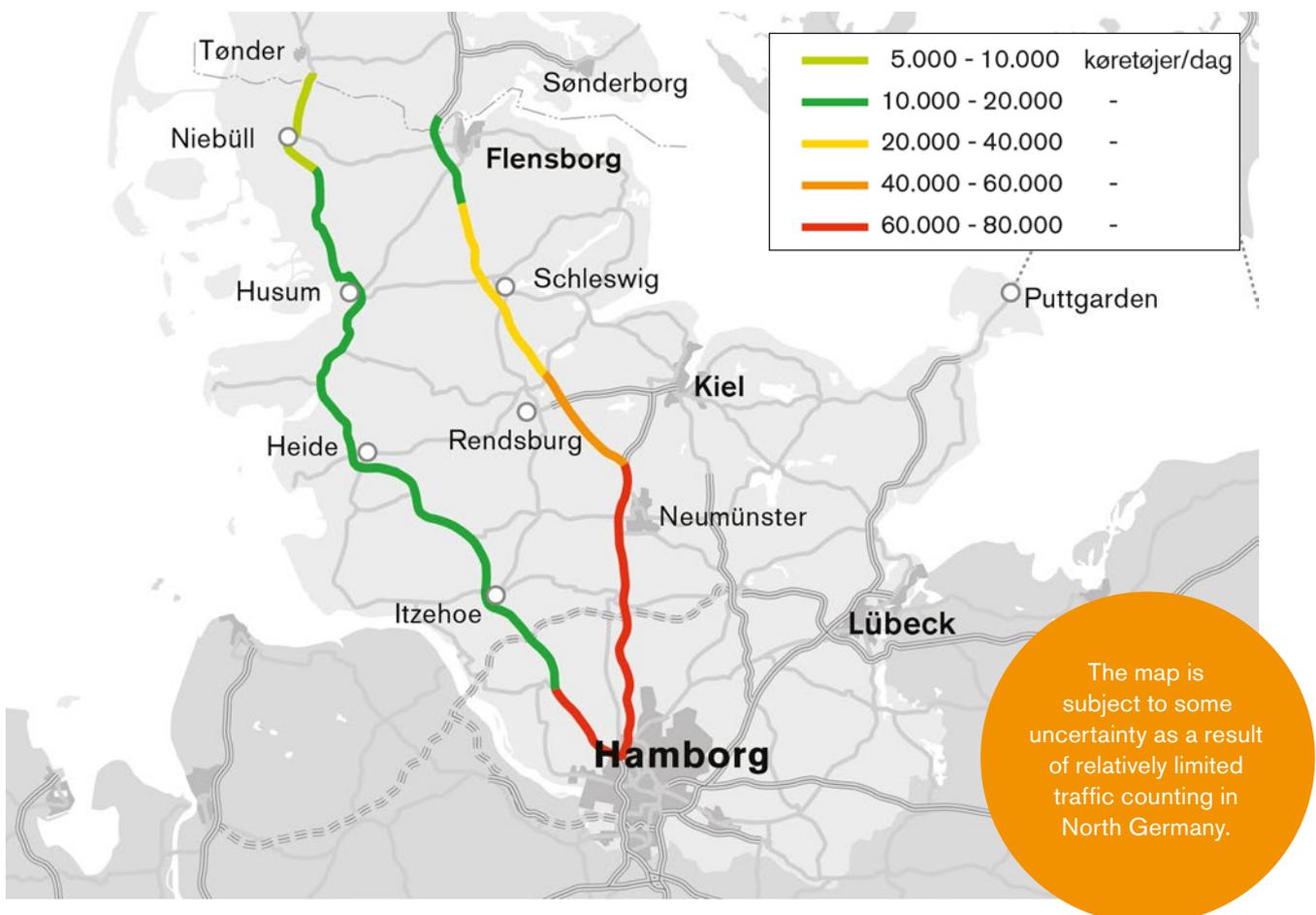
2.3 Future traffic

In the coming years, traffic is expected to increase. According to the Danish National Traffic Model (LTM), traffic on the E45 will increase by up to 57% towards 2030, corresponding to an annual linear growth of 3.8%.

The traffic growth, expected in the coming years, means that additional congestion will be seen on some parts of the road network if no decision is made on new infrastructure.

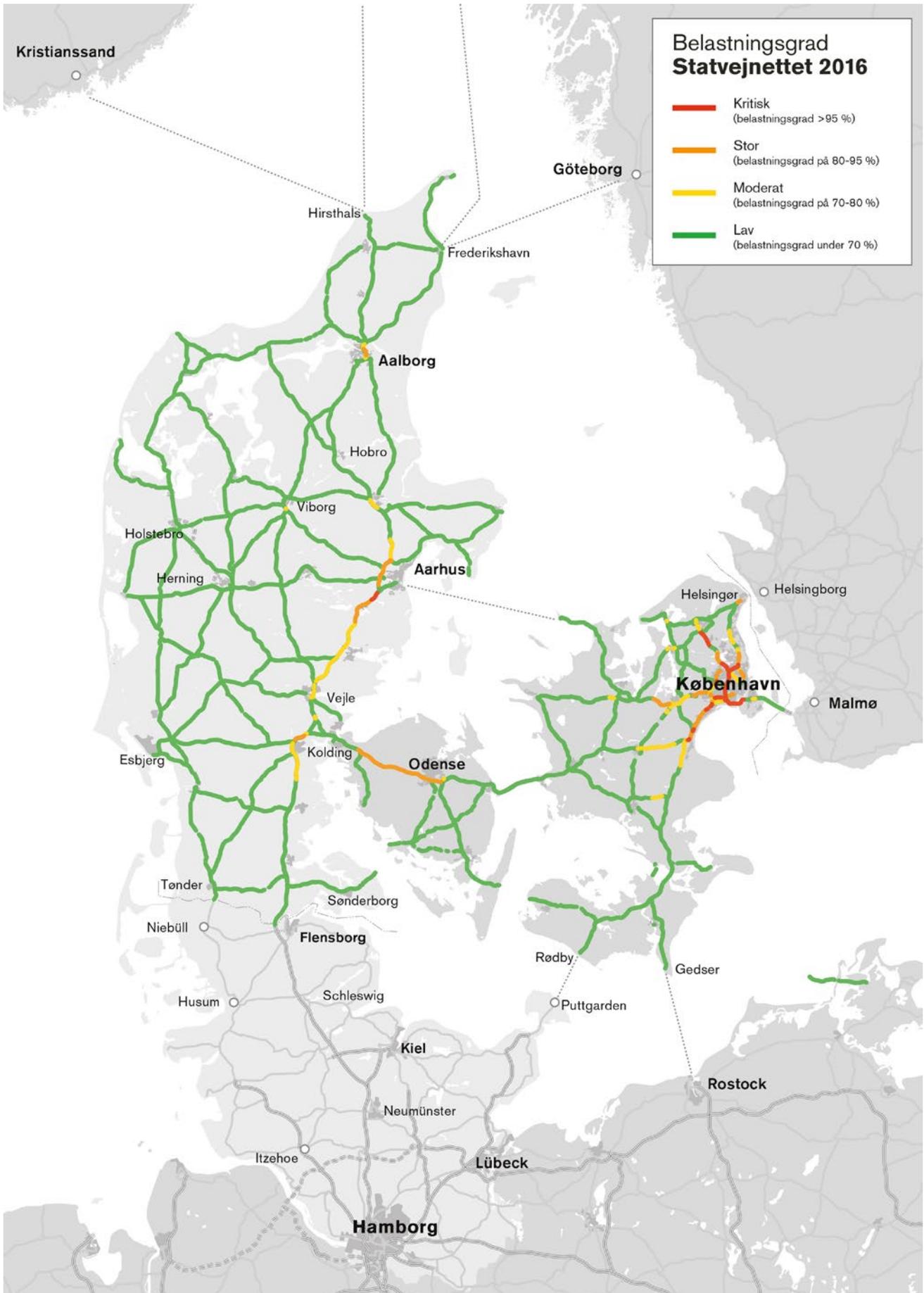
Maps 2.5 and 2.6 show the traffic load ratio on the main road network in 2016 and 2030, including major parts of the E45 being critically congested in 2030. This particularly applies to the section between Aarhus and Vejle and around Kolding and Aalborg. Moreover, there will be a high load between Kolding and Christiansfeld and moderate load at Aabenraa.

Although early signs of congestion will be seen in 2030 on the South Jutland Motorway, the level of congestion is still low compared to other parts of the main road network where, as mentioned above, the load on the East Jutland Motorway will be high or critical.

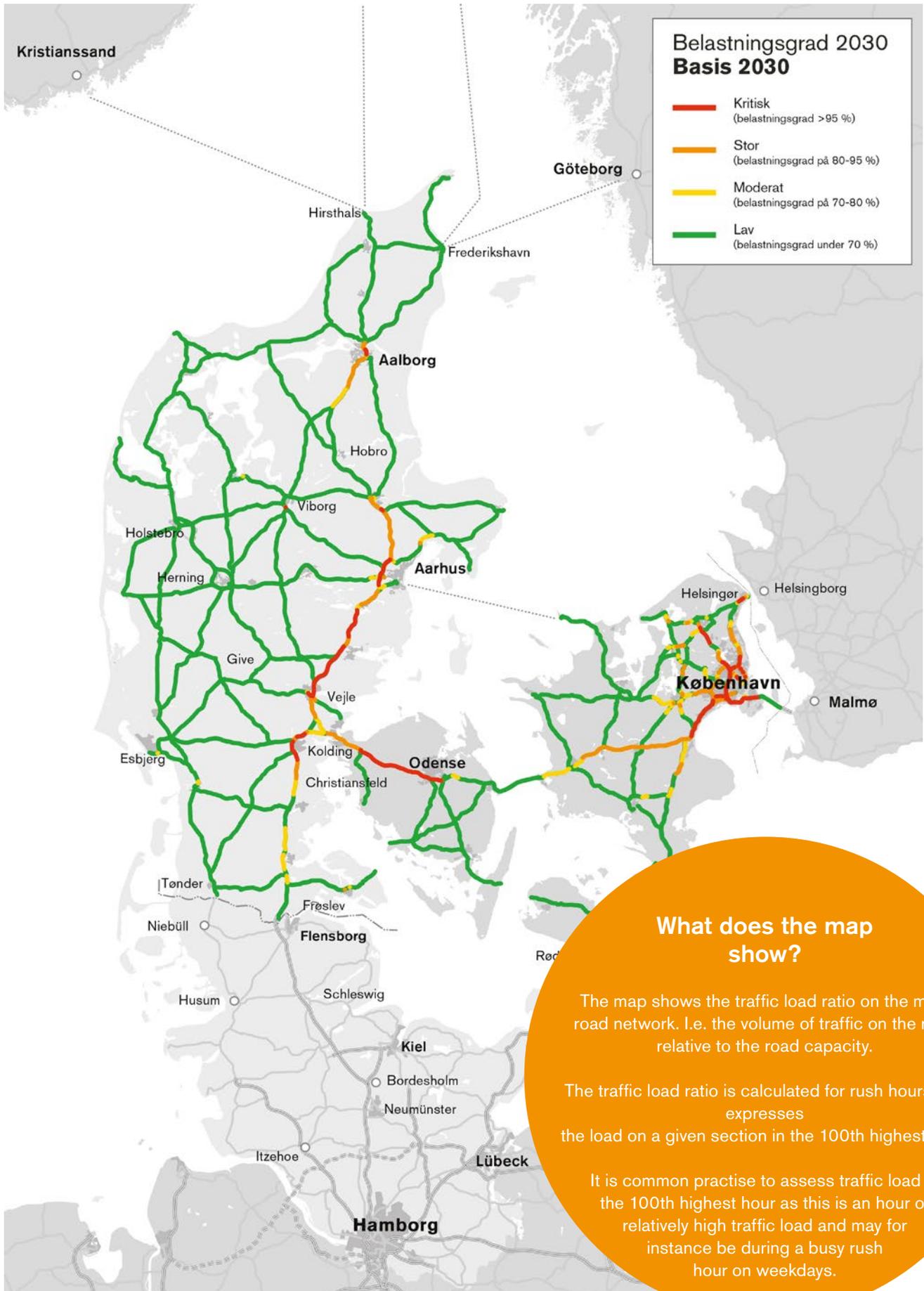


Map 2.4: Traffic on an average day in the eastern road corridor (A7) and the western road corridor (B5/A23), respectively.

2 Traffic situation in the Jutland Corridor



Map 2.5: Traffic load ratio in 2016 in the 100th highest hour.



What does the map show?

The map shows the traffic load ratio on the main road network. I.e. the volume of traffic on the road relative to the road capacity.

The traffic load ratio is calculated for rush hours and expresses the load on a given section in the 100th highest hour.

It is common practise to assess traffic load in the 100th highest hour as this is an hour of relatively high traffic load and may for instance be during a busy rush hour on weekdays.

Map 2.6: Traffic load ratio in 2030 using LTM in the 100th highest hour. The calculations were made before the political decision to expand the E20 on West Funen



Figure 2.1: Annual average daily traffic at the Danish-German border in 2016.

2.4 Cross-border traffic

The Danish-German border comprises the border crossings in Jutland and at the ferry routes Rødby-Puttgarden, Gedser-Rostock and Rønne-Sassnitz.

Today, much of the cross-border traffic takes place via the border in the Jutland Corridor which is the main transport route from the north to the south. With its seven border crossings, the Jutland Corridor is faced with six times as much traffic as Rødbyhavn.

Traffic is most intense in the eastern part of the Jutland Corridor, especially at Frøslev (E45) which is the largest border crossing in the corridor. At Frøslev, 18,500 vehicles cross the border on an average weekday, corresponding to 36% of the cross-border traffic in the Jutland Corridor, see figure 2.2.

Particularly transit traffic and business traffic cross the border at Frøslev whereas the other border crossings are mainly used by the cross-border trade.

Overall, the eastern border crossings account for 82% of the cross-border traffic in the Jutland Corridor.

The least traffic intense border crossings are located in the western part of the Jutland Corridor. Of these, the largest is the Sæd border crossing with about 6,000 vehicles per weekday.

Traffic at all seven border crossings is shown in figure 2.1.

Traffic flow across the border

Map 2.7 shows how the cross-border traffic distributes onto the road network. The map is based on calculations using LTM for an average weekday in 2015.

As illustrated on map 2.7, the main traffic flow crosses the border at Frøslev. In Denmark, much of the traffic drives through Jutland on the E45 or across Funen and Zealand. In Germany, the main traffic drives south towards Hamburg and then distributes to the rest of the country.

This means that only a small part of the traffic crosses the border at Sæd and continues up through West Jutland.

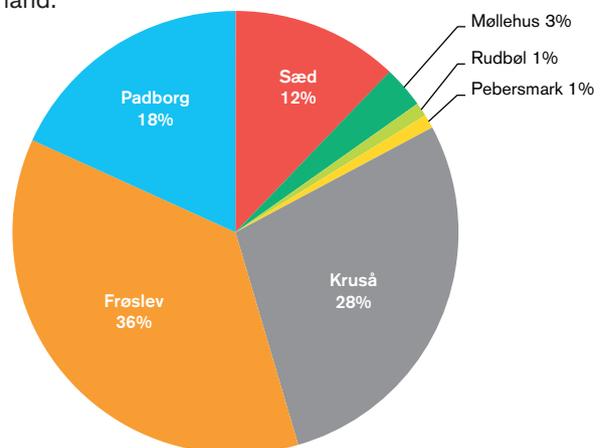


Figure 2.2: Percentage distribution of traffic across the Danish-German border in the Jutland Corridor in 2016.



What does the map show?

The map shows how traffic distributes from the border section at the Danish-German border to the north in Denmark and to the south in Germany, respectively.

Map 2.7: Traffic flows in the Jutland Corridor calculated at the border section at the Danish-German border.

Development in cross-border traffic

As part of increasing international trade, free movement of goods and services and, the general economic growth, the traffic across borders has increased.

At the border in South Jutland, traffic increased by 16% during the period 2006-2016. By comparison, traffic for all roads in Denmark increased by 12% during the same period.

Figure 2.3 shows the development in traffic across the border in the eastern (Frøslev) and western (Sæd) part of the Jutland Corridor during the period 2006-2016.

As illustrated, the most significant increase in traffic was seen at Frøslev. Here, traffic has increased by 31% over the past ten years which can mainly be ascribed to the location of Frøslev on the E45.

However, the traffic counts made by the Danish Road Directorate show that from 2015 to 2016, cross-border traffic fell slightly by 0.6%. A possible explanation could be declining cross-border trade.

What drives traffic across the border?

There is a close correlation between economic growth and traffic growth across the borders as increased growth typically also increases international trade and thereby also traffic. Moreover, the following factors contribute to the increase in cross-border traffic as a result of:

- Improved infrastructure which makes it faster and cheaper to drive across Europe.
- More companies operating in more European countries result in transport of goods over longer distances.
- Fewer trade barriers and more uniform rules for transport of goods.

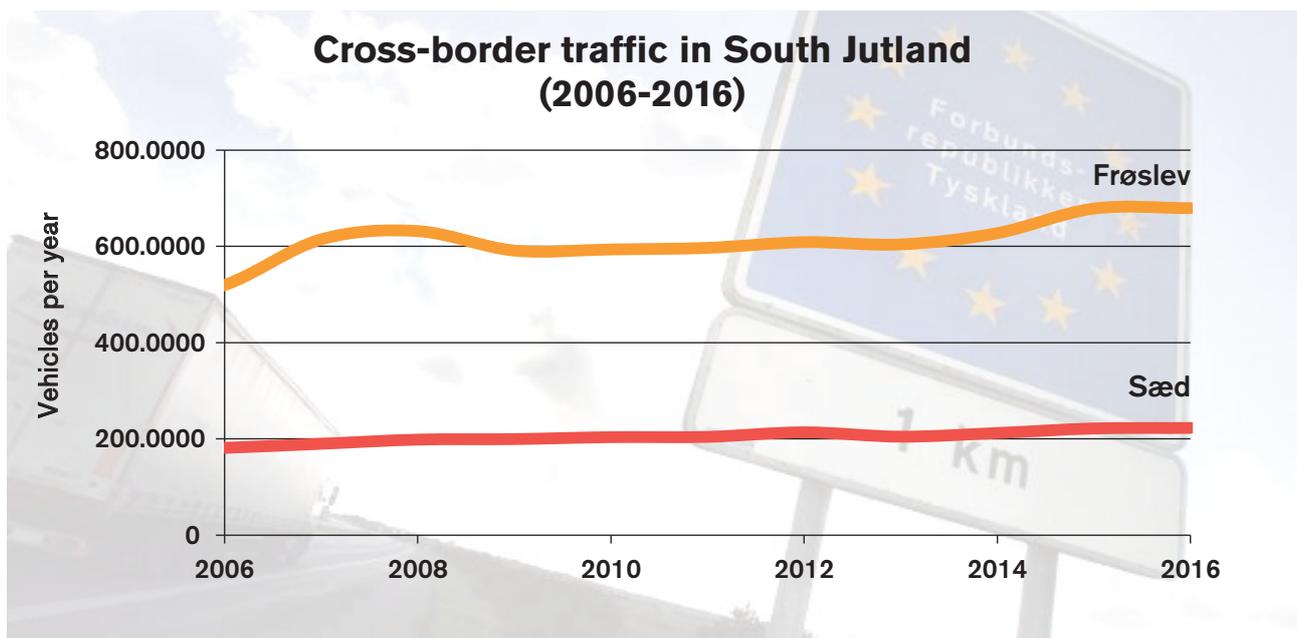


Figure 2.3: Development in traffic across the Danish-German border at Frøslev (orange) and Sæd (red) during the period 2006-2016.

Cross-border trade

The development in the cross-border passenger car traffic is affected by cross-border trade which has been declining for the past couple of years.

The declining cross-border trade is attributable to a general drop in Danes buying products such as alcohol, soft drinks and tobacco from Germany, which can, among other things, be ascribed to the Danish tax reductions.

Figures from SKAT show that cross-border trade has declined by DKK 3 billion since 2013. This appears from figure 2.4 which shows the value of Danish cross-border trade during the period 2010-2015.

The declining cross-border trade contributes to a slight fall in passenger car traffic across the border, contrary to truck traffic which has seen an increasing trend over the past years.

What do we know about cross-border trade?

Approx. 70% of the Danish cross-border trade takes place in Germany where the Danes buy especially wine, beer, soft drinks and sweets.

10 years ago, cross-border shopping accounted for 1.5% of Danish consumer spending. In 2015, the figure was 1%

Source: SKAT



Figure 2.4: The value of Danish cross-border trade during the period 2010-2015.

2.5 Truck traffic across the border

Since the financial crisis in 2008/2009, we have seen an increase in truck traffic transporting goods across the Danish borders.

This is illustrated in figure 2.5 which shows the number of trucks across the borders towards Denmark.

Figures from ITD (Business association for Danish goods transport) show that most trucks cross the border in South Jutland, which in 2016 accounted for 57% of total truck traffic, whereas Øresund accounted for 20%, see figure 2.6.

Transit traffic

Denmark's location between Norway, Sweden and Germany means that Denmark is used as a transit corridor for truck traffic.

Previous analyses show that most transit traffic crosses Fehmarn Belt and Øresund. This means that transit traffic across Zealand is triple the size of that through Jutland.

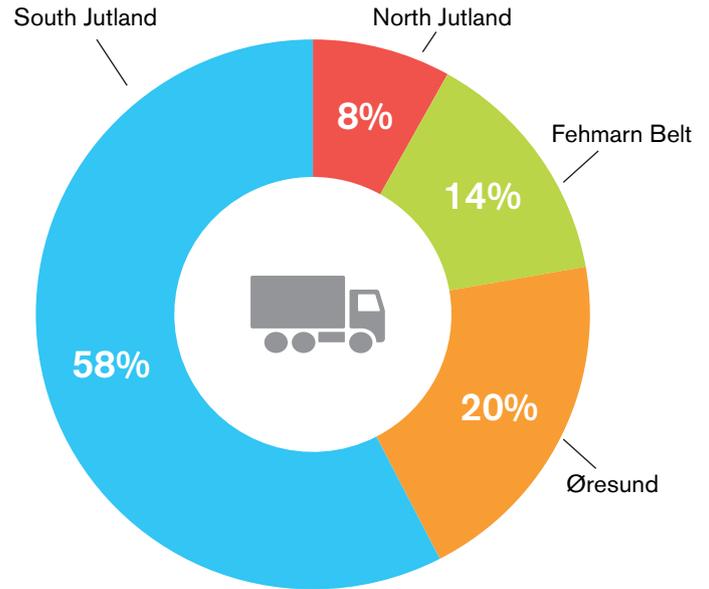


Figure 2.6: Percentage distribution of truck traffic in and out of Denmark in 2016.

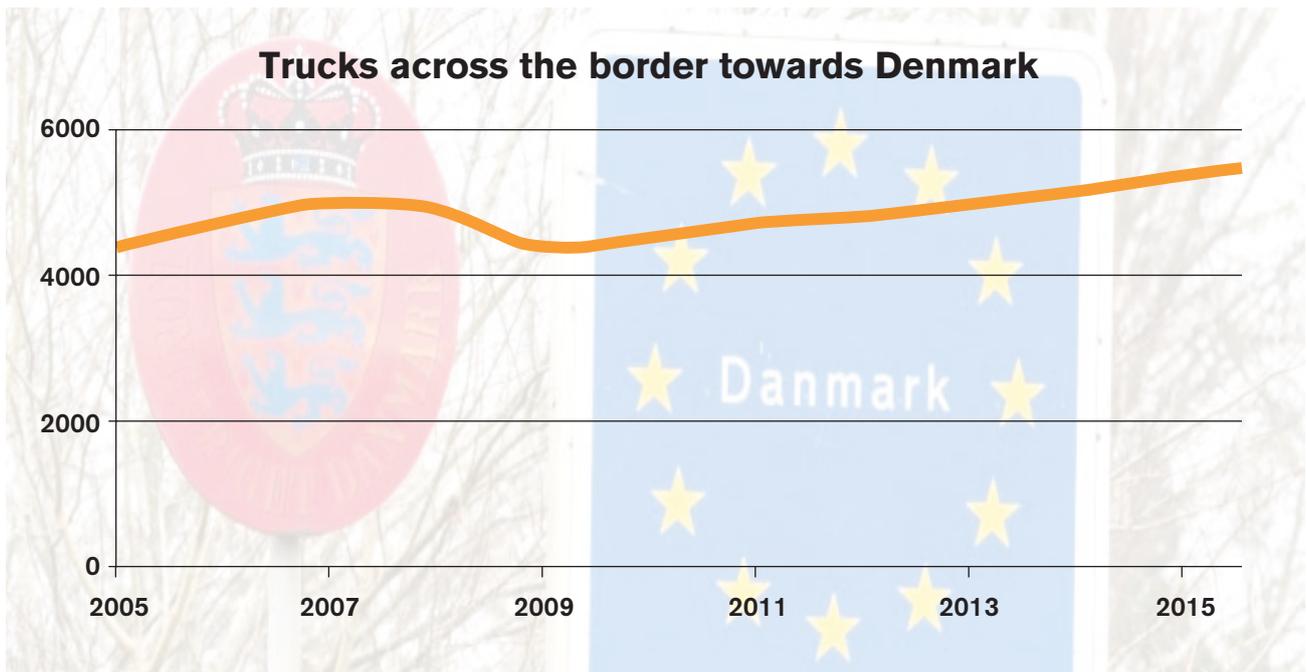


Figure 2.5: Number of trucks per day across the Danish borders towards Denmark.

Truck traffic in South Jutland

In the Jutland Corridor, most trucks drive in the eastern part of the corridor via motorway E45/A7.

This is illustrated in figure 2.7 which shows that traffic at Frøslev consists of 35% trucks. By comparison, truck traffic is only 6% at the Sæd border crossing and thereby also considerably lower in the western part of the corridor, see figure 2.8.

The high share of trucks at the Frøslev border crossing means that the South Jutland Motorway has one of the highest shares of trucks in the country. Map 2.8 shows that parts of the section have more than 8,000 long vehicles per day in the form of trucks, busses and cars with trailers.

When many trucks are driving on a section, it might affect accessibility. This is due to the fact that trucks take up more space on the roads, drive slower and overtake slower.

In order to assess whether trucks reduce accessibility on the South Jutland Motorway, separate analyses have studied traffic on parts of the section.

The simulation analysis shows that trucks have an impact on the driving speed which, to a minor degree, reduces accessibility on the section between Kolding and

Christiansfeld. However, the reduced accessibility is not enough to cause any actual problems for traffic flow.

2.6 Summer holiday traffic

In addition to the large share of trucks, the South Jutland Motorway is characterised by substantial summer holiday traffic, see map 2.9. For example, summer holiday traffic on a day in July is more than 25% greater than the annual average daily traffic on the section between Haderslev and the border.

This means that on the busiest holiday travel days, the traffic volume may exceed 70,000 vehicles per day at the Danish-German border.

A large proportion of the summer holiday traffic may be assumed to continue down through Germany via motorway A7.

The western part of the Jutland Corridor also has considerable summer traffic on route 11 between Esbjerg and Tønder.

In the summer, the section is particularly used by German tourists who spend the holiday in cottages at the West Coast or go to the beach on day trips. As a result, route 11 may be very busy during holiday periods, especially on Saturdays which are the changeover day.

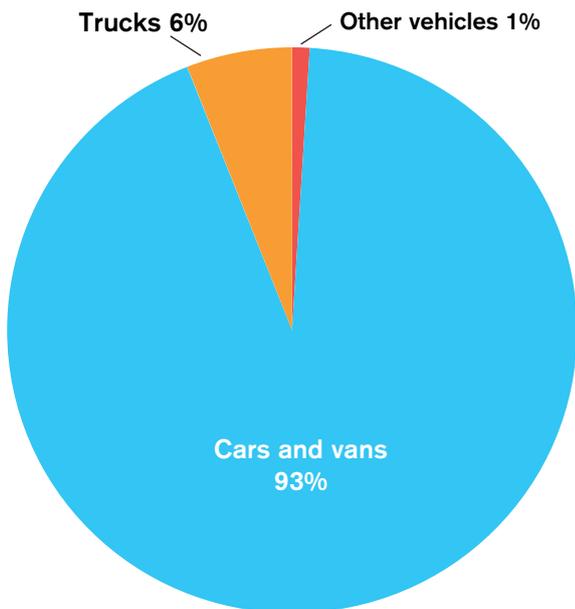


Figure 2.7: Distribution of vehicles at Sæd in 2016.

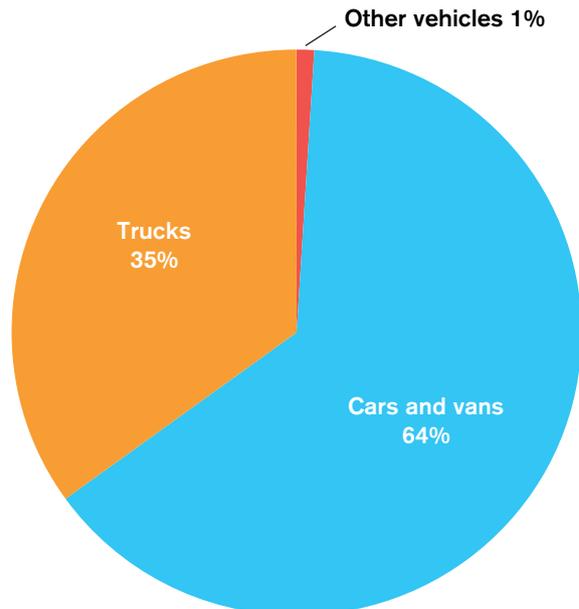


Figure 2.8: Distribution of vehicles at Frøslev in 2016



Map 2.8: Average number of long vehicles (over 5.8 m) per day on the main road network in 2016.



Map 2.9: Sections on the main road network with substantial summer holiday traffic, average day in July 2016

3 The scenarios examined

3.1 Alignment

The analysis sets out a number of different scenarios to study the traffic impact of developing the Jutland Corridor. The analysis is based on four scenarios, two western and two eastern scenarios.

The calculations in this analysis have been made using the Danish National Traffic Model version 1.2 and are based on the assumption that a Central Jutland motorway will join the E45 at Christiansfeld.

The purpose is to study the traffic impact of establishing a western motorway parallel to the E45 or extending parts of the E45 in Denmark and A7 in Germany.

To illustrate this, corridor A is used as basis for a Central Jutland motorway, see map 3.1 which involves 146 km of new motorway.



Map 3.1: Alignment for corridor A from "Central Jutland Motorway – recalculations using the Danish National Traffic Model" - Report 555 – 2016

In the western scenarios, a Central Jutland motorway is extended in corridor A (westernmost alignment) towards the south whereas one of the eastern scenarios has a Central Jutland motorway in corridor A and an expansion of the E45.

A Central Jutland motorway was most recently examined in "Central Jutland Motorway – Recalculations using the Danish National Traffic Model" - Report 555 – 2016 from July 2016 and will be studied in more detail in the ongoing preliminary study and environmental impact assessment of a Central Jutland motorway.

Focusing on the cross-border traffic, this analysis assumes that the motorway is extended down to the border and further down through North Germany.

In the current analysis, the four scenarios are referred to as scenarios 1, 2, 3 and 4 and will be described in the following.

Scenarios	Length, new motorway (km)	Expansion of exist. motorway (km)	Total length (km)
Scenario 1	394	0	394
Scenario 2	466	0	466
Scenario 3	146	149	295
Scenario 4	0	252	252

Table 3.1: Length in Denmark and Germany for scenarios 1, 2, 3 and 4. The lengths cover new motorway or expansion of existing motorway.

Alignment

The **western scenarios** (1 and 2) include:

- A Central Jutland motorway.
- An extended motorway down to the border.
- An upgrade of route B5 in Germany.

The **eastern scenarios** (3 and 4) include:

- A Central Jutland motorway.
- A partial expansion of the E45.
- A partial expansion of the A7 in Germany.

3.2 Western scenarios

The two western scenarios consist of scenarios 1 and 2 and are to illustrate the traffic potential of establishing a western motorway parallel to the E45.

Scenario 1

On the Danish side, scenario 1 consists of a Central Jutland motorway that runs from Hobro in North Jutland to Christiansfeld in South Jutland, see the dark blue alignment on map 3.2.

In order to establish connection to the border, a Central Jutland motorway will be extended from Kolding to Sæd, see the lighter alignment on map 3.2. This means that a branch consisting of 154 km new motorway will be established down to the border.

On the German side, scenario 1 will be extended by upgrading the German regional road, route B5, to a four lane motorway (94 km). Route B5 runs from Sæd to Heide after which it continues as motorway A23 down to Hamburg.

As a motorway already exists between Heide and Hamburg (A23), scenario 1 will provide a motorway between Hobro and Hamburg. The scenario is 394 km long.

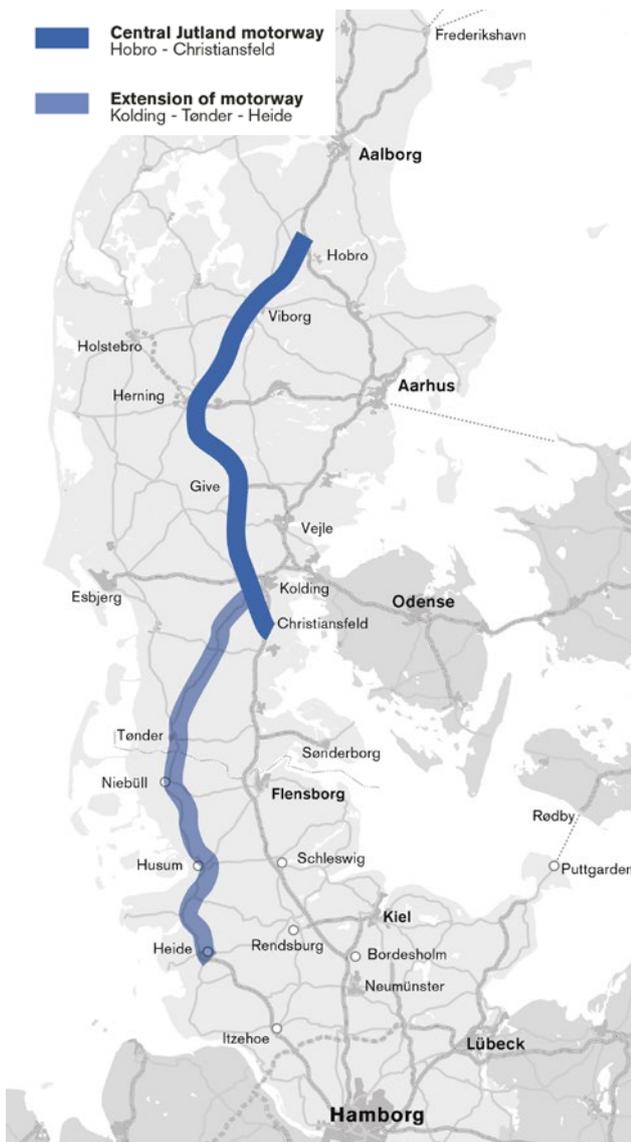
Scenario 2

Scenario 2 is another variant of a motorway parallel to the E45. On the Danish side, the scenario consists of a Central Jutland motorway, see the light blue alignment on map 3.3.

This also establishes connection to the border. It is done by extending a Central Jutland motorway from Givø to Sæd, see the lighter alignment on map 3.3. With 226 km new motorway, scenario 2 provides a longer branch compared to scenario 1.

On the German side, route B5 is upgraded to a motorway, meaning that scenario 2 will also contribute to a motorway on the entire section from Hobro to Hamburg.

With a length of 466 km, scenario 2 is the longest of the analysis.



Map 3.2: Alignment for scenario 1.



Map 3.3: Alignment for scenario 2.

3.3 Eastern scenarios

The analysis also makes calculations for two eastern scenarios which are to illustrate the traffic impact of partially expanding the E45 in Denmark and A7 in Germany.

Scenario 3

On the Danish side, scenario 3 consists of a Central Jutland motorway that runs from Hobro in North Jutland to Christiansfeld in South Jutland, see the green alignment on map 3.4.

In order to continue scenario 3 down to the border in the eastern scenario, the southern part of the E45 (South Jutland Motorway) is expanded to a 6 lane motorway. The expansion will be carried out for the section between Christiansfeld and the border.

On the German side, 84 km of the A7 is expanded on the section between the border and Bordesholm, see the lighter alignment on map 3.4.

As a further extension of the A7 is planned in Germany, scenario 3 will provide motorway on the entire section from Hobro to Hamburg.

The scenario is 295 km long. The expansion of the E45 and A7 sections account for 65 km and 84 km, respectively.

Scenario 4

Contrary to the other scenarios, scenario 4 does not contain a Central Jutland Motorway. Instead, scenario 4 assumes a longer expansion of the E45 in Denmark and A7 in Germany.

On the Danish side, 168 km of E45 will be expanded at Aarhus and from Skanderborg down to the border. Then the motorway continues down through North Germany where 84 km of the A7 will be expanded between the border and Bordesholm, see the lime green alignment on map 3.5.



Map 3.4: Alignment for scenario 3.



Map 3.5: Alignment for scenario 4.

With scenario 4, the E45/A7 will be expanded between Aarhus N and Hamburg at a section of 252 km, making scenario 4 the shortest scenario of the analysis.

This should be seen in conjunction with the fact that the E45 will only be expanded between Aarhus N and the border whereas the other scenarios start in Hobro. The

shorter expansion is a result of the fact that congestion on the E45 is most considerable from Skanderborg and southwards. To this should be added that the section between Aarhus S and Skanderborg is currently being extended to six lanes.

All four scenarios are shown on map 3.6.

Western scenarios: Extending of the Jutland Corridor

Scenario 1



Scenario 2



Eastern scenarios: Extending of the Jutland Corridor

Scenario 3



Scenario 4



Map 3.6: Scenarios for extending the Jutland Corridor.

4 Traffic impact of an extension

4.1 Basis and assumptions

In order to study the traffic impact of developing the Jutland Corridor, traffic calculations have been made using the Danish National Traffic Model (LTM) version 1.2 which has been adapted to the 2015 traffic level.

LTM has previously been used to study the impact of a Central Jutland motorway, see the strategic analysis from 2016.

The traffic calculations can provide an overall picture of traffic on the road network in connection with new infrastructure projects. This is done by calculating and comparing traffic in situations with and without new infrastructure.

The model calculations for 2030 include all adopted and funded infrastructure projects. Moreover, they include a number of assumptions about development in GDP, population, jobs, vehicle operating costs, car ownership, existing infrastructure, etc.

The Danish assumptions are based on the projections of the Ministry of Finance and Statistics Denmark, whereas the German assumptions come from Eurostat.

On the German side, it is assumed that road extensions are made in North Germany.

This includes the development of the A7 between Hamburg and Bordesholm as well as some minor road extensions of the B5/A23.

However, the German assumptions are not believed to have a major impact on the traffic results.

International model

LTM is currently the only traffic model in Denmark which is able to calculate the impact of cross-border traffic.

LTM is mainly developed to calculate traffic in Denmark and between Denmark and other countries, including transit traffic. Moreover, LTM contains an international model which includes road networks in other countries at an overall level.

LTM is therefore used in this analysis to calculate the traffic impact of developing the Jutland Corridor.

The model limitations are described below.

Limitations of LTM (DK)

LTM version 1.2 is a weekday model. This means that congestion is considered as an average over the entire day rather than during rush hours.

This makes it difficult for LTM to describe congestion correctly.

However, this will be addressed in the next model version of LTM (version 2.0) in which traffic is divided into several periods during the day.

Limitations of LTM (DE)

The international model in LTM is not nearly as developed as the Danish part of the model.

For example, LTM does not include internal traffic in Germany. This means that only cross-border traffic is included in the calculations.

Moreover, LTM is generally not able to model congestion on German roads. This, however, has been overcome by changing some of the model parameters.

As LTM is not suitable for making calculations for the fixed link across Fehmarn Belt, the traffic impact of this is not included in the calculations of the analysis.

4.2 Scenarios

The analysis uses a number of selected scenarios.

The traffic model calculations are based on a basic scenario 2030 and a number of scenarios developing the Jutland Corridor. As a result, the calculations illustrate:

- How traffic is expected to be in 2030 (basic scenario 2030).
- How traffic is expected to be in 2030 if new infrastructure is established (project scenarios).

The purpose is to study whether the scenarios can decongest the E45 and attract sufficient traffic on the new sections.

The scenarios contribute to assessing whether a traffic potential exists for developing the Jutland Corridor. The developments are not to be considered as proposals for new motorway projects but as assessments of the potential of developing the cross-border scenarios between Denmark and Germany.

This should be seen in conjunction with the Danish-German Transport Commission which in the report "Transport in the Jutland Corridor" recommends that the long-term needs for an expansion of the eastern and western parts of the Jutland Corridor be investigated.

The scenarios include:

Basic scenarios

Basic scenarios

Basic scenario 2030

Scenarios for developing the Jutland Corridor

Scenarios

- 1) Scenario 1
- 2) Scenario 2
- 3) Scenario 3
- 4) Scenario 4

Figure 4.1: Scenarios for developing the Jutland Corridor.





Figure 4.1: The percentage increase in traffic per weekday at the Danish-German border during the period 2015-2030 calculated using LTM.6.

4.3 Traffic calculations for the basic scenario 2030

In order to assess the traffic potential of developing the Jutland Corridor, calculations have been made for a basic situation in 2030. They show how traffic is expected to be in 2030 if no decision is made to establish new infrastructure.

Calculations using LTM show that traffic will increase in future. For example, the total number of individual trips in Denmark will increase by 8%, whereas the number of trips as driver of a car will increase by 15% from 2015 to 2030.

The total traffic performance in Denmark will increase by 26 million vehicle kilometres per weekday from 2015 to 2030, corresponding to an increase of 19%.

When the traffic performance increases more than the number of trips as driver of a car, it is due to the average trip getting longer.

Cross-border traffic in basic scenario 2030

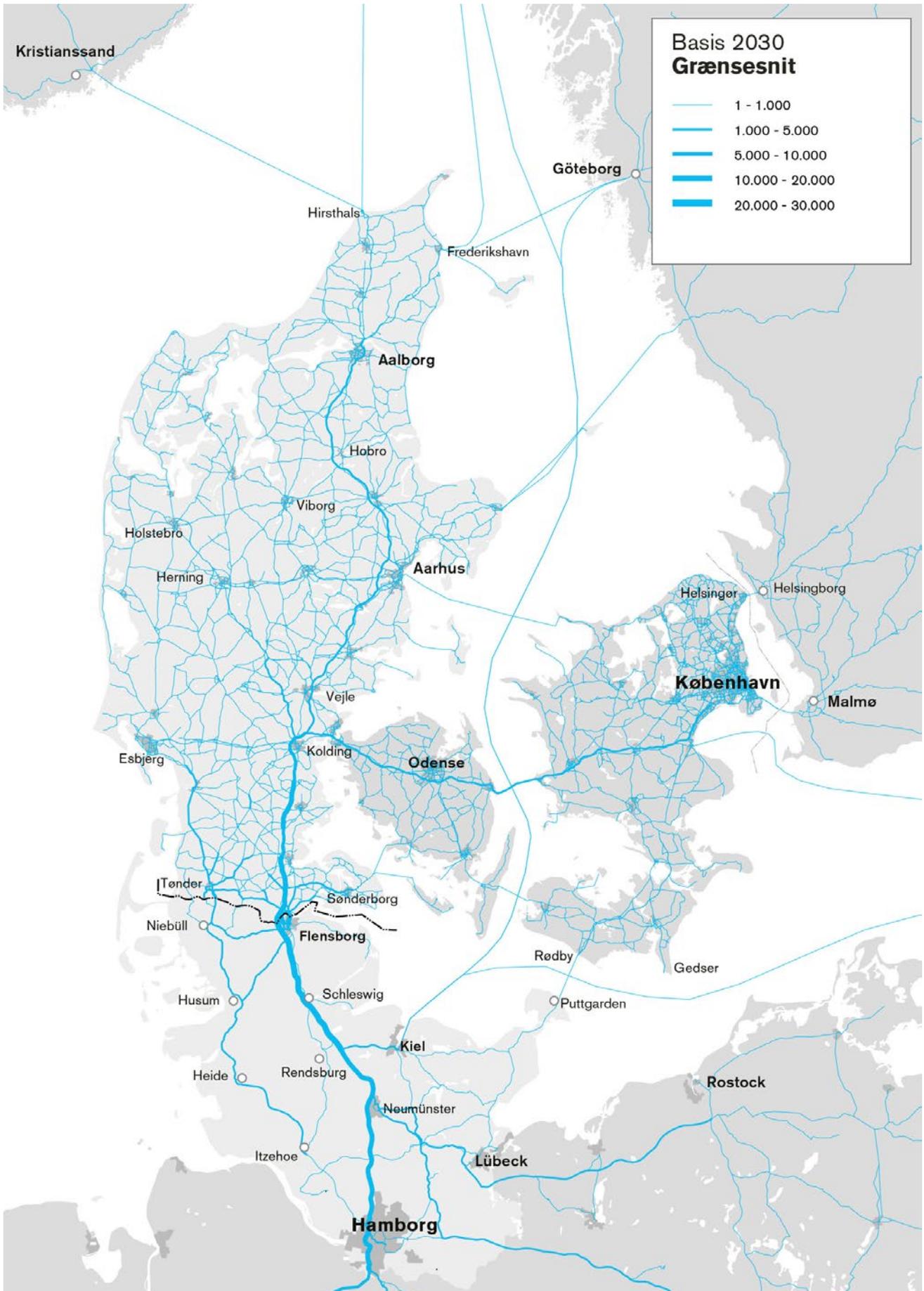
Traffic across the Danish-German border will increase by between 15% and 19% except for Frøslev which will see a 24% increase from 2015-2030.

However, the average percentage growth must be seen in conjunction with the fact that most vehicles cross the border in the eastern road corridor, see figure 2.1.

Traffic growth will mainly be in the eastern road corridor as this is where the infrastructure is best developed and as the most significant increase is expected to be seen in the long-distance traffic which mainly uses the motorways.

As a result, traffic towards 2030 will mainly take place in the eastern road corridor if no decision is made to establish a western road corridor parallel to the E45, see map 4.2.

The percentage increase in traffic from 2015 to 2030 is shown in figure 4.1.



Map 4.2: Distribution of cross-border traffic on an average weekday in the Jutland Corridor in basic scenario 2030 calculated using LTM. Traffic is calculated in a section at the Danish-German border.

4.4 Traffic calculations for scenario 1

Traffic in scenario 1

If the Jutland Corridor is extended as described in scenario 1, a Central Jutland motorway will have between 18,000 and 50,000 vehicles per weekday depending on the part of the section. The traffic level on a Central Jutland motorway is illustrated by the red columns in figure 4.2.

The most substantial traffic load will be at Herning and Give where scenario 1 coincides with the existing Central Jutland Motorway on route 18.

If a Central Jutland motorway is extended down to the border, this part of the section will have between 5,000 and 17,000 vehicles per weekday, see the yellow columns in figure 4.2. This means that the traffic level will be considerably lower compared to the traffic on a Central Jutland motorway, i.e. further towards the north.

If the scenario is extended down into Germany by upgrading route B5 to a motorway, this will result in between 1,000 and 2,500 additional vehicles per day crossing the border compared to a situation without extension of the Jutland Corridor.

Sub-sections of scenario 1	Traffic in 2030
Central Jutland motorway	18-50,000
Motorway extended down to the border	5-17,000
Upgrade of route B5 (Germany)	1-2,500*

Table 4.1: Weekday traffic on sub-sections in scenario 1.

*The traffic figure states the additional traffic on route B5 compared to a situation without extension.

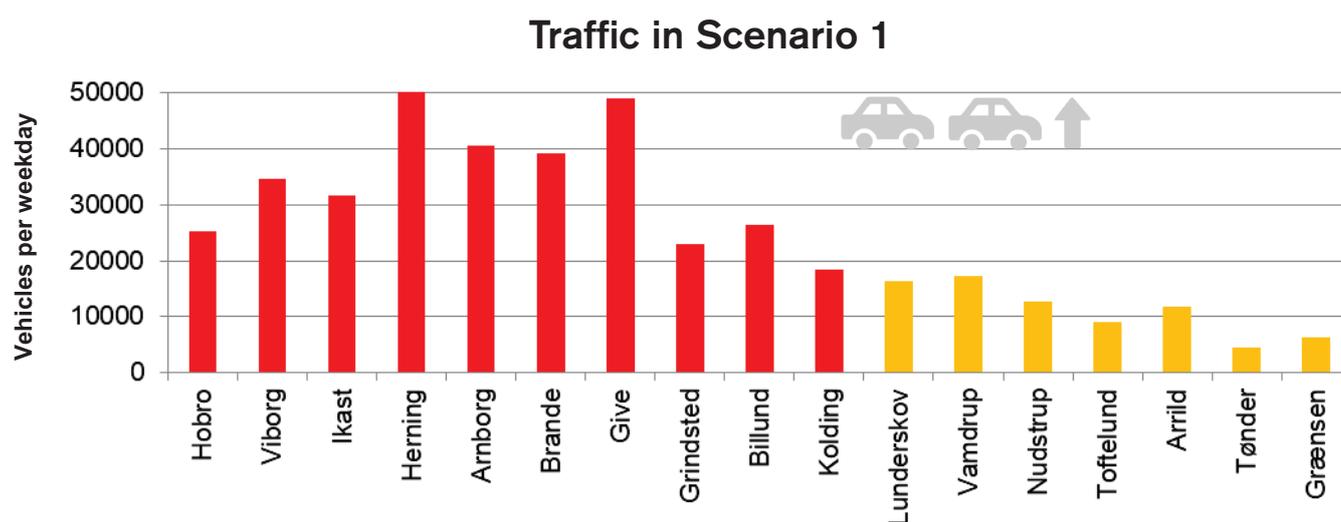
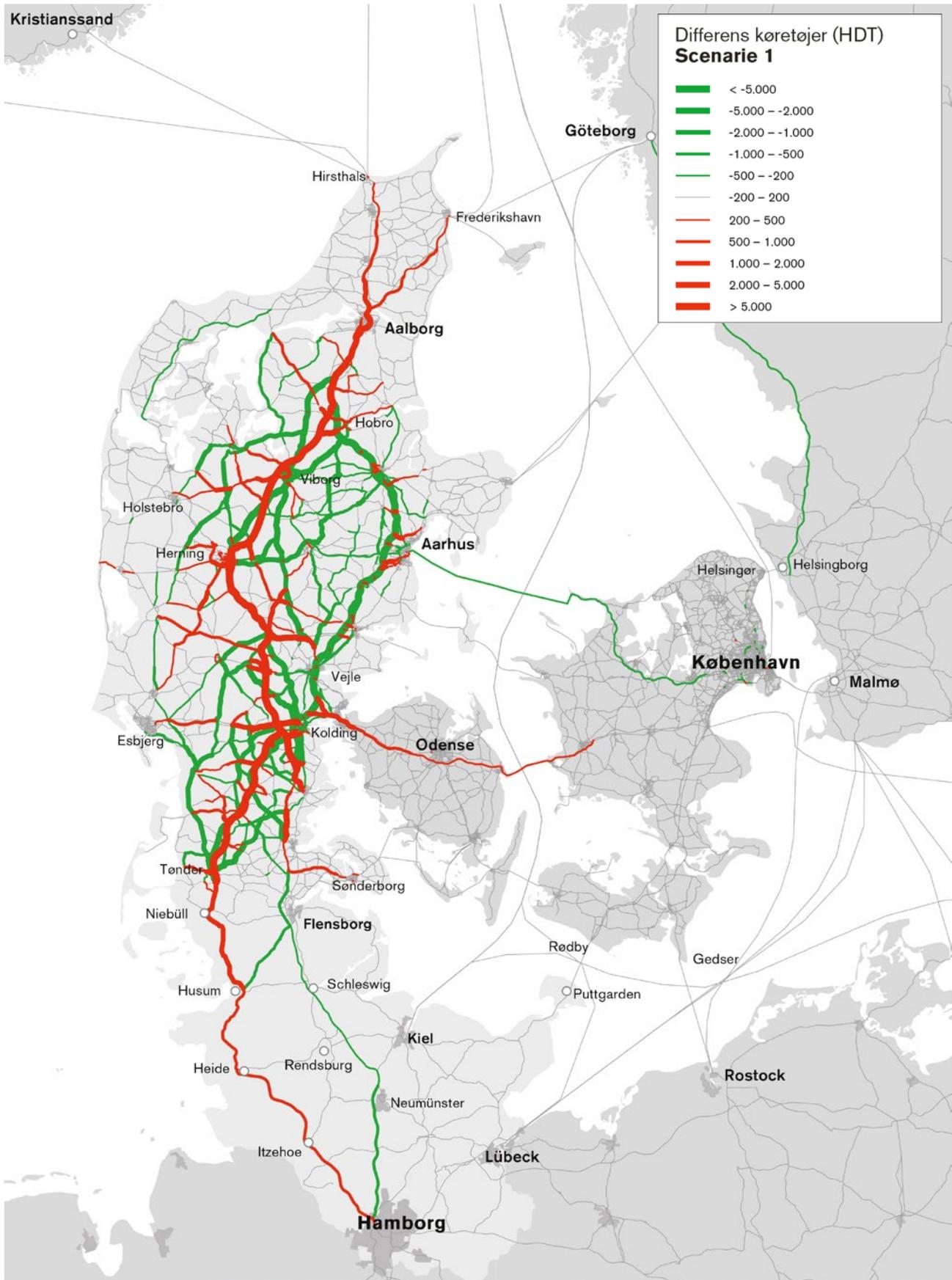


Figure 4.2: Traffic on a Central Jutland motorway (marked in red) and on the rest of scenario 1 (marked in yellow).

4 Traffic impact of an extension



Map 4.3: Increase (red) and decrease (green) in traffic if scenario 1 is established compared to a situation without extension of the Jutland Corridor.

Decongestion of E45

Establishing a Central Jutland motorway as described in scenario 1 will decongest the E45 by between 5,000 and 17,000 vehicles between Hobro and Christiansfeld, see the dark green columns in figure 4.3. That corresponds to a change of 6% - 36% compared to a situation without extension of the Jutland Corridor.

The most substantial decongestion will be at Kolding with 17,000 fewer vehicles per weekday. By comparison, traffic at Kolding will decrease less if only a Central Jutland motorway is established. This means that decongestion at Kolding will be higher if the entire Jutland Corridor is extended.

By extending a Central Jutland motorway down to the border, the decongestion of the E45 will be slightly more than 1,000 vehicles on the section between Christiansfeld and Padborg, see the light green columns in figure 4.3.

However, scenario 1 means that traffic will increase slightly at Haderslev by just over 2,000 vehicles per weekday.

In Germany, the number of vehicles on the A7, which crosses the border every day, will decrease by up to 3,000 vehicles.

Section on E45/A7	Decongestion of E45	Percentage change
Hobro - Christiansfeld	5,000 - 17,000	6 - 36%
Christiansfeld - Padborg	-2,000* - 1,000	-3 - 5%

Table 4.2: Decongestion of the E45 on establishment of subsections according to scenario 1.

* The traffic figure states the additional traffic on the E45 at Haderslev.

Congestion on E45

Even though scenario 1 extends the Jutland Corridor, congestion will still be substantial or critical on parts of the East Jutland Motorway and moderate on parts of the South Jutland motorway in 2030, see 4.4. The latter can be ascribed to the connection of the motorway to the E45 where the increased traffic at Haderslev will increase the traffic load ratio.

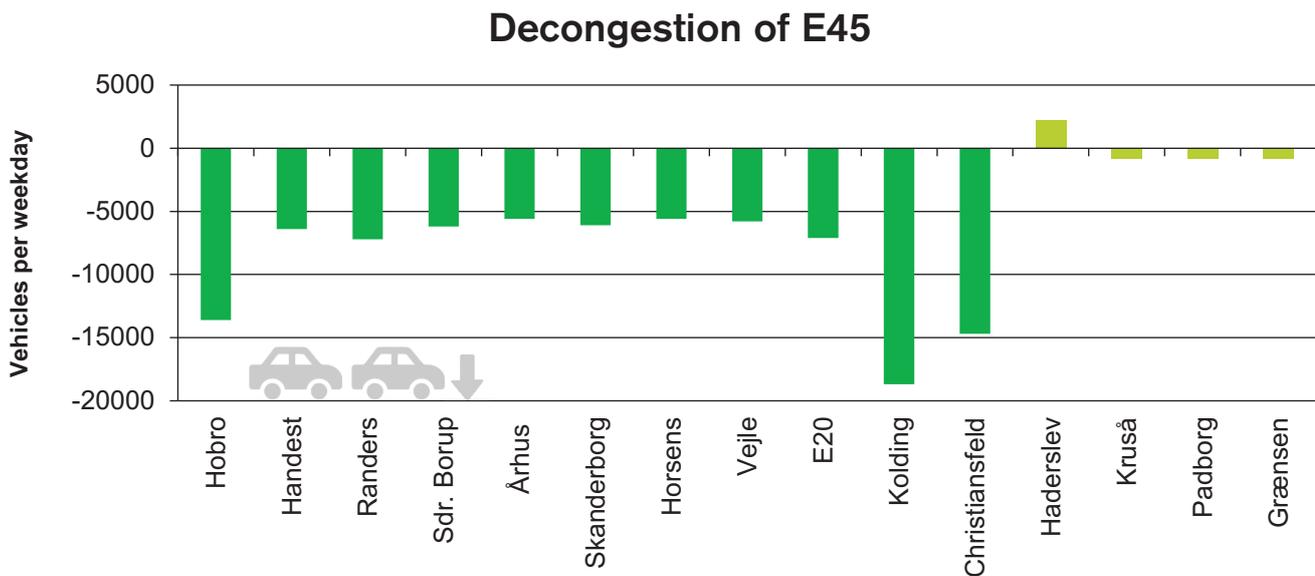
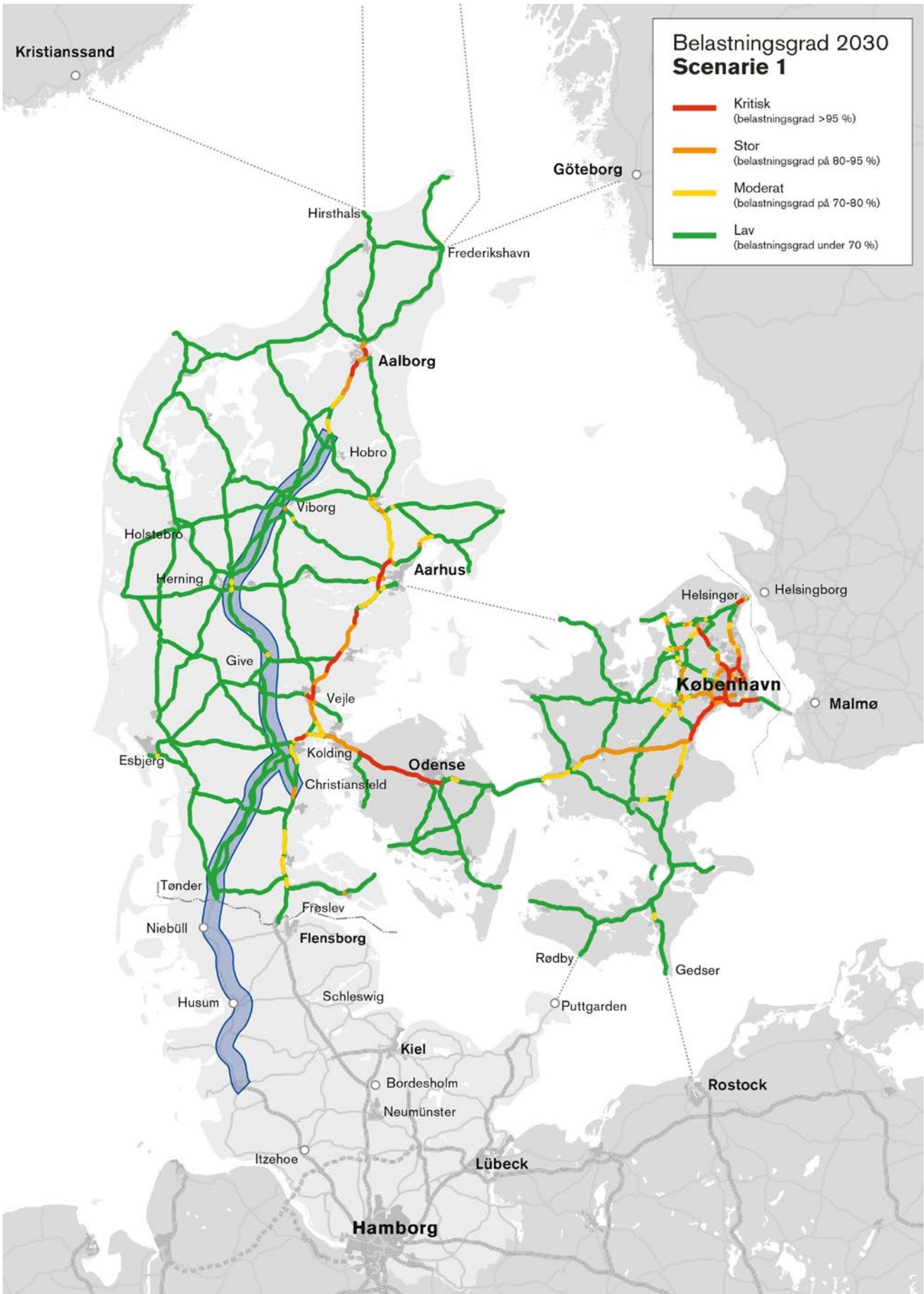


Figure 4.3: Decongestion of and additional traffic on the E45 on establishment of a Central Jutland motorway (dark green) and a branch down to the border (light green) in scenario 1.

4 Traffic impact of an extension



Map 4.4: Traffic load ratios on the main road network in 2030 if scenario 1 is used.

4.5 Traffic calculations for scenario 2

Traffic in scenario 2

With this scenario, there will be about 19,000 and 51,000 vehicles per weekday on a Central Jutland motorway, see the red columns in figure 4.4, whereas a branch down to the border will have between 5,000 and 17,000 vehicles per weekday, see the yellow columns.

This is about the same traffic level as that achieved with scenario 1. Scenario 2 will also result in significantly more traffic on a Central Jutland motorway compared to the traffic level on the section down to the border.

If route B5 is upgraded on the German side, this will result in an additional 3,000 vehicles per weekday crossing the border compared to a situation without extension of the Jutland Corridor.

This means that the traffic impact will not differ significantly from the previous scenario.

Sub-sections of scenario 2	Traffic in 2030
Central Jutland motorway	19-51,000
Motorway extended down to the border	5-17,000
Upgrade of route B5 (Germany)	1-3,000*

Table 4.3: Weekday traffic on sub-section in scenario 2.

*The traffic figure states the additional traffic on route B5 compared to a situation without extension.

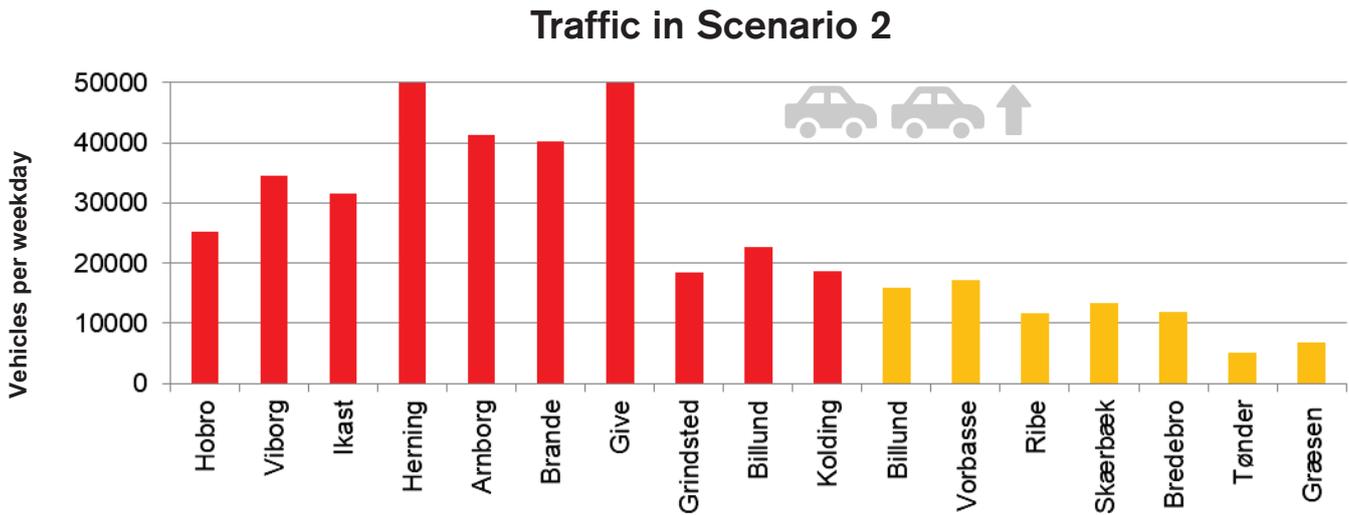
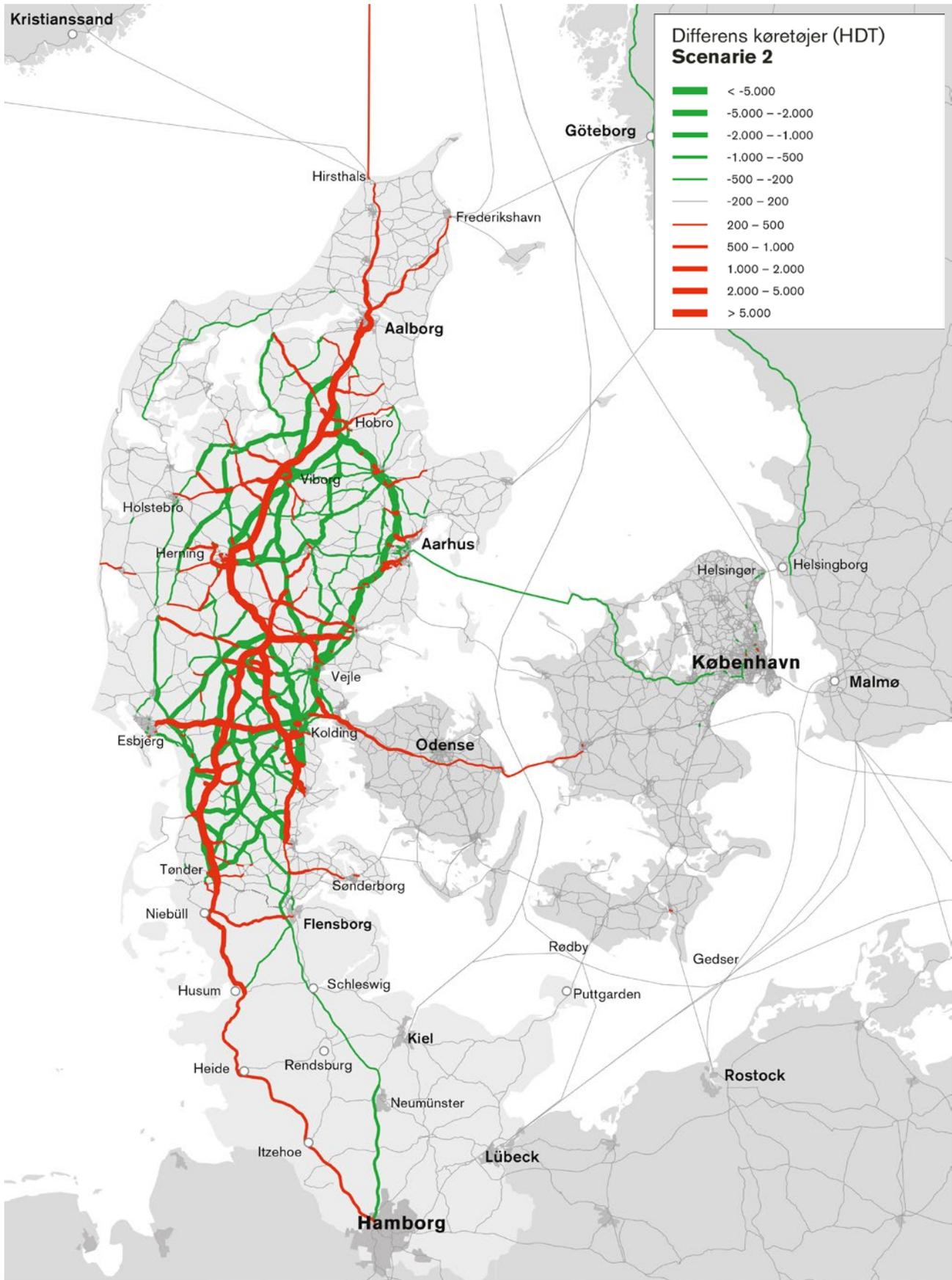


Figure 4.4: Traffic on a Central Jutland motorway (marked in red) and on the rest of scenario 2 (marked in yellow).



Map 4.5: Increase (red) and decrease (green) in traffic if scenario 2 is established compared to a situation without extension of the Jutland Corridor.

Decongestion of E45

Establishing a Central Jutland motorway as described in scenario 2 will decongest the E45 by between 5,000 and 16,000 vehicles per weekday on the section between Hobro and Christiansfeld, see the dark green columns in figure 4.5.

The decongestion will be most substantial at Kolding, north of the connection to the E45. This section will have 16,000 fewer vehicles per weekday which is slightly less than the previous scenario where the decongestion will be 17,000 fewer vehicles.

The lower decongestion of the E45 is due to the fact that the branch will be further away from the E45 and thus does not transfer as much traffic as in scenario 1.

If a Central Jutland motorway is continued down to the border, the section between Christiansfeld and Padborg will see a reduction in vehicles of just over 1,000. However, traffic will increase by just over 2,000 vehicles at Haderslev, see the light green columns in figure 4.5.

In Germany, the cross-border traffic on the A7 will be re-

duced by between 1,000 and 3,000 vehicles. The most significant decongestion will be at Hamburg.

Section on E45/A7	Decongestion of E45	Percentage change
Hobro - Christiansfeld	5,000 - 16,000	7 - 36%
Christiansfeld - Padborg	-2,000* - 1,000	-8 - 6%

Table 4.4: Decongestion of the E45 on establishment of subsections according to scenario 2.

* The traffic figure states the additional traffic on the E45 at Haderslev

Congestion on E45

As illustrated on map 4.6, the congestion level on the East Jutland Motorway and South Jutland Motorway will be almost the same in both scenarios in the form of moderate congestion on major parts of the section.

Neither scenario 1, nor 2 will be able to solve the congestion problems on the East Jutland Motorway and, nor will they be able to prevent early signs of congestion on the South Jutland Motorway.

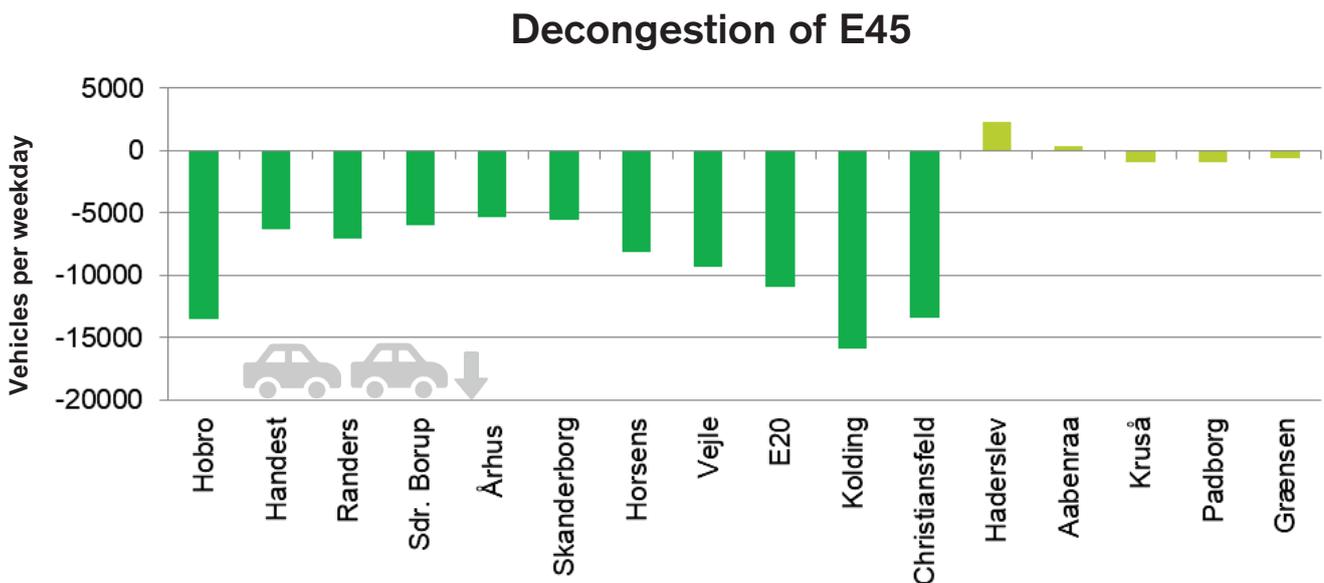
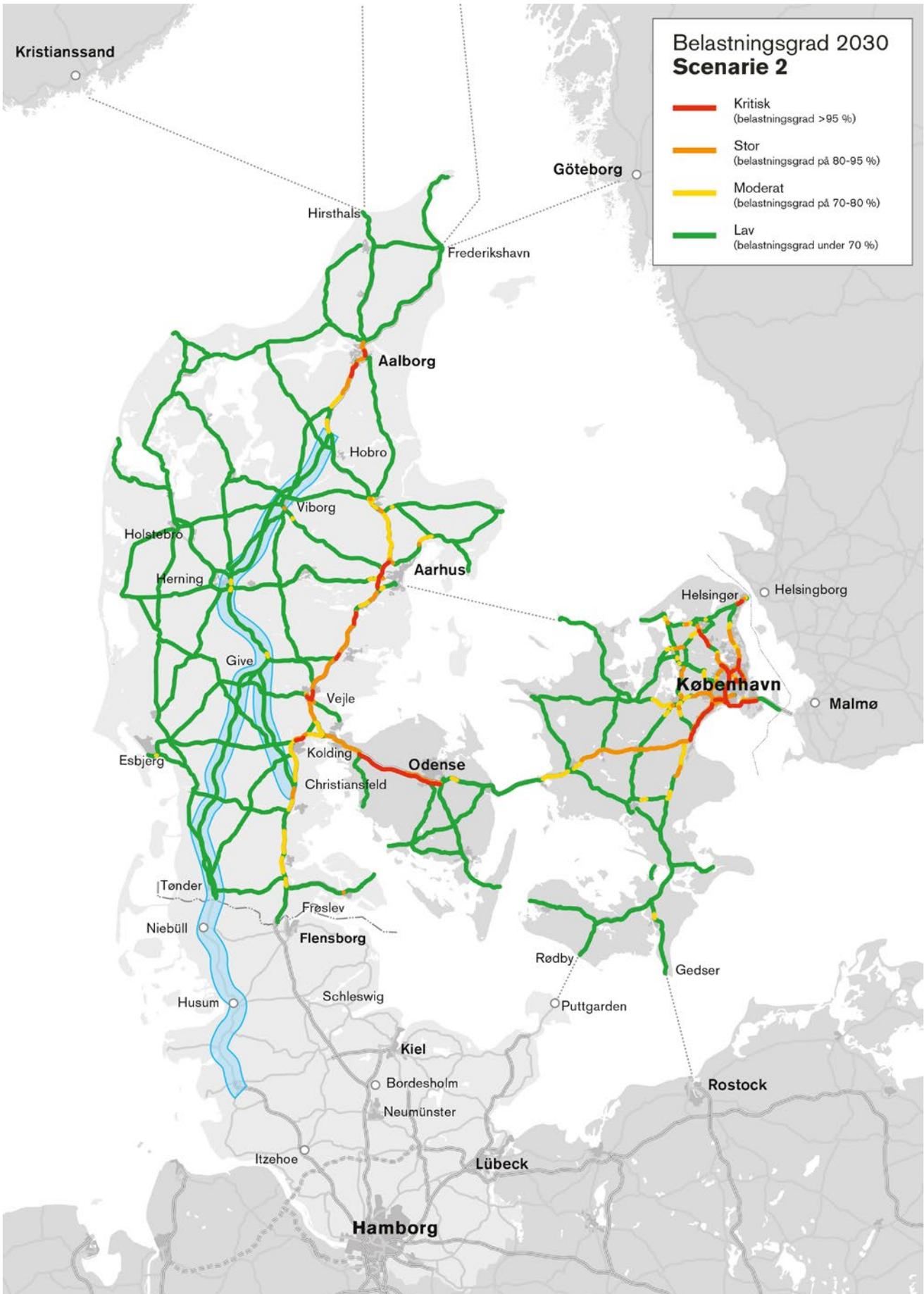


Figure 4.5: Decongestion of and additional traffic on the E45 on establishment of a Central Jutland motorway (dark green) and a branch down to the border (light green) in scenario 2.



Map 4.6: Traffic load ratios on the main road network in 2030 if scenario 2 is undertaken.

4.6 Traffic calculations for scenario 3

Traffic in scenario 3

If the Jutland Corridor is developed as described in scenario 3, a Central Jutland motorway will have between 22,000 and 51,000 vehicles per weekday depending on the part of the section. The traffic level on a Central Jutland motorway is illustrated by the red columns in figure 4.6.

The major part of the traffic will be seen at Herning and Give and again, after the motorway has joined the E45 at Haderslev.

By extending the Central Jutland motorway down to the border in the form of an expansion of the South Jutland Motorway, the section between Christiansfeld and Padborg will have between 22,000 and 48,000 vehicles per weekday, see the yellow columns in figure 4.6. This corresponds to an increase of up to 17% compared to a situation where the section is not expanded.

In addition to the road development on the Danish side, the scenario assumes that a partial expansion of the A7 is carried out in Germany. As a result of the road extensions, the number of vehicles which cross the border per weekday will increase by up to 3,000 vehicles on the A7, whereas traffic on the B5 will remain almost unchanged.

Sub-sections of scenario 3	Traffic in 2030
Central Jutland motorway	22-51,000
Expansion of the South Jutland Motorway	22-48,000
Upgrade of route A7 (Germany)	1-3,000*

Table 4.5: Weekday traffic on sub-sections in scenario 3.

*The traffic figure states the additional traffic on route A7 compared to a situation without extension.

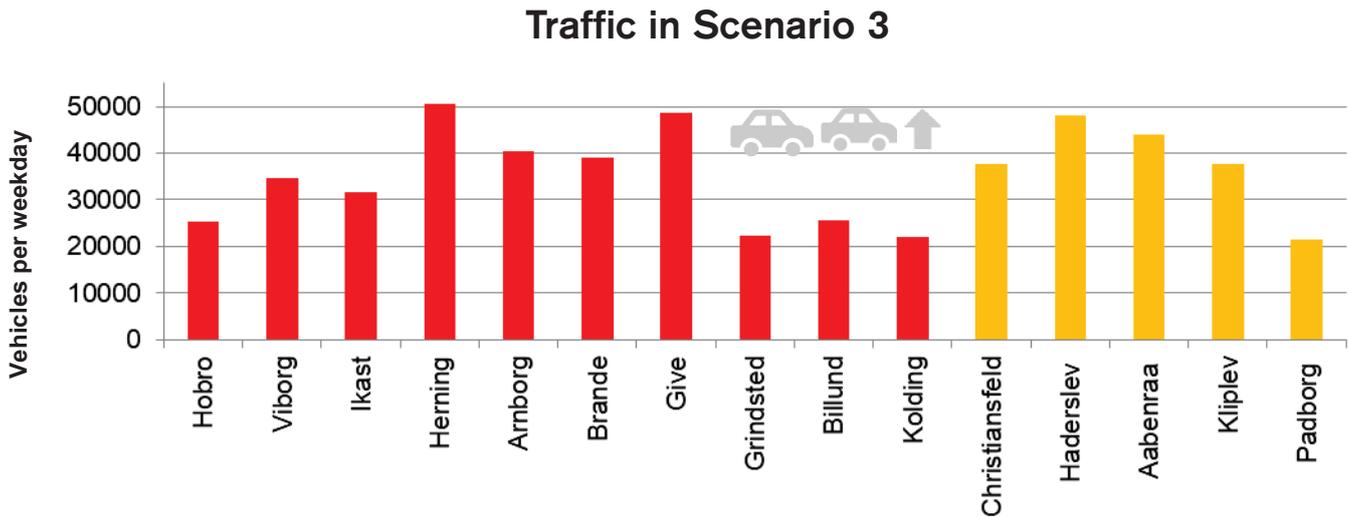
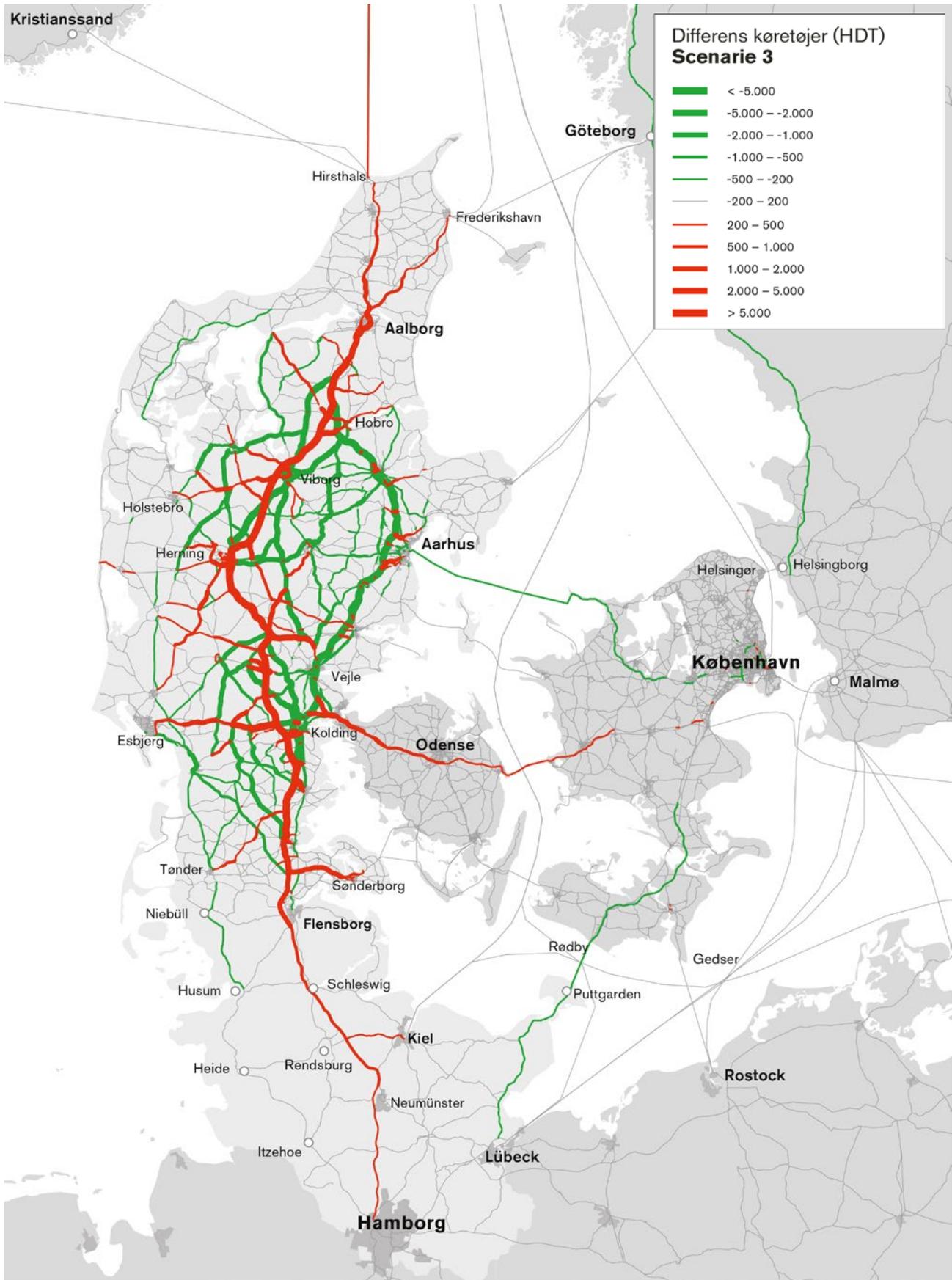


Figure 4.6: Traffic on a Central Jutland motorway (marked in red) and traffic on the E45 (marked in yellow) if the South Jutland Motorway is expanded as described in scenario 3



Map 4.7: Increase (red) and decrease (green) in traffic if scenario 3 is established compared to a situation without development of the Jutland Corridor.

Decongestion of E45

By establishing a Central Jutland motorway, traffic on the E45 will decrease by 6,000-14,000 vehicles per weekday on the section between Hobro and Christiansfeld. This corresponds to a change of 6-36% compared to a situation without extension of the Jutland Corridor.

In this scenario, traffic will not decrease on the South Jutland Motorway. This is attributable to the fact that the section will be expanded, resulting in increased traffic, see the light green columns in figure 4.7.

Congestion on E45

Contrary to the two previous scenarios, this scenario will improve accessibility on the E45 to such an extent that the South Jutland Motorway will not be congested in 2030, see map 4.8. However, congestion on the East Jutland Motorway will still be substantial or critical.

This can be ascribed to the expansion of the South Jutland Motorway where the increased capacity will allow for the traffic increase without resulting in congestion.

Section on E45/A7	Decongestion of E45	Percentage change
Hobro - Christiansfeld	2,000 - 14,000	6 - 36%
Christiansfeld - Padborg	-7,000 - 1,000*	-17 - -4%

Table 4.6: Decongestion of the E45 on establishment of sub-sections according to scenario 3.

*The traffic figure states the additional traffic on the South Jutland Motorway compared to a situation without development.

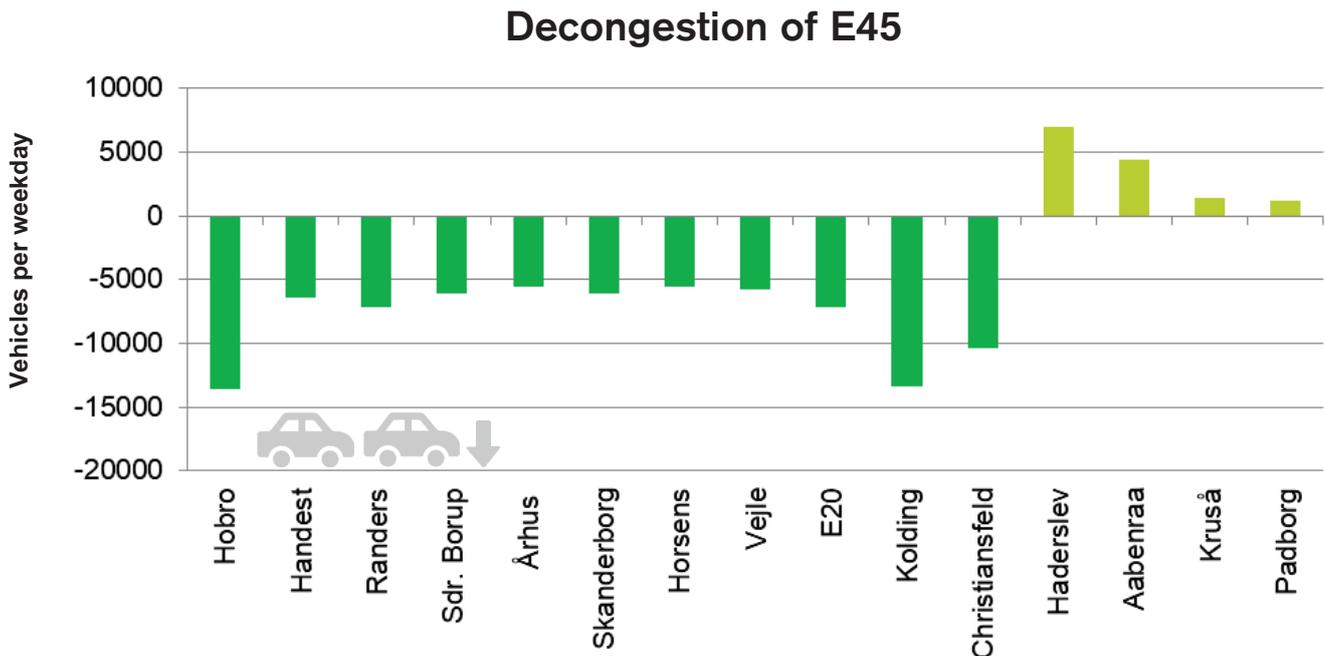
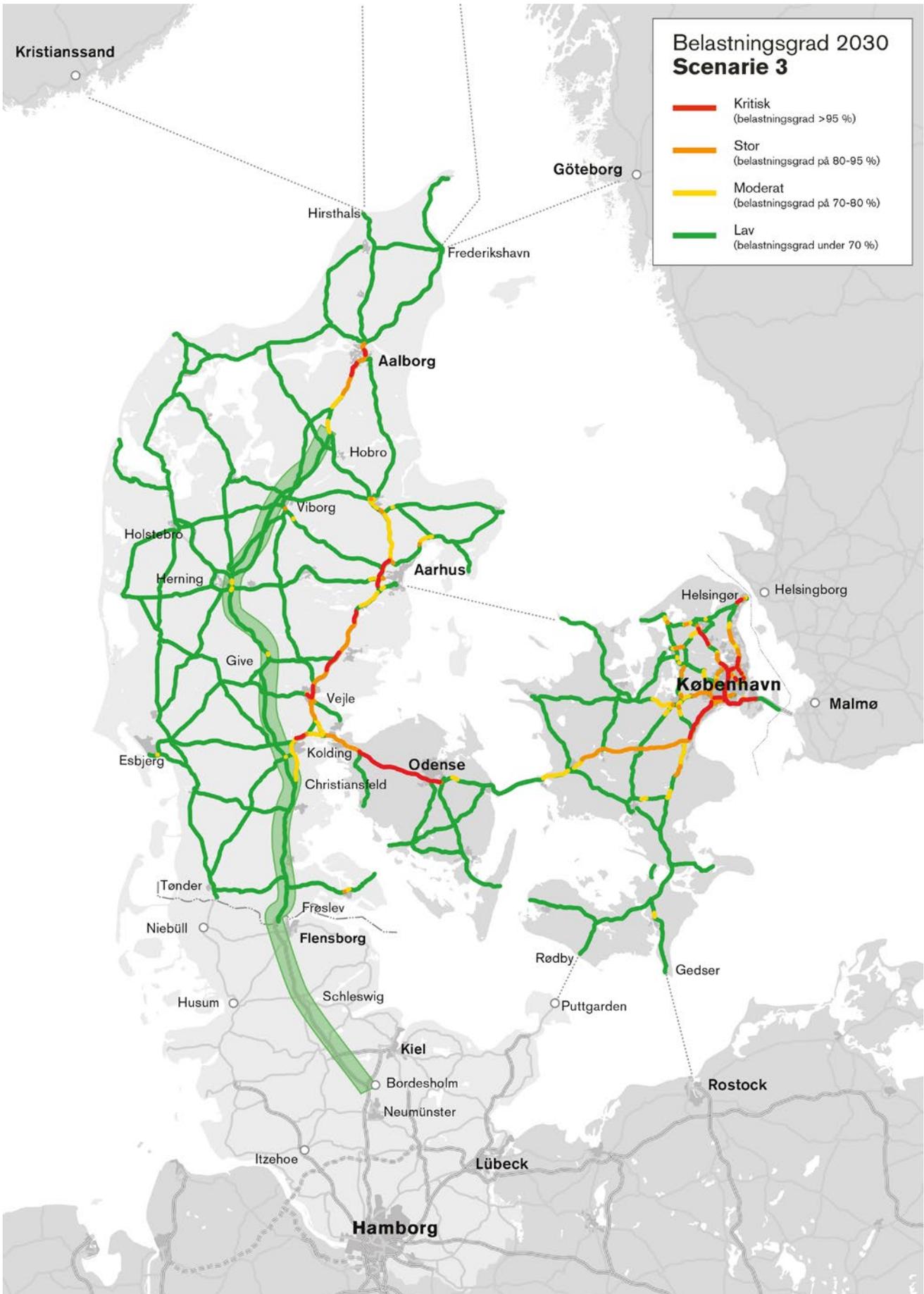


Figure 4.7: Decongestion of and additional traffic on the E45 on establishment of a Central Jutland motorway (dark green) and an expansion of the South Jutland Motorway (light green) in scenario 3.



Map 4.8: Traffic load ratios on the main road network in 2030 if scenario 3 is used.

4.7 Traffic calculations for scenario 4

Traffic on E45

Expanding the E45 between Aarhus and the border will result in more traffic on the section. Calculations show that in 2030, there will be between 1,000 and 13,000 additional vehicles on an average weekday, see figure 4.8.

The most significant increase in traffic will be on the section between Aarhus and Vejle. Here, traffic will increase by 11% - 19% compared to a situation without development of the Jutland Corridor.

On the South Jutland Motorway, traffic will increase less compared to the previous scenario. This is attributable to the establishment of a Central Jutland motorway which will entail a traffic increase on the E45 as a result of its connection at Christiansfeld.

If an extension of E45 is undertaken, traffic on the South Jutland motorway will increase by a maximum of 5,000 vehicles per weekday. This traffic increase will be seen at Haderslev.

The scenario also contains an expansion of motorway A7 in Germany. Here calculations show that the number of vehicles crossing the border will increase by up to 3,000 vehicles per weekday.

Traffic on route B5 will remain almost unchanged as a result of the eastern development of the Jutland Corridor. This means that the traffic impact in Germany will be almost the same as in the previous scenario.

Congestion on E45

As illustrated on map 4.10, an expansion of the E45/A7 between Aarhus and Hamburg will result in low congestion on the South Jutland Motorway in 2030.

Moreover, the increased capacity will decongest parts of the East Jutland Motorway. As a result, this scenario has the best potential to solve the congestion problems on the E45.

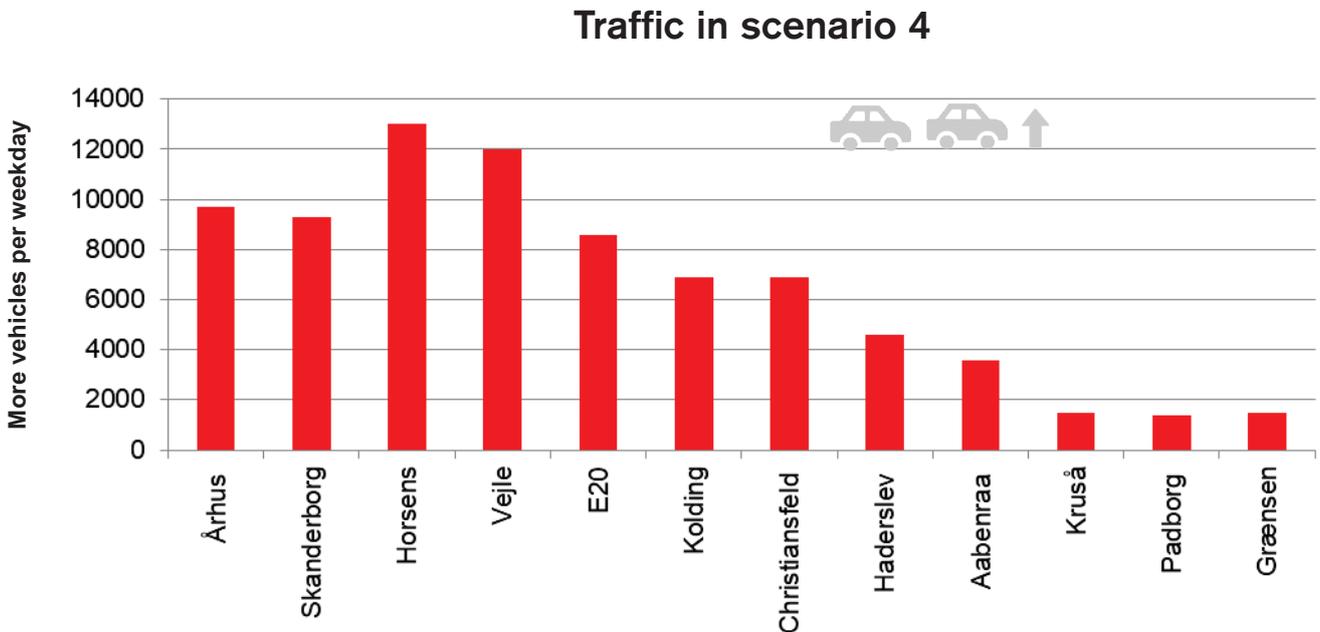


Figure 4.8: Increase in traffic on the E45 if the E45/A7 is expanded between Aarhus and Hamburg.



Map 4.9: Increase (red) and decrease (green) in traffic if scenario 4 is established compared to a situation without extension of the Jutland Corridor.

4 Traffic impact of an extension



Map 4.10: Traffic load ratios on the main road network in 2030 if the E45/A7 is partially expanded.

5 Time gains

Road users will achieve time gains when the infrastructure is developed. Moreover, it will be easier for road users to assess and estimate how long a trip will take. This is particularly relevant for deliveries of goods which can be planned better and be delivered at the optimum time.

The gains will be achieved by the road users who use the infrastructure today as well as the new road users who use the infrastructure after an improvement.

This chapter studies the time gains achieved through development of the Jutland Corridor. Moreover, the chapter describes the benefits achieved by trade and industry through development as a result of better access to workplaces.

5.1 Travel time savings

Maps 5.1 and 5.2 show the improved travel times from Aalborg in 2030, if scenarios 2 and 3 are undertaken.

If a motorway is established according to scenario 2, travel time from Aalborg to large parts of West Jutland and North-West Germany will be up to 55 minutes shorter. With this scenario, the most significant travel time savings will be seen in the western part of the Jutland Corridor.

However, if a motorway is established according to scenario 3, travel time from Aalborg to all of North Germany will be up to 40 minutes shorter.



Map 5.1: Improved travel times from Aalborg if the western corridor is extended (scenario 2).



Map 5.2: Improved travel times from Aalborg if the eastern corridor is extended (scenario 3).

Figure 5.1 shows the travel time savings achieved on trips from Aalborg to a number of cities in the Jutland Corridor, including Hamburg, Flensburg and Tønder.

Scenarios 1 and 2 will generate the most significant time savings to cities in South Jutland and Schleswig Holstein. For example, this is the case for a trip to Tønder where travel time will be reduced by up to 55 minutes.

Time savings do not differ significantly in scenarios 1 and 2. However, travel time from Flensburg to Tønder is marginally shorter with scenario 2.

Scenario 3 will generate the most significant time savings as a trip from Aalborg to Flensburg and Hamburg will be 32 and 33 minutes shorter, respectively. Thus, the combination of a Central Jutland motorway and a partial expansion of the E45/A7 will make travel times slightly lower to cities in the eastern road corridor.

By comparison, scenario 4 will result in significantly lower time savings. The main reason is that a Central Jutland motorway is not established in scenario 4 and, in this connection, it is therefore not relevant to compare scenario 4 with the other scenarios. This is the reason why scenario 4 is not included in figure 5.1.

5.2 Travel time gains

If the Jutland Corridor is extended, road users will save between 14,600 and 35,900 hours on an average weekday, depending on the scenario undertaken, see table 5.1

The most significant time gains will be achieved with scenario 2 followed by scenario 1. The least substantial time gains will be achieved with scenario 4.

Time gains must be seen in conjunction with the scenario lengths, see table 5.1.

For example, in scenario 3, new infrastructure has to be established on a 146 km long section in Denmark, thus making it one of the shortest scenarios of the analysis.

The shorter section will reduce the construction costs and thus affect the profitability of the project seen from a socio-economic point of view as it is also the scenario which generates the highest time gains.

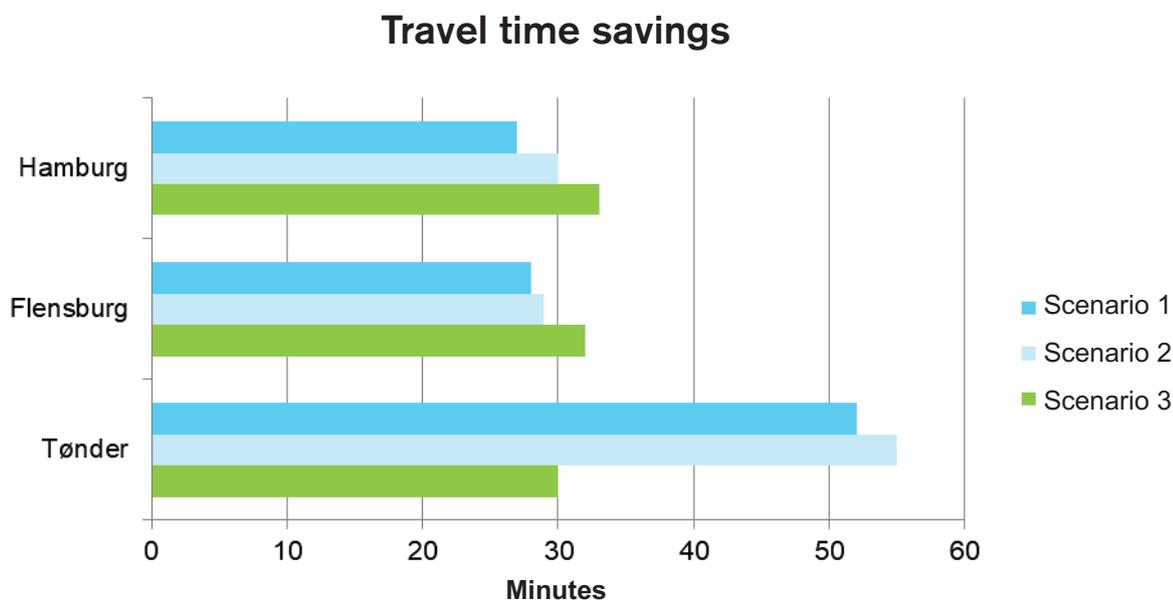


Figure 5.1 Travel time savings to a number of cities from Aalborg, if scenarios 1, 2 and 3 are undertaken.

Moreover, the time gains will differ depending on whether a Central Jutland motorway is established alone or the entire Jutland Corridor is developed.

If a Central Jutland motorway is established alone, the western alignment will save approximately 24,000 hours per weekday, whereas an extension will save up to 36,000 hours per weekday.

Although the most time gains are achieved through an extension of the entire Jutland Corridor, this must be considered against the potential construction costs which will be considerably higher than for establishing a Central Jutland motorway alone.

For example, scenario 1 is more than double as long as a Central Jutland motorway alone. Despite of this, scenario 1 only generates 35% higher time gains, meaning that the time gain is not proportionate to the scenario length.

As a result, an extension of the Jutland Corridor is not considered to be nearly as profitable, seen from a socio-economic point of view, as if a Central Jutland motorway is established alone.



Scenarios	Time gains (hours per week-day)	Construction of new motorway in DK (number of km)	Expansion of exist. motorway in DK (number of km)	Total scenario lengths in DK (number of km)
Scenario 1	32,100	300	0	300
Scenario 2	35,900	372	0	472
Scenario 3	29,200	146	65	211
Scenario 4	14,600	0	168	168

Table 5.1: Time gains for the scenarios compared to scenario lengths in Denmark.

*The total length comprises new and/or expanded existing motorway.

Motorway	Time savings (hours per weekday)	Construction of new motorway in DK (number of km)	Expansion of exist. motorway in DK (number of km)
Central Jutland motorway	23,700	146	0

Table 5.2: Time gains for a Central Jutland motorway (without branch down to the border) compared to motorway length (new motorway) in Denmark.

Purpose of travel

The time gains can be distributed on road users who travel for three different purposes - commuting, business and leisure. The purposes of travel are valued differently and have an impact on the profitability of the project from an economic point of view.

If a western development of the Jutland Corridor is decided, the main value of the time gain will accrue to business travellers.

This is reflected in figure 5.2 which shows that 55% of the value of the time gains accrues to business travellers in passenger cars, vans and trucks if scenario 2 is selected.

This is because of the fact that in the socio-economic analyses, business travellers have a time value which is 4-6 times higher than commuters and leisure travellers.

Geographical spread of time gains

Map 5.3 shows how the total travel time gains are spread on municipalities when the Jutland Corridor is extended.

The travel time gains will especially accrue to municipalities along the scenario alignments. This means that Viborg, Herning, Kolding and Tønder will see the highest total travel time gains depending on the scenario.

Road users from these areas will be able to travel much faster through Jutland as a result of the more direct connection to the Central and South Jutland cities.

As the figure shows the total travel time gains of extending the Jutland Corridor, municipalities with many inhabitants will achieve higher gains compared to municipalities with fewer inhabitants. This means that for instance Aarhus Municipality will see relatively high time gains.

Passenger cars, vans and trucks

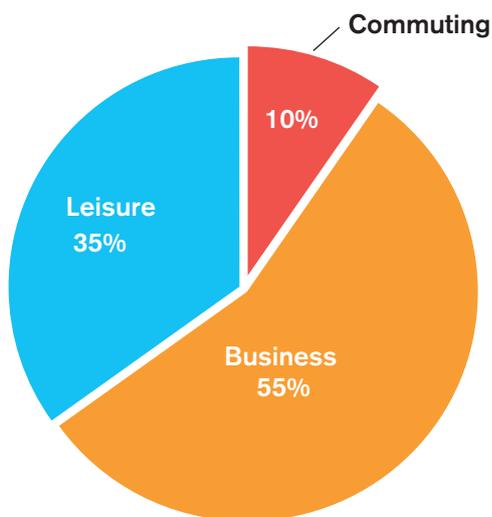
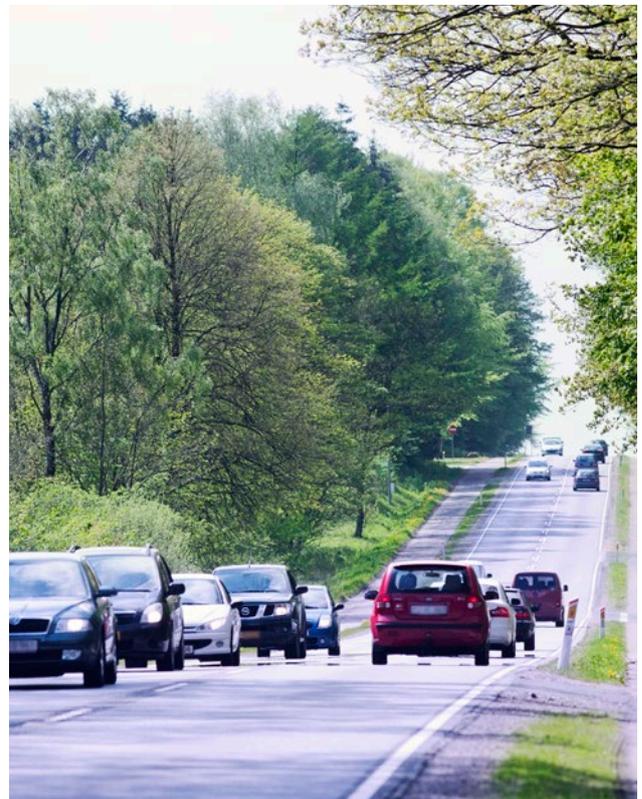
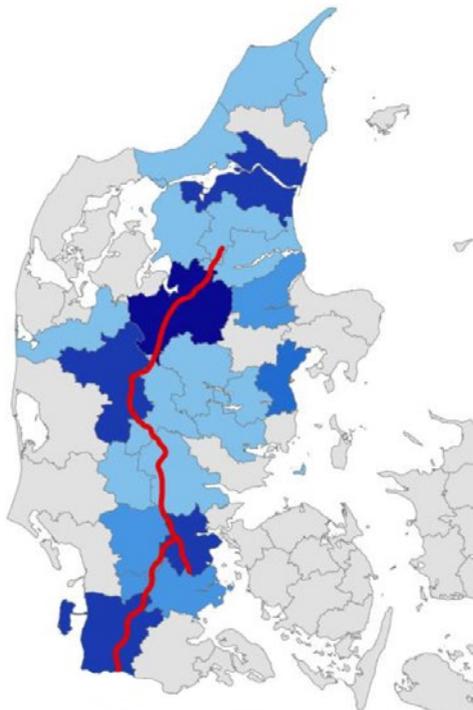


Figure 5.2: The total time gain in DKK for passenger cars, vans and trucks by the purpose of the trip, if scenario 2 is undertaken.

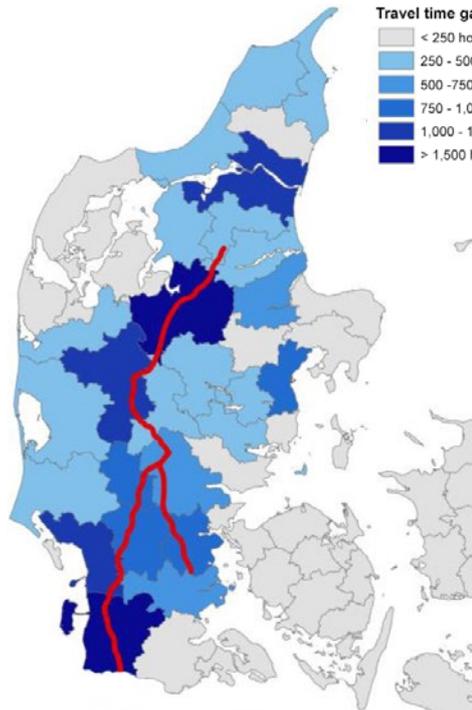


5 Time gains



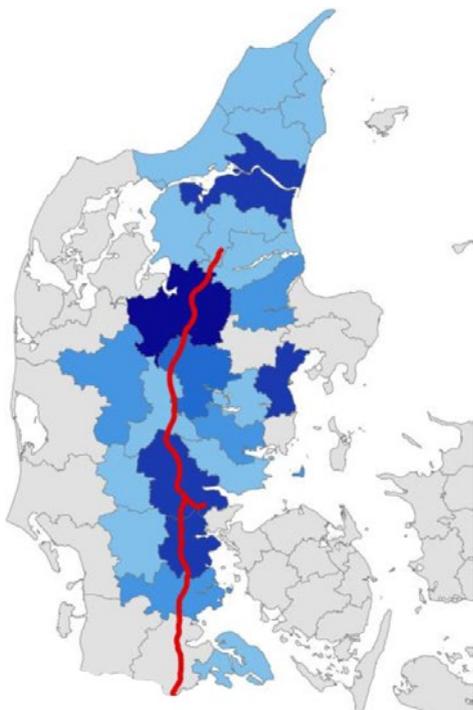
Scenario 1

Total time gain:
32,100 hours
per weekday



Scenario 2

Total time gain:
35,900 hours
per weekday



Scenario 3

Total time gain:
29,200 hours
per weekday



Scenario 4

Total time gain:
14,600 hours
per weekday

Map 5.3: Travel time gains for car traffic by municipality for all scenarios calculated as hours per weekday.

5.3 Access to workplaces

A well-functioning infrastructure does not only provide gains in the form of saved travel time but also in the form of improved accessibility to workplaces.

When access to workplaces and accessibility to an area are improved, it also makes it more attractive in the long-term to establish new businesses in the area.

Map 5.4 shows the difference in number of workplaces which can be reached within 60 minutes' travel time if the Jutland Corridor is extended.

If the western part of the Jutland Corridor is extended, access to workplaces will especially improve in Central and South-West Jutland where the workplace catchment area will increase by more than 30%.

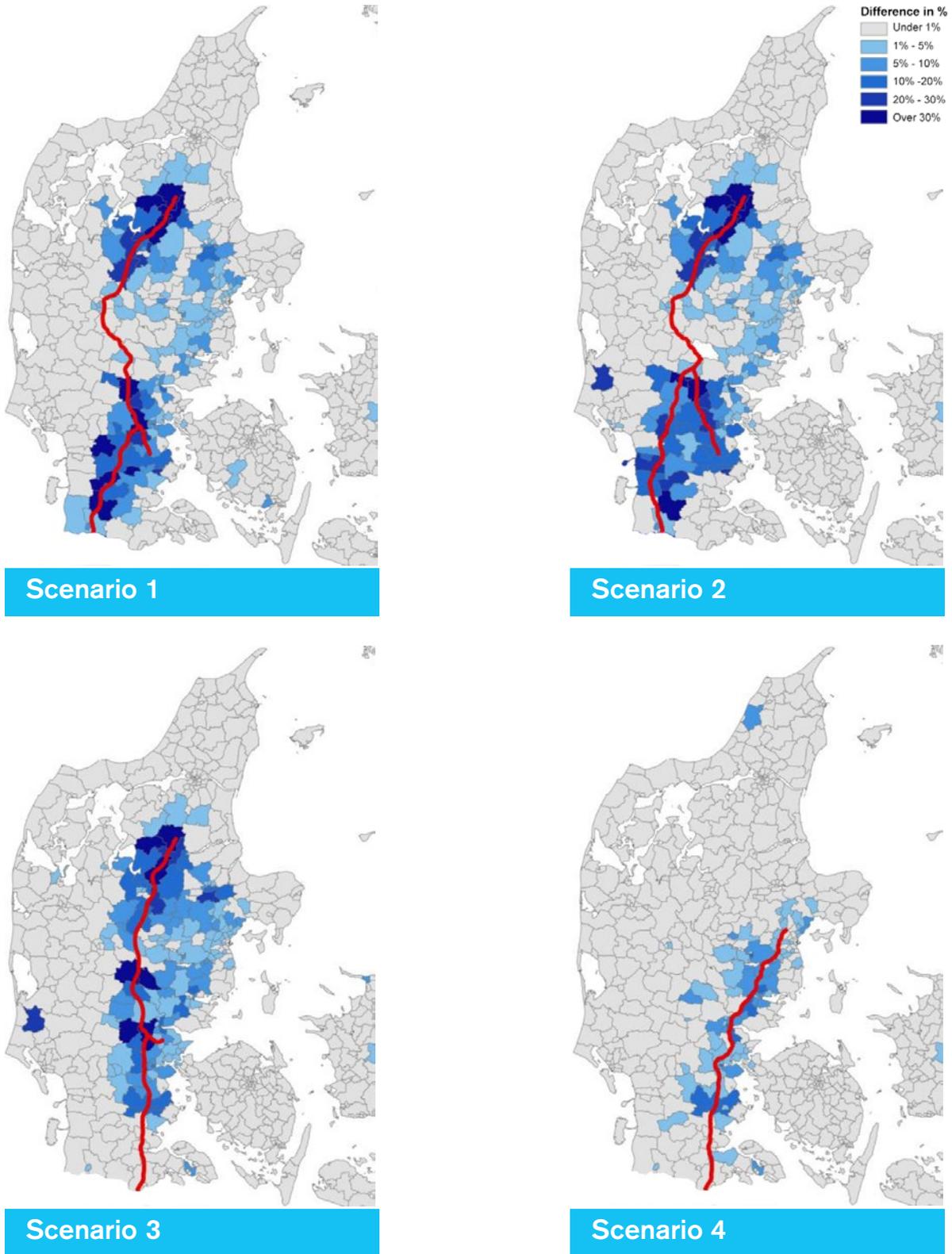
An eastern development of the Jutland Corridor will especially result in an increase in the workplace catchment area in Central and East Jutland.

Here, access to workplaces will improve by 20%, whereas in the individual municipality it will improve by more than 30%.

Access to manpower will only increase to a limited extent with scenario 4. Here, only a few municipalities will be able to achieve an improvement of 10% or 20%.

This is due to the fact that no new motorway is established in this scenario and infrastructure will therefore not be improved in areas where there is no motorway today.

5 Time gains



Scenario 1

Scenario 2

Scenario 3

Scenario 4

Map 5.4: Difference in number of workplaces that can be reached within 60 minutes' travel time, if scenarios 1, 2, 3 and 4 are undertaken

The Danish Road Directorate's headquarter is situated in Copenhagen and local offices are situated in Aalborg, Skanderborg, Middelfart, Næstved and Fløng.

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