Economic impacts in the STRING region from the Fehmarn Belt Fixed Link

RAMBØLL

Bright ideas.
Sustainable change.

STRING

The Fehmarn Belt Fixed Link is a crucial infrastructure initiative that will have far-reaching economic impacts

STRING is a political member organisation, representing local and regional northern European authorities from Oslo to Hamburg in a *megaregion* – a combination of cities and regions, spanning national borders, and considered the natural units and engines of the future global economy. As a voice for more than 14 million people, and with a strong political mandate, STRING is focused on fulfilling its potential as a green hub, and becoming a global powerhouse for innovation. One of the driving ideas behind the megaregion is to harness the benefits of agglomeration economies, and increasing connectivity and interconnectedness in the megaregion are key in this regard.

This is why we consider the construction of a fixed link across the Fehmarn Belt as one of the most important infrastructure initiatives of this decade. We believe the fixed link will serve as an impetus for remarkable development with far-reaching economic impacts – and that is why this analysis was first commissioned.

The pages you are about to read will highlight three areas in particular where considerable effects are expected from the fixed link; Trade, Labour Market, and Innovation – while seeking to answer the questions: What is the expected impact of Fehmarn-Belt Fixed Link and what barriers need to be removed, to realize the full economic potential of the Fehmarn-Belt Fixed Link?

In terms of trade, we see clear impacts – with the expected increase in international trade to and from the STRING megaregion estimated at around 900 million euro. Concerning the labour market, the better interlinking of businesses and labour, could in the short term reduce unemployment by double-digit percentages, and in the long term contribute to better conditions for investment to flow to the region, while spurring on additional innovation and trade. Moreover, as mobility is enhanced, increased international collaboration between scientist from Sweden, Germany, and Denmark is also anticipated to foster further innovation.

And while other areas such as e.g. tourism will likely see substantial effects, the scope of the report has been limited to concentrate on exploring more in depth effects in the three core areas – and notably identifying the barriers to realising the potential upside identified throughout the analysis. Therefore, specific and actionable recommendations, for policy-makers, businesses and other stakeholders conclude the report and set the stage for action and execution going forward. The construction of the Fehmarn Belt Fixed Link provides an unparalleled chance to support a low-carbon transition, increase labour mobility throughout the megaregion, and strengthen cross-border innovation. It is a prerequisite to unleashing the full potential that resides in northern Europe. That is why we need to know the potentials and barriers, to ensure we can address the remaining challenges, and ultimately leverage the Fehmarn Belt Fixed Link to truly capitalise on this opportunity in front of us.

”This is why we consider the construction of a fixed link across the Fehmarn Belt as one of the most important infrastructure initiatives of this decade.”

I hope you enjoy the read, and that the following pages can serve as a catalyst for the action we need.

Thomas Becker
Managing director STRING

Background of study

Situation

The Fehmarn-Belt Fixed Link (FBFL) will connect Rødby in the Southern part of the Danish region Zealand and Puttgarden in the Northeastern part of the German region Schleswig-Holstein with an undersea tunnel for cars, trucks, and trains. The construction is the largest infrastructure project in Denmark. Today, a ferry transports cars and trucks the same route, while trains (and cars and trucks that do not take the ferry) have to take the Western and longer route across the Great Belt bridge and Southern Denmark. The tunnel thus creates a road- and rail-based shortcut between Denmark and Germany that cuts travel time and distance.

The STRING mega-region is a political member organisation for local and regional authorities in the neighbouring regions and cities in Norway, Sweden, Denmark, and Germany, that are closely interconnected economically, culturally, and socially. STRING works to promote regional development and enhanced integration, alongside further infrastructure projects and the stimulation of green, sustainable growth in Northern Europe.

The reduced transportation time and distance enabled by the FBFL has the potential to increase interconnection between cities, regions and countries in the STRING region. Increased interconnection can in turn improve labour markets, spur trade, innovation, investments, business activity, and growth.

Need for analysis and studies

The potential economic impacts on labour markets, trade, innovation, and investments need to be analysed and understood by businesses and policy-makers. Physical transport infrastructure is only one of several necessary conditions for an attractive mega-region. Thus, policy-makers, businesses, and organisations will have to work hard to realise the full economic potential of the FBFL by coordinating actions and removing barriers. Knowing what actions to take, requires knowing the potential impacts of the FBFL and what barriers that may stand in their way.

As a key player in facilitating the realisation of the economic potential, STRING needs to gain deeper insight and better be able to answer questions related to the impact of the FBFL on the entire STRING region.

However, it is important to recognize that the impacts analysed in any report or study related to the FBFL are not an exhaustive list of all potential impacts that will be associated with this project. For example, the construction phase of the FBFL will result in job creation, and tourism effects could flourish in the opening phase. Despite the potential for additional impacts, it is often more beneficial to focus on a specific list of effects when conducting a study of this magnitude. With a focused study we are able to provide a more detailed and comprehensive analysis of the trade, labour market, and innovation effects of the FBFL.

Key questions answered in the study

This study aims to provide insights on some of key economic questions related to the FBFL, more precisely:

- How will the FBFL impact labour markets and employment?
- How will the FBFL impact business activity such as trade, innovation and investments?
- What barriers need to be removed to realise the economic potential of the FBFL?

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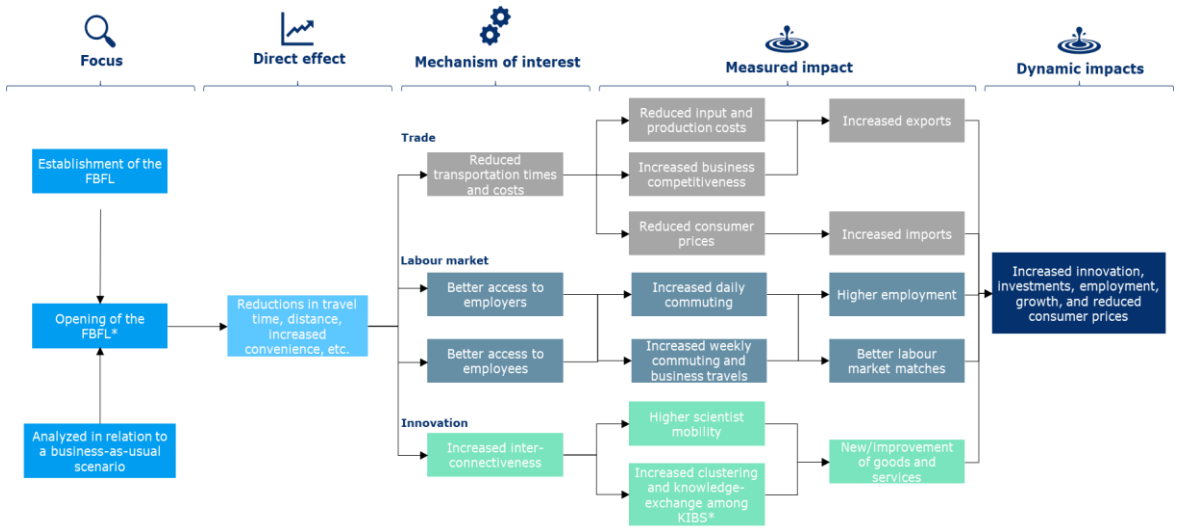
Identifying the expected impacts of FBFL using an Impact Map on trade…

Scope of the analysis

The FBFL is a mega-infrastructure project that aims to connect Denmark and Germany through a tunnel under the Fehmarn Belt. Already in the construction phase, the project has created over 6,000 jobs annually in Denmark and Germany, with 75% of the jobs located in Denmark. Following completion some of these jobs are expected to be retained through the ongoing maintenance and operation.

This report presents the likely economic impacts on the STRING region of the FBFL and its associated infrastructure projects when they are in operation: on Danish side this encompasses the establishment of the Copenhagen-Ringsted and Ringsted-Fehmarn Line. On German side this entails the upgrading of the Lübeck-Puttgarden and Hamburg-Lübeck railway.

The impacts are identified by comparing the future scenario where the FBFL and associated infra-structure is in operation to a business-as-usual scenario where the FBFL and associated infrastructure would not have been built. The FBFL and associated infrastructure in operation will have many direct effects. For this analysis the most important impact is reduced transportation time and distance, as well as increased transportation capacity and flexibility. The study generally presents results for relevant STRING regions. This means that the study neither provides a complete national perspective of the impacts, nor a perspective that is more granular, e.g. city-level, than a regional level.



The impact map illustrates key impacts

The impact map located in the lower left corner features a visualization of the three primary economic impacts that are elaborated in this report, and which can be anticipated upon the opening of the FBFL*. These are (1) increased trade, (2) higher employment and better labour market outcomes, and (3) increased innovation. These impacts are described briefly on this and the next page. Further, all three impacts jointly contribute to creating additional and likely substantial dynamic impacts such as increased investments, innovation, employment, and growth. However, these dynamic impacts are difficult to quantify, and therefore described qualitatively in this report. It is important to note that the impacts presented in this report are not exhaustive but rather represent the focus of the study.

Expected impact on trade

The FBFL and associated infrastructure will reduce transportation times and costs, which will likely impact trade in three ways:

First, lower transportation costs means that businesses in the STRING region can purchase input goods more cheaply and increase their competitiveness compared to businesses in other markets, thereby increasing exports. Second, and most importantly, reduced transportation costs reduce trade barriers imposed by long distances, thereby increasing both exports and imports (in a similar way as reduced trade tariffs boost trade). Third, reduced trade barriers lead to more imports of goods and services of better quality at lower prices, to the benefit of businesses and consumers in the STRING region.

Ramboll

Note: *Including the associated infrastructure projects (see above)

The picture displayed to the left features an impact map that highlights the key effects of interest discussed in the accompanying report. An impact map is a visual representation that helps to identify and prioritize the potential outcomes of the FBFL.

… labour market and innovation impacts

Expected impact labour markets

The FBFL and associated infrastructure reduced travel times, increased transportation capacity and flexibility, and enlarged labour markets. This means that employees living in one place can reach more potential employers within a given commuting time (e.g., 45 minutes). Similarly businesses get access to a larger pool of employees to employ within a given commuting time. As a result, we can expect more daily and weekly commuting as well as business travel. This is expected to result in improved labour market matches and increased employment rates, as a larger number of workers are able to seek employment opportunities in regions with high demand for labour.

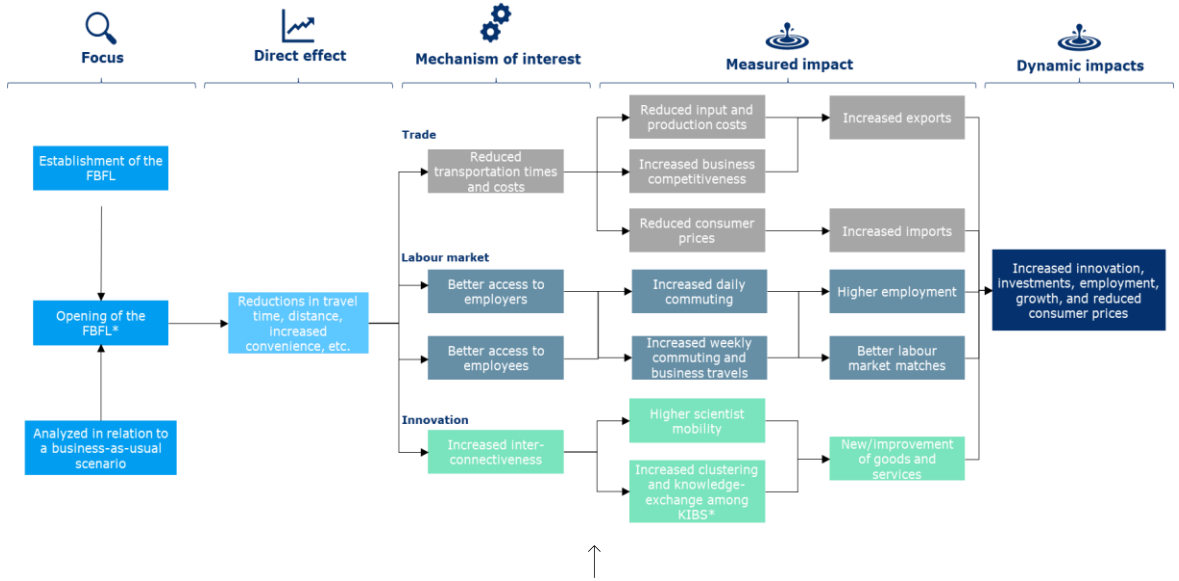
Expected impact on innovation

According to research findings, the interconnection of individuals stimulates innovation. The FBFL and its accompanying infrastructure serve as a facilitator of such interconnection in various ways. Firstly, the reduced travel time enables greater mobility among scientists, thereby fostering knowledge exchange between academic faculties and promoting innovation. Secondly, it facilitates increased clustering and knowledge exchange within and between knowledge-intensive business sectors (KIBS), leading to enhanced cooperation, synergies, and competition. In general, these mechanisms are expected to promote the development of new goods and services or the improvement of existing ones within the STRING region.

Expected dynamic impacts

The described impacts on trade, labour markets, and innovation are important, but isolated to their specific domain. They are so-called 'first-order effects'. However, the largest potential may lie in dynamic effects, or 'second-order and third-order effects'. These dynamic effects are challenging to predict and quantify, but they have the potential to generate substantial impacts. For instance, increased business activity and growth arising from greater export demand and access to a more extensive pool of employees can stimulate investments and innovation, which, in turn, can generate additional business activity, growth, and employment.

The FBFL and associated infrastructure are likely to benefit from such dynamic effects, which may prove to be critical in realizing their full potential. In hindsight, it is evident that investments in transport infrastructure and the removal of barriers to the free movement of people, goods, services, and capital in the EU internal market have facilitated increased investments and innovation, among other benefits. The FBFL and associated infrastructure can be seen as an extension of these policies and investments, with the potential to generate similar benefits for the STRING region.



The picture displayed to the left features an impact map that highlights the key effects of interest discussed in the accompanying report. An impact map is a visual representation that helps to identify and prioritize the potential outcomes of the FBFL

Large impact on international trade and business activity

The FBFL will likely result in a large increased international goods trade driven by reduced transportation times and costs. The shorter and faster land route between Scandinavia and Continental Europe means reduced transportation costs, which removes trade barriers to and from the STRING region. Transport related cost such as wages are relatively high in Scandinavia. Reducing the relatively high transport costs leads to relatively large impacts, both in terms of transport cost savings and impact on international trade.

The FBFL will benefit businesses and consumers alike, and further the Northern European economic integration. Main indirect impacts include positive impacts on competitiveness of businesses and the purchasing power of consumers in the STRING region, mostly through an expected downward pressure on prices on inputs and consumer goods that follow from regional market integration and reduced transport costs.

The goods trade response to reduced transportation costs differ among product types. The STRING regions are typically strong in exports of machinery and various types of electronics, which are expected to be relatively highly affected by transport costs.

In terms of services trade, there is a likely increase in tourism, including both leisure and business travel. The driving forces of the impact on tourism is the increased accessibility thanks to the FBFL providing more timely connections between cities in Northern Europe, the increased ability for sustainable travel, and in addition as an indirect effect of increased goods trade. The impact on trade in services is however not limited to tourism. Service exports such as ICT and business services provide important contributions to the STRING economies, and the provision of accessible, timely and cost competitive train travel routes may boost inter-regional service trade within these sectors.

Highlights

Reduced transport times and associated costs will boost business competitiveness in the STRING region.

Consumers will benefit as reduced transport costs and increased trade create a downward pressure on prices and stimulate employment.

The dynamic impacts of reduced transport costs are possibly far reaching, including increased local investments and reduced negative transport externalities.

Methodological approach

1. International transport cost impacts

- We first estimate international goods flows to and from the STRING region, by modes of transport.
- This information is combined with travel time reductions and transport costs.

2. Impact on international goods trade

- Building on the transport cost impact estimations, we estimate the goods trade impact by applying intra-EU trade elasticities and apply further adjustments to the calculations including cross-price elasticities between modes of transport.

3. Potential impact of international services trade

- We evaluate potential impact on international services trade by combining descriptive statistics with empirical findings.

4. Dynamic impacts of reduced transport costs and increased trade

- Dynamic impacts are analysed qualitativley through the lens of empirical findings.

Included STRING-regions

- Oslo & Viken County, Capital Region of Denmark, Zealand Region, Schleswig-Holstein, Hamburg, Scania, Västra Götland & Halland.
- We are including all STRING regions since we expect transport cost reductions even in more distant geographies.

Primary research method

Quantitatively

Qualitatively

Mixed method

Trade volumes affected by the establishment of the Fehmarn-Belt Fixed Link (FBFL)

				
Bilateral trading partners relevant from an FBFL perspective*	Germany, Netherlands, Belgium, France, Luxembourg, Switzerland, United Kingdom, Austria, Czech Republic, Slovenia, Slovakia, Poland, Romania, Hungary, Romania, Italy, Spain, Gibraltar, Portugal, Ukraine, Belarus, Greece, Bulgaria, Turkey, Moldova, Croatia, Serbia, Montenegro, Kosovo, North Macedonia, Bosnia and Herzegovina		Denmark, Sweden, Norway	
Approx. share of country's total goods exports	~60 %	~42 %	~40 %	~4 %

Economic impacts in the STRING region from the Fehmarn Belt Fixed Link", Ramboll Management Consulting, 2023

Transport costs and international trade will be impacted

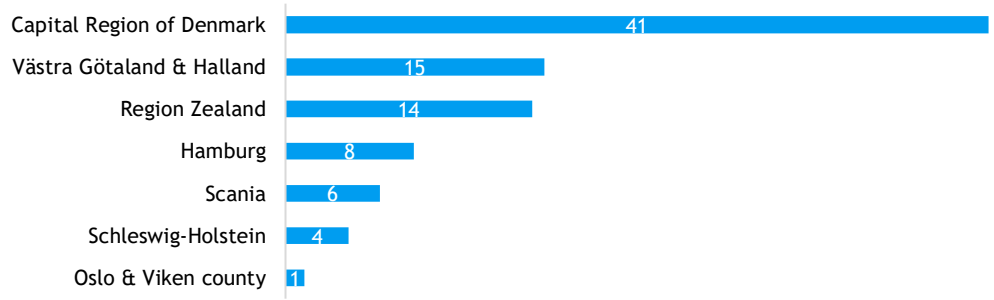
Impact on transport costs

We expect the annual transport cost savings to amount to in total around € 90 million for the STRING regions. The cost saving interval is estimated to € 34 million - € 143 million. Uncertainty remains whether significant shifts between modes of transport will take place after the establishment of the FBFL, but also regarding other factors that are included in the analysis (see methodology in chapter 3. e)).

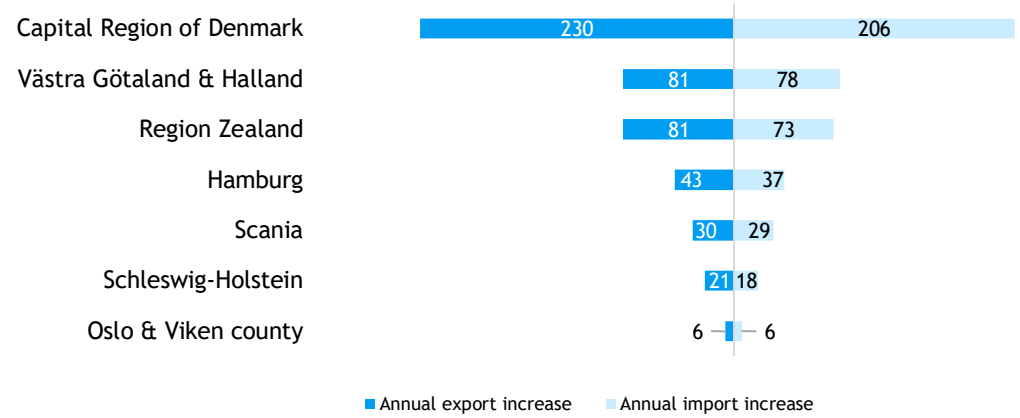
The transport costs savings are distributed unevenly across the STRING regions. In general, the closer to the FBFL, the greater the relative cost reduction impacts. This is because the relative transport cost reductions are larger for shorter transport routes, among other factors. The closer the trading neighbours are located to the FBFL, the larger is the relative transport cost impact.

The effect of FBFL on transport cost reductions is largely dependent on modal shift responses, current trade and transport flows between EU regions, the sensitivity of trade to transport costs, future fee for crossing the FBFL among other factors. The size of the fee is of particular importance to ensure significant cost reducing effects, where a higher fee leads to lower cost reductions. The transport cost reductions on the German side are typically smaller since the FBFL-relevant trading partners from a German perspective (Scandinavia) constitutes a smaller trading market than the European continent.

Estimated annual cost reduction for international goods transports (million Euro)



Estimated annual increase in international goods trade (million Euro)



Note: Ramboll's calculations. For more information, see chapter on *International trade.*

Impact on international goods trade

We estimate a total impact on increased trade of € 940 million (the sum of exports and imports increases for all the STRING regions) from the establishment of FBFL and the transport cost reductions. In relative terms, the effect equals a trade increase of almost 0.3 %, which can be compared to the annual trade growth rate of Denmark 1990-2020 of about 4 %.

We estimate the interval of the trade effect to € 330 million – € 1 550 million. This effect is calculated exclusively for the STRING regions. Hence the total trade effect of the FBFL, including other regions, can be expected to be higher. Uncertainties exist regarding several factors, including the goods trade capacity of the FBFL, the future fee of the FBFL, the competitiveness of the FBFL trade route in relation to maritime shipping routes between Scandinavia and continental Europe, future goods trade characteristics, among others.

The trade impacts are distributed unevenly across the STRING regions. In general, the closer to the link, the greater the relative trade impacts. However, the trade impacts on the German side are typically smaller since Germany's FBFL-relevant trading partners in the north constitute a smaller trading market than the European continent, which is the FBFL-relevant trading market from the Scandinavian STRING regions. The size of the trade impacts also depends on today's size of the market, and the intensity of trade that is already taking place.

Source: Ramboll's calculations. For more information, see chapter on *Transport cost effects.*

Moderate impact on regional labour markets

The FBFL is likely to have most impact on the Eastern Danish and Northern German labour markets, both through local and cross-boarder commuting within and between Denmark and Germany. This will make it more beneficial for both companies and workers to be located in these regions. It will positively impact both investments, innovation and trade as these regions become more profitable for businesses.

The access to employees increases
The access to employees increases substantially along the improved infrastructure making the region more attractive for businesses. For example, the towns south of Copenhagen, the southern part of Region Zealand and potentially the cities Lübeck and Hamburg will experience the largest increases in access to employees. Close-to-border cities are rather rural with few people and will not experience large impacts on accessibility.

The FBFL and its associated infrastructure will benefit commuting in the STRING region
Improved infrastructure will impact both short- and long-distance commuting. Commuters will likely commute to the larger cities. In Region Zealand, it is expected to result in an increase in the number of Danish domestic commuters by more than 2,000 people. The FBFL is expected to result in an increase in the number of cross-boarder commuters from Germany to Denmark by around 1,400 people and German domestic commuting will likely increase by 5,000 people. Commuting is therefore expected to increase the potential workforce by between 0.1% to 1.2% depending on the region. This has the potential to reduce the amount of vacant jobs in the regions.

Highlights

Access to employees along the improved transport routes will improve, making the regions more attractive for businesses.

With shorter commuting distances within the String region, both domestically and cross-border commuting is expected to increase lowering excess demand for labour.

An increase in commuting, and thus more business activities within the region, is expected to benefit the businesses within the region economically.

Methodological approach

1. Access to employees

- We estimate the increase in the number of households available within 45 minutes of commuting.
- We use GIS and household data in Denmark.
- We generalize these results to the German regions.

2. Potential changes in commuting

- We estimate the number of additional commuters to the regions by using statistical models based on current commuting flows both domestically and cross boarder.

3. Potential impact of increased commuting

- We assess the potential impact on local excess demand for labour and unsuccessful recruitments by using the current vacancy rate and the expected increase in commuting.
- This is used to estimate the gross-value-added for businesses under three scenarios.

The Included STRING-regions

- Capital Region of Denmark, Zealand Region, Schleswig-Holstein, Hamburg, Scania
- Considering that the analysed regions are projected to benefit the most from travel time reductions, it is crucial to include them in a labour market analysis. This is because the large reduction in travel time will have positive implications for both job seekers and job suppliers.

Primary research method

Quantitatively

Qualitatively

Mixed method

The increase in domestic and cross-border commuting will have economic impacts

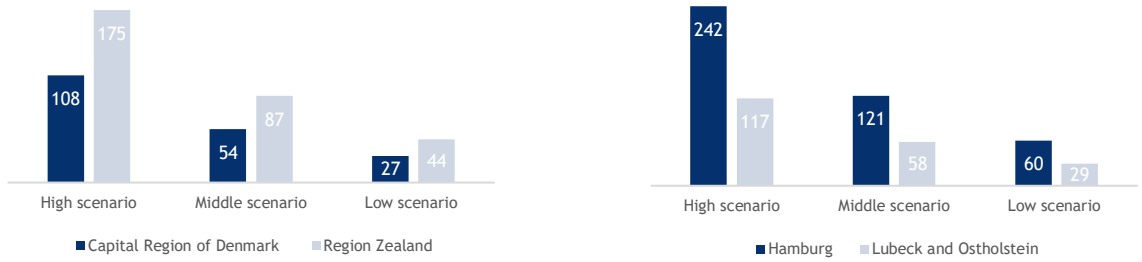
Economic impact of commuters

In the high scenario, Gross Value Added (GVA) is expected to increase by 108 million euro in the Capital Region of Denmark, 175 million euro in Region Zealand, 242 million euro in Hamburg and 117 million Lübeck and Ostholstein. GVA is a measure of the value of goods and services produced in a region/sector, minus the cost of input.

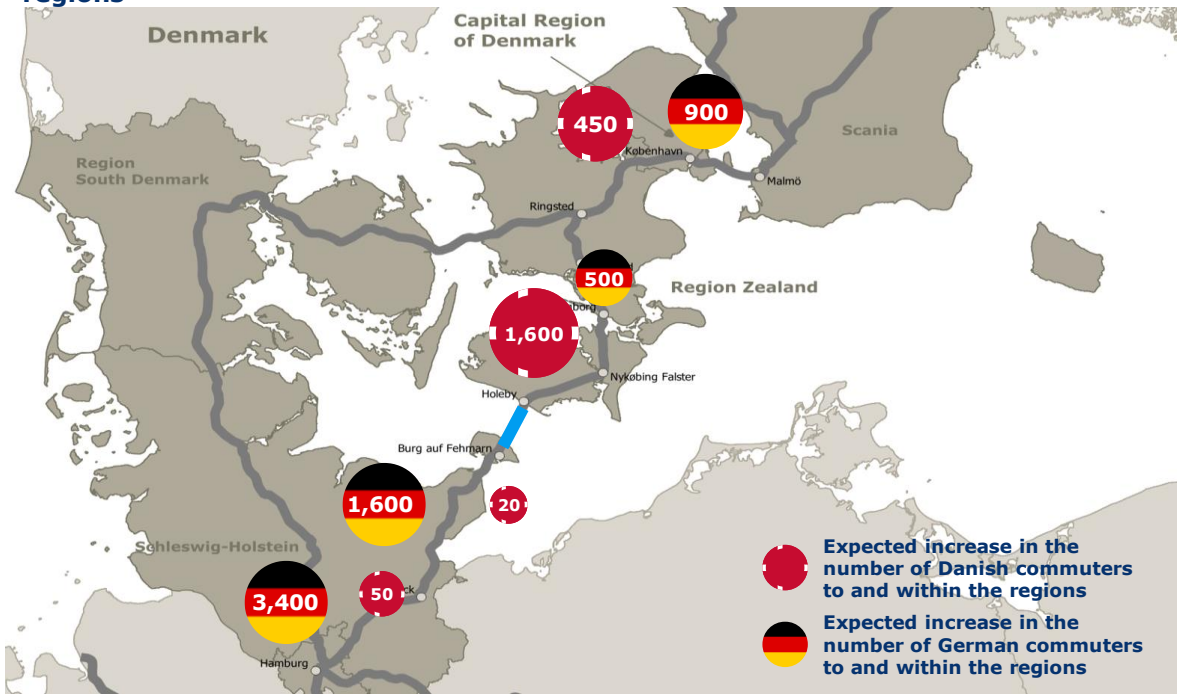
To account for the impact of commuters' prior employment, we have used three different scenarios – a high, middle and low scenario. However, the potential impact on regional GVA is limited since the increased number of commuters is a small share of total workforces across all STRING regions.

The economic benefits from potential increases in commuting as well as accessibility to workers might improve the conditions for businesses in the regions. Improved conditions could consequently lead businesses to locate their activities in the regions, thereby investing in the regions. These indirect effects might benefit both business and workers even further.

Commuters potential impact on GVA (million Euro)



Expected increase in the number of Danish and German commuters to the four regions



Domestic and cross-border commuting

In Denmark, domestic commuting is expected to increase by over 2,000 people, with the majority seeking employment in central Zealand. Cross-border commuting from Germany is expected to increase by over 1,400 people, with most commuters centred around the southern region of Zealand and the Capital Region due to significant travel time reductions and larger labour markets. Approximately 5,000 additional workers are expected to be commuting domestically to Hamburg, Lübeck and Ostholstein. Cross-border commuting from Germany to Denmark is likely to be larger than commuting from Denmark to Germany based on current workflow patterns. The expected increase in commuting will likely impact the overall size of the employed workforce in the regions modestly, but the potential for impacting excess demand for labour within the regions are substantial. Especially, the labour markets of Region Zealand and Ostholstein has potentials for being impacting positively by the improved infrastructure.

Source: Statistics Denmark, Eurostat, Danish Agency for Labor Market and Recruitment, Bundesagentur für Arbeit, DTU, Øresundsinstituttet and own calculations

Potentially large impact on innovation

FBFL will likely strengthen the STRING region as a knowledge region since the interconnection between German and Scandinavian universities and knowledge-intensive businesses will be improved. The FBFL will foster increased scope for innovation within knowledge-intensive business sectors (KIBS) where particularly the medical, advisory and research industries are likely to benefit. However, the size of the impact on innovation depends on too many factors to provide a certain quantified estimate.

The FBFL is expected to increase scientist mobility between Copenhagen, Hamburg, and Malmö, facilitating exceptional research at top universities in the STRING region. This may foster innovation by expanding scientists' knowledge base through international collaboration, leading to greater knowledge sharing and transfer from academia to industry, catalysing regional innovation.

As the KIBS sectors in the region become more interconnected, we anticipate greater collaboration, competition, and labour market access. This is likely to generate innovation synergies, leading to the introduction or improvement of goods and services. The information and communication, financial institutions and insurance, and advisory and research sectors are particularly poised to benefit from these effects, given their overlap between Hamburg and Copenhagen.

Top-tier universities and KIBS can fuel long-term economic growth in the STRING region. This can drive productivity, job creation, competitiveness, consumer benefits, and exports. However, addressing barriers like bureaucracy, supply chain integration, employee retention, high costs, and lack of patent support is crucial to realizing these benefits.

Highlights

The enhancement of scientists' mobility will be a catalyst for more innovation.

The increased interconnectedness for knowledge-intensive business sectors will also foster more innovation.

The effects of innovation have large potential but will also be confronted with significant barriers that may impede their impact.

Methodological approach

1. Enhancement of scientist mobility

- We apply results from scientific research papers on scientist mobility to identify the potential relationship between scientist mobility and innovation. By using a well-established metric of university ranking developed by U.S news & world report we can identify 29 top-tier faculties in the STRING region.

2. Interconnectedness for knowledge intensive business sectors

- By using descriptive statistics from Germany, Sweden, and Denmark we can identify six distinct knowledge-intensive business sectors (KIBS) in the STRING region, with a concentration in the metropolitan areas, Copenhagen and Hamburg.
- Innovation theory provide arguments for how the interconnectedness for the different KIBS positively affects innovation.

The Included STRING-regions

- Capital Region of Denmark, Zealand Region, Schleswig-Holstein, Hamburg, Scania
- We have included the regions that are expected to have the greatest travel time reductions. As all the included regions are relatively close to the FBFL, they will experience the most significant travel time reductions. This makes them relevant for analysing scientists' mobility and innovation synergies within KIBS.

Primary research method

- Quantitatively
- Qualitatively
- Mixed method

Scientist mobility and greater interconnectedness between knowledge sectors drive innovation

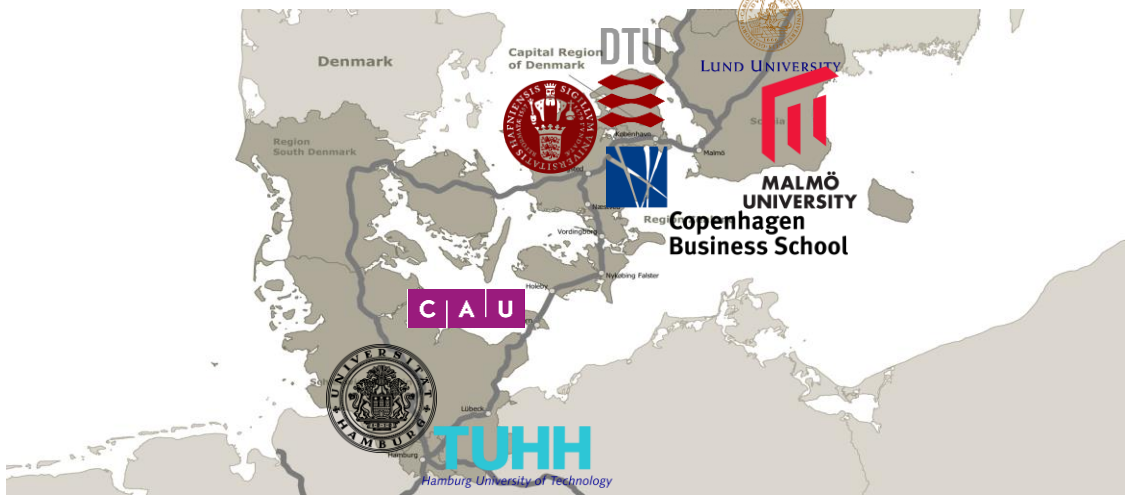
Increased scientist mobility

There are two main reasons for why it is likely that scientist mobility will increase due to the FBFL. Firstly, with the increased connectivity between top-tier faculties, the opportunity to collaborate with leading scientists and access high-quality research infrastructure is expected to rise. This could make nearby universities more attractive to researchers and scientists, increasing the likelihood of them moving to work there.

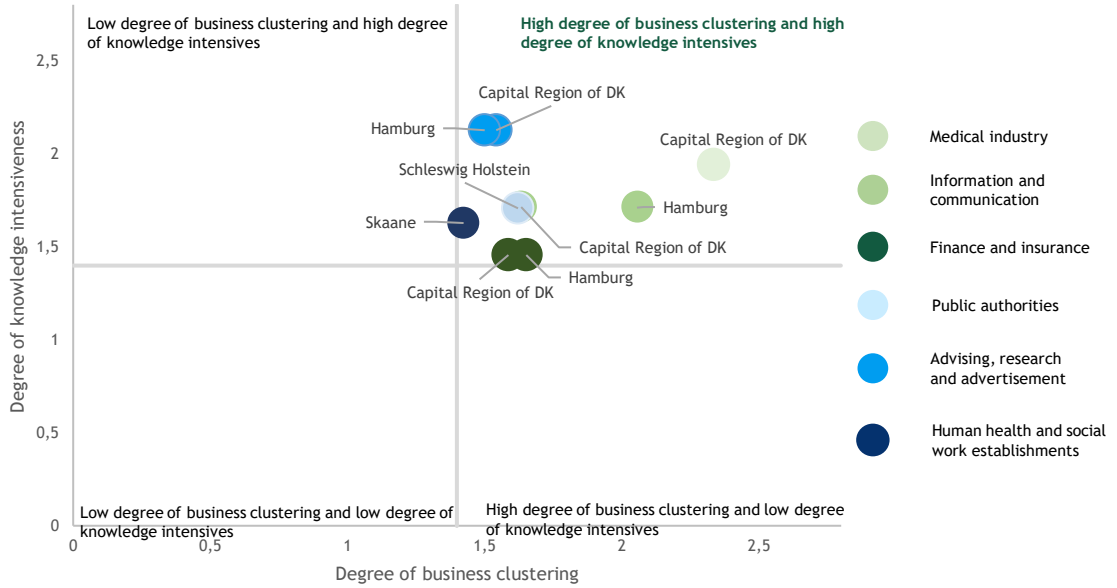
Secondly, the shorter travel times resulting from the FBFL's improved connectivity can make it more convenient for researchers and scientists to move and work abroad. This reduced distance to their country of origin could encourage more scientists to explore opportunities outside their current location, potentially increasing overall mobility in the scientific community.

This is likely to increase the rate of innovation within the scientific community

Mapping of the identified top-tier universities within the STRING-region



A descriptive mapping of relevant knowledge-intensive business sectors in the STRING region



Knowledge-intensive business sectors

Eight distinct knowledge-intensive business sectors (KIBS) have been identified in the included parts of the STRING region*, spanning six unique sectors.

Better collaboration, competition, and labour market access are three key parameters that can significantly affect innovation in the knowledge intensive business sectors due to the FBFL.

As informal knowledge sharing and knowledge spill over between firms will increase, this will positively affect innovation

With the FBFL, firms can leverage their collective knowledge and expertise to innovate and improve their products and services.

Competition also drives innovation as firms strive to differentiate themselves from their competitors by offering unique and better products and services.

With the FBFL, firms will have greater access to a larger pool of high-skilled employees, making it easier to recruit and retain the talent needed to drive innovation.

Note: *This specific analysis comprises solely the STRING regions of Hamburg, Schleswig-Holstein, Zealand, the Capital Region of Denmark, and Scania.

Reflection and interpretation of the results

Scale of impact
Although the size of the impacts quantified in this report is relatively small, the total impact of the FBFL and associated infrastructure projects could still be large. The report describes so-called first-order effects in three important domains: trade, labour markets, and innovation, but there are likely large dynamic impacts and other unforeseen impacts that will be large. These are difficult to foresee and quantify, which is why they have been described qualitatively in this report.

The chosen approach is good at explaining impacts and identifying barriers, but does not capture all possible impacts. The advantage of the chosen approach in this report is that the results can be logically explained and followed from for example travel time reductions to increased commuting and employment. This is important for identifying barriers and how to remove them. The disadvantage is that the results may not capture the value of all possible impacts. Other approaches* can approximately describe the total value of an infrastructure project, but struggle to explain why and how the value is created. Such approaches make it harder for policy-makers and businesses to understand what they need to do to realise the potential.

Qualified interpretation
This study focuses on impacts that are directly related to the FBFL and associated infrastructure. The impacts are identified by comparing the situation with the FBFL and the associated infrastructure in operation to a hypothetical baseline situation where the FBFL and related infrastructure would not have been built. All results should be understood as qualified approximations based on empirical evidence and the application of "good practice calculations". The analysis of the prioritized impacts are based on:

- Relevant input data such as trade statistics, goods transport flows by mode of transport realized time savings and commuting statistics by sector.
- Empirical evidence from the fields of wider economic impact studies and evidence from relevant infrastructure projects (cases).
- Established economic methods for impact assessment of large scale infrastructure investments.

Note: * Agglomeration models or input-output models.

Recommendations to enhance the impact of the FBFL and related transport infrastructure

The positive impacts identified in this report will not necessarily occur automatically when the FBFL opens, as they may require actions by policy-makers, businesses and individuals. Some of these positive impacts may also be reduced by barriers that limit their potentials. Therefore, policy- and decision-makers have an essential role in ensuring that the potential impacts can be realized. It is important to act swiftly and effectively since the FBFL will open in 2029 and policy and infrastructure changes have long lead times before they are fully implemented. Below, we provide recommendations for policy- and decision-makers that address specific aspects of the FBFL or the transport infrastructure. The recommendations aim at removing barriers and ensuring full realisation of the impacts. The recommendations are based on this study and discussions in two workshops with stakeholders* aimed at identifying recommendations from the study.

OPTIMISE USAGE AND CONNECTIVITY

Carefully consider the FBFL tariff level to ensure high utilization and competitiveness of the FBFL

- All impacts identified in this report depend on high utilization of the FBFL. If the tariff for using the FBFL is too high relative to alternative routes, it will likely result in lower utilization compared a lower tariff. Low utilisation generally implies lower impacts than what we have described in this report.
- Therefore, it will be essential for policy-makers to carefully consider and optimise the tariff levels to ensure that realisation of the potential positive impacts while balancing the need to collect sufficient revenue from the tariff.

Ensure there is a good mix of fast direct intercity trains and trains with frequent stops

- The impacts on labour markets and innovation depend on faster movement of people, both as fast as possible and with as many connections as possible. However, there is a trade-off between fast intercity connections (including cross-border) and stopping at every possible station.
- It is necessary for policy-makers and transport authorities and train operators to ensure there is a sufficient mix of train connections demanded and needed to realize the potentials.

OVERCOMING BARRIERS FOR TRANSPORT AND TRAVEL

Minimise capacity constraints on other transport corridors to ensure full realization of FBFL impact

- Long-distance transportation, for example from Norway and Sweden to Germany and beyond, depends on more than just the FBFL transport corridor. Capacity constraints in these transport corridors can limit the actual trade impacts.
- Therefore policy-makers and transportation authorities need to take swift and effective action based on current knowledge to minimise capacity constraints in transport corridors before the FBFL opens.

Minimise technical barriers for cross-border railway transport

- Long-distance transportation can also be hindered by technical cross-border differences in railway infrastructure and systems, for example weight limits for freight transport, differences in power systems, or other operational differences.
- To ensure efficient flows of people and goods, policy-makers and transportation authorities need to continue harmonizing the railways in Norway, Sweden, Denmark, and Germany.

Ensure user-friendly and convenient ticket systems

- The impacts on labour markets and innovation depend on people's usage of the FBFL and related infrastructure. Regional and national differences in ticketing systems and border controls could lead to inconvenience and barriers for travellers, thereby reducing usage of the FBFL and its impacts.
- Therefore, it is important that the ticket system(s) are user-friendly and convenient, making it easy for frequent and occasional short- and long-distance travel. Policy-makers and transport authorities should as much as possible ensure interoperability and harmonisation across the regions' and countries' ticket systems. Inspiration and lessons learned can for example be drawn from the suggestions (and their implementation) in the Swedish government inquiry *SOU 2020:25 Ett nationellt biljettsystem för all kollektivtrafik*.

FACILITATE CROSS-REGIONAL BUSINESS, INNOVATION, AND LABOUR

Minimize administrative burden for cross-regional and cross-country mobility and business activity

- Fast and convenient travel alone is not sufficient to increase cross-regional labour market integration, collaboration and innovation in academia and businesses. Differences in labour laws, regulations, practices, and administrative requirements between countries may create barriers to realise the full potential impact of the FBFL.
- Therefore, policy-makers should be attentive towards and strive to minimise administrative burden related to cross-regional or cross-country commuting, working, and/or relocation to maximise the potential impacts on labour markets and innovation. An example for a next step could be exploring the possibility of a single point of entry for cross-regional and cross-border related administration.

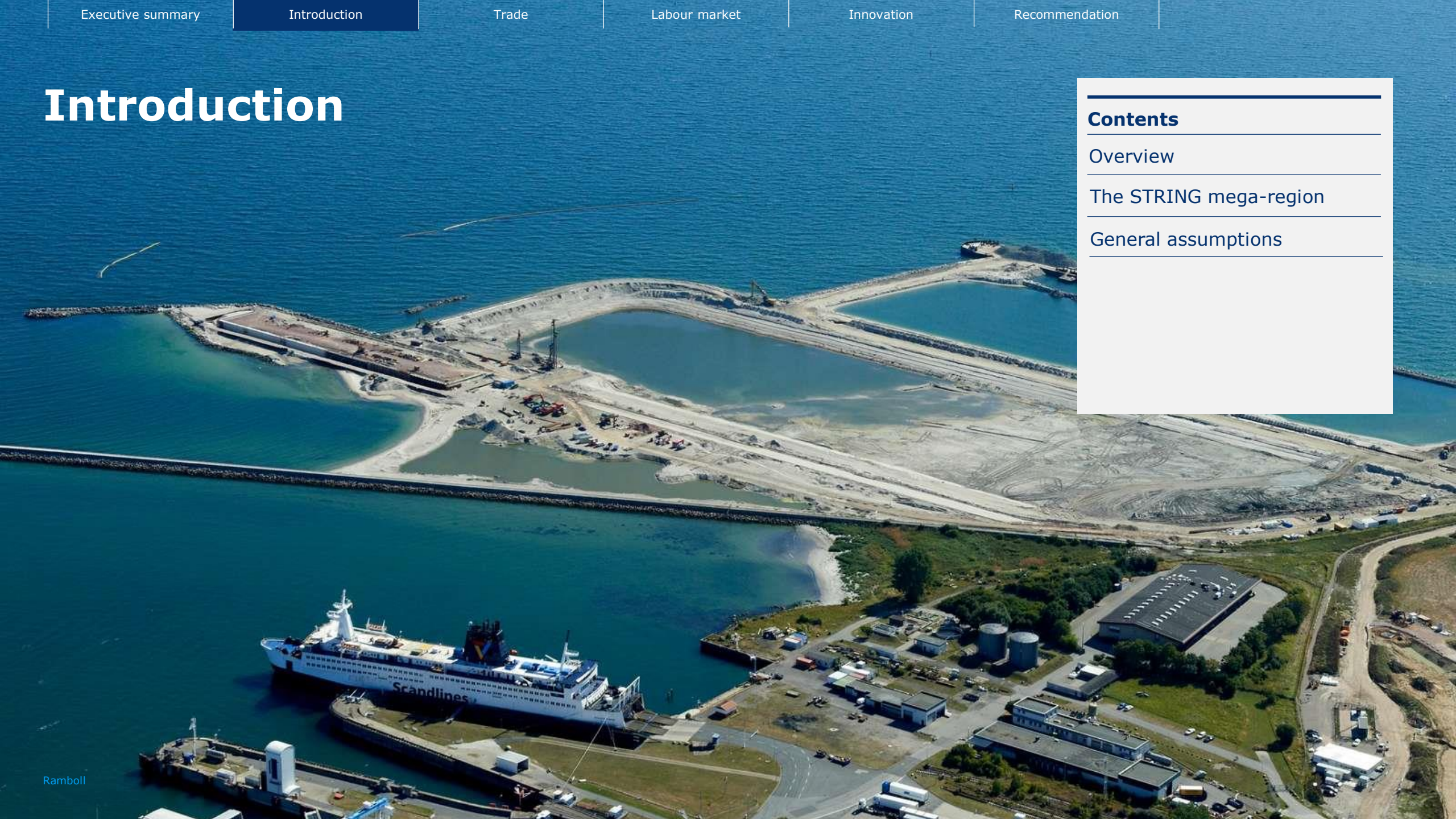
Inform, engage and activate stakeholders about opportunities to realise full potential

- In order to fully realise the potential impacts of the FBFL, it is important to raise awareness among relevant stakeholders about the opportunities it presents for regions, businesses and individuals, and activate and engage them to ensure that businesses and individuals take advantage of the opportunities the FBFL brings.

Note: *Workshop 1 held on 22nd November 2022 and workshop 2 held on 15th March 2023. Participants were from Ramboll, STRING, Femern, The Confederation of Danish Industry, City of Malmö, and the HafenCity University Hamburg (only participated in Workshop 1).

Introduction

Contents



Ramboll

By giving an overview of the STRING mega region and FBFL and its associated infrastructure projects we can give a clear explanation of the impact analysed in this report

OVERVIEW OF THE BASIS OF THE ANALYSIS

1 The STRING mega-region

The STRING mega-region is the focal point of the analysis, which is why the first part of the chapter primarily highlights the region's geographical scope, its significance in the economic and social development of Northern Europe, and some general economic statistics

2 The FBFL and its associated infrastructure projects

As the key object of this analysis is the Fehmarn-Belt Fixed Link (FBFL) and its associated infrastructure, this part of the chapter gives first a brief description of the timeline of the establishment of the FBFL and some basic background. Additionally, the chapter will map the most relevant related infrastructure projects, we can provide a comprehensive understanding of the changes that will be associated with the FBFL.

3 General assumptions

Given the limited information available about projected railway traffic and specific travel time reductions, as well as the fact that train station locations have not yet been decided, we need to make certain assumptions to complete the analysis.

By clearly explaining our assumptions, we maintain transparency and ensure that the reader has a clear understanding of our methodology.

The STRING mega-region

The STRING mega-region plays a key role in the economic and social development of Northern Europe

Description of the STRING mega-region

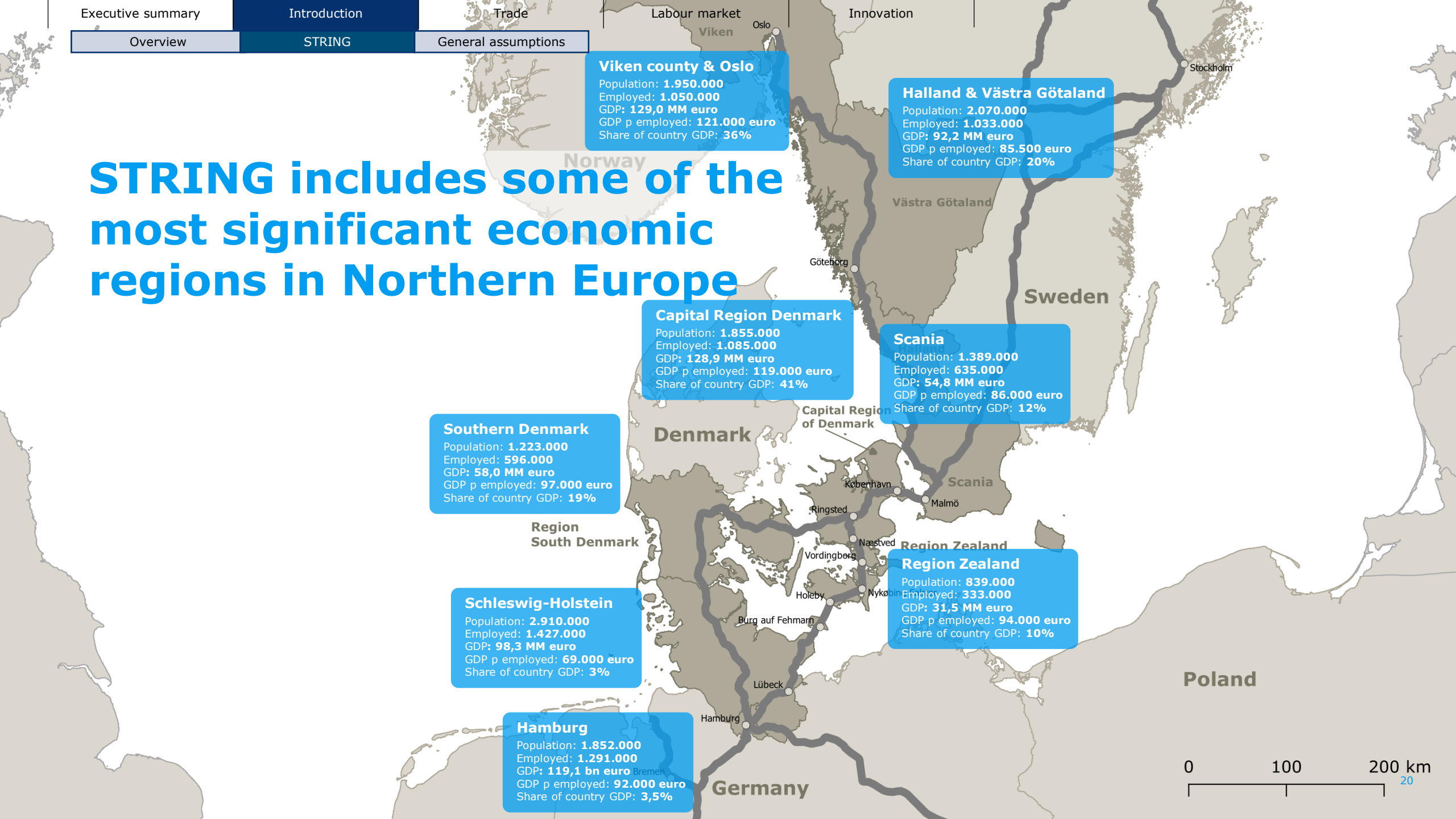
The STRING mega-region is a group of neighbouring regions located in Denmark, Germany, Sweden and Norway that are closely interconnected economically, culturally, and socially. It contains 4 countries, 6 cities, 8 regions, and 14 million people.

One of the key features of the STRING mega-region is its strong connectivity in the areas of transportation, trade, and cultural exchange. The region is home to several important transportation corridors, including roads, railways, and shipping routes, which facilitate the movement of goods and people within the region.

The STRING mega-region is known for its strong focus on knowledge-intensive business activities. This, combined with strong government support for innovation and a well-developed infrastructure, make the STRING mega-region an attractive a hub for cross-border collaboration and knowledge sharing

The region is also home to several major universities and research institutions, which contribute to its status as a hub of innovation and knowledge.

STRING includes some of the most significant economic regions in Northern Europe



Viken county & Oslo
Population: **1.950.000**
Employed: **1.050.000**
GDP**: 129,0 MM euro**
GDP p employed: **121.000 euro**
Share of country GDP: **36%**

Halland & Västra Götaland
Population: **2.070.000**
Employed: **1.033.000**
GDP**: 92,2 MM euro**
GDP p employed: **85.500 euro**
Share of country GDP: **20%**

Capital Region Denmark
Population: **1.855.000**
Employed: **1.085.000**
GDP**: 128,9 MM euro**
GDP p employed: **119.000 euro**
Share of country GDP: **41%**

Scania
Population: **1.389.000**
Employed: **635.000**
GDP**: 54,8 MM euro**
GDP p employed: **86.000 euro**
Share of country GDP: **12%**

Southern Denmark
Population: **1.223.000**
Employed: **596.000**
GDP**: 58,0 MM euro**
GDP p employed: **97.000 euro**
Share of country GDP: **19%**

Region Zealand
Population: **839.000**
Employed: **333.000**
GDP**: 31,5 MM euro**
GDP p employed: **94.000 euro**
Share of country GDP: **10%**

Schleswig-Holstein
Population: **2.910.000**
Employed: **1.427.000**
GDP**: 98,3 MM euro**
GDP p employed: **69.000 euro**
Share of country GDP: **3%**

Hamburg
Population: **1.852.000**
Employed: **1.291.000**
GDP**: 119,1 bn euro**
GDP p employed: **92.000 euro**
Share of country GDP: **3,5%**

General assumptions

When analysing the impact of the FBFL, we must also consider infrastructure projects that are directly associated

It's important in the analysis of impact, barriers and potentials of the FBFL to include the infrastructure projects that are associated with the fixed link

To fully leverage the potential of the FBFL, additional relevant infrastructure will be established in order to increase interconnectivity between the specific cities of Copenhagen and Hamburg, as well as the broader STRING region. As the primary focus of the FBFL is to enhance connections between Central Europe and Scandinavia through the establishment of a direct link between Denmark and Germany, the relevant associated infrastructure projects will be identified and mapped in both countries.

In our analysis of the impact of the FBFL on the STRING region, it is equally important to consider the infrastructure projects that are associated with the tunnel, as these have a significant impact on travel time reductions and overall interconnectivity within the region.

Relevant infrastructure project associated with the FBFL in Denmark and Germany

Establishment of the Copenhagen-Ringsted Line (2010-2019)
- Denmark's first high-speed railway provides a double-track and electrified railway in Zealand, extending from Copenhagen through Køge to Ringsted

Establishment of the Ringsted-Fehmarn Line (2017-2029)
- Banedanmark is undertaking an upgrade and modernization project for the existing line between Ringsted and Holeby. This includes electrifying the railway, introducing double tracks for high-speed trains, upgrading existing train stations and building new ones

Upgrading the Lübeck-Puttgarden railway (2022-2030*)
- According to the Federal Transport Infrastructure Plan 2030 in Germany, it has been determined that the existing route will be fully electrified and tracks for high-speed trains will be introduced

Upgrading the Hamburg-Lübeck railway (2022-2030*)
- According to the Federal Transport Infrastructure Plan 2030 in Germany, it has been determined that the existing route will be fully electrified and tracks for high-speed trains will be introduced. Further, the S4 will release congestion of regional trains which will lead to fewer delays

Upgrading the exiting motorway
- The existing motorway connections from the Danish and German sides will be upgraded to complement the tunnel connection

Note: Based on information from Femern A/S, Banedanmark and Sund & Bælts implementation statement, Bundesministerium für Digitales und Verkehr and Deutche Bahn.
*,** The year for completion is subject to change but based on insights from the Federal Transport Infrastructure Plan 2030

We need to make assumptions regarding reductions in travel time by train and train station locations in order to complete the analysis

We need to make certain critical assumptions because of limited available information

As the FBFL is not established and operational until 2029, there is currently a lack of information regarding significant infrastructure improvements on the route between Copenhagen and Hamburg. Especially on the German side of the FBFL relevant data and information are limited. In order to conduct the present analysis, it is necessary to make several critical assumptions.

The information regarding travel times differs between road and rail transport. It is widely known that the completion of the tunnel on the road network enables travel from Rødbyhavn to Puttgarden to be completed in less than 10 minutes, resulting in a total travel time reduction of 63 minutes for cars (Incentive, 2015). In contrast, information regarding rail travel is more varied. Generally, it is understood that it will be possible to travel by train from Copenhagen to Hamburg in 2.5 hours (Fehmarn, 2022). Additionally, the improvements on the Ringsted-Copenhagen and Ringsted-Fehmarn lines have been well-documented by Banedanmark. However, specifically on the German side, but also in general, information including specific travel times between stations, and which train stations that will be included on the route, are currently not well-documented. Therefore, we have to make assumptions in order to complete the analysis.

We therefore make certain assumptions regarding travel time and the corresponding train stations for rail transport

Assumptions on included train stations

- By combing information from Sund & Bælt, Banedanmark, and an interview with Rambøll experts, we have compiled a comprehensive list of train stations that are likely to be included on the Copenhagen-Hamburg route. The Danish stations on this route include Copenhagen, Ringsted, Næstved, Vordingborg, Nykøbing Falster, and Holeby. On the German side, the stations that are likely to be included are Burg-auf-Fehmarn, the station between Puttgarden and Lübeck, Lübeck and Hamburg.

Assumptions on travel time reduction for rail traffic

- By using the information that is currently available, i.e. trains will be able to travel from Hamburg to Copenhagen in 2.5 hours, and the average speed on this route will be increased from 160 km/h to 200 km/h, we estimate the reduction in travel time. The improved travel times in Denmark, have been calculated by multiplying the ratio of the before and after average speed on the existing travel time between each station. In Germany, the connection from Lübeck to Puttgarden will decrease by 16 minutes. Further, from Hamburg to Lübeck, the S4 will release congestion of regional trains which will lead to fewer delays. Together with the new fast-train which potentially could stop in Lübeck, we assume that transportation times between Hamburg and Lübeck on average will decrease by 10 minutes.

Note: Based on information from Femern A/S, Banedanmark, Sund & Bælts implementation statement and the socioeconomic impact analysis published by Incentive

We assume that the tolls/fees for using the FBFL will be similar to other existing routes between Region Zealand and Schleswig-Holstein

The actual tolls/fees of the FBFL are not yet decided

The level of the toll/fee is ultimately a political decision
The size of the toll/fee for using the FBFL is ultimately a political decision belonging to the Danish Ministry of Transport. As such, a decision will most likely be taken to achieve the highest net benefit in relation to transport demand.

The actual toll/fee level will have an effect on transport mode and route choices – but to an uncertain degree
Since the tolls and fees are important factors of transport costs, they will affect transport mode and route shifts responses of transporting companies and buyers of transport services. In a report on expected modal shift responses of the FBFL, Robertsson & Möller (2020) investigate attitudes among stakeholders by interviewing representatives from a total of seven Swedish transport companies. Several of these respondents report that the fee will decide how much the FBFL will be used. One transport company representative explained that there will be little incentive to use the tunnel if the fee is significantly higher than that of the Great Belt Bridge.

In the analysis we therefore assume that the tolls/fees will be similar to those on other connections

Since the toll/fee for passing the fixed link is yet undecided, we have chosen not to include this as a factor in the analysis. This means that we implicitly assume that the fee will the same as in the other relevant transport corridors, most notably the Great Belt Bridge and the ferry between Puttgarden and Rødby. If the actual fee of the FBFL turns out to be higher, the usage of the FBFL and hence the expected impact will be smaller than what we describe in this report. If the actual fee turns out to be lower, the usage and impact will be higher.

The bridge toll on the Great Belt Bridge is around 30-50 % of the price for the ferry between Puttgarden and Rødby according to our estimates. All the roads from Eastern Denmark to the continent are coupled with toll or ticket costs and so will the FBFL. At the time of writing, we have no certain information on how the FBFL-toll will be set in relation to existing tolls and ticket prices.

Note: Based on information from Femern's A/S website, Robertsson & Möller (2020. In a financial analysis on the Folketinget (2020) website, it is explained that a flat average tariff equivalent of DKK 545 for passenger cars and DKK 2,319 for trucks in 2020 prices were presumed for calculation purposes. However, how well these presumed levels match with the set rate is uncertain.

The cities depicted along the blue line on the map are all included train stations. Holeby and Burg auf Fehmarn will be established as brand new stations, while the other stations at the cities will undergo renovation

Note: Includes the following stations Bad Schwartau, Ratekau, Scharbeutz, Haffkrug, Neustadt, Lehsahn, Oldenburg, Grossenbrode-Heiligenhafen

FBFL’s impact on international trade

Contents

Purpose and overview of the trade analysis

Purpose

The impact on trade of the Fehmarn Belt Fixed Link due to reduced transportation times and associated costs can potentially have large economic effects for the STRING region. In this chapter, we provide novel estimates of the international goods trade impact of the FBFL for seven STRING regions and initiate the discussion on the role of the FBFL on services trade.

Limitations

We provide estimates of the direct transport cost and trade effects that are expected from the establishment of the FBFL. Hence, we do not provide estimates of potential indirect effects that may positively or negatively affect the trade impact of the FBFL, such as indirect congestion effects.

Since the toll/fee for using the FBFL is yet undecided, we have chosen not to include this as a factor in the analysis. This is discussed in the chapter *General assumptions*.

OVERVIEW OF THE TRADE ANALYSIS

1 Reduction in transportation costs

The analysis of the trade impact of the FBFL begins by providing an estimate of the transportation cost reductions that may arise as a direct effect of the FBFL. In this, we focus solely on cost reductions from reduced transportation times and distances that arise in the international goods trade taking place to and from the STRING regions.

2 International trade in goods

We present novel estimates on the potential effects on international goods trade to and from the STRING regions. We further provide insights and discussions into the pathways through which the international goods trade is affected through the establishment of the FBFL, as well as discussions on what product areas that will likely be most affected.

3 International trade in services

We initiate the discussion and provide a theoretical analysis on how the FBFL can stimulate increased international trade in services to and from the STRING regions. We exemplify by focusing on potential tourism effects, which is one of the sectors that are likely to experience large positive impacts from the FBFL.

4 Dynamic effects of transport cost reductions and increased trade

Lastly, we provide insights into the wider economic benefits, or dynamic effects, of reduced transportation costs and increased trade, following the establishment of the FBFL. In the chapter, we describe the potential of dynamic effects to be realized, as well as briefly provide insights into the potential indirect effects on innovation, investment and employment.

Main conclusions on the impact on international trade

Transportation costs

- We estimate that the establishment of FBFL will **give annual transports cost savings goods trading businesses in the STRING region of about € 90 million**. The majority of the cost savings are realised in the Danish Capital Region and Zealand Region.
- Transport related cost – in particular wages – are relatively high in northern Europe and especially in Scandinavia. **With high relative costs of transport also comes relatively impactful effects of the FBFL**, both in terms of transport cost savings and the impact it has on trade.

International trade in goods

- Lower transportation costs will spur an **increase in trade to and from STRING regions of around € 900 million**. Exports increase by about € 500 million and imports by about € 400 million, i.e. an increase in trade surplus by € 100 million. **This represents increased trade of about 0,3 % annually to and from the STRING regions**. The Fehmarn Belt Fixed Link has a higher potential to positively affect trade to and from the STRING regions located in the Scandinavian countries, compared to the regions of Hamburg and Schleswig-Holstein in German, since a larger share of Scandinavian trade will benefit from the fixed link.
- The trade response to reduced transportation costs differ among product types. **The STRING regions are typically strong in exports of machinery and various types of electronics**, which expected to be relatively highly affected by transport prices.

International trade in services

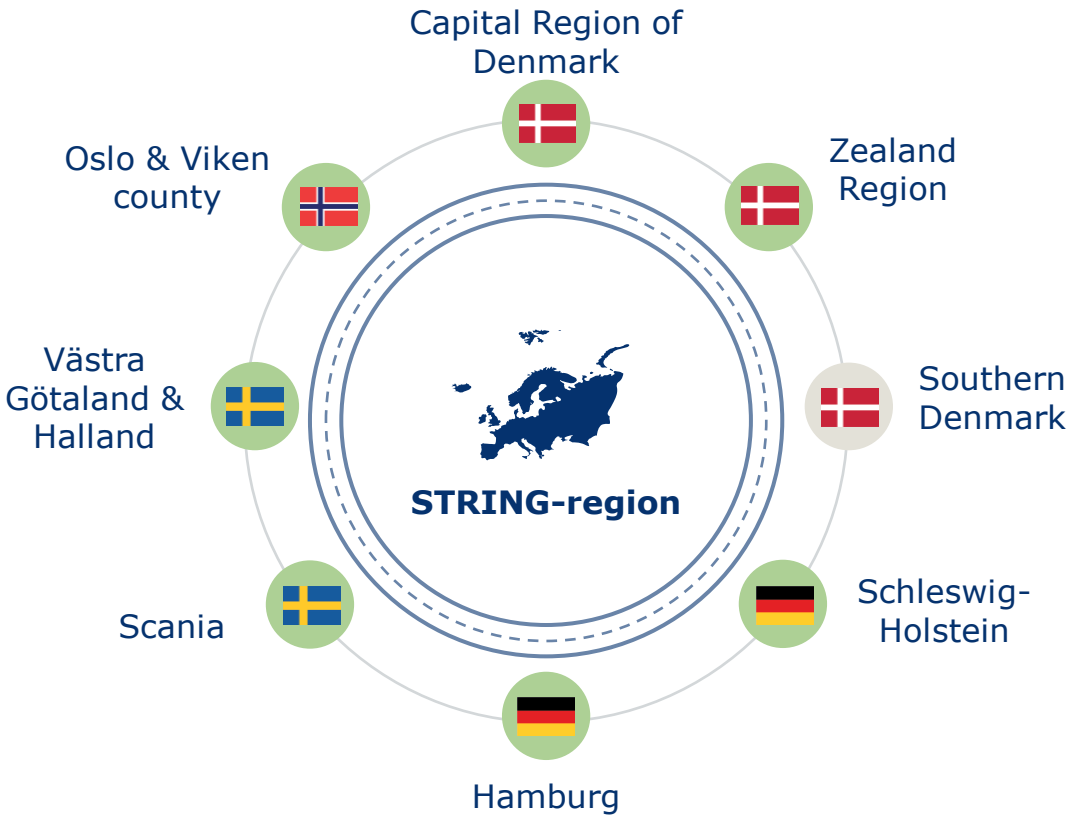
- Reduced transportation costs are likely to **also positively impact international trade in services** to and from the STRING regions. The size of this effect is however too uncertain to estimate.
- One of the biggest impacts on services exports is likely an **increase in tourism**, including both leisure and business travelling. The driving forces of the impact on tourism is the increased accessibility thanks to the FBFL providing more timely connections between cities in Northern Europe, the increased ability for sustainable travel, but through indirect effect of increased goods trade.
- The impact on trade in services is however not limited to tourism. **Service exports such as ICT and business services provide important contributions to the STRING country economies**, and the provision of accessible, timely and cost competitive train travel routes may boost inter-regional service trade development.

Dynamic effects

- The main indirect effects of transport cost reductions and increased trade are **positive impacts on competitiveness of businesses and purchasing power of consumers in the STRING region**, mostly through an expected downward pressure on prices on inputs and consumer goods that follow from regional market integration and reduced transport costs.
- In the longer term, **potential dynamic effects that follows from reduced transport costs and increased trade include boosts to employment, innovation and investments**. The realization of positive economic effects, include impacts on business competitiveness and consumer purchasing power, is however contingent on several factors such as business and labour market structures, the ability to work across cultural barriers, and more.

STRING regions in focus in the trade analysis

All STRING regions except Southern Denmark are included in the trade analysis



Including the green regions

- We include the STRING regions that we deem are directly affected by reductions in transportation times, i.e. regions where there is a high likelihood that significant transports route shifts to the Fehmarn Belt Fixed Link will take place.

Excluding the region of Southern Denmark:

- Southern Denmark has been excluded from the trade analysis because transportation times are not directly affected by the establishment of the FBFL.
- However, the possibility of reduced congestion on trade routes in Southern Denmark will have a reduction effect on transportation times, hence positively affecting cross-border trade from the region. For the scope of this analysis this effect has not been evaluated.

Based on the selection of regions we get an indicative insight into the impact of FBFL on trade

- We provide value estimations of the FBFL impact on transport costs for international goods trade, as well as goods trade impact estimations. Furthermore, insights are given into how these impact are distributed geographically between the included STRING regions.

Transport cost effects

Relationship between the FBFL and the transport costs associated with international goods trade

Transport costs are relatively high in Northern Europe - and costs have been increasing significantly during recent years

Transport costs determine for modal choice

Time-related costs for goods transport on roads are particularly high in Sweden, Denmark and Norway. In comparison to railway cargo, goods traffic on road as well as short sea shipping are particularly sensitive to fuel prices. This has also been a key effect of the 2022 rapid increase in fuel prices which have propelled several EU member states to enact support measures. This includes state aid packages for road transport enterprises (Finland) and temporary reductions on transport fuels (Sweden). Developing the railway cargo network for goods transport in northern Europe could help to strengthen the resilience of the transport networks against external shocks of the type that has occurred during 2022.

Transport costs constitute the key factor for modal transport choice alongside – but often more important than - service quality aspects such as transit time, reliability and frequency. This is in particular the case for goods transport distances longer than 700 kilometres, where the total costs of transport typically are valued higher than service-oriented aspects. A reliable, fast and cost competitive transport route over the Fehmarn Belt could indeed be a radical improvement for northern European transport route system, and with high relative costs of transport in Northern Europe also comes relatively impactful trade effects of the FBFL.

In EU 28, wages contribute to 42 % of road transport costs

Cost component	Percentage share of costs in the EU
Driver wage costs (time costs)	42 %
Fuel costs (distance costs)	21 %
Ownership Taxes (distance costs)	0,6 %
Vignettes and tolls (distance costs)	5,9 %
Other (time)	17 %
Other (distance)	13 %

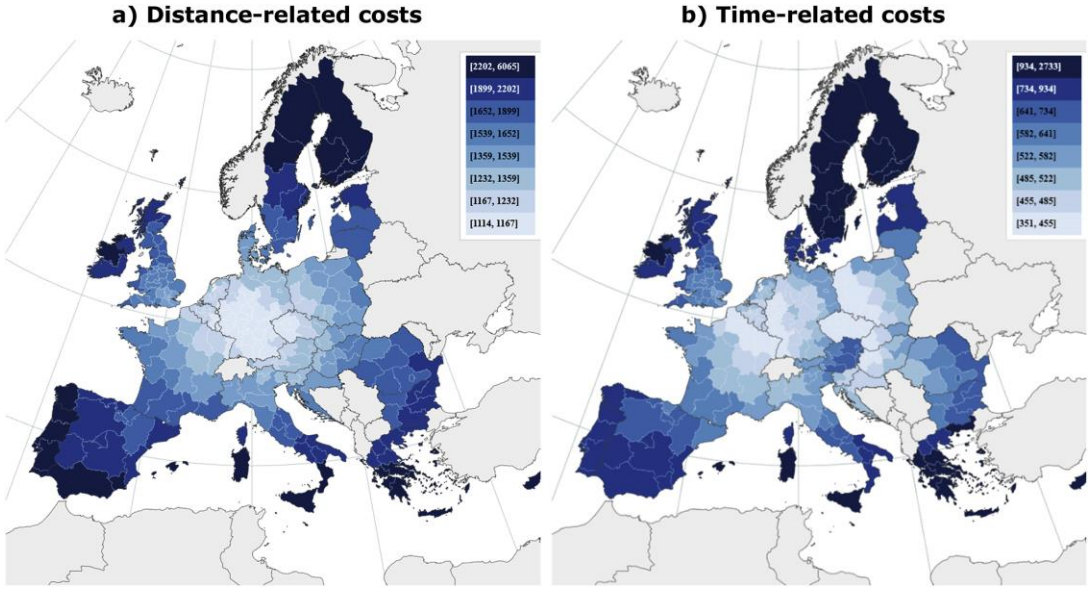
Source: Persyn et al (2019), Robertsson & Möller (2020), Macharis et al., (2016), IRU (2022), OECD (2021). Norway is excluded from the Persyn et al dataset on transport costs and has therefore been assigned estimated cost figures based on cost figures, e.g. from Transportøkonomisk institutt.

Transport costs are rising

Road freight	(~) **costs are up 15-30 %** from Q2-20 to Q2-22
Maritime shipping	(~) **costs are up 200 %** from 11/20 to 11/22

Note: Maritime shipping costs in Europe and the US, data from Freightos, road freight costs from Upply. The figures and time frame are chosen to illustrate the volatility of prices.

Time-related transport costs (wages) are high in Northern Europe



Note: The darker blue, the higher transport costs, and the lighter blue, the lower transport costs. Figure from Persyn et al (2019).

The FBFL will impact transport routes choices between Scandinavia and continental EUrope

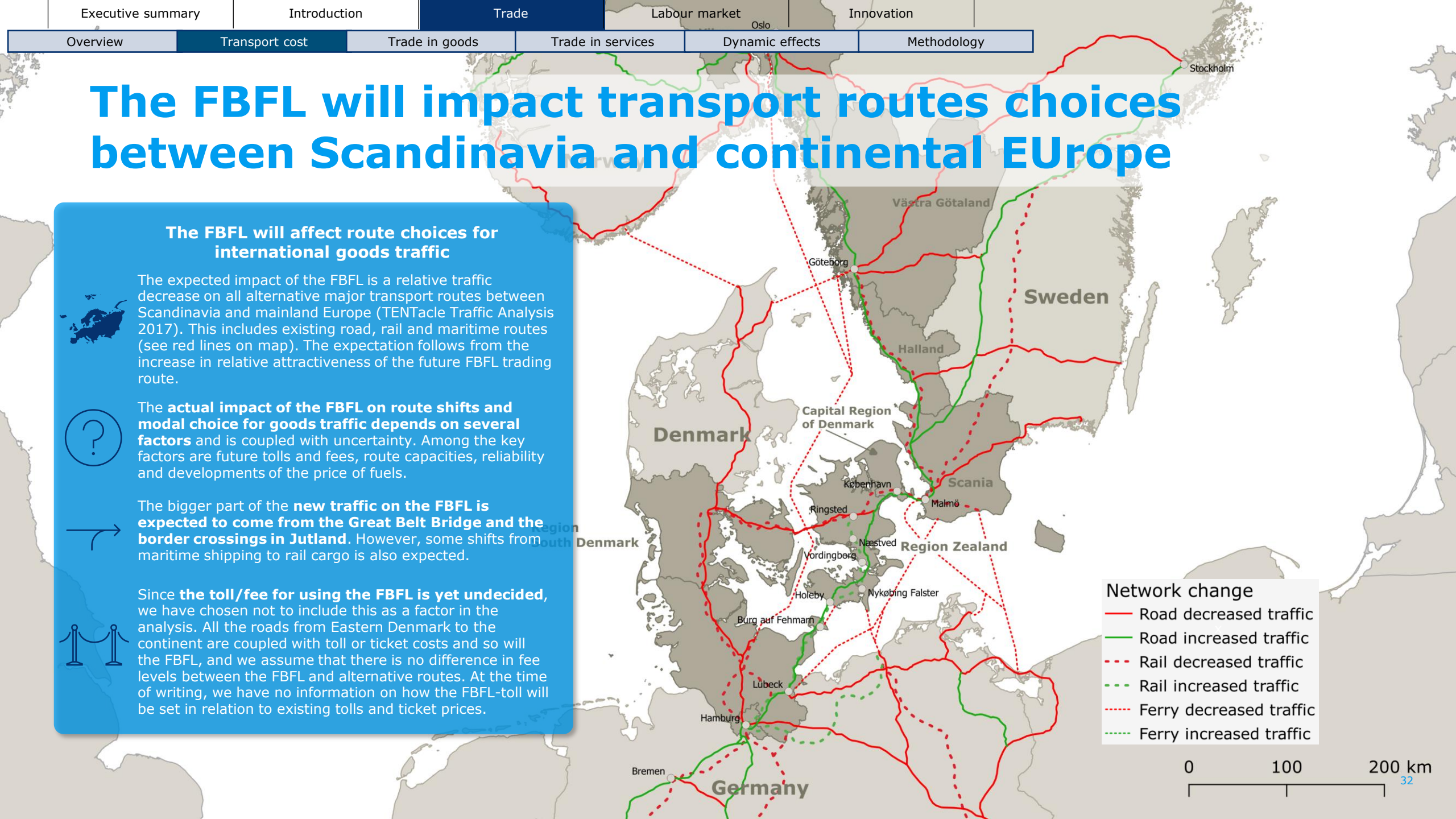
The FBFL will affect route choices for international goods traffic

The expected impact of the FBFL is a relative traffic decrease on all alternative major transport routes between Scandinavia and mainland Europe (TENTacle Traffic Analysis 2017). This includes existing road, rail and maritime routes (see red lines on map). The expectation follows from the increase in relative attractiveness of the future FBFL trading route.

The **actual impact of the FBFL on route shifts and modal choice for goods traffic depends on several factors** and is coupled with uncertainty. Among the key factors are future tolls and fees, route capacities, reliability and developments of the price of fuels.

The bigger part of the **new traffic on the FBFL is expected to come from the Great Belt Bridge and the border crossings in Jutland**. However, some shifts from maritime shipping to rail cargo is also expected.

Since **the toll/fee for using the FBFL is yet undecided**, we have chosen not to include this as a factor in the analysis. All the roads from Eastern Denmark to the continent are coupled with toll or ticket costs and so will the FBFL, and we assume that there is no difference in fee levels between the FBFL and alternative routes. At the time of writing, we have no information on how the FBFL-toll will be set in relation to existing tolls and ticket prices.



The FBFL will impact transportation costs and supply chain efficiencies in the Northern European goods trade

A higher relative trading impact in Scandinavia

Reducing transport costs for international shipping can make it more cost-effective for businesses to trade goods. On an aggregate economic level, this can lead to an increase in international trade, as businesses are able to sell their goods to a wider market at a lower cost. Additionally, lower transport costs can make it easier for businesses to access raw materials and other inputs needed for production, which further improve their efficiency and productivity.

As has been outlined in the rigorous study on the relationship between transportation costs and EU foreign goods trade by Zofío et al (2020), **there exist significant relationships between the cost of trade and the prevalence of bilateral goods trade**. The relationship is stronger the closer the trading partners are located geographically. Here, transport costs are used as the approximation for trade costs in the EU context, since bilateral tariffs are absent in the European single market.

Increased trade can have a number of positive effects, including improving business competitiveness, increasing consumer choice and improving consumer welfare by lowering consumer prices. In summary, increased trade can promote aggregate economic growth and stimulate employment.

The Fehmarn Belt Fixed Link has a higher potential to positively affect trade to and from the STRING regions located in the Scandinavian countries, compared to the regions of Hamburg and Schleswig-Holstein in Germany, because a larger share of the Scandinavian countries' trade uses the Denmark-German transport corridor. Although Germany is the most significant trade country in Europe, only percent 4 percent of its exports has its destination in the FBFL relevant trading partners of Denmark, Sweden and Norway.

Trade volumes affected by the establishment of the FBFL

Country	Bilateral trading partners relevant from an FBFL perspective*	Appx. Share of country's total goods exports
Norway	Germany, Netherlands, Belgium, France, Luxembourg, Switzerland, United Kingdom, Austria, Czech Republic, Slovenia, Slovakia, Poland, Romania, Hungary, Romania, Italy, Spain, Gibraltar, Portugal, Ukraine, Belarus, Greece, Bulgaria, Turkey, Moldova, Croatia, Serbia, Montenegro, Kosovo, North Macedonia, Bosnia and Herzegovina	~ 60 %
Sweden		~ 42 %
Denmark		~ 40 %
Germany	Denmark, Sweden, Norway	~ 4 %

Approx. € 215 billion in exports and € 211 billion in imports could be affected by the FBFL

Approximately € 215 billion in exports and € 211 billion in imports could potentially be affected, directly or indirectly, by the establishment of the Fehmarn Belt Fixed Link. These figures do not take into account trade route choices or modes or transport. Hence, the goods trade being directly affected by the FBFL is a significantly lower share of this total amount.

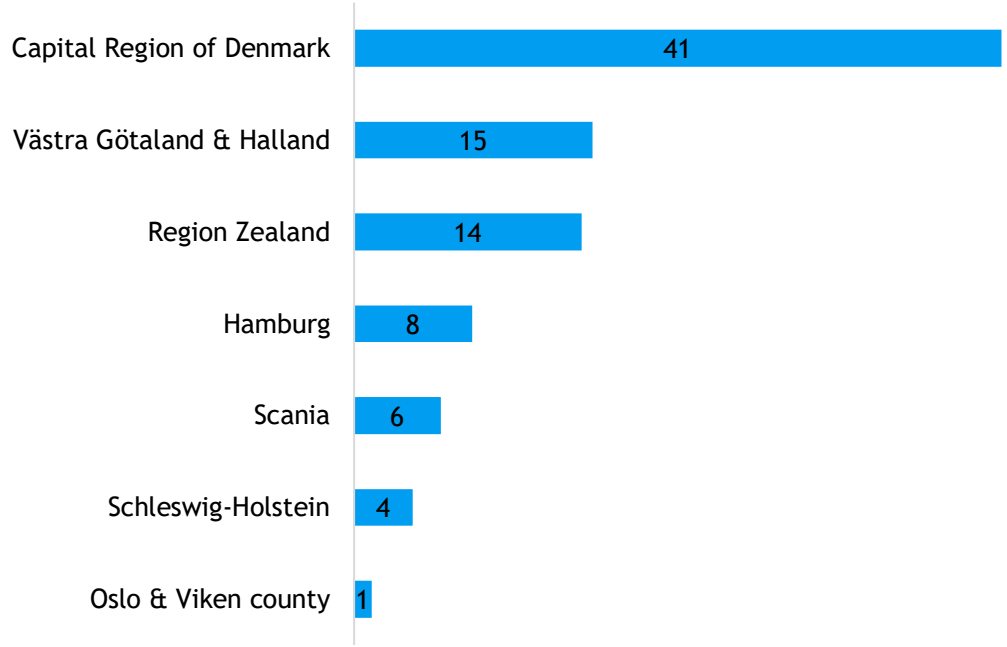
However, as goods traffic is redirected from several key transport routes between the Denmark, Norway and Sweden and the European continent, there may be some capacity gains and reduced congestion gains taking place at the alternative transport routes.

Note*: Relevant trading from an FBFL perspective are chosen based on the geographical location of the fixed link, trade statistics between the STRING countries and partner countries (goods trade, EUROSTAT), but is based on an intuitive decision in order to establish outer boundaries for the analysis. Trade volumes can be affected either directly or indirectly. Directly through shorter transport times on road or raid, an indirectly through less relative demand for maritime shipping.

 Source: EUROSTAT (2020), Zofío et al (2020).

The FBFL will benefit businesses in the STRING region by reducing transportation costs for international goods trade

Total annual transport cost reduction impact of FBFL on businesses in the STRING region (million Euro)



Note: Estimated impact on transportation costs on trade from the STRING regions of the FBFL. The calculations are based on combining a multitude of sources (see sources below)
Source: EUROSTAT, Statistics Denmark, Statistics Norway, Statistics Sweden, World Bank Trade Indicators, OEC, Vierth et al (VTI, 2020), Persyn et al (European Commission, 2019) Trafikanalys (2019)

Annual transport cost savings estimated to € 88 million

We expect the annual transport cost savings to amount to **€ 88 million** for the STRING regions. The cost saving interval is estimated to € 34 million - € 143 million. Uncertainty remains whether significant shifts between modes of transport will take place after the establishment of the FBFL, but also regarding other factors that are included in the analysis (see methodology).

The transport costs are distributed unevenly among the STRING regions. In general, the closer to the link, the greater the relative cost reductions impacts. This is due to that the relative transport cost reductions are higher for shorter transport routes. There is a larger percentage transport cost impact the closer the trading neighbours are located to the FBFL.

The effect of FBFL on transport cost reductions are largely dependent on modal shift responses, current trade and transport flows between EU regions, the sensitivity of trade to transport costs, future fee for crossing the FBFL among other factors. The cost reduction effects on the German side are typically smaller since the FBFL-relevant trading partners from a German perspective (Scandinavia) constitutes a smaller trading market than does the European continent.

Reducing transport costs for international shipping can make it more cost-effective for businesses to trade goods. On an aggregate economic level, this can lead to an increase in international trade, as businesses are able to sell their goods to a wider market at a lower cost. Additionally, lower transport costs can make it easier for businesses to access raw materials and other inputs needed for production, which further improve their efficiency and productivity.

Impact on international goods trade

Estimation and analysis of the FBFL's potential impact on international goods trade

The FBFL could boost trade both through reduced transportation costs and improved regional integration

Transport costs affect production costs, which are closely linked to consumer prices

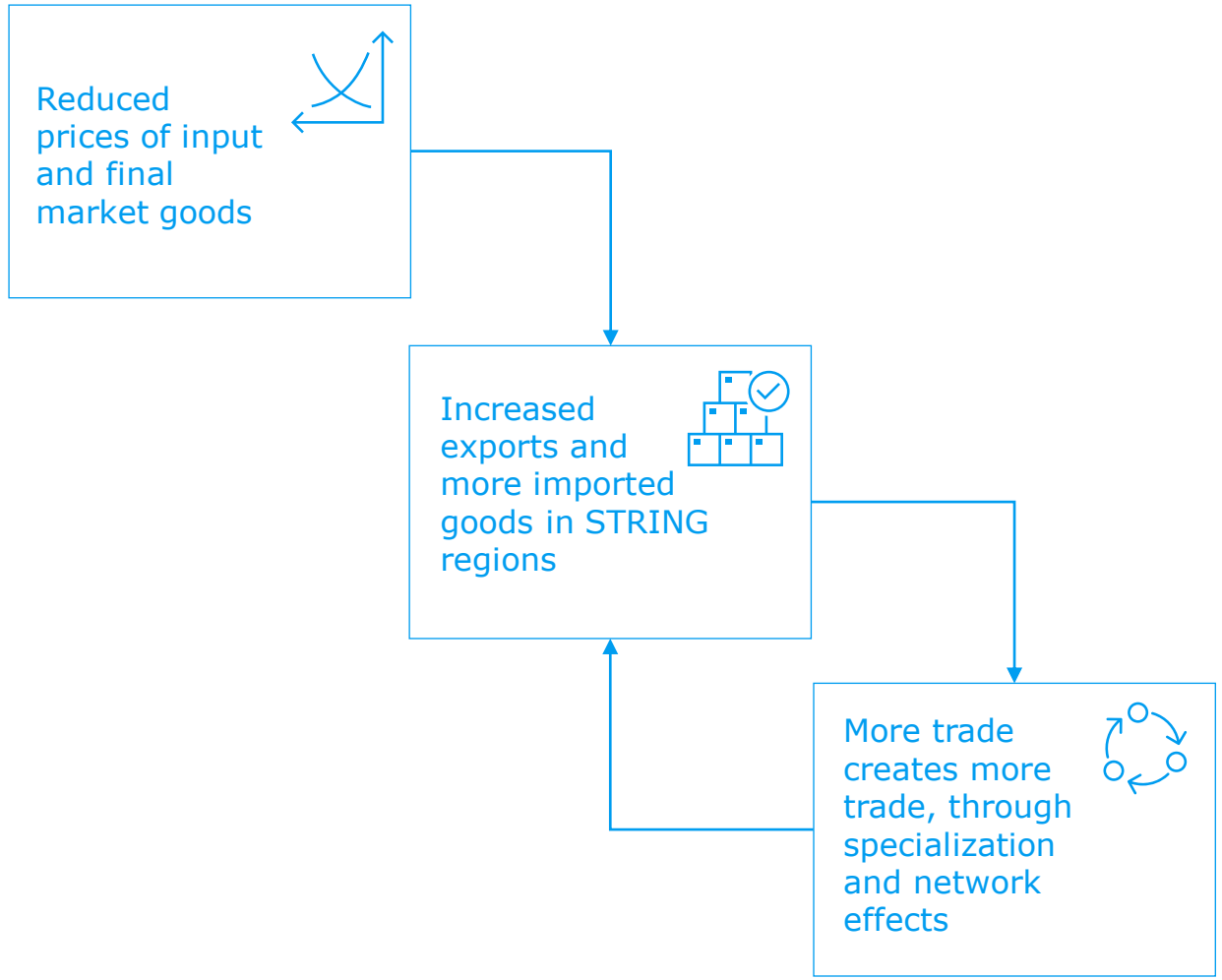
Transportation costs can have a direct impact on the pricing of goods. Transportation costs are often to some extent passed on to consumers in the form of higher prices for imported goods. Hence, lower transportation costs should lead to lower consumer prices.

Reduced transportation costs will increase exports and imports

When transportation costs decrease, products become can be sold in a wider geographical area. Thus, both imports and exports of certain goods will likely increase to and from the STRING regions. The direct result is strengthened economic activity and regional economic integration.

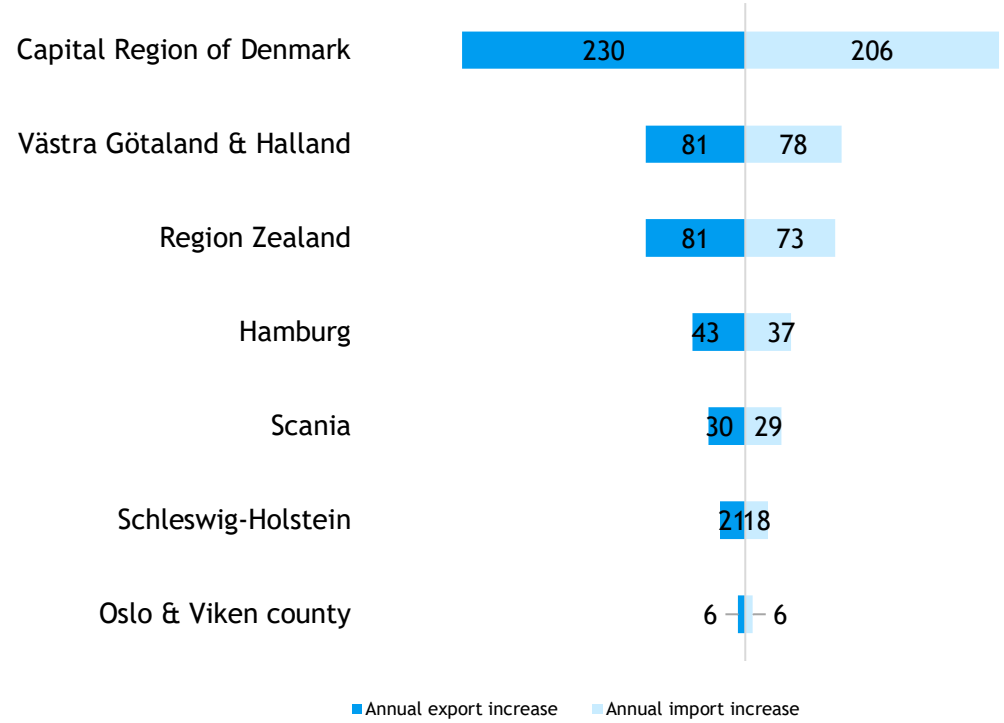
Increased trade can generate even more trade through a phenomenon known as trade creation

Trade creation occurs when regions specialize in producing the goods and services that they can produce most efficiently, and then trade the goods with other regions to obtain the goods and services that they cannot produce as efficiently. This can lead to increased efficiency and productivity, as countries are able to take advantage of their comparative advantages and economies of scale.



Reduced transportation cost are estimated to spur an increase in annual goods trade to and from STRING regions of almost € 1 billion

Estimated annual trade impact of FBFL on the STRING regions (million Euro)



Note: Estimated trade impact of the FBFL on trade to and from the STRING regions. The calculations are based on combining a multitude of sources (see sources below).
Source: EUROSTAT, Statistics Denmark, Statistics Norway, Statistics Sweden, World Bank Trade Indicators, OEC, Vierth et al (VTI, 2020), Zofío et al (European Commission, 2020), Intraplan Consult GmbH (2014)

The FBFL could positively impact international goods trade

We estimate a total impact on increased trade of **€ 940 million (the sum of exports and imports increases for all the STRING regions)** from the establishment of FBFL and the transport cost reductions. In relative terms, **the effect equals a trade increase of almost 0,3 %.** This can be compared to the annual trade growth rate of Denmark between 1990- 2000 of about 4 %.

We estimate the interval of the trade effect to € 330 million – € 1 550 million. This effect is calculated exclusively for the STRING regions. Hence the total trade effect of the FBFL can be expected to be higher. Uncertainties exist regarding several factors, including the goods trade capacity of the FBFL, the future toll/fee of the FBFL, the competitiveness of the FBFL trade route in relation to maritime shipping routes between Scandinavia and continental Europe, future goods trade characteristics, among others.

The trade effects are distributed unevenly among the STRING regions. In general, the closer to the link, the greater the relative trade impacts. However, the trade effects on the German side are typically smaller since the FBFL-relevant trading partners in the north constitute a smaller trading market than the European continent, which is the FBFL-relevant trading market from the Scandinavian STRING regions. The size of the trade effects also depends on today's size of the market, and the intensity of trade that is already taking trade.

Since **the toll/fee for passing the fixed link is yet undecided, we have chosen not to include this as a factor in the analysis**. This means that we implicitly assume that the link fee will the same as in the other relevant transport corridors. The bridge toll on the Great Belt Bridge is around 30-50 % of the price for the ferry between Puttgarden and Rødby according to our estimates. All the roads from Eastern Denmark to the continent are coupled with toll or ticket costs and so will the FBFL. At the time of writing, we have no information on how the FBFL-toll will be set in relation to existing tolls and ticket prices.

Reduced transport costs stimulate goods trade in certain product sectors where transport costs are important

Trade in some product categories is more dependent on transportation costs than others

High impact of transport costs on trade

- Fabricated metal products except machinery and equipment
- Computer electronic and optical products. Electrical equipment. Machinery and equipment.
- Textiles wearing apparel and leather products.
- Wood and products of wood and cork except furniture, articles of straw. Paper and paper products. Printing and recording services.

Medium impact of transport costs on trade

- Motor vehicles trailers and semi-trailers. Other transport equipment.
- Chemicals and chemical products. Basic pharmaceutical products and pharmaceutical preparations.
- Furniture and other manufactured goods.
- Food products beverages and tobacco products
- Mining and quarrying
- Rubber and plastics products
- Other non-metallic mineral products
- Basic metals

Low impact of transport costs on trade

- Products of agriculture hunting and related services
- Coke and refined petroleum products
- Products of forestry, logging and related services.
- Fish and other fishing products, aquaculture. Products, support services to fish.

Source: The impact of transport cost on trade (import substitution) for different product categories in the EU are gathered from Zófio et al (2020).

The FBFL can help strengthen competitive advantage and diversify the STRING region exports

Goods exports per year from the STRING regions are estimated to increase by about € 490 million. The reduction in transport costs particularly spurs trade in some product sectors, potentially strengthening the STRING regions capabilities of diversifying their exports – but also solidify their competitive advantage.

In general, the **STRING regions are strong in machinery and various types of electronics**, which are among the product areas being relatively highly affected by transport prices. Hence, the Fehmarn Belt Fixed Link could help solidify the STRING regions' competitive advantage in these product areas, vis-à-vis their relevant trading partners from a FBFL perspective.

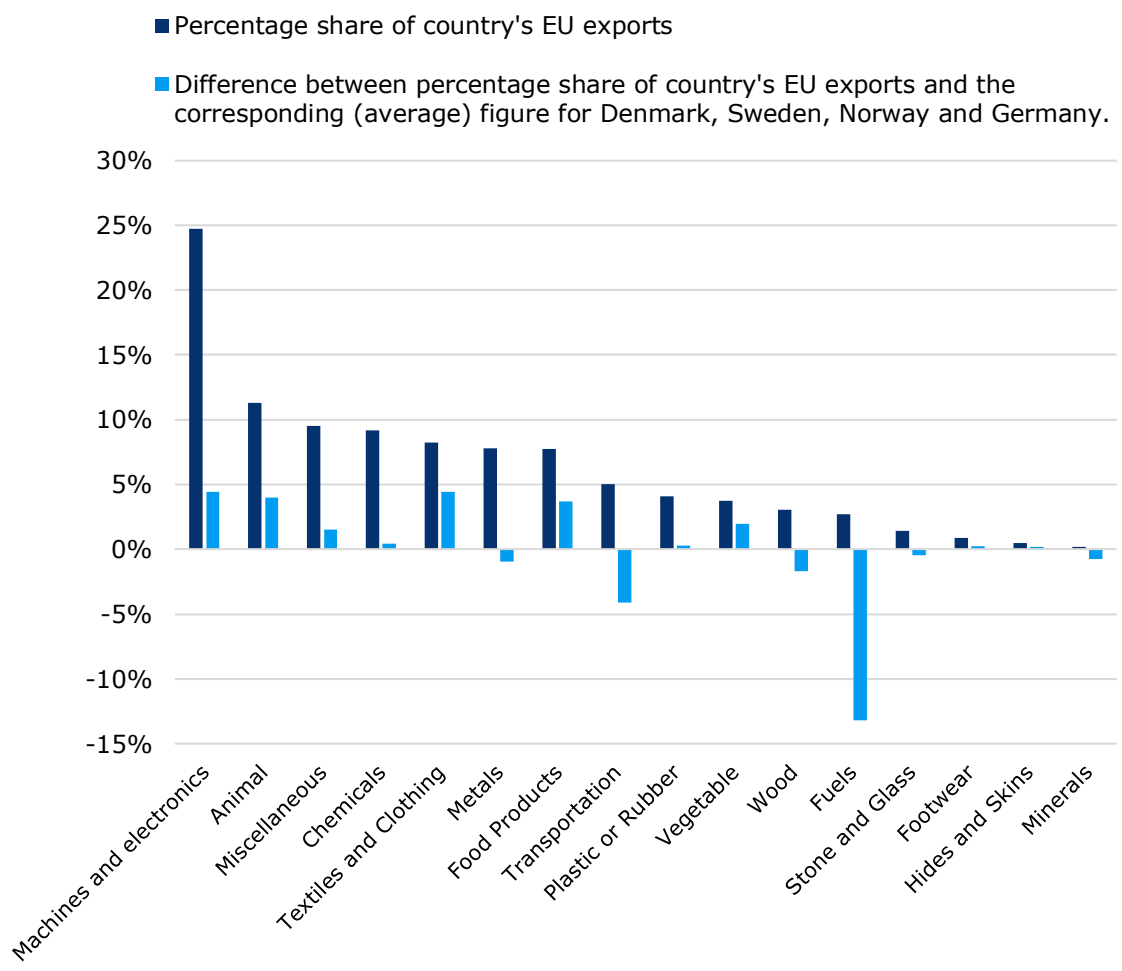
In a study on the trade sensitivity to transport costs in the EU for 14 different types of goods categories (Zofío et al 2020), the researchers found particularly high trade sensitivities for products such as computer electronic and optical products, Electrical equipment and machinery and equipment. The findings on trade sensitivity to transport costs are somewhat contradictory to economic theory, since transport costs typically constitute a rather small share of total product costs in goods that are more expensive. In contrast, product categories such as food products and beverages are estimated to have a medium relative trade sensitivity to transport costs. However, the effect of the FBFL on trade within these product categories can be affected by time sensitivity factors rather than cuts in transport costs. For example, transporting certain food products are both time sensitive and require the use of refrigerated trailers. A reduction in transportation time between southern Scandinavia and the European continent can then certainly affect the willingness to trade goods that are particularly time sensitive.

The impact of transport costs on goods trade in the STRING regional economies will differ depending on various factors, several of which are unobservable. However, it is likely that exports as well as imports "transport cost sensitive goods" will increase the most. In product areas with relative comparative advantage, exports are expected to grow the most.

On the following pages, we show which product categories the respective STRING countries export most of.

The largest relative impact is of the FBFL on international goods trade are expected in Region Zealand and the Capital Region of Denmark

Exports from Denmark to the EU per product category in 2021



Note: A positive value on the blue bar means that the country exports more of the product category then the average of the STRING countries.
Source: World Bank Trade Indicators (2021), Copenhagen Capacity (2022), Statistics Denmark (2021)

In Denmark (as in Germany) exports of machines and electronics constitutes roughly one quarter of the total exports to the EU. Animal products and chemicals constitute the second and fourth largest export products. Denmark has a comparative advantage particularly in machines and electronics, animal products, textiles and clothing and food products.

Estimated effects of FBFL on goods trade

Capital Region of Denmark

Total exports estimated to €42 billion*.

Goods exports are estimated to increase by **€ 230 million** annually in the **Capital Region of Denmark**.

Product area strengths include life sciences, ICT services, transport & logistics, business services, finance, food and additives.

Notable companies include Novo Nordisk, Maersk, DSV, Genmab, Ramboll, Novozymes.

Estimated export increase due to FBFL: **0,55 %**

Region Zealand

Total exports estimated to €10 billion*.

Goods exports are estimated to increase **by € 81 million** annually in **Region Zealand**.

Product area strengths include construction services and transport services.

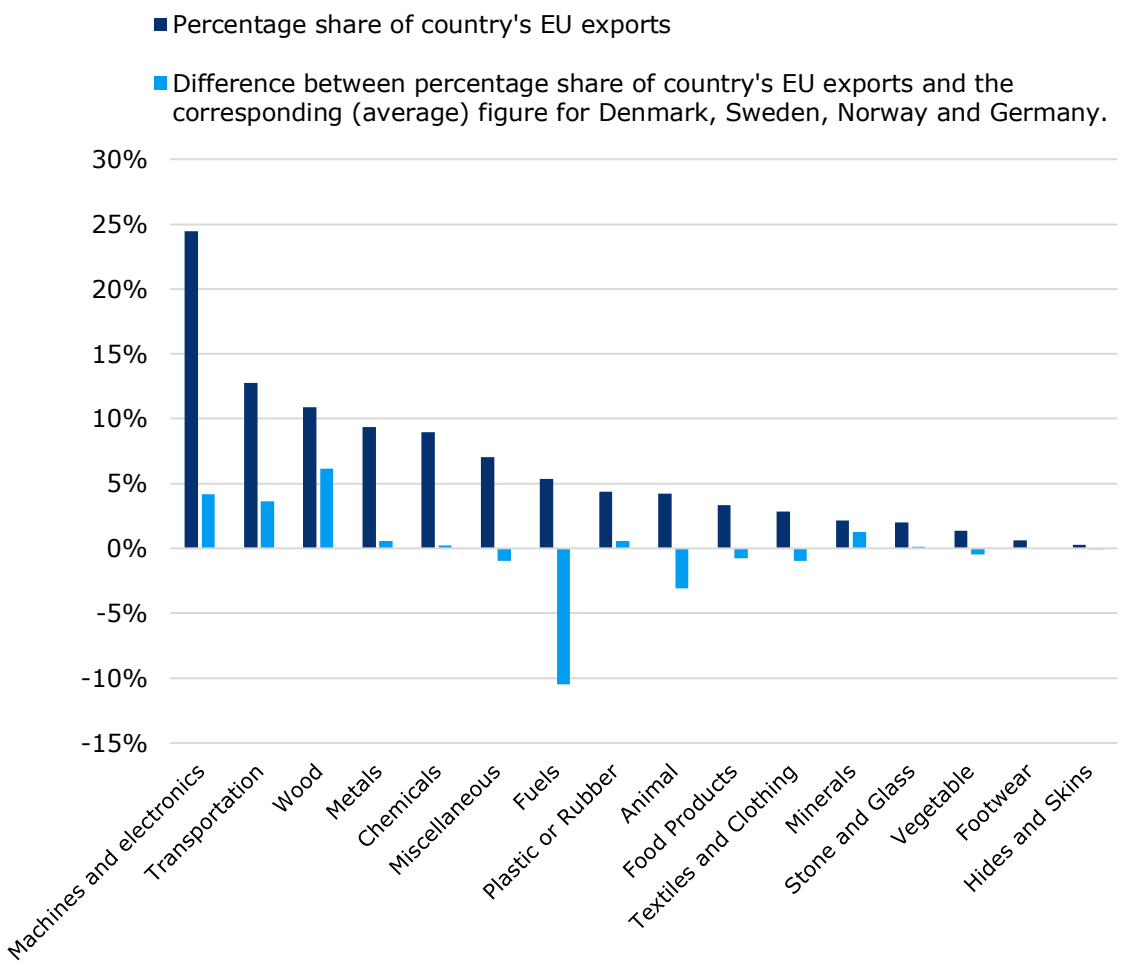
Notable companies include DI-Teknik, Vestergaard, Pharmacosmos, DSV Transport.

Estimated export increase due to FBFL: **0,81 %**

Note*: Exports by administrative region in Denmark has been estimated using the national export figures and regional GDP contribution to national GDP, 2021. Hence the estimation is based on the assumption of constant GDP to exports relationship.

Strengthened Swedish exports in machinery and electronics are expected

Exports from Sweden to the EU per product category in 2021



Note: A positive value on the blue bar means that the country exports more of the product category then the average of the STRING countries.
Source: World Bank Trade Indicators (2021), Swedish Growth Agency (2021), Stockholms handelskammare (2021), Trafikanalys (2020)

In Sweden, machines and electronics exports constitute almost one quarter of the total exports to the EU, comparable to Germany and Denmark. This is followed by exports in transportation products, wood, metals and chemicals. Sweden is particularly strong, relative to its neighbours, in terms of wood products, but also in terms of transportation and machines and electronics.

Estimated effects of FBFL on goods trade

Västra Götaland & Halland

Total exports €37 billion (2021)

Goods exports are estimated to increase by **€ 81 million** annually in the **Västra Götaland region**.

Product area strengths include transport equipment, machinery, chemical products, electronics and wood products.

Notable companies include Volvo, SKF, Carl Bennet and Getinge, Derome

Estimated export increase due to FBFL: **0,22 %**

Scania

Total exports €13 billion (2021)

Goods exports are estimated to increase **by € 30 million** annually in the Scania region.

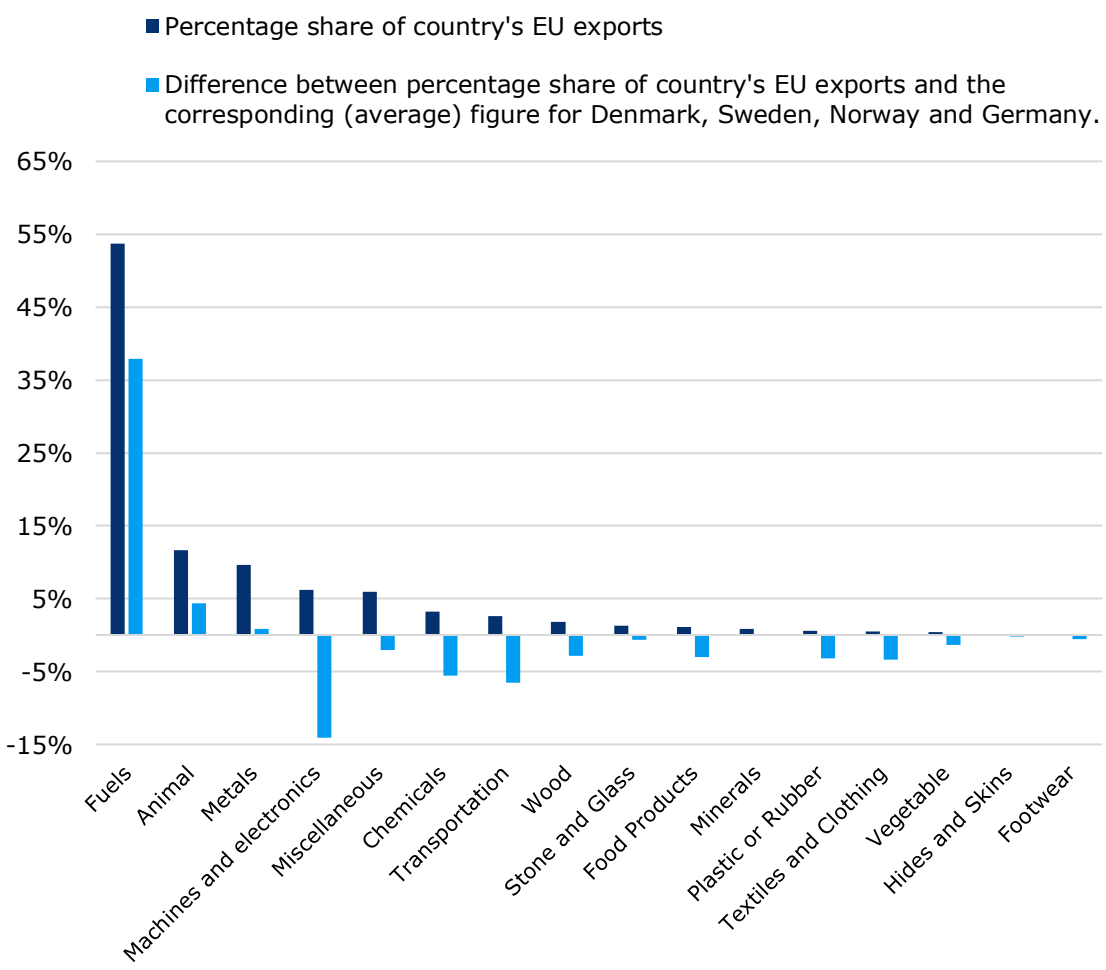
Product area strengths include machinery, electronics, chemical products metals and metal products, food products, wood products.

Notable companies include Elekta, Alfa Laval, Tetra Pak

Estimated export increase due to FBFL: **0,23 %**

A high share of goods exports going to the EU benefits Norway

Exports from Norway to the EU per product category in 2021



Fuels dominate Norway's exports to the EU. This is followed by animal products and metals. The figures indicate, unsurprisingly, that Norway has a strong competitive advantage in fuels and but also a certain competitive advantage in animal products. Compared to the other STRING economies exports in machinery and electronics are relatively weaker, as are exports in chemicals.

Estimated effects of FBFL on goods trade

Oslo & Viken county

Total (mainland) exports for Oslo and Viken county was around €4,5 billion in 2020.

Goods exports are estimated to increase by **€ 6 million** in Oslo & Viken county taken together.

Product area strengths include machinery and drilling, chemicals and pharmaceuticals, ICT services, financial services.

Notable companies include DNV GL, Telenor, DNB, Kongsberg Gruppen, Yara International,

The Norwegian economy is divided as the mainland economy and the offshore economy. Oil and gas production, which constitutes the country's offshore economy, makes up 51 % of Norwegian exports and provided the EU with around one fifth of its gas needs in 2020. A figure that has increased since the Russian invasion of Ukraine.

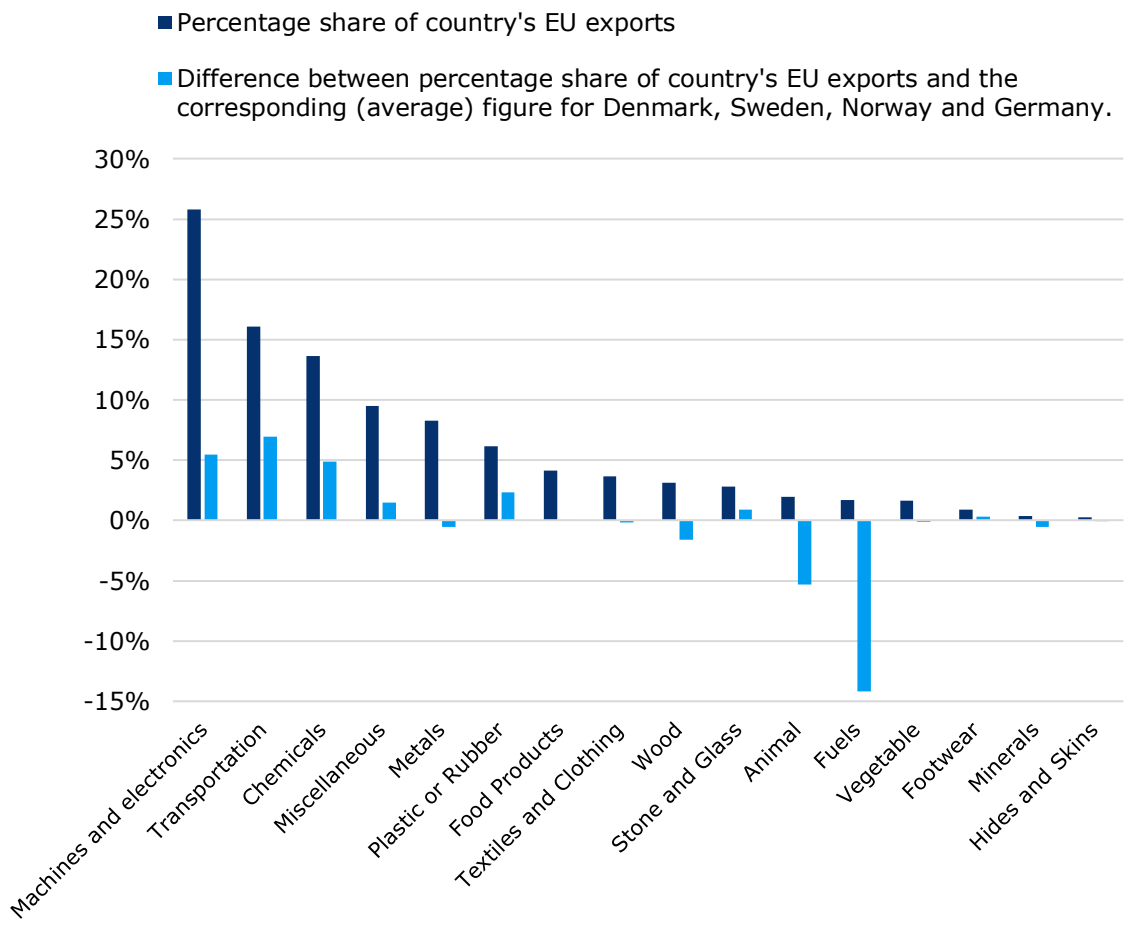
The export of fuels are not expected to be affected by the FBFL these products are transported with gas pipelines and maritime shipping.

Estimated export increase due to FBFL: **0,13 %**

Note: A positive value on the blue bar means that the country exports more of the product category then the average of the STRING countries.
Source: World Bank Trade Indicators (2021), Statistics Norway (2020)

The export impact in the Hamburg region and Schleswig-Holstein is relatively lower than in the Scandinavian STRING regions

Exports from Germany to the EU per product category in 2021



Note: A positive value on the blue bar means that the country exports more of the product category then the average of the STRING countries.
Source: World Bank Trade Indicators (2021), Federal Statistics Office of Germany (2020), OEC (2021), Hamburg Chamber of Commerce (2021), Business Development and Technology Transfer Corporation of Schleswig-Holstein, Schleswig Holstein

In Germany, exports of machines and electronics constitute roughly one quarter of the total exports to the EU. Transportation and chemicals are the second and the third most exported products. In terms of competitive advantage in relation in the product areas transportation, machines and electronics, and chemicals. It has a comparative disadvantage in animal products and fuel.

Estimated effects of FBFL on goods trade

Hamburg region

Total exports €43 billion (2021)

Goods exports are estimated to increase by **€ 43 million** annually in the **Hamburg region**.

Product area strengths include transport equipment, machinery, chemical final products, mineral oil products and ICT manufacturing.

Notable companies include Airbus, Lufthansa Technik Beiersdorf and Aurubis. It is also home to head offices of several global companies including Siemens and Philips.

Estimated export increase due to FBFL: **0,10 %**

Schleswig-Holstein

Total exports €23 billion (2021)

Goods exports are estimated to increase by **€ 21 million** annually million in Schleswig-Holstein

Product area strengths include pharmaceutical products, food processing, chemical final products, medical equipment and plastics.

Notable companies include Ammeraal Beltech, CustomCells, Dräger.

Estimated export increase due to FBFL: **0,09 %**

Trade in services and the role of the FBFL

Analysis of the potential of the FBFL as a driver of international trade in services

The FBFL can positively affect cross-border trade in services - The size of this effect is however too uncertain to estimate.

Several drivers through which the FBFL can boost trade in services

Increased market accessibility

Increased market accessibility, provided by the FBFL, is expected to be the key driver of trade. In addition to the realised increase in market accessibility given from reductions in land-based travel times and costs, The Fehmarn Belt Fixed Link could also influence businesses as a cultural marker for Northern European integration, further providing incentives to widen the sourcing of services beyond borders.

Goods trade also stimulates trade in services

Increased goods trade can often spur increased trade in services for several reasons. One explanation is the formation of new networks at the firm level. As firms start engaging in bilateral goods trade, contacts are established which can spur trade in various services. Moreover, goods trade increase the potential for policy initiatives aimed at deepening the trade relationships between trade partners, further strengthening market relationships.

Accessible and sustainable alternative to air travel

Accessibility and the convenience of travelling are key factors to stimulate tourism. The FBFL could provide travellers in Northern Europe with a convenient and sustainable alternative to air travel. This could yield benefits both for leisure and business travellers, as consumers and businesses increasingly focus on reducing carbon emissions. However, seldom at the expense of accessibility and timeliness.

Geographical market integration can help boost international services trade

As with goods trade, reduced transport times and transport costs can **increase the efficiency of trade** in services by reducing the transaction costs associated with exchanging these goods. When businesses and other organizations are located close together, it becomes easier for them to find buyers and sellers for the services they offer, as well as to negotiate contracts and other agreements. This can make it more cost-effective for these organizations to trade with each other, which can increase the overall volume of trade in services.

Second, reduced transport times and transport costs can also create **economies of scale** that can make it more profitable for businesses and other organizations to trade in services. When many businesses are located in close proximity to each other, they can share certain resources and infrastructure, such as transportation networks, utilities, and other support services. This can help to reduce the cost of providing services, which can make it more profitable for businesses to engage in trade.

Third, reduced transport times and transport costs can also foster the development of **specialized services** that are in high demand. When many businesses are located in the same area, they can benefit from the presence of a large pool of skilled workers and other resources that can support the development of specialized services. This can make it more attractive for businesses to invest in the development of these services, which can increase the overall volume of trade in services.

A more direct outcome of the establishment of the FBFL is potentially the growth of businesses **along the pathway of the fixed link and its adjacent infrastructure**. This has been recognized as an important effect of the Channel Tunnel between UK and France.

Moreover, **a boost in trade in services can serve as a second to third order outcome of the FBFL**. As more primary effects are realised such as increased innovation in northern Europe, growing investments in adjunction to the FBFL and an increased trade in goods, services trade can grow as an indirect outcome.

Source: Ariu et al (2017), TENTacle 2018, Blanquart et al 2017, Heddebout et al (2018)

Service exports are key income drivers in the STRING economies - The FBFL can facilitate enhanced mobility for services exporters

A wide range of services are traded from the STRING economies

Services exports are the sale of services from one country to another. Services are intangible goods that are not physical in nature, such as consulting, education, banking, and tourism.

These can be sold without the need to physically transports goods across borders. However, exports in services and business travel are closely linked. Services exports are important of sources of income for the STRING countries. They can also be a key driver of economic growth, as they can create jobs and stimulate demand in the domestic economy. There are many different types of services that are exported from the STRING economies, examples include:

Travel and tourism services: This includes the sale of tourist-related services, such as hotel accommodations, transportation, and sightseeing tours.
Business services: This includes the sale of a wide range of business-related services, such as consulting, accounting, and legal services.
Education and training services: This includes the sale of educational services, such as language training, university education, and vocational training.
Financial services: This includes the sale of financial services, such as banking, insurance, and investment services.
Telecommunications and information technology services: This includes the sale of telecommunications and IT-related services, such as computer programming, data processing, and internet services.
Health and social services: This includes the sale of health-related services, such as medical treatments and healthcare consulting, as well as social services, such as counselling and rehabilitation services.
Engineering and technical services: This includes the sale of engineering and technical services, such as architecture, engineering design, and technical consulting.
Cultural and recreational services: This includes the sale of cultural and recreational services, such as the performing arts, sports, and museums.

	Germany	Denmark	Sweden	Norway
Services trade as % of country GDP	**16 %**	**40 %**	**26 %**	**20 %**
Export in services strongholds	ICT-services, financial services, business services, intellectual property, travel services	Transport services, business services, travel services, ICT, construction, Intellectual property, financial services	Business services, ICT-services, travel, transport, intellectual property, financial services, insurance and pension services, construction services	Transport services, financial services, ICT-services, travel services, business services
Insights from the Channel Tunnel and European High Speed Rail lines	Of the 21 million passengers travelling through the Channel Tunnel between the UK and France, an approximate 20 % are business travellers. This accounted for around 12 % of the total business trips between the UK and continental Europe. Among the reasons for travelling with the Eurostar between the UK and continental Europe, the High-Speed Rail travel alternative through the Channel Tunnel, is the flexibility that the alternative provides. In 2018, it was estimated that the euro-per-minute cost for business travel with high-speed rail in Germany, Spain and Italy was about 10-20 % compared to air travel. Moreover, as more businesses are looking at reducing their carbon footprints, the future will likely bring an upward pressure on rail-based travel.			

Note: Services imports + exports divided by the national GDP (2020), World Bank. Strongholds from OEC (2020) and the Nordic Council of Ministers (2014), EY (2016), European Court of Auditors Special Report (2018)

Tourism is important to the STRING regional economies - the FBFL can provide an attractive travelling alternative

The economic importance of tourism

Tourism contributes to a hefty 20 % of service-related exports in OECD countries, and to almost 7 % of total employment. The economic importance of tourism in the STRING regional economies varies quite significantly from highly important (Schleswig-Holstein) to less important (Zeeland).

Before the pandemic, foreign travellers spent a total of around 21 million nights in the STRING regions. The growth of overnight visitors has been significant between 2010 and 2019, particularly in the Hamburg region (+ 105 %), the Capital Region of Denmark (+ 75%) and in Scania (+ 71 %).

The FBFL can provide travellers with convenience, accessibility and cost cuts

In addition to the providing faster train and coach connections between the large cities in Scandinavia and the European continent, the FBFL can provide leisure tourists and business travellers with a convenient and accessible alternative to air travel. High speed rail is considered to provide a convenient alternative to aircraft, especially for travelling distances up to 1000 km.

From a sustainable travel perspective, for businesses and private consumers alike, the FBFL and the faster land-based travel connections between Scandinavia and continental Europe it gives, provides a welcomed alternative.

Region	Nights spent by foreign visitors	Development 2010-2019	Economic importance of the tourism industry
Hamburg region	3,8 million (2019)	+105 % growth	Important
Schleswig-Holstein	2,2 million (2019)	+58 % growth	Highly important
Region Zealand	0,6 million (2019)	+23 % growth	Less important
Capital Region of Denmark	6,8 million (2019)	+75 % growth	Important
Scania	1,8 million (2019)	+71 % growth	Important
Region Halland and Västra Götaland	3,2 million (2019)	+37 % growth	Very important
Oslo and Akershus county	2,6 million (2016)	*Not available*	Important

Source: Tourism statistics from Eurostat. The regional economic dependence on the tourism industry gathered from Chica et al (2021). Analysis of GVA-contribution by BAK Economics, Bustos et al (2022)

Faster train connections between Scandinavia and continental Europe can boost sustainable tourism

Air travel is dominant in the STRING countries

Air travel for overnight outbound travel is more common in the STRING countries compared to the EU 27. Particularly in the case of Sweden, Norway and Denmark, which can partly be explained by geographical factors, being located in the outskirts of Europe.

In EU overall, air travel is considerably more common for business travel – for which time savings are often valued higher than costs. The provision of timely travel alternatives are key to stimulate a shift in business travel patterns.

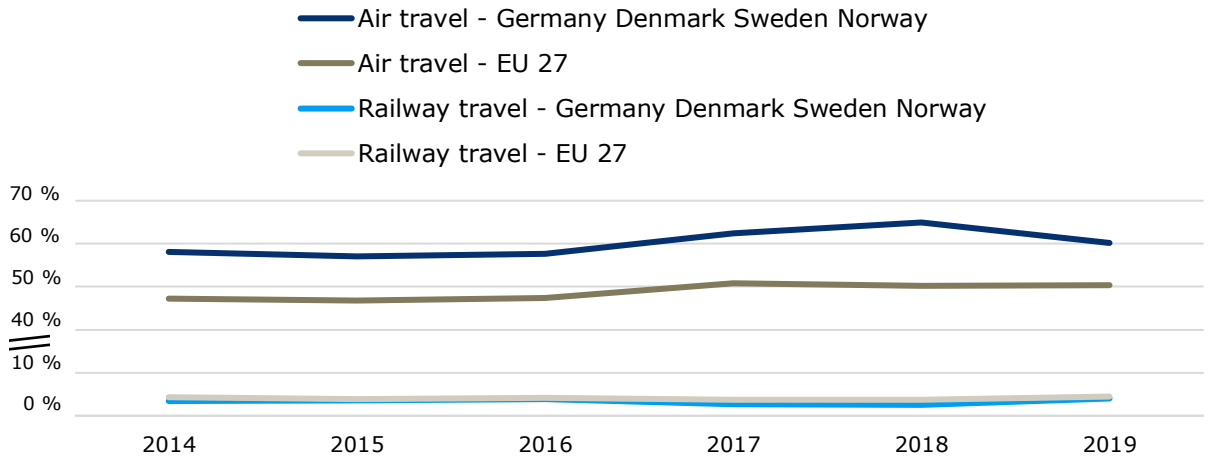
Sustainable travel is here to stay

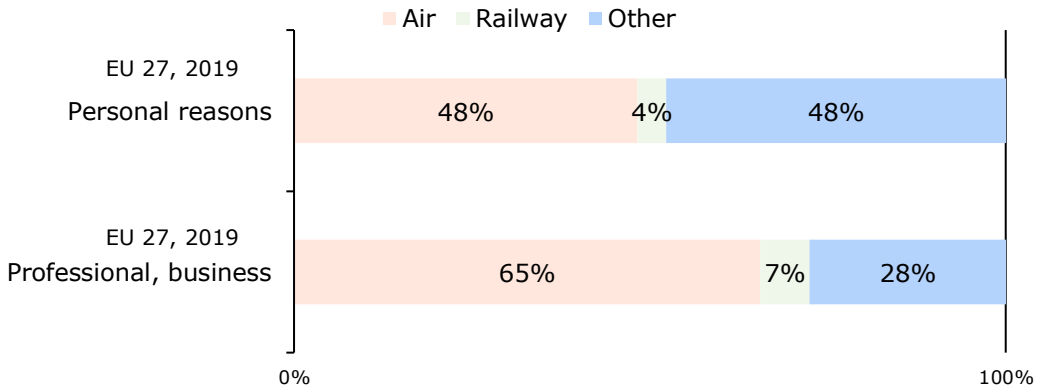
Sustainable travel by train is becoming an increasingly popular trend in Europe, as more and more people look for ways to reduce their carbon footprint and make more environmentally friendly travel choices. While the share of railway travel for outbound travel remained relatively steady between 2014 – 2019, there are signs that railway travel within the EU has been on a growth path since. The FBFL and its high-speed rail line between Copenhagen and Hamburg would provide businesses and consumers with a sought after sustainable travelling option in Northern Europe.

Potential effects include more travel, but also increasing shares for railway travel

Since the initiations of High-Speed Rail (HSR) between several European cities, the most obvious effects have been in the area of leisure of tourism. The Eurostar that connects London with Paris and Brussels, has undeniably stimulated tourism, as has the HSR connection between Paris and Madrid. In a survey study by Delaplace et al (2014), surveyed tourists in Paris listed HSR as the third most important motivation for visiting the city, while 41 % of respondents in Madrid were positively influenced by the presence of HSR in their destination choice.

Travel statistics in the EU, outbound travel, railway and air





Source: Bustos et al (2022), New York Times (2022), Naylor (2018), Delaplace et al (2014)

Source: Eurostat travel statistics (2019) for outbound travel by mode of transport (air and railway), purpose of travel, and country of origin

Potential dynamic long-term impacts

Transport cost reductions, trade, and potential dynamic effects

Reduced transport costs for international trade benefit businesses and consumers – potentially spurring investments, innovation and employment

What is happening?

BUSINESSES

+ Businesses benefit from lower production costs due to decreasing import prices and transportation costs
+ Growing incentives to expand to foreign markets
÷ Increased profitability and enhanced competitive advantage due to lower input costs

CONSUMERS

+ Lower prices for consumer goods and services
+ Increasing product variety in local markets
÷ Increased consumer welfare and purchasing power of consumers

INVESTMENTS

+ Growing business profitability incentivize firms to further invest in business development, including production and foreign markets expansion
+ Improved conditions for innovation

INNOVATION

+ Improved accessibility to capital makes innovation more likely
+ Improved accessibility to foreign suppliers makes technology diffusion more likely, thus stimulating innovation
+ Closer distance between firms makes cooperation more likely

EMPLOYMENT

+ Exporting firms are a significant force for job creation and Gross Value Added.
+ Increased profitability could lead to increased wages
+ Increases in competitiveness improves the conditions for trade
+ Increased willingness for businesses to establish enterprises in the STRING regions

Expected impact

Note: + describes a positive impact while a ÷describes a negative impact

Businesses: Reduced transportation costs and strengthened inter-regional business networks can boost business performance

The FBFL could stimulate businesses in several ways

Efficiency upstream and downstream reduces production costs

There are two obvious direct upstream and downstream effects that the reduction in transportation costs can have on businesses in the STRING region. In terms of upstream effects, lower transportation costs and more efficient supply chain transportation networks could reduce input goods prices, thus reducing production costs. Similar effects occur downstream, further adding to production cost reductions.

Businesses can compete at lower prices, while still being profitable

In international and inter-regional comparisons, businesses that benefit from transport cost reductions will gain competitiveness – thereby strengthening market positions and allowing for business expansions.

With costs of production typically being high in Northern Europe, the FBFL could provide some businesses with new opportunities that help them compete in an increasingly global market.

New room for growth

Lower transportation costs can help businesses become more efficient and create new opportunities to allocate their resources. In the short run, when prices are quite stable, the reductions in transport costs will benefit exporting firms' cash flow, allowing them to invest in other areas of business such as research and development, marketing or foreign expansion ventures.

Businesses must act to realize the benefits of the FBFL

Reduced transportation costs can help businesses in several ways. It is however important to note that **not all businesses will have the same ability to reduce their transportation cost**, it depends on the nature and the type of the business. Businesses could benefit from conducting a strategic assessment of the current transportation systems, logistics and supply chains could be helpful to identify areas of improvement and cost reduction for each business potentially affected by the establishment of the FBFL.

To realize the benefits that may arise for businesses following the establishment of the FBFL, businesses must themselves act actively and make re-organizations in supply chains, input sourcing, and take steps to belong to business networks where cost and benefit developments can be facilitated. Businesses already engaged in bilateral trade before the introduction of the FBFL, with already established international contacts, apt organizational structures and the cultural capital to engage in trade over cultural barriers, will certainly be at advantage to transform the new logistics structure that the FBFL provides into business opportunities. Businesses who are more inept to act may see however see their market positions being threatened.

The FBFL represents a form of trade liberalization

In the EU single market, the common trade policy involves the free movement of goods, capital, services and people. As such, there are no tariff reduction measures to be taken to further stimulate intra-EU trade in goods or services. There are however other policy measures which can reduce the transaction costs of trade between member states, one such being infrastructure projects that clearly enhances the logistics networks between member states. The Fehmarn Belt Fixed Link can be viewed as such, which can have a number of policy implications. While trade liberalization typically yields net economic benefits for society, there are also typically winners and losers in this process. Among businesses and among employed. Recognizing these potential outcomes and working to counter them from a policy standpoint, may prove key to realize sustainable economic outcomes from the establishment of the FBFL.

Source: Ariu et al (2017), TENTacle 2018, Blanquart et al 2017, Heddebout et al (2018), Shu et al (2019)

Consumers: Reduced transportation costs and increased trade can stimulate lower consumer prices and increase the availability of goods

The availability of goods and reduced consumer prices consumer welfare

As the business effects of the Fehmarn Belt Fixed Link include reducing costs of production and the stimulation of competition in local markets, consumers will be among the main beneficiaries. As the effects of reduced production costs are coupled with effects on prices, in particular for goods which in which competition and production costs are most affected, the net economic benefits will be shared between producers and consumers.

Moreover, with foreign firms becoming more competitive on distant markets given the improved logistics networks, a result may be more competitive local markets where consumers may witness an increase of products and brands. While increased competitiveness on local markets may put even more downward pressure on consumer prices, consumer welfare is also benefited by the sheer increase of supply, which may cater to the needs and tastes of certain consumers.

It is likely that the FBFL will impact prices of certain consumer goods

1. **Direct impact on the price of goods**
If a product must be shipped or transported a long distance before it reaches the consumer, the cost of transportation will impact the price of the product. As transportation costs go down, the consumer will likely benefit directly from price cuts – in particular in competitive product markets.

2. **Indirect impact on the price of goods**
Transportation costs can also affect the price of goods indirectly by influencing the overall cost of production. For example, if a company has to pay more to transport raw materials to its factory, it may need to charge more for its finished products in order to cover these higher costs. As the costs of production are reflected in the consumer prices, again especially in competitive product markets, the effect would be price reductions.

3. **Downward pressure on prices from increased competition**
Transportation costs can also affect competition between companies. For example, a company that is located close to its customers may have an advantage over a company that is located farther away and has to pay more to transport its products. As geographical transaction costs go down, more firms may compete for the same costumers, stimulating the competition for consumers, which theoretically would lead to a further downward pressure on prices.

Investments: Reduced transport cost and distances – and increased trade – could attract investments

Improved logistics networks can attract investors

Fast transportation can be beneficial for companies in logistics as they may have opportunities to serve as intermediary. For instance, companies might be able to take advantage of economies of scale by consolidating goods from multiple suppliers and then shipping them to a specific location, which can result in cost savings for the suppliers and the customers.

Locality based investments along the path of the FBFL and adjacent infrastructure

In the case of the Channel Tunnel between the UK and France, several private industrial investments were induced by the realisation of the tunnel, in adjunction to the tunnel itself but also further away geographically. In addition, rather large scale investments in tourism in adjunction to the tunnel were also realised.

It is likely that the FBFL will induce investments and the establishments of businesses in the areas of South Zealand and Northeastern Schleswig-Holstein. As traffic is re-routed towards the FBFL, and trade increases, the increased economic activity will give rise to increased local demand.

CASE Business Park Falster

Source: Bayark

Business Park Falster is located near exit 43 on the E47 / E55 motorway, on Falster, where the Western European traffic corridor of the E47 meets the E55 Eastern European traffic corridor –with close access to Hamburg, Berlin, Copenhagen, Malmö and Oslo.

An analysis by TENTacle (2017) shows that the business area can meet the demand from a broad range of companies, including companies within the transport-and logistics industries as well as companies within production with a large need for transport. In particular in the light of the establishment of the FBFL.

Source: Persson et al (2019), Heddebout et al (2018), TENTacle (2017)

Innovation: Increased trade can foster more innovation

Trade can improve knowledge diffusion

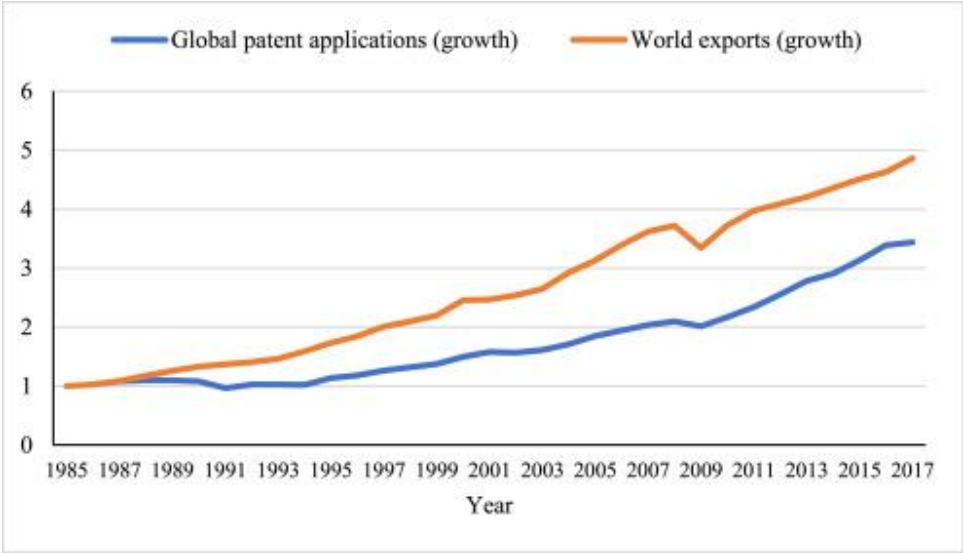
Obtaining access to technology and knowledge from other countries can greatly speed up domestic innovation and growth. There are multiple ways in which this can happen, such as through imports, foreign direct investment (FDI), and trade in technology. This exchange of technology can occur among competitors (horizontal diffusion), within a supply chain (vertical diffusion), within an enterprise group, or through interactions with universities or government research organizations.

Overall, trade can create opportunities for firms and countries to learn from each other and gain access to new technologies and best practices that can help to drive innovation and economic growth.

Trade can increase incentives to engage in innovative activities

Trade can impact innovation through its effect on competition. Overall, competition works in two main ways: First, it leads to selection among producers with different levels of productivity, with more efficient producers gaining market share and less efficient ones losing it. Second, competition can impact the innovation efforts of individual firms, although this can have both positive and negative effects. On one hand, competitive pressure can be an incentive for a company to become more efficient. On the other hand, competition can reduce the monopoly profits that would otherwise motivate a company to invest in innovation.

Global innovation and trade 1985 - 2017



Source: Geng (2021)

Source: Rubini (2014), Redding (2021), Geng (2021), Kiriyama (2012)

Employment: Trade stimulates employment

Exports support one fifth of all jobs in the EU

Exports support one out of five jobs in the EU, amounting to 38 million jobs. The jobs created provides opportunities for everyone, both skilled and unskilled workers. However, jobs in export industries are jobs are better paid on average.

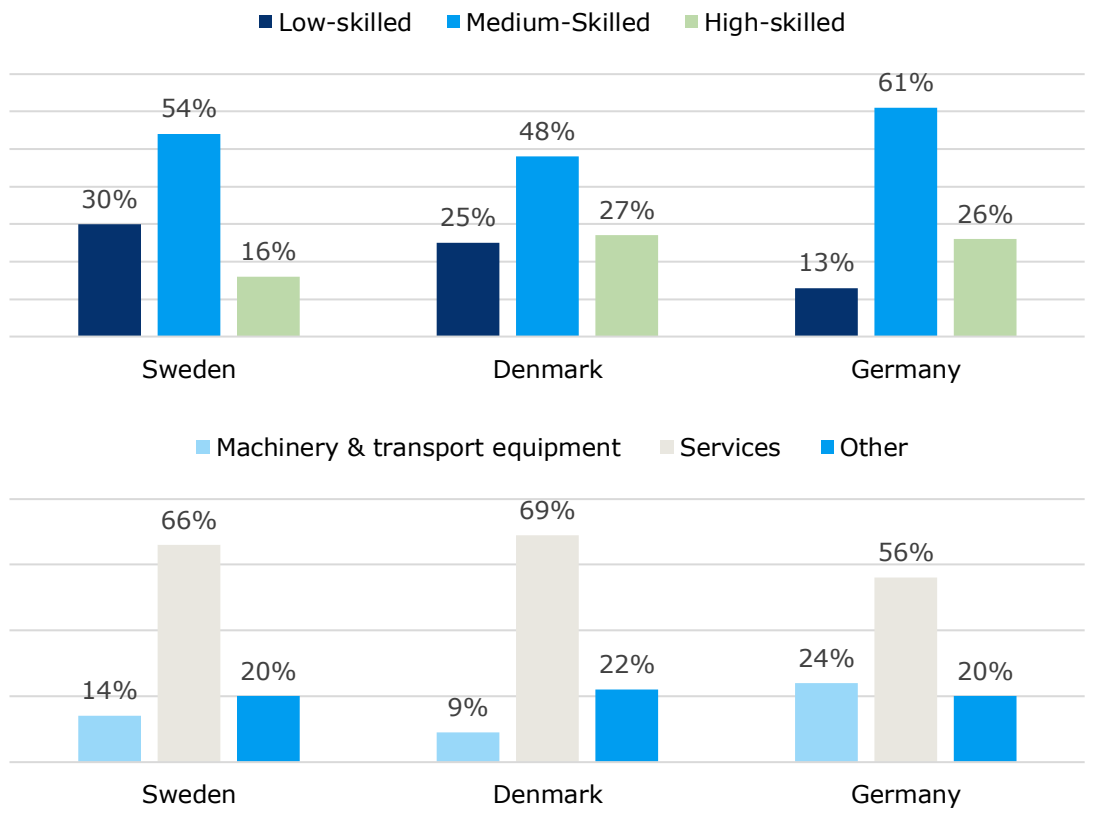
In terms of types of workers supported by exports, medium-skilled workers constitute the bulk of supported jobs. The shares between skill levels does however differ between the member states. In Sweden, many low-skilled jobs are supported by extra-EU exports whereas more than one quarter of jobs supported by exports in Denmark and Germany are held by high-skilled workers.

Job creation outweighs the job displacement effects of trade

The clearest mechanism for how trade supports domestic jobs is through increase foreign demand. Another way that trade can support employment is by increasing the productivity of domestic firms. When firms are able to access a wider range of inputs and technologies through trade, they can become more efficient and productive, which can lead to increased profits and the ability to hire more workers.

Trade can however also displace some jobs in certain sectors, when firms relocate to countries where labour is cheaper. In the long run it is widely believed that the benefits of trade outweigh the costs of job displacement.

Employment created by exports, by skill level and sector



Source: European Commission (2021)

Note: The data are based on extra-EU exports, i.e. exports by the member states to non-member states. There is no data for Norway.

Source: European Commission (2021), UNCTAD (2020)

The FBFL will reduce the externality costs of transport - if more transport is shifted over to railway cargo

The Fehmarn Belt Fixed Link could reduce the externality costs of transport

Transport has significant externality costs

- The external costs of transport in the EU amount to around 8 percent of GDP. Motorized transport account for about 90 percent of these external costs.
- Traffic externalities costs are the costs of a transportation system that are not reflected in the price paid by the user of the system. These costs or benefits can affect people who are not directly involved in the transportation, such as residents who live near a busy road or highway, or the environment around traffic routes.

The FBFL can reduce transport externality costs

- For each kilometre of traffic shifted from maritime to railway there are savings of € 0,06
- For each kilometre of traffic shifted from truck to railway, there are savings of € 0,21
- The increased capacity of railway use for passenger travel and rail cargo – as well as the reduced transportation distance between Denmark, Sweden and Norway and the European continent – could lead to a reduction of externality costs.
- Ramboll's back-of-the-envelope calculations indicate reductions in externality costs linked to international goods transports at **€ 3 million** annually, thanks to the FBFL.

Statistics on externality costs	Rail cargo	Truck	Maritime
Total estimated cost of externalities in the EU	€ 5,3 billion	€ 62,9 billion	€ 98,1 billion
Estimated externality cost per kilometre	€ 0,14	€ 0,35	€ 0,2
Largest drivers of externality costs			
Accidents		●	
Air pollution		●	●
Climate		●	●
Noise	●	●	
Well-to-tank. Indirect/upstream emissions caused by energy and fuel production.		●	●
Habitat damage	●	●	●

The external costs of all transport in the EU (including the United Kingdom) has been estimated to **€ 716 billion annually** (European Commission, 2016) which amounts to around 8 percent of GDP. Motorized transport account for about 90 percent of these external costs.

Source: Statistics of externality costs from the European Commission (2019).

Methodology in brief

Overview of methodology of the trade analyses

	Estimation of transport costs effects	Estimation of effects on international goods trade	Potential impact of international services trade	Dynamic effects of reduced transport costs and increased trade
Description				
Data sources	Persyn et al, Trafikanalys, Netherlands Institute for Transport Policy Analysis, EUROSTAT, OECD (2020) and more.	Zofio et al (2020), EUROSTAT, Statistics Sweden, Statistics Denmark, Statistics Norway, German Federal Statistics Office and more.	Eurostat, World Bank, Naylor (2018), Delaplace et al and more.	Ariu et al, TENTacle, Blanquart et al, Heddebout et al, Shu et al and more.
Estimation strategy	Calculus using shortened time and distance for goods traffic in conjunction with goods trade volumes and shares between modes of transport.	Calculus using transport cost effects and EU regional elasticities for trade responses to transport costs, together with several bi-calculations	Assessment of possible impacts (not calculations) based on descriptive data and empirical findings	Research overview
Outcome of interest	Reductions in transport costs in the STRING regions for international goods trade	Predicted response in international goods trade	Potential implications of the FBFL on international trade in services	Insights on the potential wider economic effects of the FBFL's impact on transportation costs and trade

Methodology explained – Estimation of transport costs effects

Reductions in transport costs in the STRING regions for international goods trade

The analysis consist of several different sub-analyses, including

- Investigation of trade flows to and from the STRING regions to and from relevant trading partners.
- Investigation of trade routes, by inspecting mappings such asTrafikanalys (2016) and European Commission (2019). One such example is the Trans-European Transport Network (TEN-T) mapping provided by the EC. This part of the analysis created a overview of the goods transport networks between Scandinavia and the European continent are configured. Investigation of how the international goods trade from the Scandinavian countries to the European continent is allocated between different modes of transport, and likewise for the trade between Germany and Norway, Sweden and Denmark.
- Investigation between the cost of transport per road, rail and maritime shipping – in the context of the STRING economies.

By investigating these three different parts, as well as conducting analyses with the purpose of producing customized estimations for the STRING regions, we get enough data material to further estimate transport reduction effects, both in terms of absolute figures but also in relative terms to current estimated transport costs. These transport cost effects are to varying extents estimated between EU regions at the NUTS2-level, However, each of these calculations include uncertainties of various levels, stemming from uncomplete data coverage for the various STRING countries (and in particular its regions) and that the data itself is not fully configured for the needs of this specific research questions. Examples of uncertainties in the calculations include:

- There are no available data on the allocation of goods transport by modal type (road, railway, maritime) between one EU member state and the next, hence we had to do assumption based, however partly data driven, calculations to customize the modal shares given the definitions of the FBFL relevant trading partner definition.
- Regarding transport cost data per tonne/km of goods transport, we have estimated the costs for each modal transport type first using transport cost figures on the regional level by Persyn et al (2019), then estimating comparable costs for maritime shipping and railway cargo using other literature sources such as Vierth et al (VTI, 2020) and Trafikanalys (2019)
- Uncertainties uncovered also provide the basis for the transport cost reduction estimate interval, which is based on uncertainties in modal allocation and cost figures.

As a result of the investigative analytic work conducted to build the various estimations going into the final transport cost reduction valuation, a wide array of literature has been included in the analysis. At times however, contradictory figures have been spotted, which has propelled us to make judgments, while attempting to triangulate the information using different sources. The sources used include Trafikanalys, and Netherlands Institute for Transport Policy Analysis, Persyn et al, TENTacle, OECD, Eurostat Statistics Norway, Statistics Denmark, Statistics Sweden, Federal Statistical Office of Germany.

Methodology explained – Estimation of effects on international goods trade €

Predicted response in international goods trade

Largely building on the analysis of reductions in transport costs for international goods trade, the analysis continues by estimating the potential impact on international goods trade to and from the STRING economies. The predictions for international goods trade consist of a quantitative valuation part and a qualitative part

The key source material used for the calculations in this part is gathered from Zofío et al (2020), in which foreign goods trade response elasticities (elasticities for import substitution) are estimated in an EU regional context. In the study, conducted on European NUTS2-level regions, estimations have also been done to estimate trade responses to transport costs for different product areas. Moreover, the study shows that trade response elasticities are higher the closer the trading neighbours are located geographically. This has implications for the estimations but has only been incorporated in the calculations as approximations. There exists uncertainties in the calculations as the trade flow data to and from the STRING regions to the FBFL relevant trading partners are not disaggregated at a product level basis. This prompts the calculations do be conducted on an assumption-based sense largely building on the national, and not regional, trade flow patterns.

Moreover, approximations has been made to evaluate the modal shift responses from maritime shipping to road and rail cargo, and between road and rail cargo. This is of importance since the transport cost reduction effects are different depend on modal choice of transport. The literature on cross-price elasticities for maritime/road and maritime/rail gives varying estimates, and we have therefore chosen to apply elasticities representing an interval found in Vierth et al (VTI, 2020).

For the analysis of the effects on international goods trade, we build on the literature used in the previous chapter, with the important additions of Zofío et al (2020) and Vierth et al (VTI, 2020). Moreover, the qualitative arguments on the potential international goods trade response are gathered from a multitude of sources including the national statistics offices of the STRING countries, World Bank Trade, OEC, OECD, Hamburg Chamber of Commerce, Business Development and Technology Transfer Corporation of Schleswig-Holstein, Stockholms Handelskammare, Swedish Growth Agency and Trafikanalys.

The impact of the FBFL on regional labour markets

Contents

Purpose and overview of the labour market analysis

Purpose

Following the Fehmarn Belt Fixed Link and related infrastructure improvements, the local labour markets becomes closer connected. As employees are sensitive to commuting times, the travel time reductions may make employees more willing to commute longer distances for work, thereby impacting labour markets positively.

Analysing the labour market is therefore important for understanding and assessing the impact of the FBFL.

Limitations

In this analysis, the impacts and potentials associated with the FBFL reflects an all else equal approach, meaning that the only thing changing is the FBFL and associated infrastructure improvements. In cases of data scarcity, assumptions have been introduced to allow for estimation (see methodology).

OVERVIEW OF THE ANALYSIS OF LABOUR MARKET IMPACTS

The FBFL and related infrastructure improvements cut travel times. These reductions are likely to affect the labour market through a combination of changes to the demand and supply of labour. Impacts on labour demand are seen when businesses move their activities due to improved accessibility to employees while impacts on labour supply are seen when employees either choose to commute or move closer to employers. The analyses in this chapter focuses upon the two former, i.e., how the potential for businesses is affected by increases in accessible employees and to what degree employees are expected to commute following the FBFL.

1 Access to employees

Access to employees is important for businesses when considering where to locate one's activities. Therefore, the first analysis determines the increase in available households within 45 minutes for businesses located in cities along the improved infrastructure. This showcases to what extent the cities become more lucrative for business activity thanks to increased access to employees.

2 Increases in commuting

The second analysis estimates increases in the number of short- and long-distances commuters following travel time reductions of the FBFL, thus taking the perspective of the employees.

3 Potential impact on the labour market

The third analysis assesses the potential that the expected increase in commuting has of impacting regional labour markets. In other words, how much of the regional excess labour demand (vacancies) are commuters expected to be able to fill. This analysis uses the results from the commuting analysis, data on vacancies and employees' educational levels across different sectors.

4 Expected value of improved labour markets

The fourth analysis concludes on the economic value of the labour market impacts by estimating the gross value added (GVA) brought by each additional employee. GVA is comparable to a Gross Regional (or Domestic) Product.

Main conclusions on the impact on the labour market

Access to employees

The access to employees increases substantially along the improved infrastructure making the **region more attractive for businesses**. For example, the city of Ringsted, the southern part of Region Zealand and potentially the cities of Lübeck and Hamburg will experience large increases in access to employees. Close-to-boarder cities are rather rural and will experience lower impacts on accessibility.

Increases in commuting

Improved infrastructure will impact both short- and long-distance commuting. In Region Zealand, improved infrastructure is expected to result in an **increase in the number of Danish domestic commuters by more than 2,000 people**. The FBFL is expected to result in an **increase in the number of cross-boarder commuters from Germany to Denmark by around 1,400 people**. **German domestic commuting will likely increase by around 5,000 people in this region**. Commuting will expectedly have the potential of increasing the workforce by up to 1.2%.

Impact on the labour market

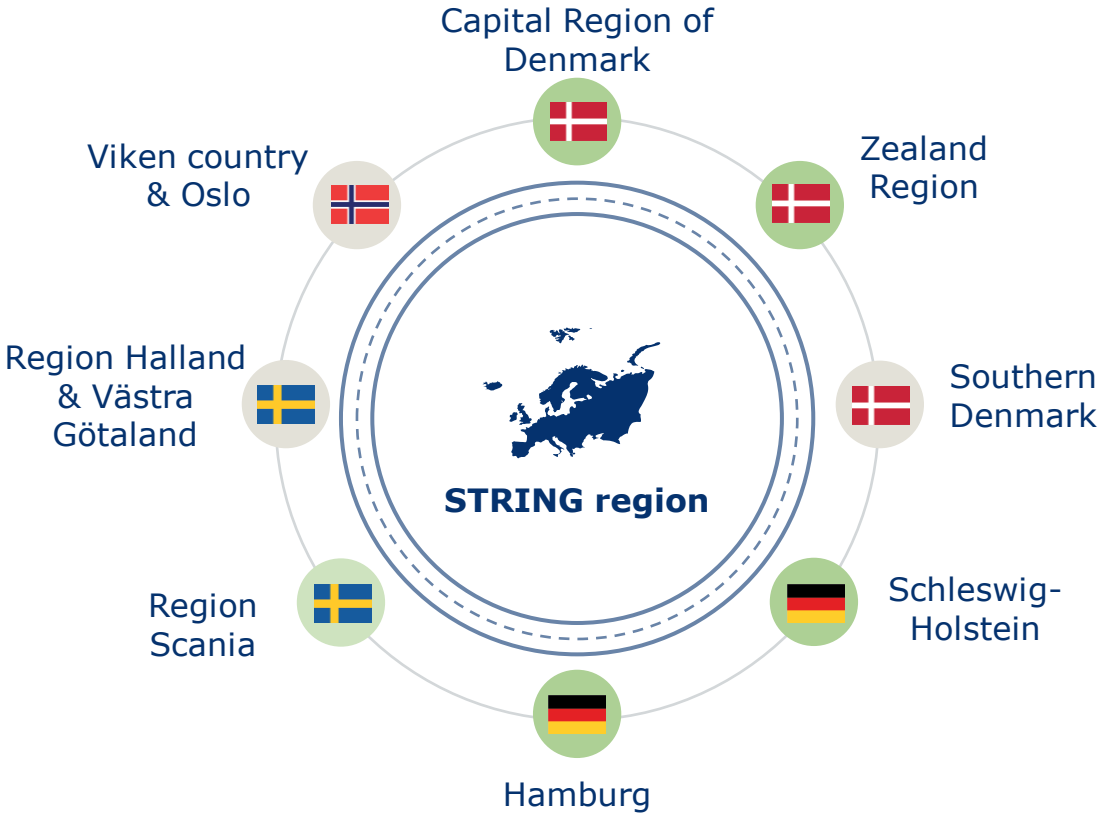
Commuting is expected to have the **largest proportional impact on excess demand for labour in Region Zealand.** Here, the expected number of commuters are likely to constitute a relative large proportion of excess demand. Oppositely, even though the Capital Region of Denmark and Germany are expected to experience larger commuting effects, impacts on the overall excess demand for labour in most sectors will likely be lower as the number of vacant jobs are higher.

Value of Commuting

The labour market impacts are expected to result in a gross value added of between 44-175 million euro in Region Zealand, 27-108 million euro in the Capital Region of Denmark and 64-257 million euro in Hamburg and Lübeck depending on the previous employment status of commuters.

STRING regions in focus in the Labour Market Analysis

The STRING regions marked in green are relevant to include in an analysis of labour market impacts



Note: In the labour market analyses, the southern part of Zealand is analysed as Region Zealand

Hamburg, Schleswig-Holstein, Region Zealand, Capital Region of Denmark and Scania are relevant to include

We include the green regions due to:

- The proximity to the improved infrastructure following the Fehmarn Belt Fixed Link which reduces travel times in these regions. Thus, labour markets in these regions are most likely to experience substantially impacts.

We exclude the grey regions due to:

- The geographical distance to the FBFL is too large for the excluded regions (Viken country & Oslo and Region Halland & Västra Götaland) to experience substantial travel time reductions of the improved infrastructure.
- No relevant infrastructure improvements in Southern Denmark.

For the included regions, we get a comprehensive insight into the impact on the labour markets

Access to employees

Most people live relatively far away from the FBFL

Infrastructure improvements in the STRING region

The FBFL connects two relatively rural areas, Southern Zealand and North-eastern Schleswig-Holstein. This means that relatively few people and businesses can utilize the link for short-distance commuting and transportation, e.g., from Denmark to Germany, contrasting the case of the Øresund bridge connecting two major cities.

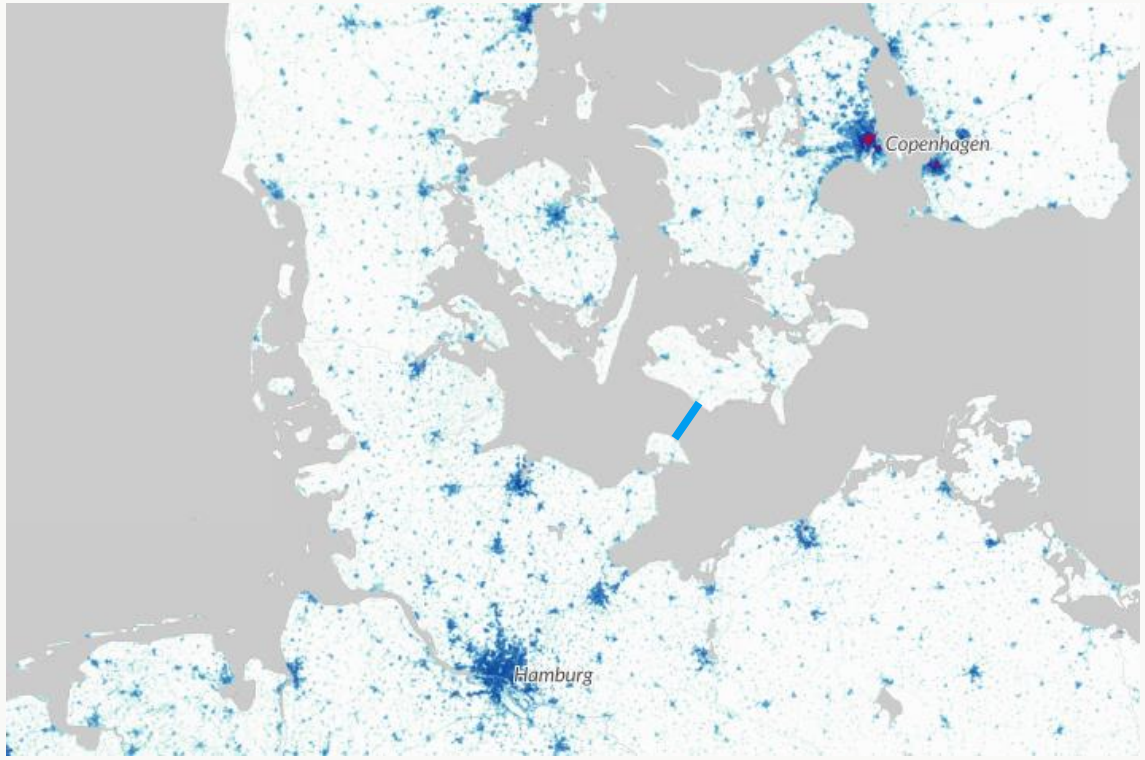
Hence, the FBFL will have limited impact on short-distance cross-boarder mobility since the FBFL connects mostly rural areas.

However, the FBFL and its associated upgrades in related infrastructure substantially cuts travel times long-distance, e.g., between Copenhagen and Hamburg.

On top of this, the related infrastructural investments also benefit travel times locally in Denmark and Germany.

Therefore, the largest impacts are likely to be found locally and between larger cities with substantial travel time reductions.

Population density in geographical areas close to the FBFL and associated infrastructure upgrades



Note: The blue dots indicate population density – where people live. The larger the blue dots, the more people live there.
Source: https://luminocity3d.org/WorldPopDen/#7/55.494/11.008 (accessed 16 November 2022)

The FBFL and associated infrastructure improvements will increase the potential access to employees for businesses

Impact on size of labour market

Businesses along the railway becomes available to substantially more potential employees. **This makes it increasingly more beneficial for businesses to locate their activities here.**

All companies located near the train stations get access to **at least 10 thousands additional households** within 45 minutes of commuting via public transport.

Expected travel time reductions between **Hamburg and Lübeck** makes more than **50 thousand additional households** available within 45 minutes of public commuting for the two cities.

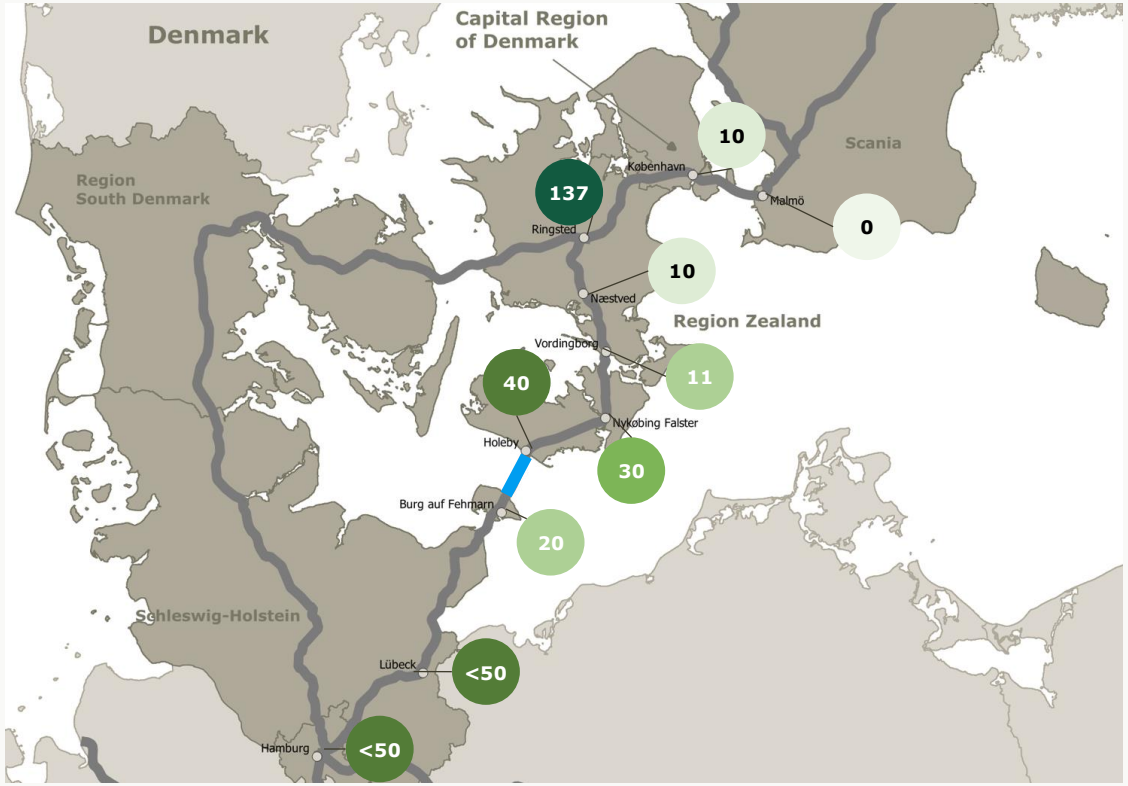
A town like Ringsted could see a large increase in additional households within 45 minutes due to its proximity to Copenhagen. Thus, **Ringsted and the towns south of Copenhagen would potentially become lucrative for businesses to be located**.

The southern part of Zealand will too see a substantial increase in potential employees. This may make this Region more attractive to potential employers.

Large impacts from close-distance cross-boarder commuting are unlikely as close-to-boarder towns are rather small and rural.

However, this analysis only shows the potential that stems from increased access to employees. For it to have a real business impact, the employees must have the skillsets that the businesses are demanding.

Expected increase in number of households (thousands) accessible from each station within 45 minutes of commuting via public transport



Light green indicates smaller impacts while dark green indicates larger impacts

Note: Increases in number of households within 45 minutes of commuting via public transport (in thousands) for an average firm (assumed to be located 3 km from the stations). Changes from Ringsted to Copenhagen is included as "a new high-speed railway between Copenhagen and Ringsted, is a vital part of the PP20 (Railway axis Fehmarn Belt) in Denmark" (European Commission).
Source: Statistics Denmark and own calculations

Commuting impacts

Domestic and cross-boarder commuting will expectedly increase by approximately 8,000 people

Regional commuting will increase the most

Generally, **local commuting effects are most likely** as improvements of the short-distance travel times has larger impacts than of the long-distance travel times. With that being side, **commuting is in general expected to increase the most to bigger cities.**

In Denmark, domestic commuting is expected to increase by more than 2,000, most of which will seek employment in the central parts of Zealand. **Cross-boarder commuting from Germany is expected to increase by more than 1,400 people** and mainly be centred around 'the south' of Region Zealand due to the larger proportional reduction in travel times and to the Capital Region due to the size of this labour market.

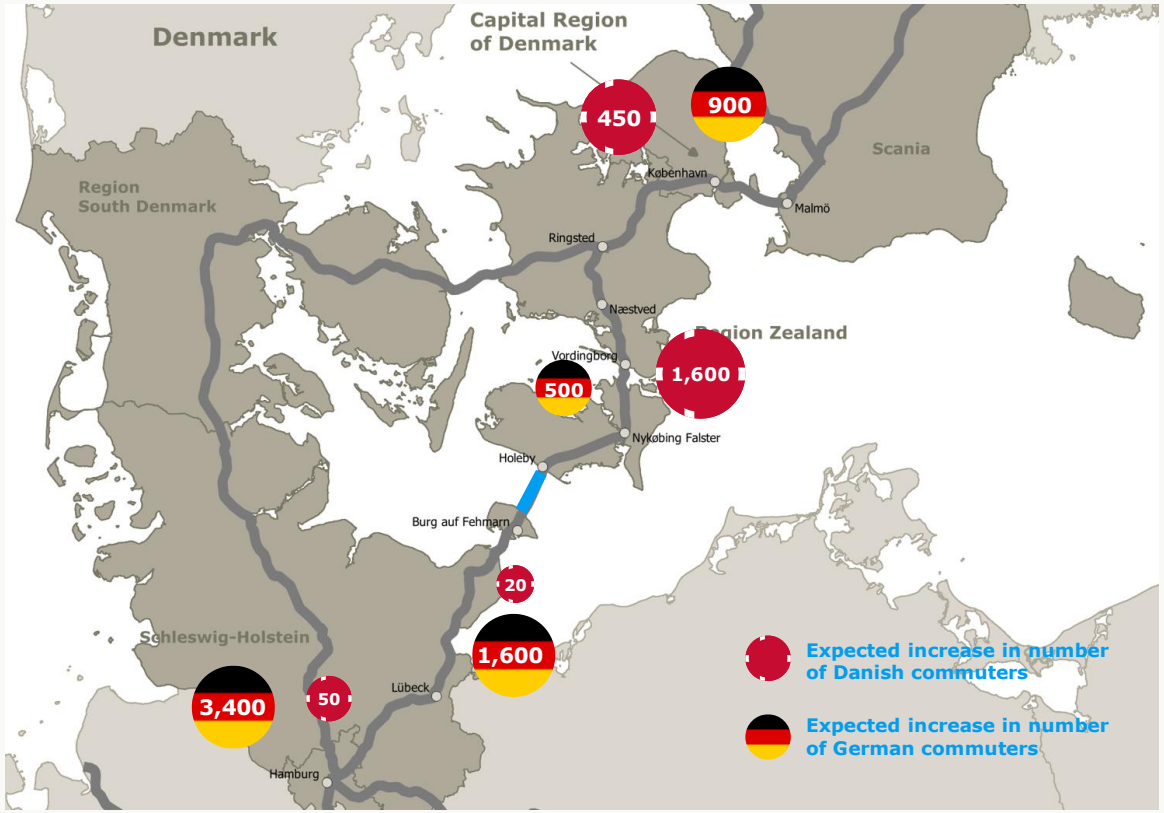
In Hamburg and Lübeck, approximately 5,000 additional citizens are expected to commute domestically. The German labour markets will likely be little affected by cross-boarder commuting based on knowledge of current workflow patterns. Hence, **cross-boarder commuting will likely be the largest from Germany to Denmark.**

Commuting from Scania is expected to increase by only around 50-100 people in total following the improved infrastructure (not shown in the figure). This is due to Scania having no travel time reductions to the Capital Region of Denmark, only modest proportional travel time reductions to Region Zealand and is rather far to Germany. Further, there is currently very few commuting from Sweden to Germany and Region Zealand.

Impacts on cross-boarder commuting from Denmark to Scania is unlikely due to very modest travel times reduction. However, commuting from Germany to Scania could see a substantial increase.

The largest proportional increase in commuting is found in Region Zealand, i.e., in relation to the size of the local labour markets.

Expected structural increase in the number of Danish and German commuters to the four Regions



Note: Numbers in the figure represents the expected increase in the number of both 'long-distance' and 'short-distance' commuters to the respective cities from Denmark (red and white/Danish flag) and Germany (black, yellow and red/German flag). The estimates don't represent creation of jobs, but rather impacts on commuting, business-as-usual. Naturally, the estimates are associated with uncertainty. Domestically, travel time changes is assumed to only affect the public commuting proportion of the population while cross-border travel time changes is assumed to affect the entirety of commuters. Effects include the impact of the Ringsted-Copenhagen, Ringsted-Puttgarden and Puttgarden-Lübeck and Lübeck-Hamburg railway improvements and constructions. Commuters are defined as the number of employments incl. both full-time and part-time. Reductions in travel times are computed based on the Copenhagen-Hamburg being 150 minutes as well as insights from local improvements, see assumptions in the introduction.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark, Eurostat, Bundesagentur für Arbeit, DTU and *Øresundsinstituttet.

Especially The Capital Region of Denmark and Hamburg have a high density of high skilled workers

Skill-levels vary substantially across regions

When looking at the potential labour market impacts of the FBFL, **it is especially relevant which types of employees that can be expected to commute to the different regions**. Here, educational attainment (or skills) and sectoral occupation are applicable to categorize the employees. E.g. high skilled employees can often be more efficiently utilized within innovative occupations.

Within the STRING region, skills vary considerably. This means future growth in commuting is expected to contribute to different types of sectors with different demands and needs to skill levels of employees. This will contribute to **better labour market matches between employees and employers since both have better access to broader labour markets.**

Medium skilled workers generally constitute a large percentage in the German regions, especially in Schleswig-Holstein where medium skilled workers constitute 57% in the region.

Especially employees in The Capital Region of Denmark, Scania and Hamburg have a high percentages of high skilled workers, making these regions particularly relevant for knowledge intensive businesses to locate their activities with increased access to these employees.

As barriers such as employee availability and trade costs gets reduced, this both creates opportunities for knowledge intensive activities to be moved towards the skilled employees and sectors, as well as to attract these employees more easily.

Educational background of potential commuters

Geographical coverage	Low skilled	Medium skilled	High skilled
Capital Region of DK	**21%**	**34%**	**45%**
Zealand	**30%**	**43%**	**27%**
Hamburg	**19%**	**47%**	**34%**
Schleswig-Holstein	**19%**	**57%**	**23%**

Note: The regions are classified from respective national categories of administrative regions.
* Numbers in the figure represent the share of a population group with an educational attainment level relative to the sum of all school graduates in the region. Non-academic educations such as vocational training have been excluded. *Low skilled* refers to graduates with a general school certificate or a lower secondary school certificate as highest educational attainment. *Medium skilled* refers to graduates with a short-cycle tertiary education or upper secondary school as highest educational attainment. High skilled refers to graduates with either a bachelors, masters or a doctorate as highest educational attainment.
Source: Own calculations based on data from Eurostat

Potential labour market impacts of commuting

Commuting effects will impact labour markets to varying degrees – Region Zealand will be impacted the most, proportional to the size of its labour market

Capital Region of Denmark

Commuting impacts
The Capital Region of Denmark is expected to attract 900 additional German commuters and 450 Danish commuters leading to more than 400 high skilled commuters. This corresponds to a 0.1% increase in employed workforce

Potential impacts on labour market
Due to the large size of the labour market in the capital region, the commuting effects will be unlikely to fill substantial parts of the excess labour demand in the region. The large inflow of cross boarder commuters could however aid the complex needs of labour capabilities within the capital region.

Region Zealand

Commuting impacts
Region Zealand is expected to attract 500 additional German commuters and 1,600 Danish commuters leading to more than 600 high skilled commuters in total. This corresponds to a 1.1% increase in employed workforce

Potential impacts on labour market
However to the relatively small size of the labour market, increases in commuting is expected to have substantial impacts on the excess labour demand in Region Zealand. Nevertheless, the large increase in commuters with high skill levels, could help the region in terms of special labour requirements.

Lübeck and Kreis Ostholstein

Commuting impacts
Lübeck and the Ostholstein is expected to attract 1,600 additional commuters with more than 500 of the commuters being high skilled. This would corresponds to 0.8% increase in employed workforce

Potential impacts on labour market
Though the expected increase won't mitigate most of the excess labour demand, the increase in commuting to the region is likely to help levitate the needs of especially high skilled workers in the region.

Hamburg

Commuting impacts
More than 3,400 additional commuters are expected to commute to Hamburg from Lübeck, Ostholstein and the Danish regions corresponding to a 0.3% increase in the employed workforce. Of additional commuters, 1,100 are expected to be high skilled.

Potential impacts on labour market
Since the labour market of Hamburg is rather large, the relative impact is rather small. However, the increase in commuting is likely to assist the right match between vacancies, and skills required in the region, since the educational backgrounds of the regions differ.

Note: In this analysis business-as-usual is assumed, meaning that commuting will have no negative impact on home-markets. Due to this assumption, impacts should be interpreted as potentials

The Capital Region of Denmark: 1,350 additional employees are expected to commute constituting more than 400 high skilled commuters

Types of German and Danish commuters to the Capital Region

The Capital Region of Denmark is expected to attract 900 additional German commuters and 450 Danish commuters. This would corresponds to a 0.1% increase in employed workforce

30% percent of the commuters is expected to be high skilled leading to more than 400 additional high skilled employees to the Capital Region of Denmark following the FBFL and improved infrastructure.

High skilled commuters are expected to be within the Danish sectors of public administration and information and communication as well as the German sectors of manufacturing, public administration and professional, scientific and technical activities.

The majority of German commuters is expected to work within the sectors of construction and manufacturing, partly because language barriers are less important in these sectors.

Especially, domestic commuting are expected to facilitate high skill occupations.

Sectors	Expected number of German commuters	Expected number of Danish commuters
Accommodation and food service activities	9	18
Agriculture, forestry and fishing	< 5	< 5
Construction	211	9
Cultural activities	5	15
Financial and insurance activities	16	34
Information and communication	41	58
Manufacturing	214	14
Professional, scientific and technical activities	80	45
Public administration	84	133
Real estate activities	< 5	10
Service sector	86	30
Transportation and storage	37	17
Wholesale, retail trade, repair of motor vehicles	67	55
Other activities	36	20
Sum of all sectors	~900	~450

Low Skilled
Medium Skilled
High Skilled

Low Skilled
Medium Skilled
High Skilled

Note: Calculations assumes business-as-usual meaning indirect effects are not included and that the distribution of commuters are as of today. This means that potential dynamic impacts that may come from increased commuting are disregarded.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark and Eurostat.

The Capital Region of Denmark: Excess labour demand is large and commuting will not have a potential to fill large gaps in most sectors

Business as-usual: Mitigating excess labour demand

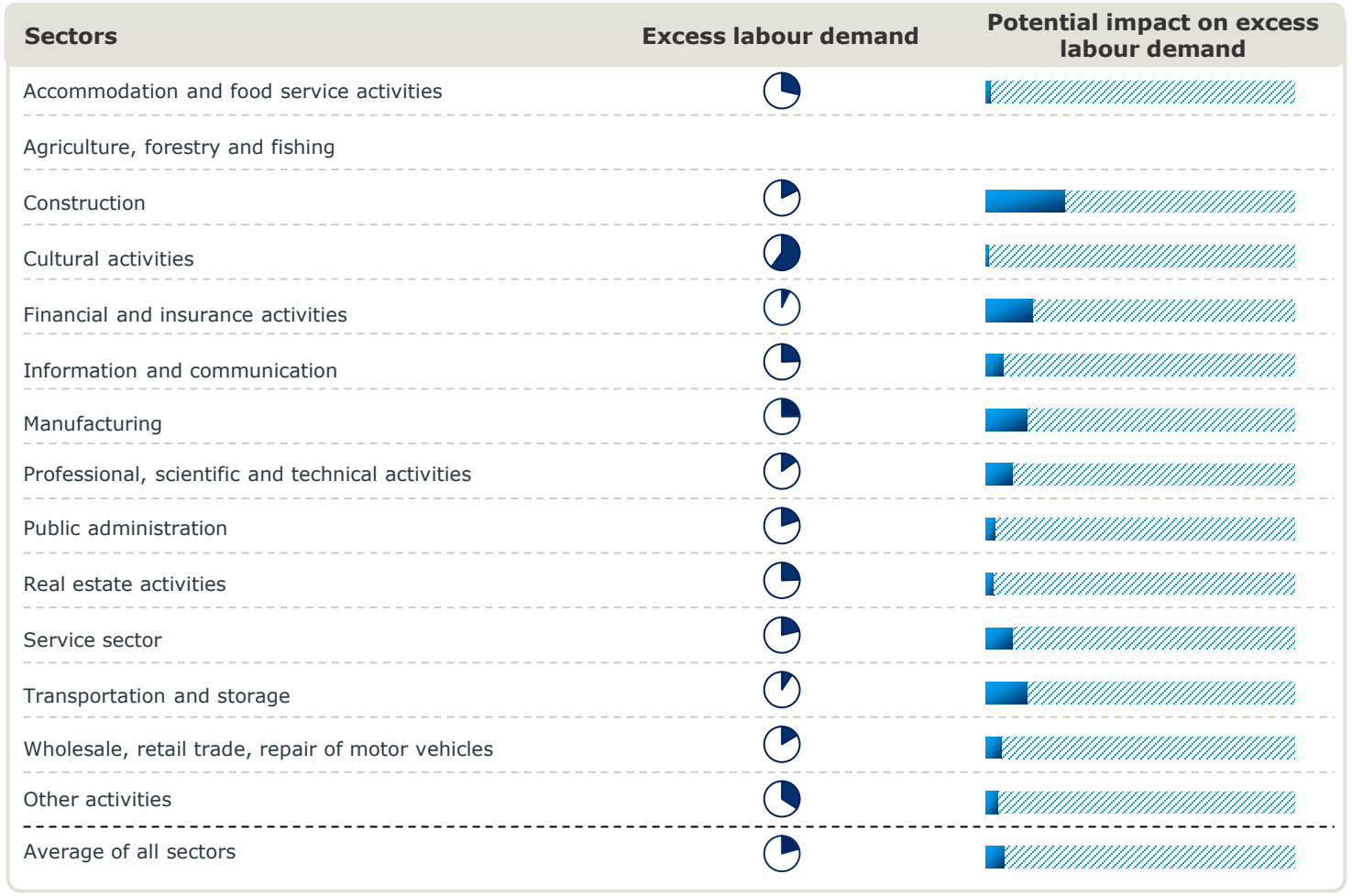
Excess labour demand

Excess labour demand is modest across most sectors in the Capital Region of Denmark. **On average 2.1% of job positions are vacant.** It is biggest within Accommodation and food service activities, Construction, Cultural activities, Information and communication, Manufacturing, Public administration and other activities.

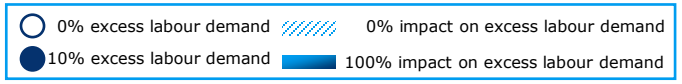
Potential impact on excess labour demand

Due to the size of the labour market in The Capital Region of Denmark, even though excess demand is modest, commuters will be too few to fill in substantial parts of the excess labour demand. **The overall impact of the increase in commuting has the potential to reduce the total number of vacancies in the region by 6.4%.**

Impacts from increased commuting will likely fill the excess labour demand within the construction sector the most.



Note: Excess labour demand is defined as the ratio of the number of job vacancies without successful employee match to employments. Potential impact on excess labour demand illustrates how much of the excess labour demand that can potentially be filled by the increase in commuting. Calculations assumes business-as-usual meaning indirect effects are not included. This means that potential dynamic impacts that may come from increased commuting are disregarded. It is assumed that commuting are not influencing the 'home market' negatively.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark and Eurostat.



Region Zealand: 2,100 additional employees are expected to be commuting constituting more than 600 high skilled jobs

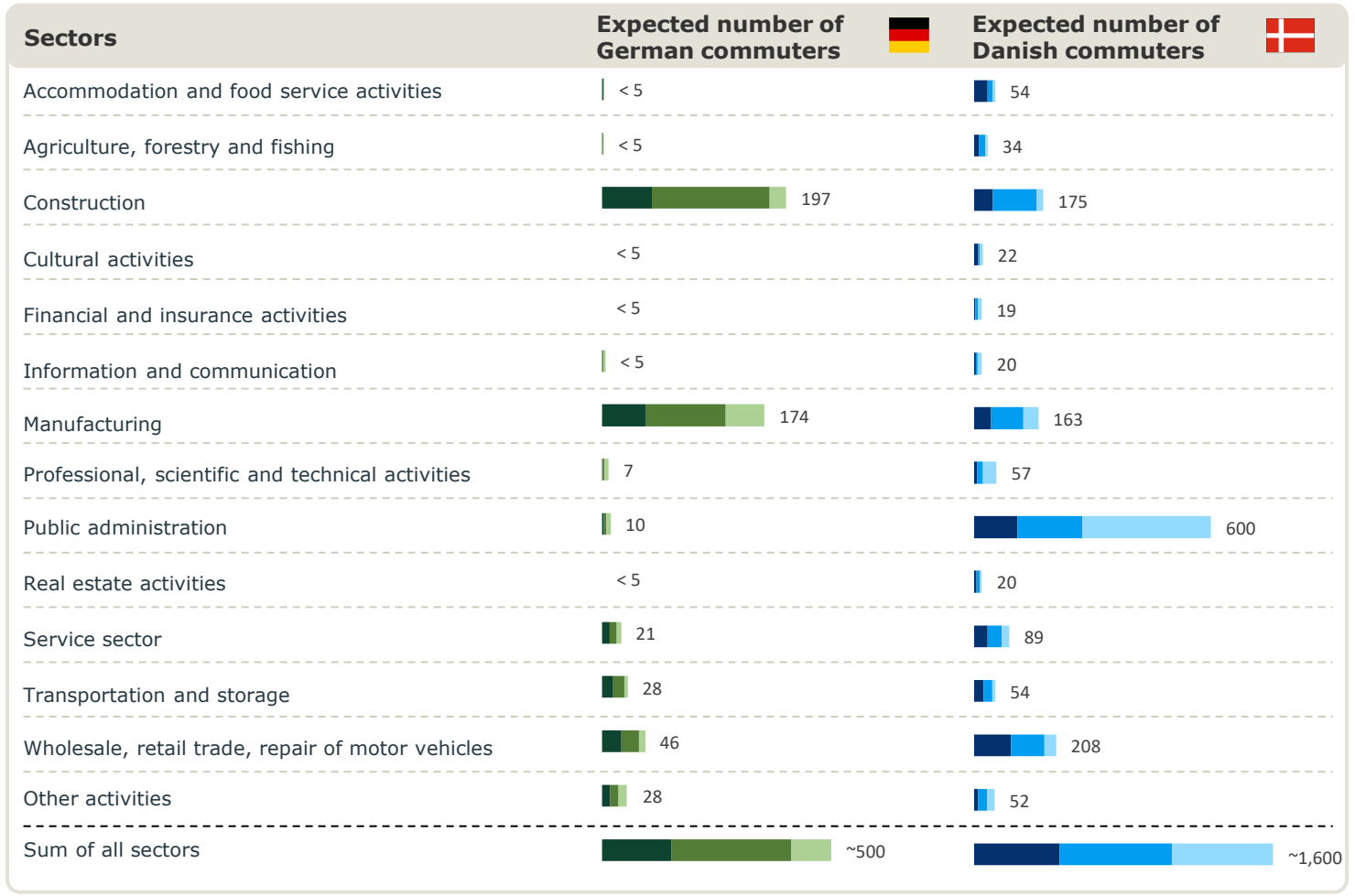
Types of German and Danish commuters to Region Zealand

Region Zealand is expected to attract 500 additional German commuters and 1,600 Danish commuters. This would corresponds to a 1.2% increase in employed workforce.

29% percent of commuters to Region Zealand will expectedly be high skilled leading to more than 600 additional high skilled employees following the FBFL and improved infrastructure.

The majority of high skilled commuting will expectedly be within the Danish sector of public administration as well as both the Danish and German manufacturing sector.

German commuters will expectedly be within the sectors of construction and manufacturing.



Note: Calculations assumes business-as-usual meaning indirect effects are not included and that the distribution of commuters are as of today. This means that potential dynamic impacts that may come from increased commuting are disregarded.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark and Eurostat.

Region Zealand: Commuting is expected to have the potential of creating relatively large impact on the labour market as excess labour demand could be lowered

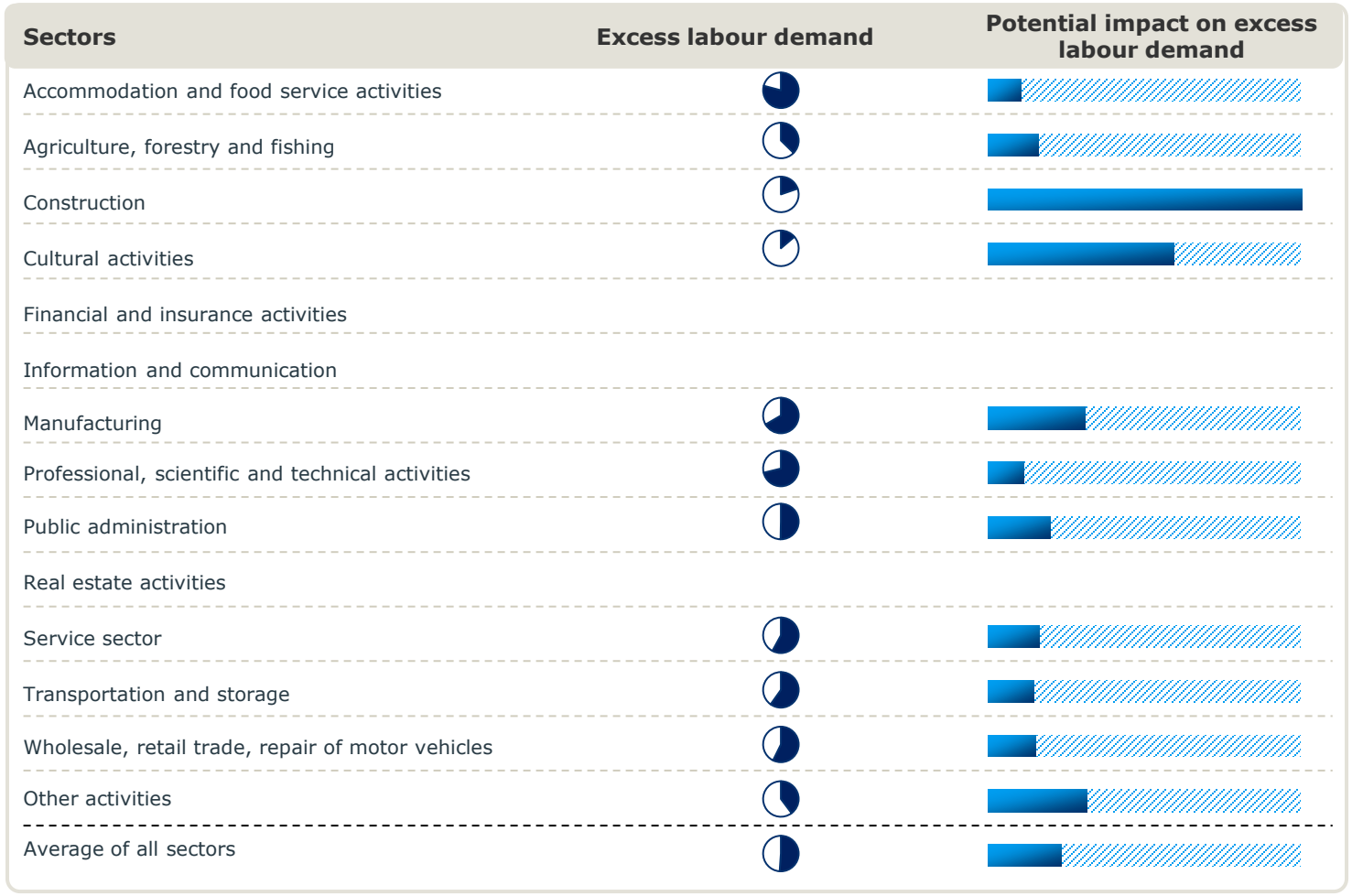
Business as-usual: Mitigating excess labour demand

Excess labour demand

Excess labour demand is relatively large across most sectors, especially within Accommodation and food service activities, Construction, Manufacturing, Professional, scientific and technical activities and Transportation and storage. **On average 5.1% of job positions are vacant.**

Potential impact on excess labour demand

Generally, increases in commuting has the potential of substantially impacting excess labour demand in Region Zealand. **The overall impact of the increase in commuting has the potential to reduce the total number of vacancies in the region by 23.6%.** Commuters could fill in substantial proportions of the excess labour demand, especially within Construction, Cultural activities and Manufacturing.



Note: Excess labour demand is defined as the ratio of the number of job vacancies without successful employee match to employments. Potential impact on excess labour demand illustrates how much of the excess labour demand that can potentially be filled by the increase in commuting. Calculations assumes business-as-usual meaning indirect effects are not included. This means that potential dynamic impacts that may come from increased commuting are disregarded. It is assumed that commuting are not influencing the 'home market' negatively.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark and Eurostat.

Hamburg: 3,400 additional employees are expected to be commuting to Hamburg constituting more than 1,100 high skilled jobs

Types of Commuting between Hamburg and Lubeck

Commuting is expected to increase by 3,400 with almost 1,100 high skilled jobs in Hamburg from mainly Lübeck and Ostholstein. This would correspond to a 0.3% increase in employed workforce.

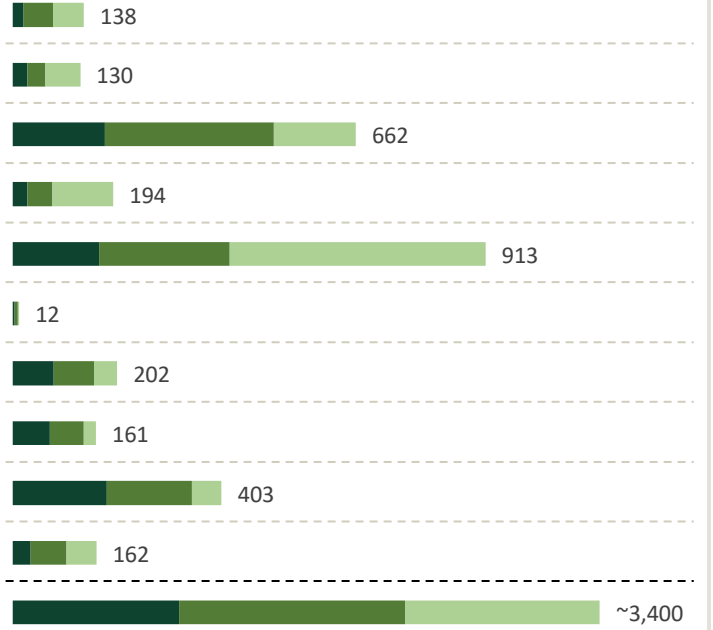
32% of all new commuters between the two regions are high skilled.

Of the additional domestic commuters most will likely work within manufacturing and public administration.

The sector of public administration, has the highest share of expected high skill commuters, with more than 50%.

In the manufacturing sector, where a large proportion of commuters are expected to work, a large share of the commuters are classified as medium skilled, constituting half of new expected commuters.

Sectors	Expected number of domestic commuters
Accommodation and food service activities	119
Agriculture, forestry and fishing	15
Construction	259
Cultural activities	32
Financial and insurance activities	138
Information and communication	130
Manufacturing	662
Professional, scientific and technical activities	194
Public administration	913
Real estate activities	12
Service sector	202
Transportation and storage	161
Wholesale, retail trade, repair of motor vehicles	403
Other activities	162
Sum of all sectors	~3,400



Note: Calculations assumes business-as-usual meaning indirect effects are not included and that the distribution of commuters are as of today. This means that potential dynamic impacts that may come from increased commuting are disregarded. Cross-boarder commuting effects are disregarded as the expected number of commuters are scarce.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark, Eurostat and Bundesagentur für Arbeit.

Hamburg: Commuting is expected to be able to impact some sectors of the labour market substantially

Business as-usual: Mitigating excess labour demand

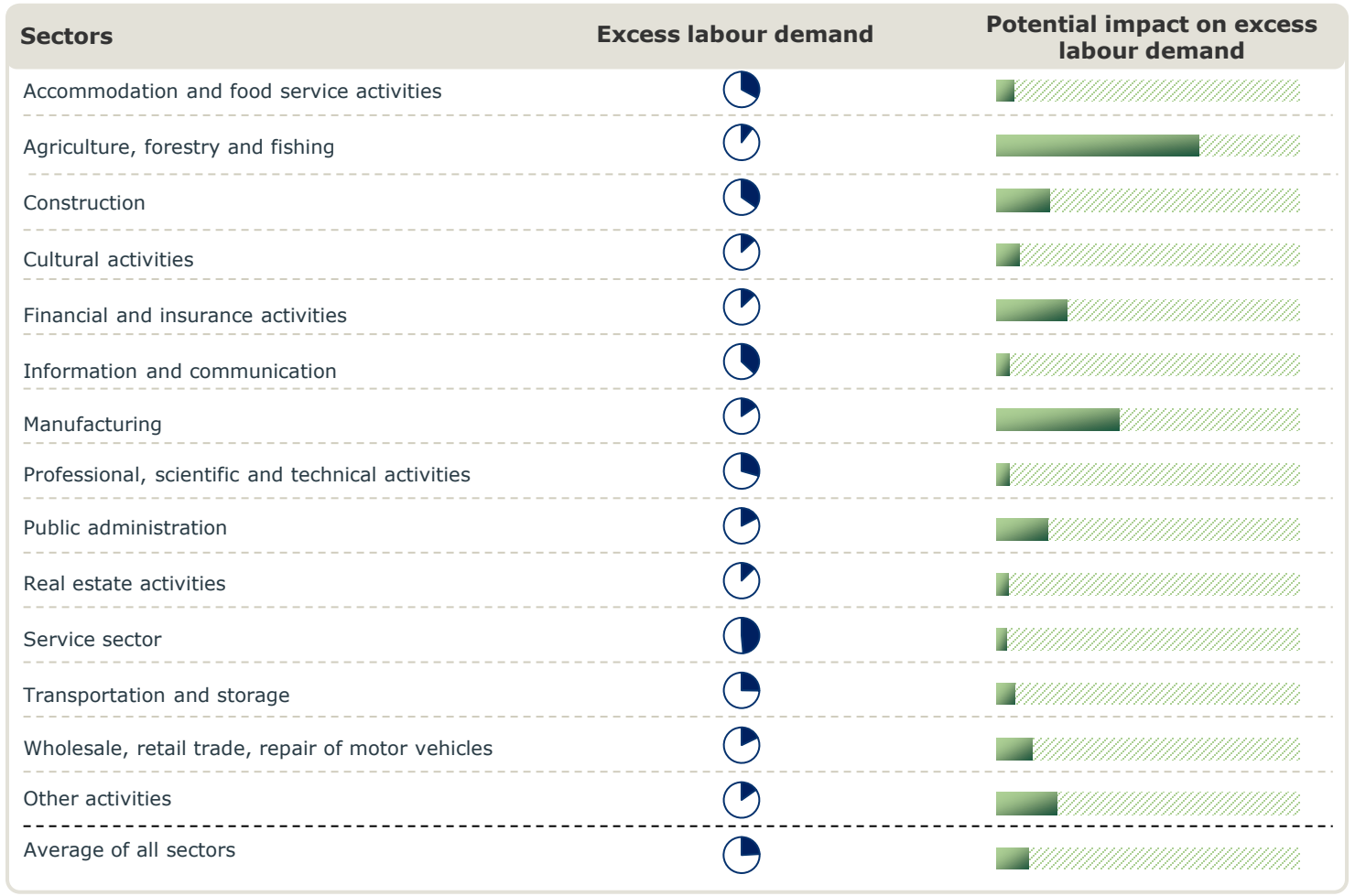
Excess labour demand

Excess labour demand is modest across all sectors in Hamburg and Lübeck. **On average 2.4% of job positions are vacant.**

Potential impact on excess labour demand

The overall impact of the increase in commuting has the potential to reduce the total number of vacancies in the region by 11%.

Commuting is expected to have the potential of substantially impacting excess labour demand in the Financial and Insurance activities sector and Manufacturing, where additional commuters to Hamburg could mitigate 24% and 41% of excess labour demand. Agriculture will likely also be largely impacted, however excess labour demand is already very low.



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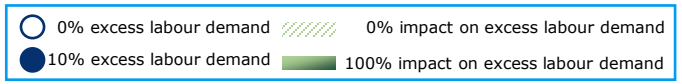


Lübeck and Kreis Ostholstein: 1,600 additional employees are expected to be commuting to Lübeck and Ostholstein constituting more than 500 high skilled jobs

Types of Commuting between Hamburg and Lubeck

With an updated train line from Burg auf Fehmarn to Hamburg, travel times are expected to decrease, which will likely lead to commuting within the region, and from the city of Hamburg.

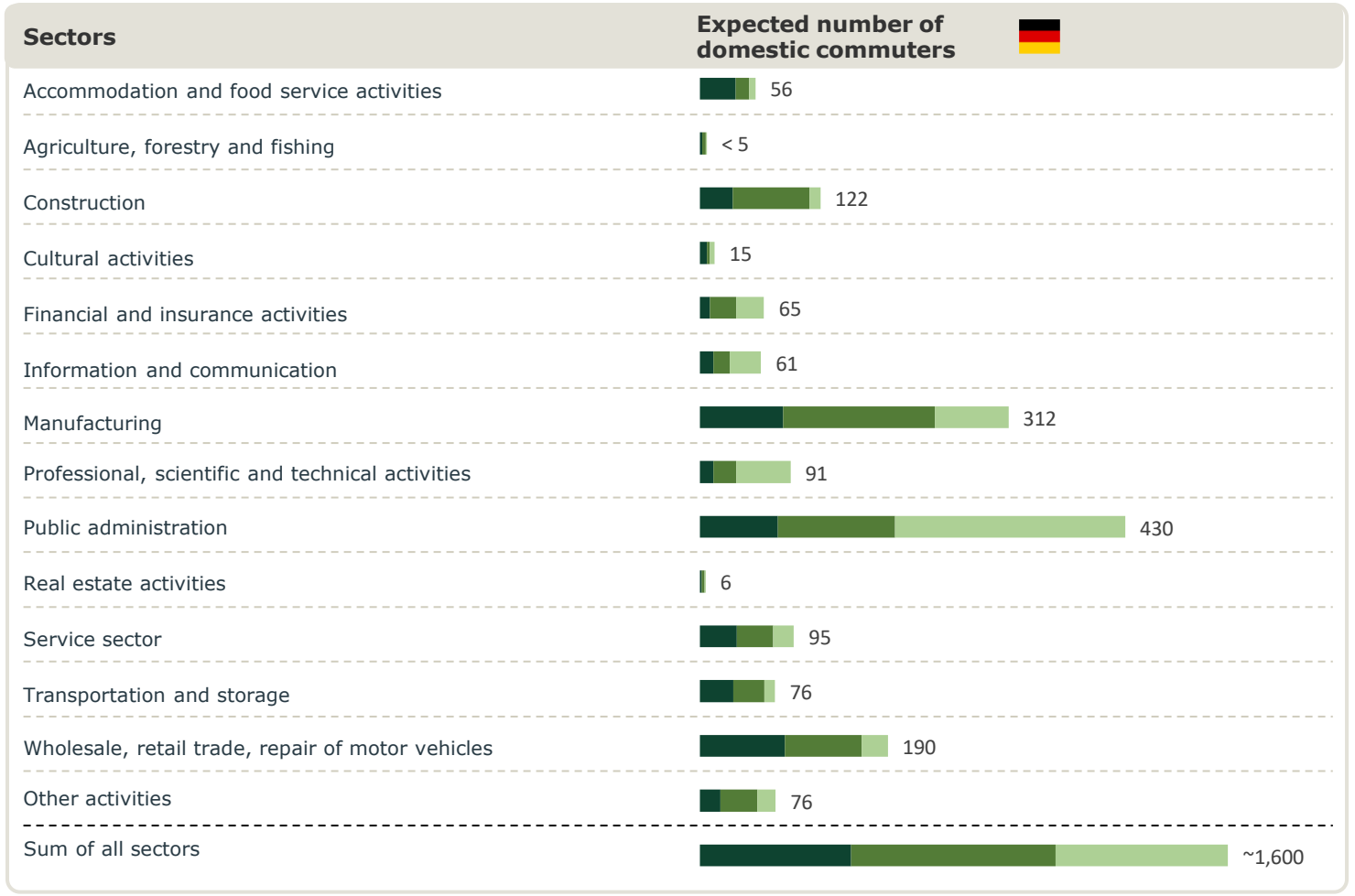
Commuting is expected to increase by 1,600. This would correspond to a 0.8% increase in employed workforce.

The improved infrastructure is expected to increase high skilled commuting by 500 employees, constituting 31% of all new expected commuters, mainly driven by commuters from the metropole of Hamburg.

Most sectors are expected to gain influx of commuters, with the largest sectors being construction, manufacturing, public administration and wholesale.

Especially, the sector of public administration will likely experience high skilled commuting, with 230 new high skilled commuters and a total of 430 new commuters.

The manufacturing sector is expected to grow by 310 new commuters across all three skill levels.



Note: Calculations assumes business-as-usual meaning indirect effects are not included and that the distribution of commuters are as of today. This means that potential dynamic impacts that may come from increased commuting are disregarded. Cross-boarder commuting effects are disregarded as the expected number of commuters are scarce.
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark, Eurostat and Bundesagentur für Arbeit.

Lübeck and Kreis Ostholstein: Commuting is expected to be able to impact the sectors rather evenly

Business as-usual: Mitigating excess labour demand

Excess labour demand

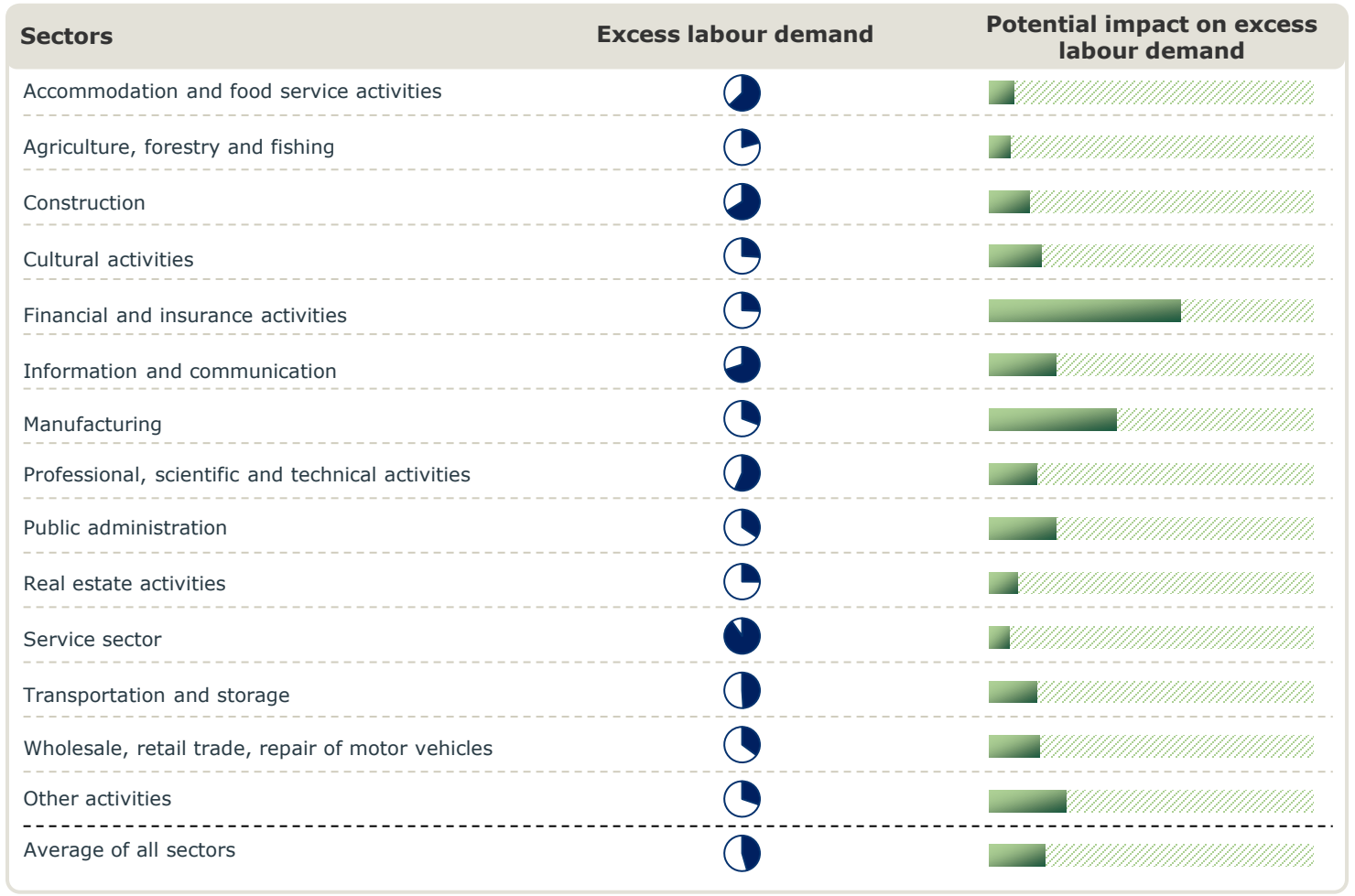
Excess labour demand is modest across all sectors in Ostholstein and Lübeck. **On average 4.5% of job positions are vacant.**

However, excess labour demand is relatively high within Accommodation and food service activities, Construction, Information and communication, Professional, scientific and technical activities and Service sector, with excess demand of up to 9%.

Potential impact on excess labour demand

The overall impact of the increase in commuting has the potential to reduce the total number of vacancies in the region by 17.4%

In the manufacturing sector and the Financial and insurance activities sector, the excess labour demand is rather large, and the impact varies between 40% and 59% which means the effects are rather substantial.



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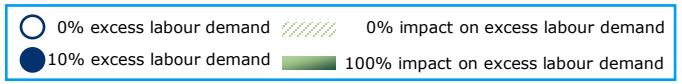
Source: Own calculations based on Danish Agency for Labour Market and Recruitment, Statistics Denmark and Eurostat.



Value of commuting

By utilizing the metric of Gross Value Added per employee by sector, we can quantitatively assess the economic impact of commuters

Understanding how the increase in commuting adds value to the regions

Measuring the impact of regional commuting

- To measure how the commuters impact the regional economy in general, we have applied the economic productivity metric, Gross Value Added (GVA) which provides a monetary value for the value of goods and services that have been produced in a region/sector minus the cost of input.

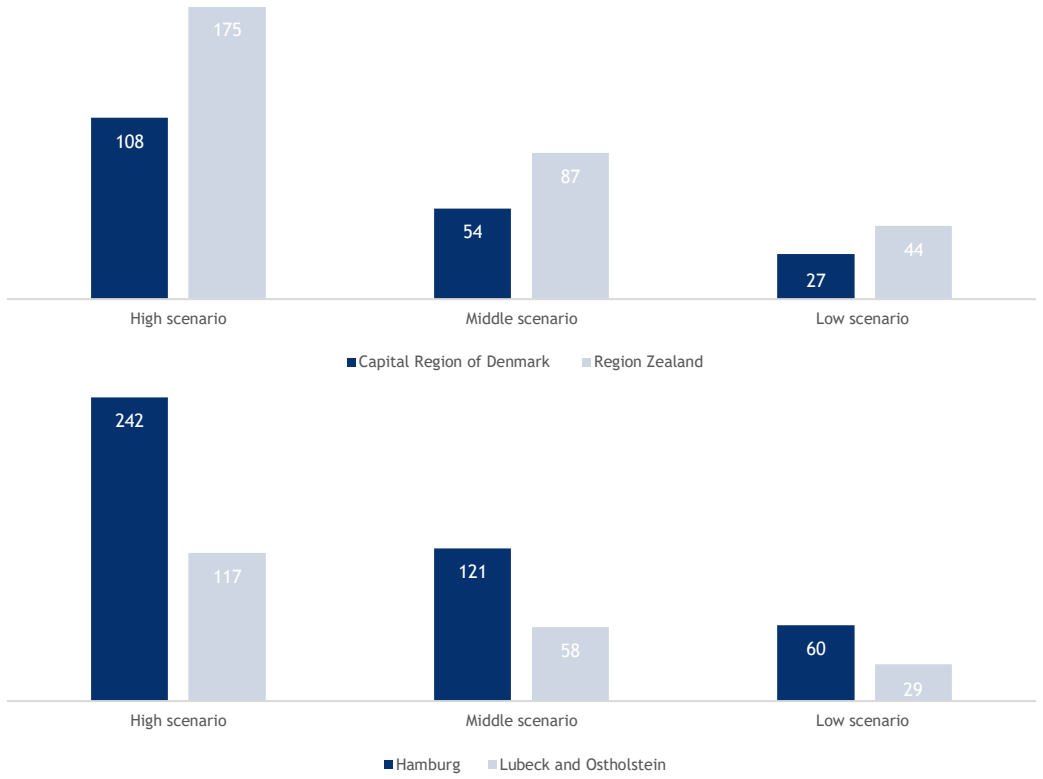
Potential increase in GVA across STRING regions

- We have calculated a GVA per employee for each sector in the 4 relevant STRING regions and multiplied by the expected number of commuters for each sector.
- Since the impact of commuters on the regional GVA depends on their prior employment, we use three different scenarios to account for this – a high, middle and low scenario.

Relative magnitude of impact

- The potential impact on regional GVA is limited since the increased number of commuters constitute a very small share of total work forces across all STRING regions. In the high scenarios GVA will increase by 0.1% in the Capital Region of Denmark, by 0.9% in Region Zealand, by 0.3% in Hamburg and 0.8% in the Lübeck and Ostholstein region.

Potential gross value added of commuters for high, middle and low scenarios



Note: High scenario assumes that 100% of commuters goes from unemployment to employment, 50 % in the middle scenario and 25% in the low scenario. The figures are rounded to integer values, meaning the Danish and German numbers do not necessarily add up to the total amount exactly. The regional GVAs in German Regions are estimated from the national GVA, based on their regional employment share of total employment, due to lack of regional statistics.

Source: Statistics Denmark, Eurostat and own calculations based on prior analyses

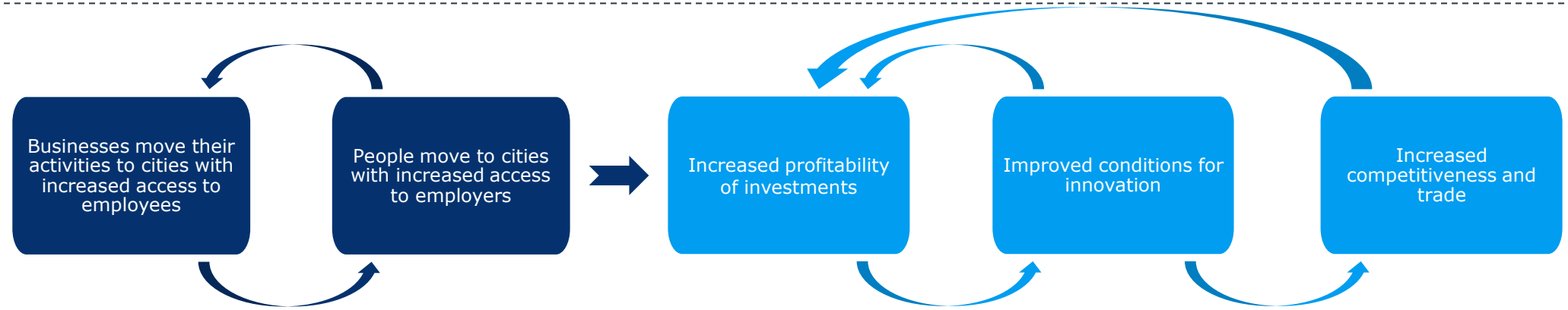
Potential dynamic long-run impacts

More integrated labour markets create potential for businesses and employees. More lucrative to invest, innovate and trade in the region

What is happening?

BUSINESSES	EMPLOYEES	INVESTMENTS	INNOVATION	TRADE
+ Access to larger pool of qualified workforce + Improved access increases profitability of locating business activities near improved infrastructure ÷ Increased competition as employees gets access to more employers	+ Access to larger pool of employers + Improved access makes it more attractive to live near improved infrastructure ÷ Increased competition for jobs as employers gets access to more employees	+ Increased profitability of doing businesses in areas with improved business activities makes it more profitable to invest + As workers find it more attractive to live in these cities, it becomes more profitable to invest in housing + With more investments, conditions for innovation gets improved	+ Improved accessibility to qualified employees makes innovation more likely + Improved accessibility to capital makes innovation more likely + Improved accessibility to universities makes innovation more likely + Closer distance between firms makes cooperation more likely	+ Improved accessibility to qualified employees makes firm more profitable and thus more competitive + Increases in investments and improved conditions for innovation makes firms more competitive + Increases in competitiveness improves the conditions for trade

Expected impact



Note: + describes a positive impact while a ÷describes a negative impact

Methodology

Overview of methodology of labour market analyses




	Potentials for businesses	Potential changes in commuting	Potential impact of increased commuting	Value of potential commuters
Description				
Data sources	Household and company data from Statistics Denmark	Danish Agency for Labour Market and Recruitment and Statistics Denmark	Danish Agency for Labour Market and Recruitment	Sectoral national account, Statistics Denmark
Estimation strategy	Before/after GIS-analysis	Logistic regressions	Estimations based on commuting effects and statistics of regional and sector specific excess labour demand	Scenario calculations
Outcome of interest	Changes in access to potential employees	Predictions of the changes in number of commuters across relevant cities	Reduction in excess labour market demand	Gross value added by sector due to increase in commuting

Methodology explained – Potential for businesses

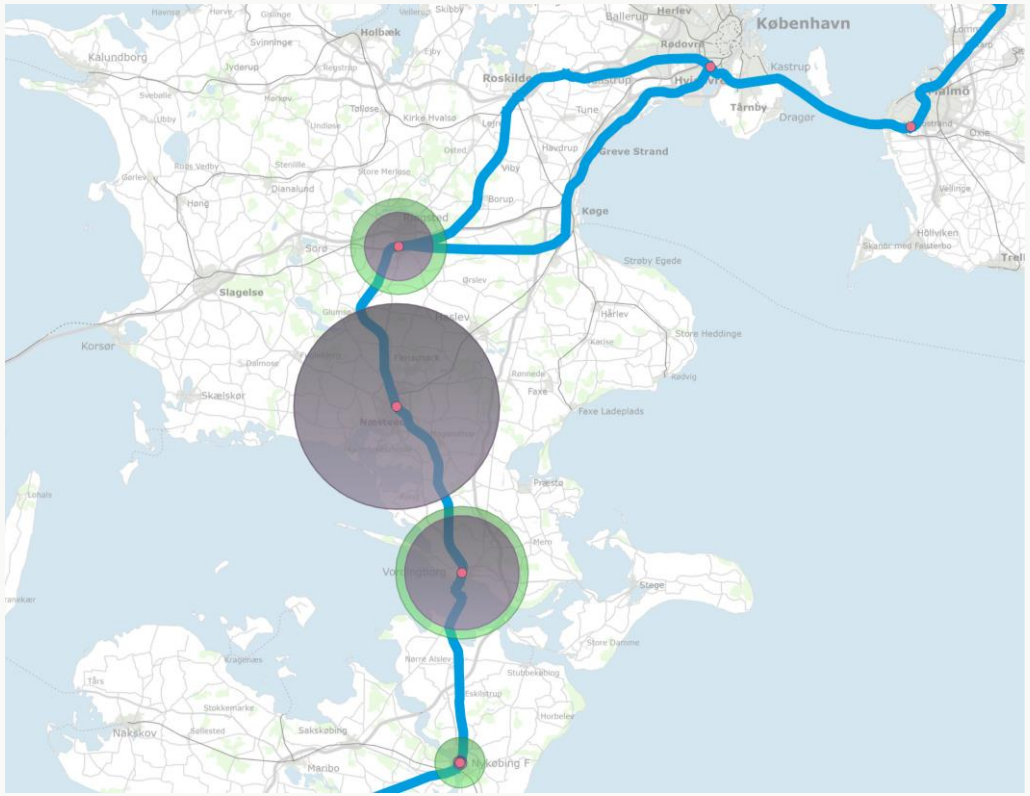
Potentials for businesses

To estimate the number of additional household within 45 minutes of public transportation for a particular city along the improved infrastructure, the first step is to determine how far a commuter can travel in 45 minutes. For simplicity, it is assumed that a business on average is located 10 minutes of public commuting from the cities' train stations to make the analysis generalizable. On top of these 10 minutes, the public transportation is added. Here, the changes from the improved infrastructure occurs. Therefore, a prior and a post scenario is estimated where the travel times before and after is added separately. The post travel times are estimated based on the method from slide 20. Afterward, it is assumed that a commuter can travel 1 km per 3 minutes (typical speed for bus/bike). This results in areas for businesses in each city which is reachable within 45 minutes of commuting both before and after (as is shown in the figure where green area is additional area).

The number of households within these areas for Danish cities can then be computed with GIS and 'BBR'-statistics from Statistics Denmark.
For Germany, due to lack of available household statistics, we assume the density of households per square meter to be equivalent in Hamburg and Lübeck to Copenhagen.

Lastly, the additional number of commuters is computed by subtracting the post number of available commuters by the prior number of commuters.

Example of computation of number of additional computers for businesses in Ringsted



Note: Grey area is the prior area of available commuters while green area (grey area included) are the post area of available commuters. Green ring is additional are of available commuters due to improved infrastructure.
Source: Statistic Denmark and BBR

Methodology explained – Potential changes in commuting

Potential changes in commuting

To estimate the number of additional commuters to the regions, several statistical models are trained on Danish data where each municipality is an observation. The response variable is the number of commuters to a given city and the predictors are the distance in minutes by public transportation and the population size. Each model is trained on 80 percent of the data and tested on the remainder using the Root Mean Squared Error (RMSE). The model with the lowest average RMSE out-of-sample is chosen for predictions.

This model is then trained using all data, but the cities which commuting effects is to be estimated. Afterward, data is fitted using prior and post travel times. The ratio (i.e. the number of post commuters over the number of prior commuters) is multiplied with the current known commuting number. This corrects the estimate to be in line with current known commuting dynamics.

Because only a fraction of the total number of commuters use public transport, and thus is affected by the infrastructure improvements domestically, region specific data on fraction of commuters using public transportation is used to correct the estimate. This is done by multiplying the impacts by this ratio. For cross-boarder commuting this step is omitted due to the effect influencing all types of commuting, i.e. both commuting by rail and road will be influenced.

To estimate the commuting for Danish regions we use data from the Danish Agency for Labour Market and Recruitment and Statistics Denmark. To estimate domestic effects in Germany, data from Bundesagentur für Arbeit is used. German data is much less detailed than the Danish, and for that reason, more assumption have been necessary for estimations. For that reason estimates regarding German domestic commuting should be viewed with proper care

Due to the lack of available data showing Danish commuters to Germany, the current ratio of cross-boarder commuting from Denmark to Germany and vice versa is assumed in computation of Danish commuters to the German cities

The fraction using public commuting is included from the Technical University of Denmark which studies Danish commuting patterns. The fractions in Hamburg and Lübeck is assumed to be equivalent to Copenhagen due to a lack of data on German regions.

Methodology explained – Potential impact of increased commuting

Potential changes in excess labour demand

With the estimation of expected commuters between the STRING regions of interest in place, a study is conducted to assess the potential impact on local excess demand for labour and unsuccessful recruitments. The total number of estimated commuters from a given region is split into expected NACE sectors*, based on current commuting patterns and sector sizes. Furthermore the commuters are divided into skill levels, based on the average educational level across sections using Danish data. Hence we assume 1:1 comparability in the distribution of educational levels for a sector across all regions.

This enables an analysis of how the increase in commuting to a specific region mitigates the recruitment issues across different sectors.

Since the area of interest covers regions across countries, different data sources are used. For the Danish regions, vacancy rates for the different sectors are gathered from an annual recruitment survey conducted by the Danish labour market and recruitment agency, STAR. The proportion of unsuccessful recruitments to job vacancies out of the total number of employees in the sector yields the share of excess labour demand for the region. For comparability, the reported unsuccessful recruitments that were due to miss-match of expected qualification have been removed.

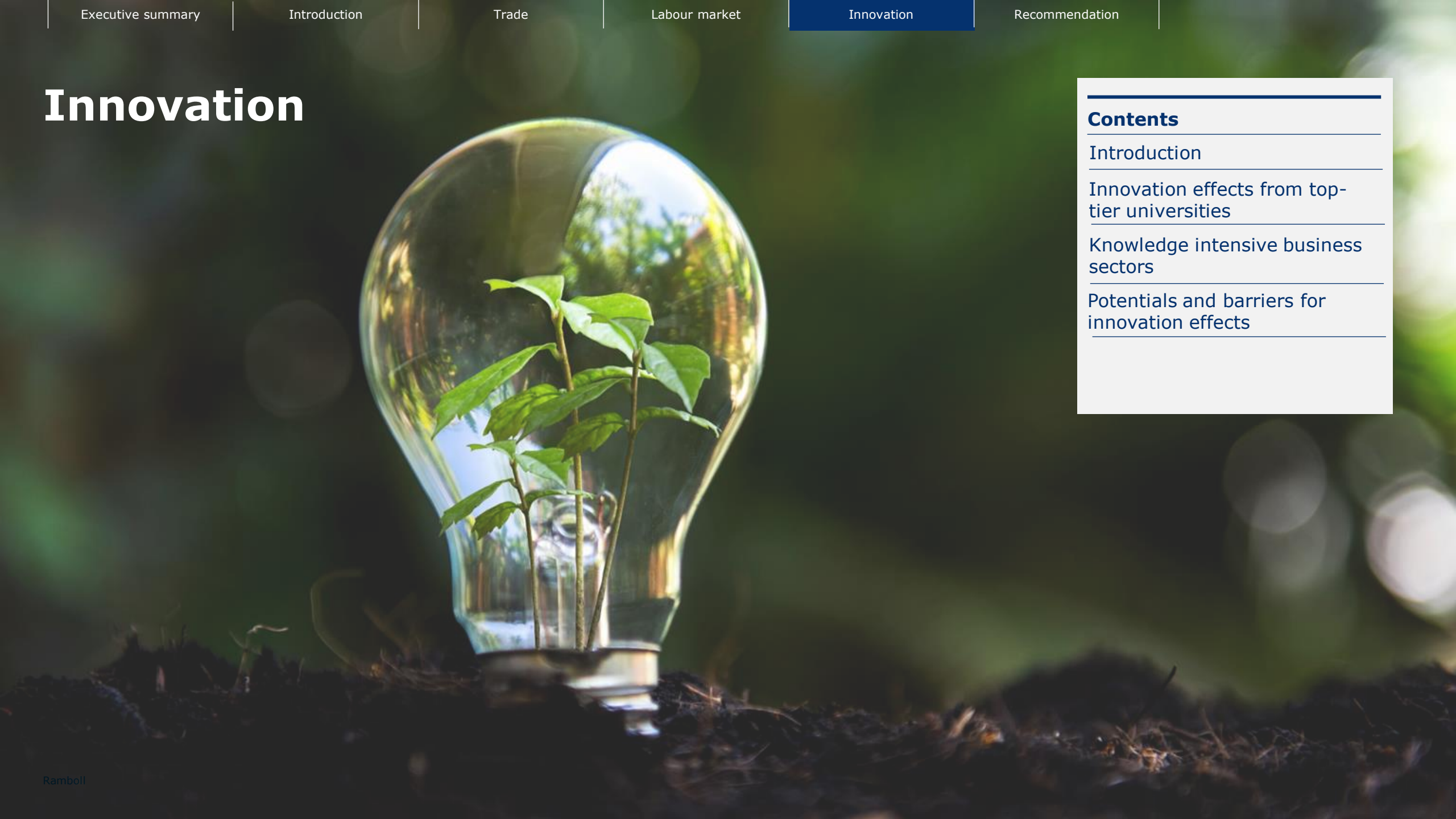
For the German excess labour demand, no data has been available with specific information about unsuccessful recruitments at regional level. Hence, data on job vacancy rates by NACE sector has been used as a proxy at national level, collected from Eurostat. The values are then translated into regional figures, by investigating the two German regions of interest's respective share of total unemployment rates at national levels. The regional proportions are corrected by factoring in the region's share of employees at sector level, to not overestimate the regional excess demand at a sectoral level.

The excess demand for labour in Germany and Denmark, respectively, are illustrated using Harvey balls, with a standardized unit of measure. A 10% vacancy rate correspond to a full circle vacancy rate. We assume that the dynamics of the current labour markets is constant over time for simplicity.

With the regional sector level excess demand for labour in Germany and Denmark in place, the study computes the potential percentage reduction in excess demand after the expected influx of commuters from other regions. This reductions are illustrated using an "impact-o-meter", where a 100% reduction in excess demand in a given sector means the impact-o-meter is rotated to the very right, as opposed to an unchanged indicator to the very left, where no mitigation of excess demand are to be expected. Importantly, this showcases the potential reduction in excess demand assuming no negative impact on "home-market's" excess demand. Hence, it will be reasonable to expect that if the potential is reached other part of the region will experience negative impacts for employees moving between employments.

Note: **NACE sectors* refer to the statistical classification of economic activities in the European Community. The version used is revision 2 from 2006.

Innovation



Contents

We analyse the effects of innovation by focusing on how top-tier universities and knowledge-intensive business sectors can enhance innovation synergies

Purpose

Innovation plays a crucial role in the success and competitiveness of the STRING region within knowledge-intensive sectors.

By considering the impact of innovation, we can better understand how the region can differentiate itself from its competitors and identify opportunities for growth.

Course of action

As the measurement of innovation can be challenging, this chapter primarily relies on findings from literature and descriptive statistics to provide insight into the potential impact of the FBFL on innovation in the STRING region

OVERVIEW OF THE ANALYSIS OF INNOVATION

Innovation is a multifaceted concept that encompasses a wide range of parameters. In this analysis, we define innovation as the practical implementation of ideas that leads to the introduction of new goods or services, or improvements in the offering of existing goods or services. We analyse the impact on innovation trough the effect on universities and on knowledge-intensive business sectors.

1 Innovation effects from top-tier universities

As a result of the Fehmarn Belt Fixed Link (FBFL), universities in the STRING region will become more interconnected, and Scandinavian and German universities will likely capitalize on this opportunity.

Research in the academic literature has established a strong correlation between improved mobility of scientists and various innovation outcomes that can benefit both firms and industries.

By mapping the top-tier universities in the STRING region using a metric developed by USNews, it is possible to identify which departments will be best poised to increase the innovation benefits.

2 Knowledge-intensive business sectors

The FBFL will serve as a catalyst for increased connectivity within the knowledge-intensive business sectors (KIBS) in the STRING region. This, in turn, has the potential to increase innovation synergies.

By utilizing national statistics from Denmark, Germany, and Sweden, it is possible to quantify which sectors are knowledge-intensive and can be defined as a cluster. Applying the mediating effects of innovation, such as collaboration, competition, and high-skill recruitment, we gain a deeper understanding of how these knowledge-intensive business sectors will be positively impacted by innovation synergies, ultimately benefiting both companies and consumers.

3 Potential and barriers

Lastly, the chapter will provide a brief overview of the long-term economic potentials stemming from innovation. Additionally, it will highlight some of the barriers that can hinder future innovation effects.

Main conclusions on the impact on innovation

Universities

- The FBFL is likely to **enhance scientist mobility between Copenhagen, Hamburg, and Malmö**, as it will facilitate the ability to conduct outstanding research at various leading universities in the STRING region.
- The enhanced mobility of scientists within the STRING region is anticipated to **foster innovation by expanding the knowledge base of scientists** through increased international collaboration. This may result in a higher degree of **knowledge sharing and knowledge transfer from academia to industry**, thereby catalysing innovation in the region.
- Our analysis identifies **29 leading faculties** spanning various disciplines, including Biology and Biochemistry to Social Sciences, that are expected to benefit from improved scientist mobility.

Knowledge-intensive business sectors

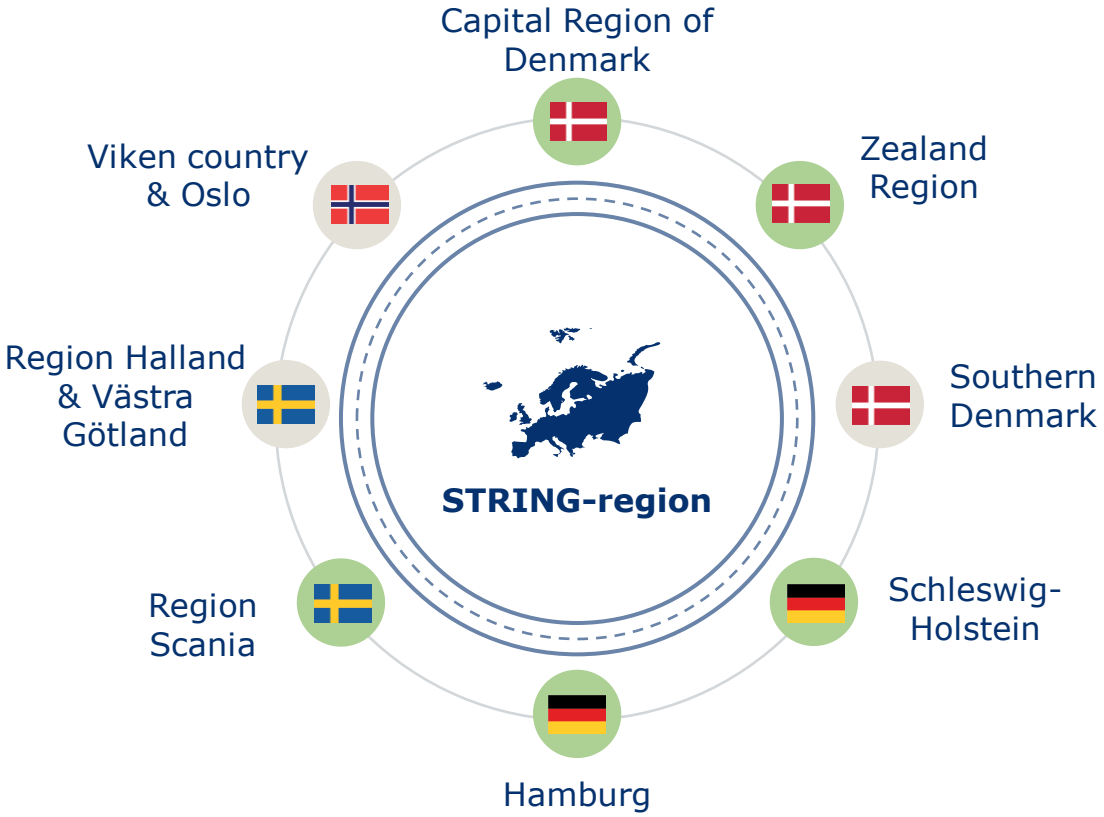
- The use of descriptive statistics from Germany, Sweden, and Denmark allows for the **identification of six distinct knowledge-intensive business sectors (KIBS)** in the STRING region, with a concentration in the metropolitan areas, Copenhagen and Hamburg.
- As these KIBS in the region become increasingly interconnected, we expect to **see increased collaboration, competition, and labour market access**, which, in turn, will likely lead to innovation synergies and thereby the introduction or improvement of goods and services.
- The sectors of ***information and communication***, ***financial institutions and insurance***, **and** ***advisory and research*** are particularly likely to **experience these effects**, as they overlap between Hamburg and Copenhagen and therefore stand to benefit from enhanced collaboration and knowledge spill over effects.

Potentials and barriers

- The potential for long-term economic growth in the STRING region can be significantly enhanced through the innovative contributions of top-tier universities and the KIBS. These efforts have the potential **to drive productivity, create jobs, increase competitiveness, benefit consumers, and promote exports**.
- However, to fully realize these benefits, a **range of barriers must be addressed**, including bureaucracy, supply chain integration challenges, employee retention, high costs, and lack of patent support

This section of the analysis centres on the regions that will experience substantial enhancement in interconnectedness as a result of the FBFL and thereby significantly impact innovation effects

The regions that are in closest proximity to the (FBFL) are deemed relevant to include in the analysis



Hamburg, Schleswig-Holstein, Region Zealand, Capital region of Denmark and Scania are relevant

Including the green regions

- The universities and knowledge intensive sectors within these regions will benefit greatly from increased interconnectedness as a result of the FBFL, making them relevant in the analysis of innovation effects

Excluding the grey regions:

- In contrast, the specific regions of Norway and Sweden, being situated at a considerable distance from the FBFL, will not see a significant impact on interconnectedness, making them less relevant for the analysis of innovation
- Similarly, the Southern Denmark region, owing to its proximity to Hamburg and lack of significant travel time effects, will also not experience a substantial impact

Based on the selection of regions, we obtain a comprehensive understanding of the actual impact of innovation

Innovation effects from top-tier universities

Relationship between increased scientist mobility and innovation

Several important connections between increased mobility of scientists and relevant outcomes for innovation has been established in the academic literature

Clear findings from the literature about scientists' mobility and innovation

As the FBFL will enhance commuting and overall mobility within the region, it is reasonable to assume that it will also have an impact on the mobility of scientists. The literature suggests that scientist mobility is a crucial element in driving innovation.

The most important determinant of scientists' mobility is the opportunity to undertake excellent research (European Commission, 2022). This is consistently highlighted as the most important factor mentioned by researchers regardless of their career stage, nationality or destination.

International mobility seems to broaden scientists' knowledge base (Williams and Baláž 2008; Aman 2018; Coey 2018) and to ease knowledge transfer to colleagues working in both academic and corporate environments (Edler, Fier and Grimpe 2011; Trippl 2013; Gibson and McKenzie 2014; Bauder, Hannan and Lujan 2017)

Location and distance are important for explaining the innovation process, and the significance of knowledge spillovers (Agrawal et al., 2006, Agrawal et al., 2008, Audretsch and Feldman, 2004). Knowledge spillovers tend to be bounded geographically, and researcher mobility can influence this feature.

It's likely that the FBFL will increase scientist mobility and thereby impact innovation in the STRING region by:

1. **Higher knowledge base**
   - Due to shorter travel time, scientists in the STRING region will have a higher degree of personal interaction with their international colleagues. This will increase their existing knowledge base, as knowledge from distant places can be more innovative for scientists than their local knowledge.

2. **Favourable knowledge-spillovers from academia to industry**
   - The higher mobility of scientists within the FBFL is likely to increase knowledge production in terms of patents, investments, and publications, which will benefit the knowledge-intensive industries in the STRING region.

3. **Attracting top tier scientists**
   - As international collaboration among the universities in the STRING region is likely to increases, it will enhance career development by enabling access to additional specific expertise, gaining new perspectives on research, and building relationships with others in the field.

Note: Ferbändez-Zubieta, Geuna, Lawson (2015): What Do We Know of the Mobility of Research Scientists and Impact on Scientific Production. UK Research and Innovation (2022): Global mobility of research and innovation personnel: evidence report. EU Commission (2022): Study on mobility flows of researchers in the context of the Marie Sklodowska-Curie Actions.

By focusing on top-tier universities, we gain insights into where scientist mobility will have the greatest impact on innovation

Importance of including top-tier universities in the analysis

Top-tier universities (and their respective faculties) are important to focus on when analysing the link between scientist mobility and innovation for several reasons.

First, these institutions tend to be centres of research and innovation and often attract top researchers and scientists. As such, they are likely to produce a high volume of research and innovations that can have a significant impact on society and industry. Second, top-tier universities tend to have well-established research infrastructure and resources, which can facilitate the production of high-quality and impactful research – which positively affect innovation. Finally, the reputation and prestige of top-tier universities, and their specific departments can also contribute to the perceived value and impact of the innovations produced there.

Identifying top-tier universities in the STRING region

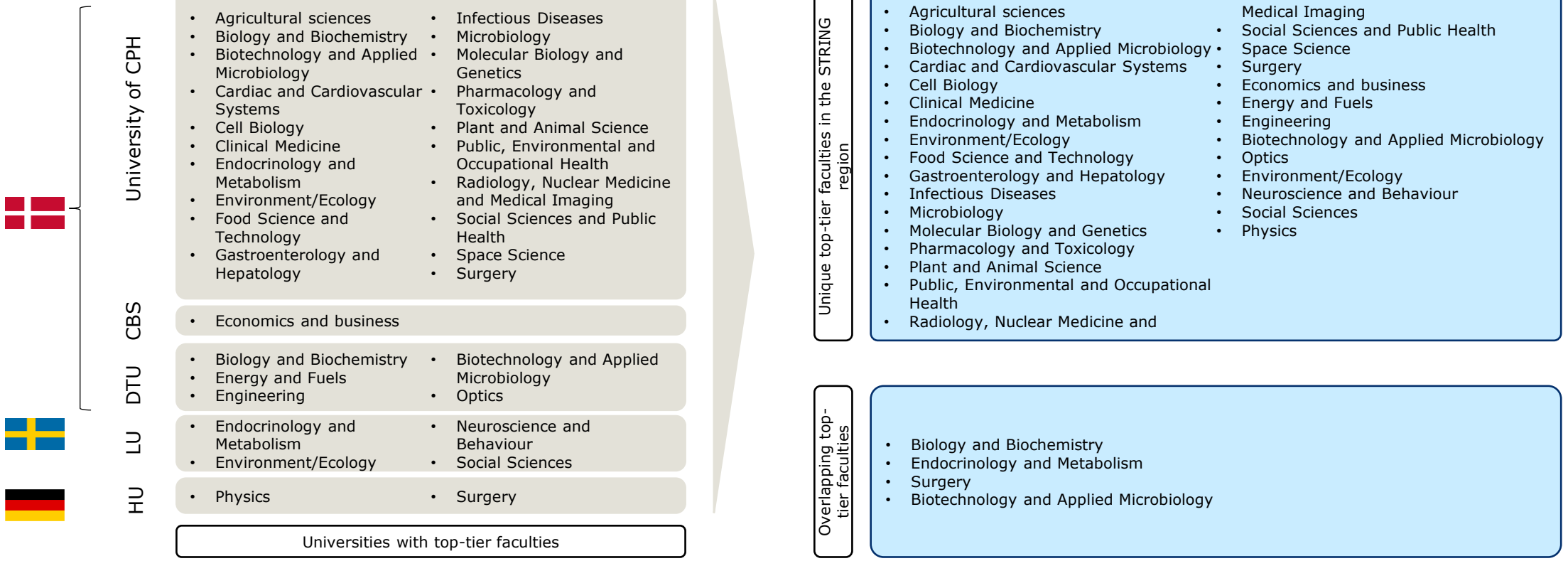
We have used the metric created by U.S. News to identify which universities, as part of the STRING-region, in Denmark, Sweden and Germany that can arguably be defined as top-tier. Parameters included in the metric are e.g., number of publications, percentage of total publications that are among the 10% most cited and global research reputation. Only universities meeting the criterion of having published at least 1,250 papers from 2016 to 2020 are included in the ranking. We identify a university of being top-tier if it has one or more faculties that are globally ranked top 50.

	Name of University	Region	Size
	Malmö University	Skaane, Sweden	• 2.200 employees • 12.700 students
	Lund University	Skaane, Sweden	• 8.400 employees • 29.000 students
	Copenhagen University	Capital region, DK	• 9.000 employees • 43.500 students
	Technical University of Denmark (DTU)	Capital region, DK	• 6.000 employees • 11.000 students
	Copenhagen Business school (CBS)	Capital region, DK	• 2.200 employees • 20.800 students
	Christian-Albrechts-universität zu kiel	Schleswig Holstein, DE	• 600 employees • 20.000 students
	Hamburg University	Hamburg, DE	• 7.500 employees • 44.000 students
	Hamburg University of Technology	Hamburg, DE	• 1.500 employees • 7.750 students

Note: A full explanation of the metric used for for identifying top-tier universities can be found here: www.usnews.com/best-global-universities/methodology.
Descriptive statistics about the top-tier universities are based on information from their respective websites

By narrowing the top-tier universities down to their most prestigious and best faculties, we identify which departments that will be most impactful on the potential innovation-effects

Identifying top-tier faculties for each university



Note: based on data from USNews
CBS: Copenhagen Business School. DTU: Danmarks Tekniske Universitet (Technical university of Denmark). HU: Hamburg University. LU: Lund University

As scientist mobility within the top-tier universities increases due to the FBFL, it is likely to act as a catalyst for innovation that will benefit both research and industry in the STRING region

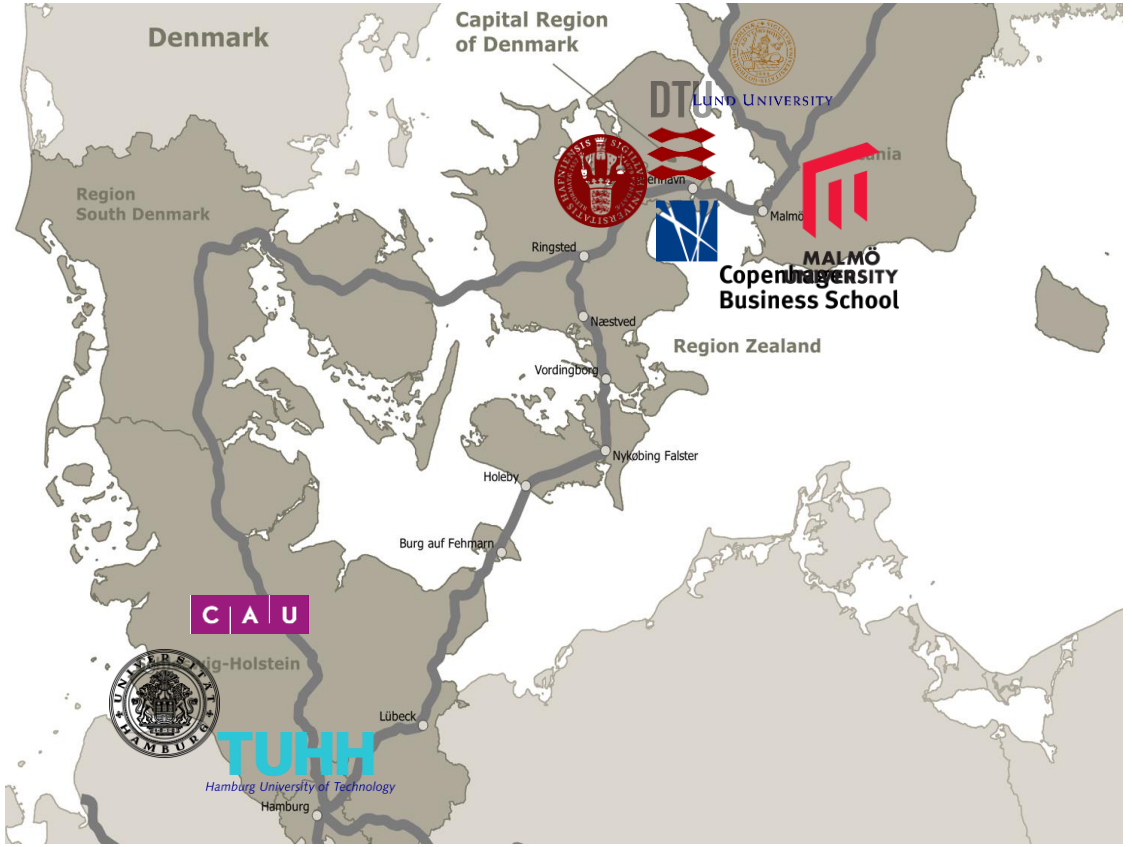
Higher scientist mobility

- There are in general two overall arguments for why it is likely that the scientist mobility (between the faculties identified on the previous slide) increases due to the FBFL. First, as the different top-tier faculties becomes more interconnected, the opportunity to work with leading scientists and to have access to high-quality research infrastructure increases. This can therefore increase the likelihood for researchers and scientists to move and work with nearby country-region universities. Second, as the distance to country of origin decreases due to shorter travel times, it becomes more coinvent to move or work abroad.

Improved innovation within the STRING region

- As it is likely that the scientist mobility increases within the identified top-tier universities and faculties in STRING region, it can impact innovation in a number of ways. One way is by advancing the state of knowledge in a particular field – e.g. within the identified top-tier research area of *Biotechnology and Applied Microbiology*. For example, if a scientist makes a significant breakthrough in their research of gene editing technology, it may inspire other scientists to build on their work and come up with new ideas that were previously unimaginable. This can then have significant impact on business in the STRING region, as they can lead to the development of new products, processes, and technologies that can be used in a variety of industries.

Mapping of the identified top-tier universities within the STRING region



Note: The above arguments are based on Ferbández-Zubieta, Geuna, Lawson (2015): What Do We Know of the Mobility of Research Scientists and Impact on Scientific Production, data from USNews and EU Commission (2022): Study on mobility flows of researchers in the context of the Marie Sklodowska-Curie Actions.

Especially the overlapping top-tier faculties in Copenhagen, Hamburg and Malmö will likely have large innovation effects as the increased scientist mobility goes in both directions

Copenhagen as the centre for overlapping top-tier faculties

The map illustrates that all of the overlapping top-tier faculties are affiliated with universities in Copenhagen

The impact of increased scientist mobility is likely to be most significant in Copenhagen, as researchers who relocate or visit from abroad can increase knowledge spill over and drive innovation

Synergies within the area of surgery between Copenhagen and Hamburg

As the map shows, their will be an overlap within the top-tier research area of Surgery between Copenhagen and Hamburg

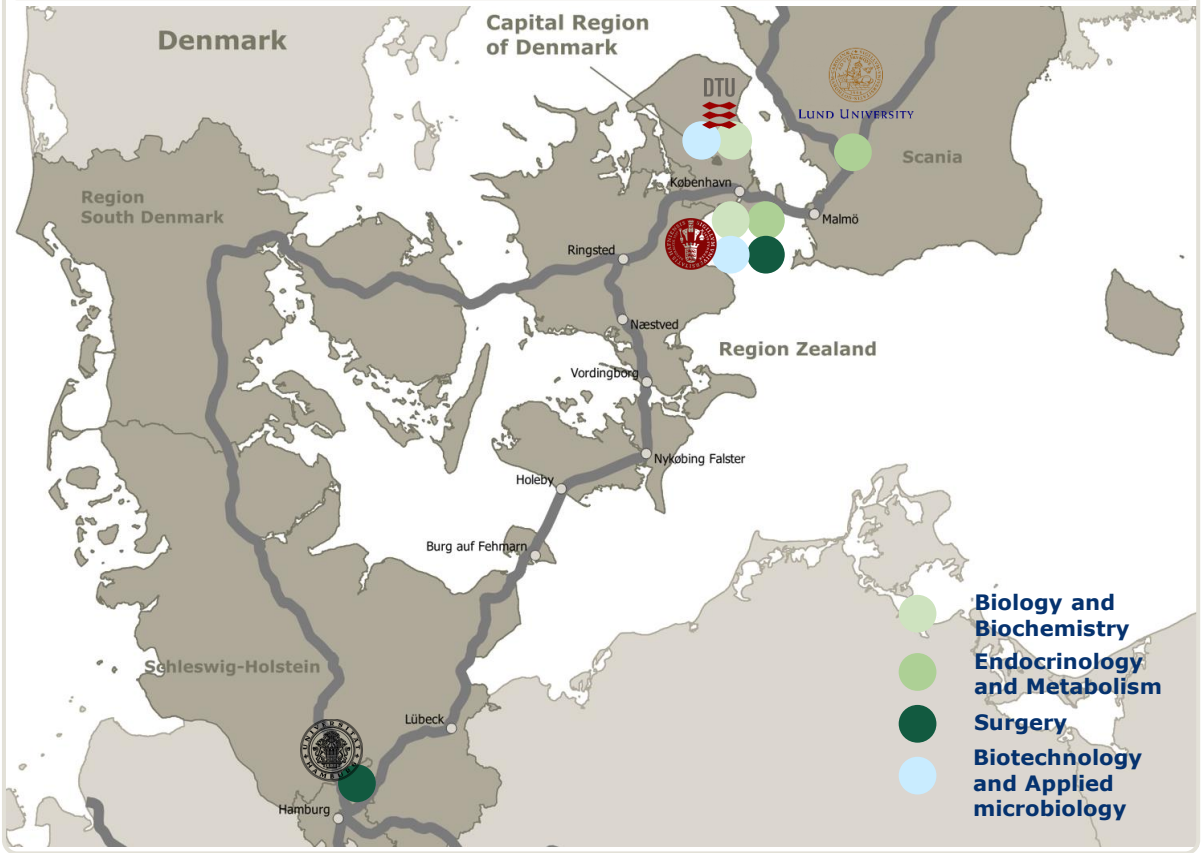
It's likely that scientist for Hamburg will visits the surgery department in Copenhagen and vice versa. The increased scientist mobility in this research area will likely improve innovation for both university and industry purposes.

Indirect Synergies within the area of Endocrinology and Metabolism between Copenhagen and Malmö

As the map shows, their will be an overlap within the top-tier research area of Endocrinology and Metabolism between Copenhagen and Malmö

Given the existing connectivity between Malmö and Copenhagen via the Oresund Bridge, the innovation synergies from scientist mobility will only be indirect from Hamburg, limiting the overall innovation effects for this particular research area

Mapping of the identified overlapping top-tier faculties in the STRING region



Note: The depicted faculties are overlapping faculties only. In Hamburg, the surgery faculty is represented at Hamburg university. At Copenhagen University, Surgery, Biotechnology and Applied microbiology, Endocrinology and Biology and Biochemistry is represented as top-tier faculties. At DTU, Biotechnology and Applied Microbiology is represented, and at Lund University, the Endocrinology faculty is represented.

Knowledge-intensive business sectors (KIBS)

A deep dive in which sectors that will experience positive innovation-synergies

Using descriptive data from the STRING region, we can quantify the relevant knowledge intensive business clusters that likely will positively impact innovation

Defining KIBS and relevant business clusters

Measure of knowledge intensive sectors (KIBS)

- Using the ratio of a certain sectors' percentage of employees with a higher education to the national percentage of employees with a higher education, we can define a sector as knowledge intensive based on whether the coefficient are greater or lower than 1
- A coefficient greater than 1 means that the sector has a disproportionality large number of employees with a higher education

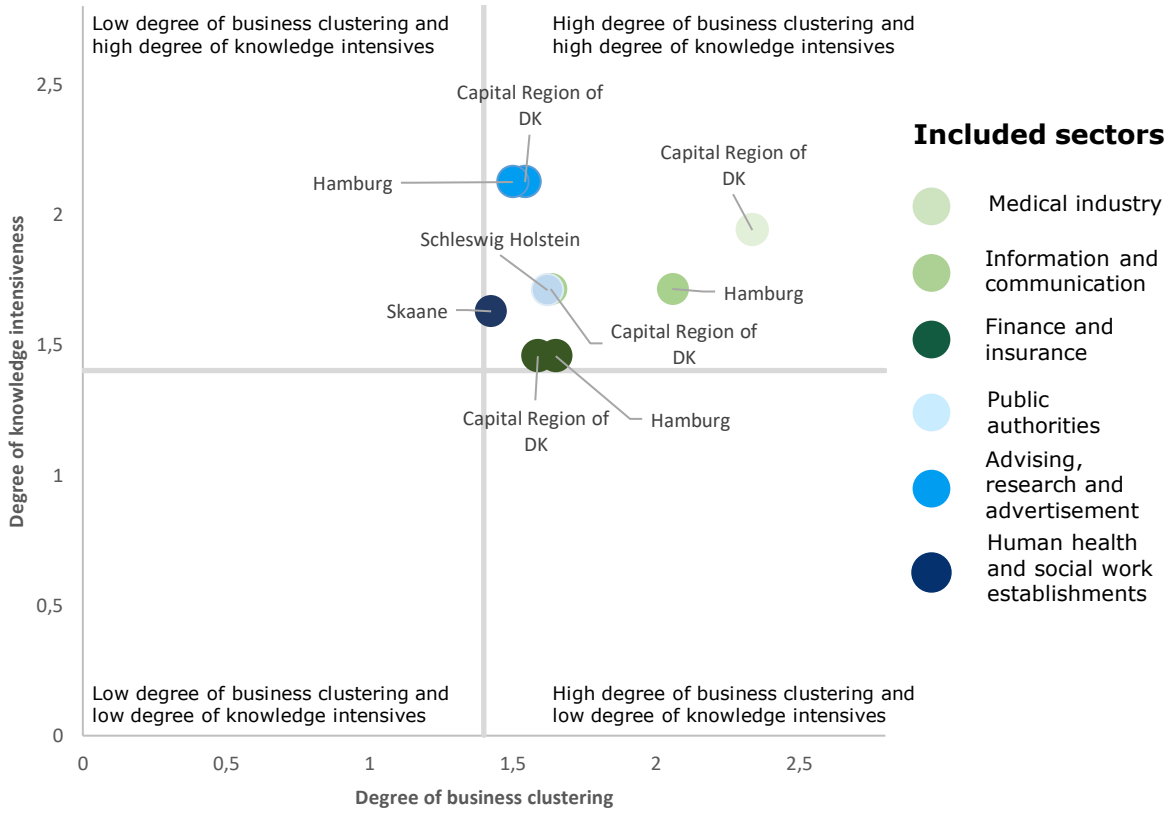
Measure of business clusters

- Using the ratio of a certain region's percentage of employees in a sector relative to the region's percentage of all employees nationally, we can define a sector as a business cluster based on whether the coefficient is greater or lower than 1
- A coefficient greater than 1 means that the region has a disproportionately large number of employees in that industry

Scope of analysis

- Since the scope of this analysis is to identify the most impactful knowledge intensive business clusters, we use a threshold of 1.4 for the KIBS and business cluster coefficients, meaning that only the north-east quadrant of the figure are included in the analysis

Mapping of relevant KIBS for the analysis of innovation



Note: the method of measuring KIBS is based on the approach presented by Lindqvist et al (2002): Swedish Cluster Maps. The threshold of 1.4 is based on Ramboll's selection. The data are based on national statistics from Denmark, Germany and Sweden.

Helper: Values above 1 on the horizontal axis indicate that the sector regionally constitutes a larger share of the sector nationally than its population share. Values above 1 on the vertical axis indicates that the specific sector has a larger share of high-skilled workers than the country's average.

Innovation in the KIBS-clusters will likely increase thanks to easier collaboration, increased competition and better labor market access

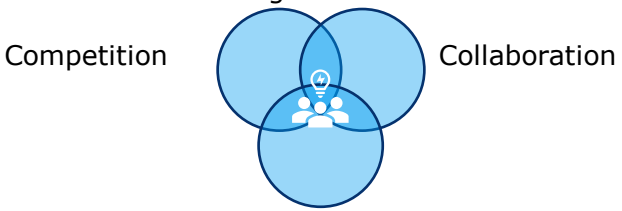
Innovation in the KIBS-clusters are positively affected by three different mechanisms

Collaboration if certain knowledge intensive sectors across different regions becomes more interconnected due to the FBFL, it will likely catalyse the level of informal knowledge sharing and knowledge spillover between the affected firms which will positively affect the sectors level of innovation

Competition if certain knowledge intensive sectors across different regions becomes more interconnected due to the FBFL, it will likely increase the overall level of innovation in the sectors as the affected firms will be driven to adopt more efficient production processes and improved products and services to consumers as a result of higher competition

Labour market access The access for high skilled employees will in general be increased due to FBFL (see labour market), which will make it easier for companies within the sector to recruit relevant work capacity meaning that the knowledge level of the companies will be more dens and thereby positively affect innovation

Higher **innovation** in KIBS-clusters results in a strategic advantage for the affected firms and welfare gains for the affected consumers



Affected KIBS-clusters across regions	CPH	ZEA	SKA	HAM	SCH
The **medical industry** is likely to thrive in the Capital Region of Denmark as access to highly skilled labour increases due to the FBFL, which enhances learning and, therefore, innovation in the sector	●				
The **information and communication** sector in the Capital Region of Denmark and Hamburg will become more connected due to the FBFL, which is likely to stimulate innovation in the sector as access to the labour market, collaboration, and competition between the regional sectors increase	●			●	
The **financial institution and insurance** sector in the Capital Region of Denmark and Hamburg will become more connected due to the FBFL, which is likely to stimulate innovation in the sector as access to the labour market, collaboration, and competition between the regional sectors increase	●			●	
Public authorities are likely to thrive in Schleswig-Holstein as access to highly skilled labour increases due to the FBFL, bringing cities like Lübeck closer to Hamburg and Denmark. This enhances learning and, therefore, innovation in the sector					●
The **advisory and research** sector in the Capital Region of Denmark and Hamburg will become more connected due to the FBFL, which is likely to stimulate innovation in the sector as access to the labour market, collaboration, and competition between the regional sectors increase	●			●	
Human health and social work are likely to thrive in Skaane as the access to high skilled labour increases due to FBFL which increases learning and thereby innovation in the sector.			●		

Sources: Biglardi et al. (2020): The influence of open innovation on firm performance

Potential for large innovation synergies between Copenhagen and Hamburg within the sectors of advising, finance and communication will likely benefit both companies and consumers within the STRING-region

The key driving sectors	The advising*, finance**, and communication*** sectors in Copenhagen and Hamburg will likely benefit from the FBFL as these sectors become more concentrated. This will generally increase interactions between companies and provide access to new ideas, skills, and technologies, which will enhance the possibility of successful innovation
Innovation as a catalyst for synergies in the metropolitan area	The knowledge-intensive sectors are primarily located in the metropolitan areas of the STRING region. Innovation synergies between the KIBS sectors are likely to occur in Copenhagen and Hamburg, which will benefit both companies and consumers
Firms can benefit by strategic competitiveness and acquisitions of new technology	The firms will likely increase the realization of new types of products and their financial performances due to an improved strategic competitiveness (holistic value-creating strategy) The firms will likely accelerate automation by converting parts of their value chain into intelligent data driven systems which makes them pay more attention to the acquisition of new technology
Welfare gains for consumers	In general, consumers of the sectors will experience higher welfare gains, as the products will likely both be cheaper and of better quality

Example of firms that are likely to benefit from innovation synergies

Note: *Advising, research and advertisement, **Finance and insurance, *** Information and communication

Potentials and barriers for innovation

Potentials - The innovation effects for both universities and KIBS have potential long-term economic effects

	Increased productivity	Job creation	Competitiveness	Consumer benefits	Increased export
Potential	Innovation can lead to the development of new and improved technologies, processes, and products, which can increase efficiency and productivity within the affected sectors	The probability that the innovation processes within the impacted industries will lead to the emergence of new technologies that necessitate new skill sets, has the potential to generate new employment opportunities for individual	Companies that can innovate and introduce new products and services are often able to stay ahead of their competitors and capture a larger share of the market	Innovation can lead to the development of new and improved products and services, which can provide benefits to consumers in the form of increased convenience, better quality, and lower prices	Regions that can innovate and produce high-quality, innovative products and services are often able to increase their exports, which can drive economic growth and competitiveness
Example	For example, the medical industry in Copenhagen is expected to contribute to economic growth and increase business profitability through improved productivity	For example, the increased collaboration between the KIBS in Copenhagen and Hamburg is likely to generate more high-skilled job opportunities	Overall, the KIBS in the STRING regions are likely to gain a competitive advantage in product development due to increased innovation	Consumers of the medical industry, for example, will generally experience an increase in welfare as the quality of products and services improves and prices decrease	For example, the already-robust export service sectors are expected to experience further growth as a result of increased competitiveness brought about by higher interconnectivity

Note: The above effects are based on theoretical arguments from the economic literature that are exploring the relationship between innovation and economic performance

Barriers - However, barriers can impede the potential innovation synergies in the STRING region

	Mobility obstacles	Supply chain integration	Retainment of workers	Language and culture	Patent support
Barrier	Mobility obstacles, such as visa restrictions, uncertainty of work permits, and limited access to insurance and healthcare, can pose significant challenges for researchers seeking to pursue opportunities in other countries.	With larger labour market access, companies will have to adapt to new regulations, taxes and labour laws between countries. This could require integration of the supply chain and logistics, making it more complex and harder to manage	Companies may find it difficult to retain top talent, as the increased labour market access could make it easier for workers to move between countries in search of better job opportunities.	When employees are from different countries, language and cultural barriers can arise and make communication, collaboration and the sharing of ideas more difficult which in general can hinder the innovation processes	If there is competition and the products that are being innovated are not protected by patents, there will not be any incentive to innovate as the innovation will simply be copied by competitors, resulting in wasted money on research and development
Example	For instance, if the process of relocating to another university for scientists is met with complex administrative procedures, it can impede the exchange, which in turn can inhibit the mobility of scientists	For instance, integrating different supply chains can make it harder for companies to maintain control over its operations, which makes them shift focus for the potential innovation processes	For instance, the availability of increased job opportunities for highly skilled may enable greater mobility among this group, as they are able to take advantage of the additional options available	For instance, different languages and cultures can also affect the way in which ideas and feedback are shared and interpreted, and this can lead to missed opportunities for innovation	For instance, if the conditions for firms to introduce new products are not favourable, they will lack the incentive to invest in research and development of new products.

Note: Above argumentation are primally based on the EU Commission (2017): Current challenges in fostering the European innovation ecosystem and Guthrie et al. (2017): International mobility of researchers

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