



# Allocation of user benefits for international freight transports – in cost-benefit analysis

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<b>Abstract</b> <p>The aim of this project is to analyse when, if and how a transport cost reduction, following an infrastructure investment affecting international freight transports, should be allocated between countries in a cost-benefit analysis (CBA).</p> <p>In order to analyse this question, the project has been split into two stages. This first stage aims at presenting a more general picture of how the user benefits could be allocated according to the scientific literature, how recommendations on this issue are designed in other countries CBA guidelines, and whether this issue is treated in the planning process of transnational infrastructure projects.</p> <p>The available, but scarce, scientific literature indicates that the allocation of user benefits can have substantial effects on the profitability of infrastructure measures. Having studied CBA guidelines and CBAs of transnational infrastructure projects, the conclusion from our study is that to our knowledge, no other country has a well-founded allocation method that could be implemented in Sweden.</p> <p>Finally, the literature does not offer any strong recommendations or straightforward theoretical methods, with the exception of a first suggestion by Fosgerau and Buus Kristensen (2005).</p>			
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<b>Referat</b> <p>Syftet med detta projekt är att analysera när, om och hur transportkostnadsminskningar, som följer av en infrastrukturåtgärd som påverkar internationella godstransporter, bör fördelas mellan olika länder i en kostnadsnyttoanalys (CBA).</p> <p>För att besvara frågan har projektet delats upp i två delar, där denna rapport utgör den första delen och syftar till att ge en övergripande bild av hur en fördelning kan ske enligt den vetenskapliga litteraturen, hur eventuella rekommendationer ser ut i andra länders CBA-riktlinjer, samt om frågan har behandlats i planeringen av gränsöverskridande infrastrukturprojekt.</p> <p>I den knappa forskning som hittats indikeras att fördelningen av transportkostnadsminskningar kan ha betydande effekter på lönsamheten för infrastrukturåtgärder. Vidare är slutsatsen från vår studie att det inte finns något annat land som har en välunderbyggd fördelningsmetod som skulle kunna implementeras i Sverige. Inte heller finns någon stark rekommendation eller teoretiska metoder att hämta från litteraturen, med undantag för ett första förslag från Fosgerau &amp; Buus Kristensen (2005), eller tidigare genomförda CBAer för gränsöverskridande infrastrukturprojekt.</p>			
<b>Nyckelord:</b> CBA, Godstransporter, Utvärdering, Nyttor.			
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## Preface

The use of Cost Benefit Analysis (CBA) as an appraisal method for Swedish infrastructure investments and measures is mandatory in national transport planning, and the Swedish Transport Administration is responsible for the development of CBA guidelines. This project is a first step to address the question on how to handle cross-border transports and the allocation of user benefits related to these transports in the CBA context. Whether a second step will be realized will be decided by the Transport Administration based on the conclusions of this report. The project is financed by the Swedish Transport Administration.

The project has been carried out by Anna Mellin, Åsa Wikberg and Inge Vierth at VTI May–September 2013.

Stockholm, 21 October 2013

*Anna Mellin*  
*Project Manager*

## Kvalitetsgranskning

Granskningsseminarium genomfört 25 september 2013 där Henrik Swahn var lektor. Anna Mellin har genomfört justeringar av slutligt rapportmanus 21 oktober 2013. Projektledarens närmaste chef Anders Ljungberg har därefter granskat och godkänt publikationen för publicering 21 oktober 2013.

## Quality review

A review seminar was carried out on 25 September 2013, where Henrik Swahn reviewed and commented on the report. Anna Mellin has made alterations to the final manuscript of the report. The project manager's research director Anders Ljungberg examined and approved the report for publication on 21 October 2013.

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### Summary

The aim of this project is to analyse when, if and how a transport cost reduction, following an infrastructure investment affecting international freight transports, should be allocated between countries in a cost-benefit analysis (CBA).

In order to analyse this question, the project has been split into two stages. This *first stage* aims at presenting a more general picture of how the user benefits could be allocated according to the scientific literature, how recommendations on this issue are designed in other countries, and whether this issue is treated in transnational infrastructure projects. The first stage also addresses issues concerning the geographical scope of CBAs, the external effects included in the analysis, and the components that form the time-related user benefits. This study is divided into three steps. First, we present a survey of the scientific literature, where research in the area is presented at a general level. Second, we present a review of national CBA guidelines. Finally, we present some case studies of transnational infrastructure projects. The study is limited to freight transports.

The conclusions from this report will form the basis for a decision of whether to proceed with an extended analysis, which, if realized, will be the *second stage* of the project. The second stage would aim at giving recommendations on how the allocation issue could be addressed in the Swedish CBA guidelines. The second stage would also contain a more thorough description of the methods presented in stage one.

The allocation of user benefits for freight transports is rather complex, since cost savings do not only affect the operator of the vehicle or vessel, but also the cargo sender and/or receiver. Hence, the nationalities of the sender and receiver are more relevant than that of the vehicle owner. The division of the cost reduction between the sender and receiver is also important. The allocation of user benefits for cross-border freight transport cost due to infrastructure investment has not been frequently addressed in the scientific literature. The available scientific literature however indicates that the allocation of user benefits can have substantial effects on the profitability of infrastructure measures.

The review of national CBA guidelines shows that recommendations or discussions on the allocation of user benefits outside national boundaries are very rare.

Recommendations on this specific issue are given only in Finland and Sweden, although the topic is discussed to some extent in a few more countries. In Germany, the issue is acknowledged, but handled somewhat differently than in Sweden and Finland. The EU has CBA guidelines advocating a broader perspective than the national level, but no recommendations on the allocation of user benefits for international freight are given.

The final step in the study was to look at a few case studies of transnational infrastructure investments, and the CBAs preceding these investments. A first conclusion is that such CBAs are not easily available. In our review we found one case

study, the Fehmarn Belt fixed link, where an allocation of the benefits from time savings and vehicle operating costs includes both countries involved in the investment and some of the surrounding countries. The allocation of user benefits in this CBA follows a simplified version of the method discussed in the scientific literature.

The conclusion from our study is that to our knowledge no other country has a well-founded allocation method that could be implemented in Sweden. Nor does the literature offer any strong recommendations or straightforward theoretical methods, with the exception of a first suggestion by Fosgerau and Buus Kristensen (2005).

## **Fördelning av nyttor för internationella godstransporter i kostnadsnyttoanalyser**

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### **Sammanfattning**

Syftet med detta projekt är att analysera när, om och hur transportkostnadsminskningar, som följer av en infrastrukturåtgärd som påverkar internationella godstransporter, kan fördelas mellan olika länder i en kostnadsnyttoanalys (CBA).

För att besvara frågan har projektet delats upp i två delar, varav denna rapport utgör den första delen och syftar till att ge en övergripande bild av hur en fördelning kan ske enligt den vetenskapliga litteraturen, hur eventuella rekommendationer ser ut i andra länder, samt om frågan har behandlats i gränsöverskridande infrastrukturprojekt. I den första delen behandlas också frågor kring den geografiska avgränsningen för CBA, vilka externa effekter som ska inkluderas i analysen, samt vilket komponenter som ingår i de tidsrelaterade nyttorna. Studien är uppdelad i tre steg. Först genomförs en studie av vetenskaplig litteratur, där forskning kring ämnet presenteras på ett övergripande plan, sedan följer av en översyn av nationella CBA-riktlinjer för olika länder och slutligen presenteras några fallstudier av gränsöverskridande infrastrukturprojekt. Den här studien är begränsad till godstransporter. Slutsatserna från den här rapporten ska sedan ligga till grund för ett beslut om en fördjupande studie, d.v.s. del två. Del två syftar till att mer specifikt ta fram ett förslag på en metod för hur allokeringsspörsmålet skulle kunna behandlas i de svenska riktlinjerna. I del två ges också en fördjupning av de metoder som presenterats mer generellt i denna första del.

Fördelningen av transportkostnadsminskningar för gränsöverskridande godstransporter är komplex, eftersom kostnadsbesparingar inte bara påverkar fordonsägaren eller fartyget, utan även avsändaren och mottagaren. Därför är avsändarens och mottagarens nationalitet, samt hur kostnadsminskningarna fördelas dem emellan, mer relevanta faktorer än fordonsägarens nationalitet. Fördelningen av transportkostnadsminskningar för gränsöverskridande godstransporter till följd av infrastrukturåtgärder är inte särskilt utforskat i den vetenskapliga litteraturen. I den knappa forskning som hittats indikeras att fördelningen av transportkostnadsminskningar kan ha betydande effekter på lönsamheten för infrastrukturåtgärder.

Översynen av de nationella riktlinjerna för CBA visar att det sällan finns rekommendationer eller diskussioner kring fördelningen av kostnadsminskningar inom och utanför landets gränser. Det är bara Finland och Sverige som har rekommendationer kring allokering, samt att det i några fler länder förs en diskussion kring ämnet. I Tyskland behandlas också frågan, men med ett annat tillvägagångssätt än i Sverige och Finland. På EU-nivå finns riktlinjer kring CBA som förordar ett större perspektiv än det nationella, men det ges inga specifika rekommendationer om hur nyttor kan fördelas mellan flera länder.

I studiens sista steg har tre fallstudier av transnationella infrastrukturinvesteringar och deras CBA:er studerats. En första slutsats är att dessa analyser är svårtillgängliga. I vår granskning fann vi enbart en studie, som rör Fehmarn Belt-förbindelsen, där en

fördelning av nyttorna mellan länder har genomförts. Nyttofördelningen i denna CBA är en förenkling av den metod som diskuteras i den vetenskapliga litteraturen.

Slutsatsen från vår studie är att det inte finns något annat land som har en välunderbyggd fördelningsmetod som skulle kunna implementeras i Sverige. Inte heller finns någon stark rekommendation eller teoretiska metoder att hämta från litteraturen, med undantag för ett första förslag från Fosgerau & Buus Kristensen (2005).

# 1 Introduction

## 1.1 Background

Cross-border freight transports are essential for international trade. In Sweden, the export and import flows almost equal the size of the GDP (SCB, 2013), and the EU is the largest trader in the world, accounting for 20 % of the global exports and imports (European Union, 2013). The EU is further the most important trade partner for Sweden. In other words, foreign trade is important for the Swedish economy, and efficient international freight transports are an important factor in achieving competitiveness in the foreign trade market (Kommerskollegium, 2012; Nowak, 2005). In the early 1990s, the EU started its work to create a single internal free market without barriers for people, goods, services and money, with the aim to increase the prosperity and economic growth within the region.

This led to a discussion on how to handle pricing in a free transport market. As for the road sector where two principles were set against each other: the territorial principle, implying that taxation should be based on the geographical area that the haulier operated in, and the national principle, according to which taxation should be based on the country of register of the vehicle. The aim was to enable hauliers levied with (high) national taxes to be able to compete with hauliers from countries with already implemented territorial taxes/charges (and low national taxes). This resulted in the Eurovignette Directive 1999/62/EC, which regulates how user charges can be levied for heavy good vehicles, since an introduction of user charges on transport, in this case for road, can lead to increased trade barriers for carriers within the region (European Parliament, 1999; Lindberg, 2013).

The present study focuses on international freight transports and how they are treated in socio-economic analysis. To achieve efficient transport networks for cross-border transport, technological development and infrastructure investments are needed. Cost-benefit analysis (CBA) is an evaluation method used to facilitate efficient allocation of scarce resources. By weighing the costs and benefits of a planned infrastructure project, CBA provides important information for decision makers. In the case of infrastructure investments, partial CBA is the most common method used. This approach is limited to the direct effects of the investment, and not secondary effects such as network effects and dynamic feedback in the economy as a whole. For infrastructure projects within the EU, Schade et al. (2013) provide a discussion on the traditional partial CBA, which does not incorporate European added value such as regional accessibility, border-crossing sections and removal of bottlenecks in corridors. The allocation of user benefits from international freight transports should be seen in this context, and as a methodological issue in the CBA practice.

In Sweden, CBA guidelines for the transport sector are decided by a working group called ASEK, which consists of representatives from all transport modes, from both academia and the national transport-related agencies. The aim of the group is to assure that the same set of principles and values are used in socio-economic analyses throughout the Swedish transport sector.

For domestic freight transports<sup>1</sup>, where senders and receivers are located in Sweden, the firms' time and cost savings as well as the external effects caused by the whole transport are included in the CBA for infrastructure measures.<sup>2</sup> However, it is less obvious how a CBA should handle the user benefits for border-crossing freight transports. The Swedish CBA guidelines published in 2002 do not specify how to allocate the user benefits between countries. In a 2008 guideline update<sup>3</sup>, this changed after a reoccurring discussion on how to allocate the user benefits of improved port-related infrastructure, e.g. fairways.<sup>4</sup> The discussion resulted in a new recommendation for projects that affects cross-border transports to a large extent (with an origin or destination in Sweden), and where significant user benefits are expected. This recommendation suggests that in such cases, 50% of the user benefits should be allocated to Sweden and the other half to other countries affected by the investment. The main reasoning behind this is that investments may lead to more efficient international transports also outside the Swedish territory and consequently reduce transport costs for non-Swedish actors. The current guidelines maintain this recommendation<sup>5</sup> (Trafikverket, 2012a).

However, the theoretical basis for the specific recommendation in the Swedish CBA guidelines – that half of the user benefits from an investment affecting international transports should be accounted for in the Swedish CBA – has not been clearly identified. It should be noted that allocating benefits among several countries strongly affects the relation between costs and benefits. All things equal, an allocation of user benefits to several countries, rather than just one, increases the costs relative to the benefits (given that one single country is financing the investment), which lowers the profitability of the investment. ASEK provides recommendations on a number of parameters connected to traffic and infrastructure but does not address the geographical scope of the costs and benefits, apart from user benefits for cross-border transports. For example, when it comes to air pollution and CO<sub>2</sub> emissions, the recommendation is to apply a strictly national basis for the analysis (Trafikverket, 2012a).

The Swedish CBA guidelines are open for alternative approaches if motivated. Recent examples of alternative procedures include the CBA of an expansion of the fairway in the port of Hargshamn, planned by the Swedish Maritime Administration. The port of Hargshamn mainly handles import and export, and in this case all user benefits are allocated to Sweden instead of only half, as is recommended in the CBA guidelines. The motivation behind this is that the market prices of the goods handled in the port are strongly dependent on world market prices, and therefore an improvement in this Swedish port will not affect the prices of the goods to the final consumer. However, an improvement may lower the producers' costs by facilitating economies of scale and

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<sup>1</sup> This study focuses on freight transports. The issue is also relevant for passenger transport, but for freight the international and transit aspect is larger and more complex.

<sup>2</sup> For sea transports (to/from Gotland), only the transport on Swedish territory (12 distance minutes from the coast) is taken into account.

<sup>3</sup> ASEK 4 guidelines (SIKA, 2008)

<sup>4</sup> (Eriksson, 2013).

<sup>5</sup> The recommendation states that it is the consumer surplus that should be allocated, however it should be both consumer and producer surplus (to include freight), that should follow the allocation principle (Bångman, 2013).

hence reducing transport costs. This generates a producer surplus that is accounted for in the analysis. On the import side, the price of the goods is also set on the world market and is not affected by the fact that larger ships can call the port of Hargshamn. Swahn argues that whether the transport is contracted by the foreign producer or the Swedish importer, the larger ships' lower cost per tonne of transported goods generates a decrease in the total cost of the product in the long run, which generates a producer surplus in Sweden (the importer) (Swahn, 2013).

The inclusion of user benefits outside Sweden in the Swedish CBA guidelines originates from the Swedish Maritime Administration.<sup>6</sup> However, the allocation of the benefits can also be relevant for land-based transport modes. VTI (Vierth & Karlsson, 2012) estimates that an investment in the main rail line between central Sweden and the Øresund Bridge, so that this rail line could carry 750 m long trains instead of the current limit of 630 m, would be repaid after only 1-5 years. The motivation for this relatively short period is that the Danish and German infrastructure is already prepared for 750 m trains, and the removal of the Swedish "bottleneck" is calculated to generate cost savings for all transports along the entire route with Swedish senders and/or receivers. The payoff time would be much longer if not all border-crossing transports were included.

It is finally worth noting that in practice, the traffic flows are (in the Swedish case) not separated in the CBA. Rather, the measured flows are calculated on roads, tracks and in ports, without distinguishing between nationality neither for passenger nor freight.

## 1.2 Purpose of the study

The aim of this report is to analyse the allocation of user benefits of transport infrastructure measures that affect international freight transports to, from and through Sweden. The main question addressed is *when, if and how a transport cost reduction for international freight transports following an infrastructure measure should be allocated between countries, in the context of a CBA.*

Relating to national CBA guidelines, we will also study how a few selected countries handle the following issues related to the main question.

- Which is the geographical scope of the CBA?
- Which externalities (i.e. safety, and different health and environmentally related impacts) are taken into account in the CBA, and what is the geographical scope of these?
- Which components are included when analysing the value of time for freight transports, and cost reductions for both cargo and vehicles?

Focus is placed on how a CBA should treat the user benefits for cross-border freight transports following a national or cross-border infrastructure investment or measure.

## 1.3 Method and limitations

The project is conducted in two stages, where this *first stage* focuses on what relevant knowledge can be extracted from the scientific literature, from general CBA practice in other countries and from experiences gained in transnational infrastructure projects. The aim is to give a general description of the field, and not to present an in-depth analysis

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<sup>6</sup> Bångman, 2013.

of methodological details. A more thorough methodological discussion will instead follow in *stage two*, if realised.

The paper consists of three parts. The first part is a literature survey exploring whether and how the topic of interest is treated in the scientific literature. The main tool used to search the literature is Summon (Serial Solution<sup>7</sup>), which covers more than 18 million papers in full text and approximately 22 million bibliographic posts from Web of Science, VTI's national library, ERIC, RePEc IDEAS och SwePub. The keywords used in the literature search were:

- *Allocation*
- *Benefit cost analysis (BCA)*
- *Cost benefit analysis (CBA)*
- *Cost savings*
- *Distribution*
- *Freight*
- *Guidelines*
- *Time savings*
- *Transport*
- *User benefits*

In the second part, we study whether the allocation of user benefits is addressed in national CBA guidelines for transport. In addition to collecting guidelines from the relevant countries, we contacted some national transport agencies and ministries. An online literature search via Google covered the so-called grey literature (e.g. working papers and reports). The literature survey and CBA review were complemented with contacts with researchers and practitioners in Sweden and other relevant countries. The third part of the paper includes an account of a few case studies of transnational infrastructure projects, where a CBA was carried out as part of the planning process. Admittedly, the scope of the latter two parts was limited by the authors' language skills.

This paper will serve as a background for a potential *second stage*, which if implemented will aim at developing the Swedish approach concerning the allocation of user benefits. This will include a discussion on the relevance and application of the existing recommendations, and the possibility to improve the present CBA guidelines. The aim should be to use recommendations in the Swedish CBA based on scientific outcomes.

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<sup>7</sup> <http://vti.summon.serialssolutions.com/>



## 2 Literature study

Cost-benefit analysis, or CBA, is an evaluation method based on welfare economics, used to weigh the benefits against the costs of a planned project, e.g. a planned infrastructure investment. The basic principle is that a project is worthwhile from a societal point of view if its benefits are greater than its costs, and not worthwhile if the costs instead exceed the benefits (Brent, 2009). The method was introduced in Sweden in the 1960s, and has been applied mainly within the Swedish transport sector (Trafikverket, 2012f).

There is a massive literature on the application of CBA within different sectors. Today, many countries have guidelines for CBA within the public sector, and many also have specific guidelines for CBA within the transport sector. Within the EU, a CBA must be completed prior to infrastructure investments co-financed by the EU (European Commission, 2008).

An issue that has rarely been explored in the scientific literature is the particular situation when an infrastructure investment concerns more than one country, as for example when building a bridge connecting two countries. In a co-financed cross-border investment, the CBA naturally has to consider the effects for the citizens in at least the two directly involved countries. For passenger transport, it is rather straightforward to separate the effects, at least in theory, since passengers can be categorized by nationality, and externalities are relatively easily tied to specific places. The user benefits can be divided accordingly. For freight, however, the distribution of user benefits is more complex. The issue is that the user benefit does not only affect the operator of the vehicle or vessel, but also, or even mainly, the cargo owner (seller) and the receiver (buyer) (Fosgerau and Buus Kristensen, 2005).

In the transport decision for freight, there are also several other actors involved, such as suppliers, carriers and receivers. These can be divided into several sub-groups, e.g. the supplier (producer) may not be the actor selling the product to the final customer, and normally a third party acts as the carrier, which may not own the vehicle used for the actual transport. There are in other words many actors involved in the logistics from producer to end consumer. In the context of a CBA, the main issue is what shares of the transport cost reductions accrue to the sellers and buyers respectively, and where the actors are located (Fosgerau and Buus Kristensen, 2005). Hence, the country of origin of the vehicle or vessel is not very important for the outcome of the CBA.

The literature survey shows that this is a rather unexplored area for freight transports. To our knowledge, only one paper, by Fosgerau and Buus Kristensen (2005), addresses the allocation of user benefits. They study the allocation of user benefits from freight transport cost reductions, with a case study of a cross-border investment, i.e. the Fehmarn Belt fixed link (see also Section 4.1). The analysis focuses on two countries, Denmark and Germany, although other countries are added in the allocation analysis as well. Fosgerau and Buus Kristensen (2005) base their theoretical analysis on a model developed by Jara-Diaz (1986) and Transport and the Economy (1999) to assess the allocation between seller and buyer of goods, depending on if a country has an excess supply of or demand for different goods. The model needs input on the demand and supply elasticities (i.e. import and export elasticities) in the relevant countries or regions assessed. The results show that a country with a less elastic import demand or export supply than the rest of the world (or other countries in the analysis) receives a greater share of the user benefit. The allocation also depends on the countries' total share of the supply of and demand for a good. The example shows that if the share of the demand is

low or the share of the total supply is high in one country, this country receives the greater user benefit. This means that if there is trade between a small peripheral region, such as the Scandinavian countries, and a larger region more centrally located, such as Germany, the proposed model stipulates that the small peripheral region would most likely be allocated the most user benefits (Fosgerau and Buus Kristensen, 2005).<sup>8</sup>

Fosgerau and Buus Kristensen's (2005) analysis indicates the feasibility of allocating the user benefits in a cross-border CBA, and that the choice of allocation principle can have a significant impact in distributing these benefits, especially for infrastructure measures or investments with a significant impact on freight transports.

## 2.1 National CBA guidelines

This section presents an overview of national CBA guidelines. The countries have been selected based on the relevance for Sweden and the availability of guidelines in languages mastered by the authors or by contacts in their network.

### 2.1.1 Austria

In Austria, the lack of general guidelines in infrastructure investments has been acknowledged, and recently, a set of standardized procedures and appraisal methods were compiled. These guidelines consider economic, environmental and social consequences of infrastructure investments (Bmvit, 2013).

The guidelines recommend an *extended CBA* approach meaning that the CBA is embedded in an impact analysis. It is stressed that the extended CBA can support but not replace a decision. The regional dimension can be municipal, national or European. The guidelines do not specify time and cost savings in detail (Fritz et al., 2012). The monetary valuation of the external effects is based on the handbook produced within the IMPACT project (CE Delft, 2008). However, the guidelines do not specify which external effects have to be included in the CBA.

The guidelines differentiate between *planning region*, for which infrastructure measures are planned, and *study region*, which comprises the area influenced by the traffic in the planning region. There is no specific rule on how to allocate the user benefits between the countries.

The assessment approach is explained for the Baltic-Adriatic axis. The Baltic-Adriatic Corridor is among the most important cross-Alpine lines in Europe by railway (BATCo, 2013). In this case, the whole of Austria is seen as the *planning region*, while the NUTS2 regions<sup>9</sup> in the countries along the corridor constitute the *study region*. It is mentioned in the guidelines that the traffic and socio economic impacts outside Austria, and the European dimension needs to be taken into account. The impacts addressed are the modal shift from road to rail due to the improved service level and economic impacts like increased demand during the operation phase (improved access, lower transport costs) (Fritz et al., 2012).

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<sup>8</sup> An additional complication for practical use is the presence of the factor of the cost of public funds (e.g. in Sweden); see more in Fosgerau and Buus Kristensen (2005).

<sup>9</sup> NUTS (Nomenclature of Territorial Units for Statistics), by regional level (NUTS)

### 2.1.2 Denmark

The Danish ministry of transport (Transportministeriet) has a set of CBA guidelines adapted to the transport sector. Cross-boundary effects are mentioned in the guidelines, for example in reference to international freight corridors. Yet, as of today, a valuation of these effects is not a part of the standard procedure for CBA, since the national territory sets the geographical limitation of the CBA. However, it should be mentioned that cross-boundary effects were part of the CBA preceding the decision to build the Fehmarn Belt connection (Trafikministeriet, 2003).

A paper by Danish authors Fosgerau and Jensen (2003) discusses the allocation of user benefits to other nations, and concludes that the allocation of user benefits for freight transport is not obvious. This is because the nationality of vehicle or vessel is not of main relevance since cost reductions are rather divided between senders and receivers (see further in the literature review). They conclude that for simplicity in cross-national CBA, the user benefits could be split equally between the senders and receivers, i.e. split equally between the countries.

The external effects considered are air pollution (NO<sub>x</sub>, HC, SO<sub>2</sub>, CO and particles), global warming (CO<sub>2</sub>), health effects, noise and barrier effects. These externalities are quantified using four categories: effects from increased (new) traffic, effects from changed route, effects from passenger transfer through modal change, and effects of goods transfer through modal change (Trafikministeriet, 2003).

The time-related effects are measured via travel time and costs related to operating a vehicle. Travel time savings are measured through changes in travel time and are valued through willingness to pay studies referred to in HEATCO (2006). Changes in costs related to operating a vehicle are valued using the market price for relevant components, such as fuel, wear and tear and capital costs (Trafikministeriet, 2003).<sup>10</sup>

### 2.1.3 Finland

Finland has both general guidelines for transport-related assessments and mode-specific guidelines. All of these are available, in Finnish, at the website of the Finnish Transport Agency (Liikennevirasto, 2013). The general guidelines state that only effects for Finnish citizens and companies should be included in the CBA. Since this recommendation is not always feasible in practice, there are specific guidelines for the different transport modes. For road transports, international and national traffic are treated equally, i.e. time savings for Finnish and foreign goods vehicles are fully included in the CBA, but only Finnish unit values are applied. The same argument is applied for rail and maritime transports. Transit transports are however treated differently, since there is a notion that the user benefits in this sector also accrue to other countries than Finland. In the following effects are included in the CBA:

- 1) Change in producer's surplus of domestic transport service providers (e.g. harbours).
- 2) Net effect on government's revenue from railway and fairway charges.
- 3) Effects on railway and fairway maintenance costs.

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<sup>10</sup> Recommended unit values for the above mentioned effects are provided in cooperation with the Danish Technical Universities (DTU) and can be found at the DTU website (DTU, 2013).

4) The global and local emission costs. CO<sub>2</sub> emissions are calculated from total route kilometres, which means that also emissions outside Finland are included. For other emissions, only emissions inside Finnish borders are included.

5) The effects on accident costs.

The guidelines for allocation of user benefits came from the former Finnish Maritime Administration. The interpretation of the guidelines was provided by Anton Goebel at the Finnish Transport Agency (Goebel, 2013).

The following externalities are addressed, and should be quantified and valued: accidents, air pollution (CO, HC, NO<sub>x</sub>, PM<sub>2.5</sub> and SO<sub>2</sub>), greenhouse gas emissions (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) and noise. Only air pollution within the national borders is covered. However, for greenhouse gases the geographical scope can be wider if it has been proven that the planned investment affects emissions outside Finland. For freight user benefits, it is stated that it is not feasible to distinguish between producer (e.g. a ship owner) and consumer (e.g. a forest industry) surplus. Vehicle costs and the value of time are discussed, yet there are no specific instructions for freight transports (Liikennevirasto, 2013<sup>11</sup>).

#### 2.1.4 France

France has guidelines for transport-related CBAs from 2001. They are called “Rapport Boiteux” and were written in French by the former institution for economic planning (Commissariat General du Plan, 2001). An updated version of the guidelines is underway and should be presented by the end of 2013 (Treich, 2013). The update however, do not address the allocation of user benefits (Meunier, 2013)

The current guidelines do not address allocation of user benefits of international freight transports, and the geographical limitation of the CBA is the national territory. When it comes to time savings, these are divided between carriers and shippers. For carriers, the time savings include values for goods, fuel and maintenance costs. For shippers, the time is valued per hour and consignment. The externalities considered are accidents, airborne pollutions (i.e. PM, VOC, NO<sub>x</sub> and SO<sub>2</sub>), greenhouse gases and noise (Commissariat General du Plan, 2001).<sup>12</sup>

#### 2.1.5 Germany

The German CBA guidelines for the national road, rail and inland waterway network (Bundesverkehrswegeplan, BVWP) are provided by the Ministry of Transport, Building, and Planning (Bundesministerium für Verkehr, Bau- und Wohnungswesen, 2005). Improvements of the conditions for border-crossing transports that can enhance the international integration aspect are mentioned. In BVWP 1992 and BVWP 2003, a mark-up of up to 10% of the time and cost savings is allowed to be applied for infrastructure measures which are considered important for international transports.

Recently a new approach has been developed that takes into account the benefits independently of in which country they occur. It is assumed that cross-border infrastructure projects in Germany lead to integration and employment effects. The new method has already been applied in the planning of rail projects, e.g. the hinterland

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<sup>11</sup> Johanna Jussila-Hammes, VTI, helped us with the translation from Finnish.

<sup>12</sup> Claire Papaix, IFSTTAR, helped us with the translation from French.

connection of the fixed link over the Fehmarn Belt (BVU & Intraplan, 2010). The new method will be documented in the 2015 BVWP guidelines, scheduled to be published in early 2014 (draft) and 2015 (final version) (Monse, 2013).

The CBA guidelines address the following external effects: safety, air pollution (CH, NO<sub>x</sub>, SO<sub>2</sub> and PM), climate gases (CO<sub>2</sub>), noise and intrusion in the landscape. The estimations of time and cost savings for freight transports, only include savings related to the vehicles and staff and savings related to the cargo transported are not taken into account.

#### 2.1.6 Ireland

The Irish Department of Transport has compiled CBA guidelines for investments in the transport sector (Department of Transport, 2009). The guidelines also incorporate recommendations for a complementary multi-criteria analysis (MCA).

The guidelines do mention the importance of having a transport system that is integrated with those of other countries, and cross-border infrastructure improvements are acknowledged to generate user benefits. However, the guidelines do not further elaborate on the issue of user benefit allocation between countries, nor are any geographical limits explicitly stated for the appraisal. Dempsey (2013) confirms that such aspects are currently not considered. Hence, the guidelines do not provide any recommendation on how to allocate the costs and benefits of international freight transports.

Benefits for transport users and operators are addressed, including travel time savings. Time-related benefits are only mentioned in relation to passenger transports. User benefits in the freight sector focus on vehicle operating costs. These are divided into fuel costs and non-fuel costs, including for example maintenance and depreciation of the vehicle (Department of Transport, 2009).

The term externality is not used explicitly in the guidelines. However, they do recommend that effects on safety and environment, including noise and airborne emissions, should be monetized. For other environmental impacts, such as effects on landscape, cultural heritage and biodiversity, it is recommended to quantify the area directly impacted (Department of Transport, 2009).

#### 2.1.7 The Netherlands

The Netherlands has national guidelines available at CPB (Centraal Planbureau, or the Netherlands Bureau for Economic Policy Analysis), which is an independent research institute under the Ministry of Economic Affairs. The guidelines are a result of a major research programme, OEI – research programme on the effects of infrastructure, carried out jointly by several Dutch economic research institutes (CPB, 2013).

The general recommendation is to limit the CBA to the Dutch territory and only include costs and benefits within the Netherlands. The document includes a discussion on allocation of user benefits related to international transports. In general, the guidelines states that the funding for infrastructure measures is from Dutch taxpayers, and therefore the most relevant are the user benefits to firms and households within the national borders (i.e. the Dutch taxpayers). There is also a discussion on the indirect effects, such as the difficulties in estimating how an infrastructure measure affects the Dutch ability to compete in relation to actors abroad. An allocation could be made, e.g.

by looking at the domestic flows and the domestic parts of international transports in the transport model. In practice, however, the time benefits for both national and international flows from improvements in The Netherlands will be fully included in the CBA (de Jong, 2013; CPB and NEI, 2000).

The guidelines recommend including monetizing of externalities, such as air pollution, CO<sub>2</sub> and accidents, but also effects that are more difficult to monetize, such as intrusion in the landscape. The main report does not recommend any explicit values (CPB and NEI, 2000), but officially recommended time values are found in the Annexes and on the website of Rijkswaterstaat, which is part of the Ministry of Infrastructure and the Environment. New guidelines on the time value and reliability for both passenger and freight transports are available from 2013 (KiM, 2013).

### 2.1.8 Norway

In Norway it is the Ministry of Finance that sets guidelines for socio-economic analysis. Although transport measures are a frequent reference, the guidelines apply to all public measures and are not specific for the transport sector. In the Norwegian CBA guidelines, there is no recommendation on how to allocate the cost reductions in international freight transport. There is, however, a discussion on the distribution of user benefits, but it focuses mainly on individual households and refers to the guidelines recommended at the EU level in HEATCO (2006), in the UK and in Sweden (Norwegian Ministry of Finance, 2012). There are also more specific guidelines for the transport sector presented by the Norwegian Road Administration (Statens vegvesen, 2006). However, their handbook does not address the issue of cross-border transports. Nor does it set specific geographic limits, although it does recommend that the geographic scope be limited in a way that suits the project at hand.

The Norwegian handbook recommends both methods and values for time savings and externalities. The value of time for freight transports includes wages, administrative costs and capital costs. Recommendations are only given for heavy trucks, above 3.5 tonnes. Inconvenience in ferry connection, e.g. waiting time, is also included. Externalities that are valued are accidents, noise, air pollution (NO<sub>x</sub>, NO<sub>2</sub>, PM<sub>10</sub>) and greenhouse gases (i.e. in CO<sub>2</sub> equivalents mainly consisting of CO<sub>2</sub> and N<sub>2</sub>O). The last two categories should be presented at a local, regional and global level (Statens vegvesen, 2006).

### 2.1.9 Sweden

The national guidelines for transport-related CBAs and the allocation issue have already been described in the background section of this report. This sub-section will focus on the limitations and externalities and the value of time.

The general approach in CBAs of Swedish infrastructure investments, financed by Sweden, is that the scope of the costs and benefits should be limited to the Swedish territory. For the external costs, it is therefore recommended to include local and regional emissions (i.e. NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>2.5</sub> and VOC) as well as global emissions (i.e. CO<sub>2</sub>) that are emitted in the Swedish territory. These effects should also be valued according to the CBA guidelines. It is further discussed that the guideline concerning the scope of global emissions could be adjusted if the transport sector is included in an international regulation implementing responsibility for emissions outside Swedish territory. Since today the responsibility of Sweden is limited to the national territory

(Trafikverket, 2012a; 2012b). There are also recommended values for safety and noise (Trafikverket, 2012c; 2012d).

To value time and quality for freight transports, two values are recommended in the Swedish guidelines. First, the value of time (VOT) is commodity specific and based on the value of the products transported. The same is true for the value of reliability (VOR) for rail and road, which is assumed to be two times the VOT. Second, the transport costs are vehicle specific and based on wages, capital costs and other administrative costs, such as insurance (Trafikverket, 2012e).

#### 2.1.10 United Kingdom

UK guidelines for socio-economic analysis are found in the Transport Appraisal and The Treasure Green Book by the Department for Transport (2011), as well as in other documents with specific guidelines in the so-called WebTAGs (Department of Transport, 2013).

The boundary of the CBA is the national borders, although the guidelines do mention the effects on non-UK residents and firms. It is concluded that as the costs and benefits for non-UK actors are insignificant for most infrastructure measures, it is not reasonable to spend resources attempting to identify and quantify them. In some cases, when an infrastructure measure is expected to have a significant impact on non-UK residents and firms, these costs and benefits should be included in the so-called Supporting Analyses. However, this document is still under development (Department of Transport, 2013).

The externalities accidents (safety), local air pollution, noise and greenhouse gases are addressed and monetized. Impacts on landscape, townscape, biodiversity and water environment are excluded so far, since these effects are not yet given a monetary value. These impacts, as well as other non-monetized effects, should be addressed and assessed in the so-called Appraisal Summary Table, and there is specific guidance for this (Department of Transport, 2012). Value of time is given in the guidelines, but there are only recommendations for passenger transports (Department of Transport, 2012).

#### 2.1.11 Australia

Australia has general CBA guidelines for investments in the public sector in a handbook published by the Department of Finance and Administration. The handbook does not address the issue of how to allocate the costs and user benefits of international freight transport (Commonwealth of Australia, 2006).

There are also specific CBA guidelines for the transport sector. In these guidelines, the issue of international transports is not discussed, and it appears that the geographical scope of the CBA is the national borders. Interstate investments are discussed, but there is no mentioning of allocation of user benefits (Australian Transport Council, 2006).

The guidelines state that if valuations of environmental externalities are not available, a qualitative assessment should be done. The guidelines provide monetary values for the following externalities: air pollution (i.e. CO, NO<sub>x</sub>, PM<sub>10</sub> and THC<sup>13</sup>), GHG emissions (CO<sub>2</sub>, CH<sub>2</sub> and N<sub>2</sub>O), noise, water run-off from roads, nature and landscape, and urban separation. Also safety is included. Value of time only seems to be addressed for passenger traffic, and freight user benefits are captured via reduced vehicle operating

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<sup>13</sup> Total hydrocarbons

costs, including fuel, tyres, maintenance and depreciation (Australian Transport Council, 2006).

Updated guidelines are under development (GHD, 2012).

#### 2.1.12 Canada

Canadian national guidelines for socio-economic analysis are referred to as benefit-cost analysis (BCA). CBA guidelines for the transport sector are provided by Transport Canada, an organization under the Minister of Transport with responsibilities for transportation policies and programmes (Transport Canada, 2013a).

The Canadian guidelines include user benefits for non-Canadian residents. The motivation behind this is primarily reciprocity, i.e. that Canadian residents benefit from other countries' investments as well. They further argue that there is usually insufficient data to separate the user benefits from national and international actors (Transport Canada, 2013b).

Benefits covered by the guidelines are safety, transportation efficiency, productivity gains, and environmental and transitional effects. The external effects covered are safety and different environmental effects, such as noise, pollution (to ground, air and water), degradation of habitats and natural environments, loss of amenities, and disposal of contaminated soil. However, many of the environmental effects are difficult to measure and not mandatory to include, and it is stated that these effects should be quantified to the extent practicable (p. 50, Transport Canada, 2013b).

Time-related benefits for freight are related to vehicle operating costs, fuel costs, value of transit time for cargo, and wages (Transport Canada, 2013b).

#### 2.1.13 USA

As in Canada, CBAs are referred to as BCAs in the U.S. The federal guidelines are provided by the U.S. Department of Transportation (2013), and there is a focus on the user benefits for U.S. residents. With regard to allocation of user benefits, there are no recommendations, neither between states nor between countries (U.S. Department of Transportation, 2013). However, the issue is discussed in a document of frequently asked questions. The question concerns ports and the benefits diverted from foreign ports to the national economy due to a national investment. The response to this question is that cost savings or increases in productivity associated with the port activity created should be included in the national calculation (U.S. Department of Transportation, 2012).

Distributional effects are to be handled via an identification of winners and losers. For economic incidence, the final recipients of income are individuals and households; hence costs and benefits should be identified based on how these groups are affected. There is however a complexity when considering these aspects in practice (Whitehouse, 2013).

The U.S. guidelines state that there is a need for more research before recommending complete values of time in freight (U.S. Department of Transportation, 2013). For externalities, there are recommendations for safety (i.e. fatalities, injuries and property damage) and environmental impact (i.e. CO<sub>2</sub>, VOC, NO<sub>x</sub>, SO<sub>x</sub> and PM) (U.S. Department of Transportation, 2013).



## 2.2 CBA in the European Union

The aim of an integrated European transport system has resulted in several trans-European infrastructure projects. The EU programme TEN-T aims at harmonizing national infrastructure toward a common European standard, in order to facilitate the circulation of goods and people within the union. The projects within TEN-T are often large scale and demand a meticulous appraisal prior to the investment decision. A standardized transport system requires a standardized evaluation methodology, which has prompted the initiation of a number of EU projects, resulting in several methodological handbooks. One of these projects is HEATCO (2006), which has led to a set of standards aimed at establishing a harmonized European appraisal method.

Furthermore, EU has compiled a set of general CBA guidelines. CBA has been used in the cohesion policy since the 1990s and has been a requirement since 2000. The guidelines cover investments in a range of sectors, including transport investments. Although they do not directly address transnational effects of investments, they do mention the possibility of a transnational perspective on infrastructure investments. The guidelines provide that even regional transport projects should be evaluated from a larger perspective since regional projects can be important in an integrated network. It is also mentioned that the perspective in a CBA could be local, regional, national, EU or global (European Commission, 2008).

For the value of freight and passenger time savings, estimations from HEATCO and IMPACT (CE Delft, 2008) are used. Environmental externalities are also analysed in relation to time savings, since these depend on travel distance and exposure to polluting emissions. When local values are not available, it is recommended to use prices from the scientific literature (European Commission, 2008).

External costs considered are emissions, noise, accidents and congestion. User benefits considered are changes in transport costs, such as fares, tariffs, tolls and vehicle costs, vehicle operating costs, profits and losses of infrastructure managers and transport service operators as well as variations in taxes and subsidies for the government and in external costs. A distinction is made between the benefits for existing traffic (e.g. time and cost reductions), the benefits for the traffic diverted from other modes (variation in cost, times and externalities due to shifts in mode), and the benefits for the generated traffic (social surplus variation) (European Commission, 2008).

## 2.3 Summary

The review of national CBA guidelines includes a total of 13 countries. All the studied countries have specific guidelines for the transport sector, and some have both general guidelines for public measures and specific guidelines for the transport sector.

Usually, national transport agencies or governmental departments are responsible for the guidelines for the transport sector. The guidelines are generally developed by a group of experts from e.g. research programmes or academia, and are usually published in the respective countries' official languages. The level of specification, i.e. on explicit unit values to be used, varies between countries.

The issue of how user benefits from infrastructure investments could be treated in an international context is only mentioned in the guidelines of the Netherlands, Germany, Canada, Sweden and Finland. The guidelines from the EU are however clear on the fact that a CBA must not be limited by national borders; rather, an infrastructure investment

should be seen in a regional, international, and even global perspective. It is not further specified how the international allocation of user benefits should be treated. The only countries in our survey that give any specific recommendations for allocation of user benefits outside their respective borders are Finland and Sweden. A common denominator for Finland and Sweden is that the initiative for this recommendation came from the maritime sector. In Germany there is also a recommendation for international freight transports, but instead of allocating the user benefits it is recommended to mark up the user benefits by up to 10 %. As for externalities, these are generally, in all countries, limited to the national territory. However, for greenhouse gases the recommendations differ. For example, in Finland, also emissions emitted outside the country are included.

### 3 Case studies

The literature review and the national guidelines only generated few indications on how to handle the issue of allocation of user benefits for international freight transports. To deepen our analysis, we studied the appraisals of a few selected cross-border infrastructure investments.

We focused on large infrastructure investments that involve two or more countries, such as tunnels and bridges. The case studies will focus on considerations and approaches in the studied CBAs that are relevant for our main question.

There will also be an account of how user charges enter in the CBA, and how these can be relevant for the final conclusions of a CBA. The user charges for the road sector are regulated in the Eurovignette directive. The directive states that levying tolls on road transport should be limited to only recover the infrastructure costs, including mainly construction, operating and maintenance costs,<sup>14</sup> not to be profitable for the country. However, the directive does allow for variation in the toll rates, if transparent and non-discriminatory, to incorporate environmental damage, congestion, minimizing infrastructure damage and road safety (European Parliament, 2006). The variation may not, however, affect a weighted average toll related to the recovery of the infrastructure costs (European Parliament, 2006).

When choosing case studies, we found that CBA reports are available for only a few of these infrastructure investments. In some cases, no CBA was conducted prior to the investment decision. In other cases, CBAs were conducted by private firms, limiting the availability of reports. The lack of available material thus limited the selection of case studies somewhat.

#### 3.1 Fehmarn Belt (Germany/Denmark)

A fixed link between the Danish island of Lolland, and the German island of Fehmarn has been discussed for a long time, as this strait has been considered a gap in the infrastructure between Scandinavia and the rest of Europe. A fixed link in this region would induce considerable travel time savings for both passengers and freight transport, which are both expected to grow in the future (Femern, 2013a). Denmark has been the driving force in the planning process, since Germany has e.g. feared that a fixed link would lead to loss of jobs when the ferry traffic would be phased out and that the environmental effects could be significant. In 2007, the two countries however decided to build the link, either as a bridge or a tunnel. A few years later, it was concluded that a tunnel was the best alternative, due to fewer construction risks. The project has been surrounded by a number of uncertainties, but in September 2013, Femern A/S<sup>15</sup> initiated the process of seeking the necessary permissions (Femern, 2013b).

The link will include a four-lane motorway and a double-track railway. Apart from the link, the project also involves an extension and refurbishment of the adjacent roads and railways. The tunnel will be a prioritized project within the TEN-T development. It is estimated that the tunnel will be ready in 2020 (Transportministeriet, 2013).

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<sup>14</sup> "Tolls shall be based on the principle of the recovery of infrastructure cost only. Specifically the weighted average tolls shall be related to the construction costs and the costs of operating, maintaining and developing the infrastructure network concerned. The weighted average tolls may also include a return on capital or profit margin based on market conditions" (European Parliament, p. 13, 2006).

<sup>15</sup> Company appointed and fully owned by the Danish Transport Ministry.

The link will yield considerable travel time savings, and the (land-based) travel distance between Denmark and Germany will be shortened by 160 km. For freight trains, the travel time will be reduced by 3.5 hours, and passenger trains, cars and trucks will save approximately 1 hour (Transportministeriet, 2013). According to one study, approximately one-fourth of the utility of the time savings from the shortened travel route will benefit actors in other countries than Germany and Denmark (Danish Ministry of Transport 2004).

An additional gain for Denmark is that the link will free up some railway capacity on the busy railway line between Sjaelland, Fyn and Jutland. As the ferry traffic is phased out, CO<sub>2</sub> emissions are also estimated to go down slightly (Transportministeriet, 2013).

Having the strongest interests in the link, Denmark carries most of the financial responsibility for the building of the tunnel, as well as for connecting infrastructure on the Danish side (Schade, 2013). Revenues from the tunnel tolls will also go to Denmark, and will be used to pay off the investment costs. Germany pays only for the connections on the German side (Transportministeriet, 2013). As Germany lately has expressed concern about the unstable financial situation in Europe, parts of the investments on the German side have been postponed (Politiken, 2011).

### 3.1.1 CBA

The construction of a fixed link between Denmark and Germany is interesting for several reasons. Since it connects two different countries, it is interesting to see how the user benefits are allocated between the countries. Since Denmark has a considerable amount of transit traffic to and from Scandinavia, it is also interesting to see how the benefits have been allocated to nearby countries. A number of reports on different perspectives of the link have been published. Among these are a CBA published by the consultancy firm COWI in cooperation with the Danish Ministry of Transport (COWI, 2004). Further, there are other reports on the regional dynamic and strategic effects of the regions surrounding the fixed link. The CBA from COWI will be of main interest for the purpose of our study.

The CBA that was the basis for the decision to build the link is somewhat unique in considering the user benefit allocation for other countries than those directly affected by the link. The CBA is based on three geographical perspectives; Denmark, Denmark and Germany together, and all countries (COWI, 2004). The third, international perspective is rare in CBA. In fact, we have not found any other case with this kind of application of CBA measures. The CBA sets off in a reference case where no link is built. This case then compared with two scenarios with a bridge or a tunnel, linking Denmark and Germany.

The building of a fixed link will have large effects on traffic, and the quantification of costs and benefits of the investment are to a great extent based on traffic volumes. Assessing expected traffic volumes have thus been a fundamental part of the CBA. The traffic model includes information on travel patterns, transport costs, user charges and infrastructure characteristics. The focus is on eastern Denmark and northern Germany, but the model also covers the European continent. There are a number of impacts which are not quantified in the analysis, and the time value for goods is one of these effects. It is however concluded that the non-quantified effects should be of minor importance. (COWI, 2004)

The economic analysis includes the following elements; investment costs, operating costs, user benefits (time savings and reduced operating costs), environmental costs, ticket revenues, consequences for other operators, as well as duties, subsidies and tax distortion (COWI, 2004).

The CBA is based on Danish unit costs and values. It is thus assumed that the values for passenger and freight traffic are the same for all nationalities. For freight, the distribution of benefits between countries of origin and destination is assumed to be equally divided between the countries included in the analysis.

Ticket revenues are included as a benefit in the economic analysis of the CBA, and they accrue to the Danish government. Furthermore, EU subsidies are expected to cover some of the financing costs (Roadtraffic-technology, 2013). Pricing and the cost of the infrastructure has a great impact on the CBA results. In this case, the user charges can bring back some of the consumer and producer surplus to the Danish part of the analysis (which is the financing part).

Taking all countries into account, the CBA shows that the fixed link would give considerable benefits for users due to time savings and reduced vehicle operating costs. It is assumed that approximately one-fourth of the benefits in time savings, including shorter freight train routes, can be allocated to users in other countries than Denmark and Germany. When analysing Denmark and Germany separately, the user benefits decreases. (COWI, 2004)

## 3.2 The Brenner Base Tunnel (Austria and Italy)

The Brenner Base Tunnel (BBT) has been discussed for several decades, and will form an important part of the railway route Berlin/Munich-Verona/Milano-Palermo. This rail route is one of the top priority projects within the EU programme TEN-T, aiming at establishing an efficient multimodal transport infrastructure in Europe (Schade et al., 2013). The BBT will be a 55 km long railway tunnel connecting Austria and Italy, from Innsbruck to Fortezza. The tunnel is envisioned mainly for heavy freight across the Alps and is currently planned to open in 2025 (BBT, 2013).

According to recent plans, the construction costs are divided equally between Austria and Italy, apart from EU co-funding of approximately 30 % (Schade et al., 2013).

### 3.2.1. CBA

Several CBAs have been conducted for this tunnel. A CBA from 2007 indicates that the investment for the tunnel will cost 8.6 million euro, and that the tunnel construction will be beneficial with a benefit cost ratio (BCR) of 1.9 (Schade et al., 2013).<sup>16</sup> The most recent publicly available CBA is from 2013. This CBA takes the benefits during the building phase and the operating phase into account, but only the effects expected during the building phase are quantified and hence a BCR is not calculated (Brennerbahn, 2013). The reason for this is that the effects during the about 150-year operation phase are fraught with a lot of uncertainties when it comes to the transport forecasts and the capacity of the single track sections of the TEN-T corridor Berlin/Munich – Verona/Palermo.

During the operation phase, the following benefits are expected:

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<sup>16</sup> This report on the CBA has, however, not been found by the authors of this report.

- a reduction of the travel time for passenger transports and freight transports (halving of the travel time) - as the BBT will reduce the travel distance by 21 km.
- an increase (doubling) of the net tonnes that can be transported since the number of gradients will be reduced and 700 m long trains can be used instead of 400 m long trains, and the capacity in terms of number of trains will increase
- a shift from road to rail, which is a goal in EU's White Paper
- a reduction of air pollution and greenhouse gases, noise and traffic accidents, as well as lower road maintenance costs due to the modal shift
- a reduction of the transport costs via the integration of the BBT in the 2 200 km long Berlin – Palermo rail corridor
- a contribution to the goal of integration of the internal market in Europe.

The preliminary calculations carried out have been based on the European CBA guidelines (HEATCO, 2006), the Austrian CBA guidelines (Fritz et al, 2012), and the Swiss CBA guidelines for rail infrastructure projects (BAV, 2006). Since the user benefits of the reduction of transport costs have not been quantified, they have neither been allocated between the countries. Yet, there is a discussion in the report on the welfare effects at a national (Italy/Austria) and more local (South Tyrol and Tyrol) level for the building phase. It is also stated that the investment would stimulate the internal EU market. There is no discussion on user charges or ticket revenues for this project. (Brennerbahn, 2013)

### 3.3 Helsingborg – Helsingør (Sweden/Denmark)

The Øresund Bridge, connecting Copenhagen in Denmark and Malmö in Sweden, was finalized in 2000. To facilitate further expansion of the region, several other infrastructure investments are being discussed. One of them is a second fixed connection between Denmark and Sweden between Helsingborg (Sweden) and Helsingør (Denmark). This distance is 5 km, compared to the 16 km between Malmö and Copenhagen. Today, the cities are connected by ferry. The suggested investment is to instead build a tunnel. The aim is to enhance the economic growth in the Øresund region, and to further integrate Denmark and Sweden. The planners have developed several alternatives, of which four have been evaluated in a study by IBU-Øresund (2010). These are stated in Table 1.

*Table 1 Alternatives for the Helsingborg – Helsingør tunnel*

<b>Alternative</b>	<b>Description</b>
Alternative 1 (HH 0.2)	Tunnel for passenger train
Alternative 2 (HH 4.2)	Tunnel for passenger train + double-lane for road vehicles
Alternative 3 (HH 4.2.1)	Tunnel for passenger train + for freight train + double-lane for road vehicles
Alternative 4 (HH 2.2.1)	Tunnel for passenger train + for freight train + single-lane for road vehicles

Source: IBU-Øresund, 2010.

### 3.3.1 CBA

In the CBA report, the infrastructure limit is set to coast-to-coast, hence the connecting infrastructure on both sides of the tunnel is not included. To simplify the analysis, it is based on Danish values only, instead of including values from both countries. Included in the CBA are the costs for investment, operation and maintenance, time savings, vehicle operating costs, environmental impact and revenues from ticket sales (IBU-Øresund, 2010) Ticket revenues are one of the larger benefits in the calculations. The revenues depend on the forecasted transport flows, which are uncertain. However, there is no word on when the costs can be expected to be recovered.

Transit traffic is addressed since it constitutes the majority of transport flows, at least for freight trains. Hence, the main benefits in time savings will be attributed to non-Danish sellers and buyers. There is no allocation of time savings in the CBA, but it is argued that the average time values used from HEATCO (since no specific values for Denmark are available) are more representative since it is an European average rather than specific for Denmark (IBU-Øresund, 2010).

For externalities, only emissions to air are included; CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, HC, CO and PM. Other externalities are not included due to a lack of available trustworthy data. To complement the CBA with the impacts in the town centres of Helsingør and Helsingborg, as well as impacts for the accessibility and economic growth in the region, a multi-criteria analysis (MCA) was conducted. By using a composite modelling assessment (COSIMA<sup>17</sup>), a weighted total value of the CBA and MCA is generated. The results show that all alternatives have a positive net present value (from the CBA) and total value (from the COSIMA). The order of the different alternatives does however change. Only using the CBA, alternative 4 is ranked as the most profitable. When combining the CBA and MCA, however, alternative 4 drops to third place and alternative 1 is ranked first (IBU-Øresund, 2010).

## 3.4 Summary of case studies

The three selected case studies are all large infrastructure projects with the aim to connect countries within the EU.

The Fehmarn Belt fixed link is a large and somewhat controversial infrastructure project that will join Denmark and Germany by an immersed tunnel for rail and road traffic. Since Denmark has a large amount of transit traffic to and from other Scandinavian countries, the tunnel will obviously be of great importance also to other countries than the two linked by the tunnel. In this project, the CBA has focused on user benefits for other countries than just Denmark and Germany, which makes this an interesting project for the purpose of the present study.

In the case of the Brennero Base Tunnel, which connects Austria and Italy and aims at improving the rail freight through the Alps, it is argued that user benefits will be gained at a larger regional level. However, they are not allocated among the different countries.

For the planned tunnel between Denmark and Sweden, transit is also an important part of the transport flows. A regional perspective is assumed, but many simplifications have been assumed in the CBA. Hence there is no allocation of the benefits from time savings or operating cost reductions for freight transports.

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<sup>17</sup> The COSIMA model is further described in Salling et al. (2006).

Ticket revenues constitute important benefits in the CBAs for the Fehmarn Belt connection and the Helsingborg-Helsingør tunnel. However, there are no references to how long the cost recovery period might be.

To conclude the section on case studies, it is noteworthy that there are so few CBAs available for larger infrastructure investments in the EU. It seems that either a CBA has not been conducted or a CBA was conducted by consultancy firms and did not result in a publicly available report. In the case studies we have found, CBAs have only been available in other languages than English, which makes finding and interpreting relevant documents difficult. This lack of available CBA material seems peculiar considering that the EU requires a CBA to be conducted prior to applying for EU funding of infrastructure investments. The difficulties in getting a hold of CBAs are also concluded in an assessment of the TEN-T projects' investments and costs (Schade et al., 2013).



## 4 Discussion and conclusions

This project has focused on how user benefits in the form of reduced time and transport costs, following infrastructure investments affecting international freight transport, should be allocated between countries in a CBA. With the aid of the scientific literature, existing national guidelines and a few case studies, the aim was to present a general view of user benefits are allocated today.

The current Swedish CBA guidelines recommend that when infrastructure investments give rise to user benefits for other countries than Sweden, only half of the benefits should be allocated to Sweden if the project in question has major impacts on cross-border traffic. It is not clear if this recommendation rests on a scientific basis, since there is no such reference in the guidelines. Further, it is questionable why an international perspective is relevant for this particular issue and not for others. The Swedish CBA guidelines contain recommendations on a number of parameters, but it is only when it comes to user benefits that an international perspective is encouraged. A more consistent approach would be to maintain an international perspective also when it comes to other areas, such as emissions of air pollutants and CO<sub>2</sub>. The argumentation for the example of airborne emissions and CO<sub>2</sub> is that the legal abatement responsibility of Sweden is within national borders.

The literature review indicated that allocation of user benefits between several countries is a rather unexplored area in the CBA literature (for freight transport). The few available articles, however, indicate that the choice of allocation strategies can have a significant impact on the profitability of infrastructure measures. A more thorough analysis of the method discussed in the literature review can be conducted if a second stage of this project is realized.

To complement the rather scarce scientific literature, the national CBA guidelines in 13 countries were reviewed. The review showed that the issue of how to allocate user benefits when infrastructure investments affect several countries has only been discussed in a few of the guidelines. Only in Finland and Sweden has this discussion led to specific recommendations on how to allocate user benefits between countries. The discussions in Finland and Sweden have their origins in the maritime sector. Since a large share of international transports occur by sea, the issue of allocating user benefits and costs often occurs in the analyses of for example fairway investments. Questions concerning allocation of user benefits and costs have also been addressed in the U.S. based on investments for maritime transports. Another example of addressing user benefits can be found in the German guidelines. As mentioned earlier the guidelines allows a mark-up of up to 10 % of time and cost savings, for infrastructure measures that are important for border crossing transports.

It appears in some of the national guidelines that the issue of cross-border transports is not relevant for most investments, e.g. in the case of the UK. The UK guidelines conclude that for most infrastructure investments, the costs and benefits for non-UK actors are insignificant and it is therefore not reasonable to spend resources on identifying and quantifying these costs and benefits. The Canadian guidelines recommend that user benefits for non-Canadian residents be included as well, referring to principles of reciprocity and difficulties to attain sufficient data to separate national and international user benefits. It is worth repeating that in practice, in Swedish CBAs (and also in other countries) all transports within the national territory are included and foreign traffic is not separated. However, the allocation issue can be relevant in the case of national infrastructure investments as well. This concerns national infrastructure with

a major impact on national imports and/or exports, i.e. with a high share of cross-border freight transports. This is illustrated in the beginning of this report with the fairway investments that allow larger ships to call the port of Hargshamn, which has led to decreased transport costs for industry, and with the investments in the Swedish rail infrastructure, which enables the use of longer trains for Swedish exports. The example of the port of Hargshamn shows that alternative approaches to the Swedish CBA guidelines are possible. Here it is also important to note that investments in the maritime infrastructure are often financed through user fees, while other infrastructure investments usually are financed through taxes.

In all the national guidelines reviewed, consideration of cost and benefits is generally limited to the national territory and residents. This is sometimes expressed explicitly in the guidelines, and in some cases only implied. It is for example stated in several of the guidelines that since most measures are financed by the taxpayers of the country, CBAs should focus on the impact on them. The EU guidelines emphasize that each project should be analysed from a relevant geographical perspective, e.g. local, national, or even global.

The compilation of national guidelines indicates that allocation of user benefits between countries affected by infrastructure measures is seen as a peripheral issue. When it comes to transnational infrastructure projects, we expected to see that this issue would receive some focus. The allocation issue should be relevant in the planning of major transnational infrastructure projects, especially when they are aimed at integrating different countries with each other and investment costs are shared, like in the connection between Helsingborg and Helsingør. Interestingly, it was first of all difficult to get hold of the CBAs of these kinds of projects, even though they are required for EU funding. Further, only in the case of the Fehmarn Belt fixed link could we find a broader discussion and an attempt to allocate the user benefits from freight transport between several countries.

To summarize, all three parts of this study indicate that the issue of allocation of user benefits has not frequently been addressed. At the same time, there is an increasing focus on international corridors in policy discussions at the national and European levels. This raises the question of why this issue has not yet been more frequently explored and why it is not highlighted more explicitly in national and international guidelines, such as the ones from the EU. One reason could be that the national guidelines are mainly constructed in a national perspective, with the focus on national investments financed with taxes; hence the costs and benefits of main interest are the ones affecting the taxpayers. Yet from a regional EU perspective it has been addressed in the sense that all countries are responsible to individually defend their investment decisions through a CBA and not through a CBA that includes an overall perspective. Another reason for not allocating the benefits could be that it affects the benefit cost ratio negatively if parts of the benefits are allocated to other countries, hence making projects with high impact on international transports less profitable. At the same time, organisations such as the EU have a political objective to improve efficiency for international transport to increase the accessibility.

The conclusion from our study shows that, to our knowledge, there is neither any country from where a benefit transfer of a well-founded allocation method could be evaluated, nor any strong recommendations or straightforward theoretical methods in the literature, with the exception of a first suggestion by Fosgerau and Buus Kristensen (2005).

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